

# Guide to Bryophytes of sub-Saharan Africa

## KEY TO FAMILIES - MOSSES

The diversity of mosses in sub-Saharan Africa is estimated at 78 families, 363 genera and 2791 species (O'Shea 2003), but a more realistic estimate would be nearer 2000 species. For those desiring a taxonomic sequence of families, the following list is provided. This reflects the current ideas about the general patterns of evolutionary history with regards to African mosses. It must be noted, however, that this is not necessarily a phylogenetic sequence, and the monophyly of most families (or higher levels) has not been demonstrated. Currently there is a healthy debate with regard to the definition of family limits and relationships within and between families.

*Literature.* **Goffinet, B. & Buck, W.R. 2004.** Systematics of the Bryophyta. In: Goffinet, B., Hollowell, V. & Magill, R. (eds.) *Molecular Systematics of Bryophytes*. St Louis: Missouri Botanical Garden Press. **Edwards, S. R. 1984.** Homologies and inter-relationships of moss peristome. In: R. M. Schuster (ed.), *New Manual of Bryology* 2: 658-695.

It is recommended that those trying to identify an unknown moss should use the **general key to families** below, although those with a good knowledge of the families might find it faster to go straight to the **summary of sections**.

### Taxonomic sequence of families

Class SPHAGNOPSIDA	Order <b>Dicranales</b> (cont.)	Order <b>Hypnales</b>
Order <b>Sphagnales</b>	Family Eustichiaceae	Family Amblystegiaceae
Family Sphagnaceae	Family Fissidentaceae	Family Anomodontaceae
	Family Leucobryaceae	Family Brachytheciaceae
Class ANDREAEOPSIDA	Family Rhabdoweisiaceae	Family Calliergonaceae
Order <b>Andreaeales</b>	Family Rhachithecaceae	Family Catagoniaceae
Family Andreaeaceae	Order <b>Pottiales</b>	Family Cryphaeaceae
	Family Cinclidotaceae	Family Entodontaceae
Class POLYTRICHOPSIDA	Family Pottiaceae	Family Fabroniaceae
Order <b>Polytrichales</b>	Family Serpotortellaceae	Family Fontinalaceae
Family Polytrichaceae	Family Splachnobryaceae	Family Hylocomiaceae
	Order <b>Splachnales</b>	Family Hypnaceae
Class BRYOPSIDA	Family Splachnaceae	Family Lembophyllaceae
Order <b>Diphysciales</b>	Family Meesiaceae	Family Leptodontaceae
Family Diphysciaceae	Order <b>Orthotrichales</b>	Family Leskeaceae
Order <b>Encalyptales</b>	Family Orthotrichaceae	Family Leucodontaceae

# Guide to Bryophytes of sub-Saharan Africa

Family Encalyptaceae	Order <b>Hedwigiales</b>	Family Meteoriaceae
Order <b>Funariales</b>	Family Hedwigiaceae	Family Myriniaceae
Family Funariaceae	Family Rhachocarpaceae	Family Neckeraceae
Family Gigaspermaceae	Order <b>Bryales</b>	Family Phyllogoniaceae
Order <b>Splachnales</b>	Family Aulacomniaceae	Family Plagiotheciaceae
Family Splachnaceae	Family Bartramiaceae	Family Prionodontaceae
Order <b>Bryoxiphiales</b>	Family Bryaceae	Family Pterigynandraceae
Family Bryoxiphiaceae	Family Mniaceae	Family Pterobryaceae
Order <b>Grimmiales</b>	Family Orthodontiaceae	Family Pylaisiadelphaceae
Family Grimmiaceae	Family Phylloprepariaceae	Family Regmatodontaceae
Family Ptychomitriaceae	Order <b>Rhizogoniales</b>	Family Rhytidiaceae
Family Seligeriaceae	Family Rhizogoniaceae	Family Rigodiaceae
Order <b>Archidiales</b>	Family Racopilaceae	Family Rutenbergiaceae
Family Archidiaceae	Order <b>Hookeriales</b>	Family Sematophyllaceae
Order <b>Dicranales</b>	Family Adelotheceaceae	Family Stereophyllaceae
Family Bruchiaceae	Family Daltoniaceae	Family Symphyodontaceae
Family Calymperaceae	Family Hookeriaceae	Family Thuidiaceae
Family Dicranaceae	Family Hypopterygiaceae	
Family Ditrichaceae	Family Leucomiaceae	
Family Erpodiaceae	Family Pilotrichaceae	

## Keys to the classes and families of mosses of sub-Saharan Africa

The following keys are intended to assist in the identification of mosses from sub-Saharan Africa. The keys are designed to stress gametophytic features whenever possible. Sporophytes are often not present in collected material, and, in some cases, not known in our area or elsewhere. For this reason, and because a number of families exhibit considerable variation, families are often keyed out in more than one place. The keys often emphasize salient features of families with primary emphasis on gametophytic characters, secondarily on

# Guide to Bryophytes of sub-Saharan Africa

sporophytic characters, and lastly on habitat or geography. In using the keys, one normally follows the lead that best fits the two alternative choices given. When one reaches a point in the keys at which neither lead appears appropriate, one then should follow both, hopefully ending with two alternative families. Both should then be compared carefully with the descriptions, keys to genera and illustrations. If neither alternative appears appropriate, then one must back-track in the keys to find where the problem of interpreting a particular character exists. In any case, one should read carefully the family description, keeping in mind the variation exhibited by that family (this applies equally to genera).

## Key to classes

1. Plants typical of boggy or marshy sites, whitish; branches spirally arranged in fascicles; laminal cells of stem and branch leaves alternating between leucocyst (hyaline cells) and chlorocyst (green) cells; capsules globose, supported by a pseudopodium	<b>Sphagnopsida (Sphagnaceae)</b>
1. Plants mostly of drier sites, mostly green, yellow or brown; laminal cells uniformly similar with chlorophyll, or chlorophyll cells layered between hyaline cells above and below; not alternating between hyaline and green cells; capsules variously shaped, supported by a pseudopodium or seta	2
2. Plants small, deep dark red or blackish, largely restricted to open high elevations; capsules supported by a pseudopodium, opening by 4 (division throughout) or 8 (distal tip) slits or valves	<b>Andreaeopsida (Andreaeaceae)</b>
2. Plants small to medium sized or robust, present in all environments; capsules stegocarpic, supported by a seta, generally with a peristome and operculum	3
3. Leaves bearing rows of lamellae on distal upper surface; capsules with a single series of peristome teeth, teeth 16, 32, or 64, distally attached to a circular membrane (epiphragm)	<b>Polytrichopsida (Polytrichaceae)</b>
3. Leaves lacking rows of lamellae, or very rarely so (see Grimmiaceae, Pottiaceae); capsules either with a peristome in a single series with 16 teeth, or a double series with the outer series of 16 teeth (exostome), and an inner series with a basal membrane bearing 16 segments and cilia (endostome); in a number of cases the peristome is reduced	<b>Bryopsida</b>

## General key to the families

1. Plants whitish, laminal cells alternating or layered between leucocyst and chlorocyst cells	<b>Section 1</b>
1. Plants variously green, yellow to golden or brown to blackish; laminal cells uniform, neither layered or alternating between leucocyst and chlorocyst cells walls	2
2. Upper distal surface of leaf with discontinuous or continuous rows of lamellae	<b>Section 2</b>
2. Upper distal surface lacking lamellae	3
3. Plants acrocarpous; stems erect or occasionally spreading, solitary or in short to long tufts or cushions; sporophytes terminal on stems or branched innovations; peristome single (a single series of teeth 16 or divided into 32 narrow segments) or double (two series, outer series of 16 teeth, inner series often with 16 segments and often cilia atop a short to tall membrane)	4
3. Plants pleurocarpous, stems creeping, spreading, or pendent, frondose or dendroid from a conspicuous or inconspicuous creeping primary stems; sporophytes lateral on stems; peristome	6

# Guide to Bryophytes of sub-Saharan Africa

double or variously reduced	
4. Leaves arranged in 2 ranks (distichous) or 4 ranks (but appearing 2-ranked)	<b>Section 3</b>
4. Leaves arranged in 3 or more rows	5
5. Laminal cells papillose or mammillose	<b>Section 4</b>
5. Laminal cells smooth	<b>Section 5</b>
6. Leaf costa absent, short and forked, or elongate and double	7
6. Leaf costa single	9
7. Leaves distinctly 2-ranked, usually strongly folded	<b>Section 6</b>
7. Leaves in 3 or more ranks, when complanate often with lateral asymmetric leaves (occasionally partially folded on one side) and median symmetric leaves	8
8. Leaves ecostate (some to most leaves lacking a costa, but some leaves may have a weak to strong costa)	<b>Section 7</b>
8. Leaves with costa, short and forked or elongate and double	<b>Section 8</b>
9. Leaves strongly dimorphic, upper or lower leaves on stems smaller and differing in shape than larger lateral leaves	<b>Section 9</b>
9. Leaves monomorphic, usually differing if at all between smaller branch leaves or lateral leaves asymmetric and median leaves symmetric	10
10. Laminal cells mammillose or papillose	<b>Section 10</b>
10. Laminal cells smooth	<b>Section 11</b>

## Summary of Sections

### **Section 1. Plants whitish, laminal cells alternating or layered between leucocyst and chlorocyst cells.**

Plants whitish, occasionally reddish or purplish tinged; laminal cells differentiated, alternating or layered between hyaline cells (leucocysts) and green cells (chlorocysts).

### **Section 2. Upper distal surface of leaves with rows of lamellae or short filaments.**

### **PLANTS ACROCARPOUS**

Plants acrocarpous, stems mostly erect or occasionally spreading, solitary or in short to tall loose or dense tufts; sporophytes terminal on stems or branched innovations; peristome single or double, rarely absent.

# Guide to Bryophytes of sub-Saharan Africa

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**Section 3. Plants acrocarpous. Leaves arranged in 2 ranks (distichous) or in 4 ranks but appearing 2-ranked.**

**Section 4. Plants acrocarpous. Leaves in 3 or more rows. Laminal cells papillose or mammillose (cells often isodiametric or shortly elongate).**

**Section 5. Plants acrocarpous. Leaves in 3 or more rows, ranked or not. Laminal cells smooth.**

## PLANTS PLEUROCARPOUS

Plants pleurocarpous; stems creeping, spreading, forming mats, or pendent, frondose or dendroid, often forming tufts, from a creeping primary stem; sporophytes lateral on stems; peristome double or variously reduced, rarely absent.

**Section 6. Plants pleurocarpous. Leaves 2-ranked, strongly folded throughout.**

**Section 7. Plants pleurocarpous. Leaves ecostate.**

**Section 8. Plants pleurocarpous. Leaves costate; costae short and forked or double and elongate (often 1/2 or more than lamina length).**

**Section 9. Plants pleurocarpous. Leaves costate; costa single. Leaves strongly dimorphic, upper or lower leaves on stem smaller and differing in shape from larger lateral leaves.**

[Sections 10-11. Plants pleurocarpous. Leaves monomorphic, usually differing only in that branch leaves are somewhat smaller, differing in shape or not, or that lateral leaves asymmetric and median leaves symmetric, or primary and secondary stem leaves differentiated; costa single.]

**Section 10. Plants pleurocarpous. Leaves costate; costa single; laminal cells mammillose or papillose.**

**Section 11. Plants pleurocarpous. Leaves costate; costa single; laminal cells smooth.**

# Guide to Bryophytes of sub-Saharan Africa

## Section keys

### Section 1. Plants whitish, laminal cells alternating or layered between leucocyst and chlorocyst cells.

Plants whitish, occasionally reddish or purplish tinged; laminal cells differentiated, alternating or layered between hyaline cells (leucocysts) and green cells (chlorocysts).

1. Plants typically of boggy or seepy sites; forming a compact head of clustered short branches (capitulum), below capitulum stems with short to elongate fasciculate branches; leaves of stem and branch dimorphic; in cross-section lamina unistratose, cells alternating between chlorocysts and leucocysts	<b>Sphagnaceae</b>
1. Plants of moist to semi-dry sites, often lignicolous or epiphytic; stem and branch leaves monomorphic, mostly evenly distributed along stems; in cross-section lamina bi- to multistratose, chlorocysts layered between 1 or more layers of leucocysts above and below	2
2. Leaves appear singly costate, costal stereids forming a rib on the abaxial (back) side of leaf	<b>Calymperaceae p.p.</b>
2. Leaves apparently ecostate, lacking a central rib of stereids	<b>Leucobryaceae</b>

### Section 2. Upper distal surface of leaves with rows of lamellae or short filaments.

1. Lamellae in long continuous rows, occasionally rows few or discontinuous; peristome teeth 16, 32 or 64, entire, usually with tips of teeth attached to an epiphragm	<b>Polytrichaceae</b>
1. Lamellae forming short rows or occurring as short filaments scattered over surface; peristome of 16 teeth, often perforate or divided	2
2. Distal upper surface covered by filaments, often papillose, if with lamellae then leaves ovate with margins plane; calyptra cucullate	<b>Pottiaceae p.p.</b>
2. Distal upper surface covered by rows of lamellae, with leaf margins erect to incurved; calyptra campanulate, lobed at base	<b>Grimmiaceae p.p.</b>

## PLANTS ACROCARPOUS

Plants acrocarpous, stems mostly erect or occasionally spreading, solitary or in short to tall loose or dense tufts; sporophytes terminal on stems or branched innovations; peristome single or double, rarely absent.

### Section 3. Plants acrocarpous. Leaves arranged in 2 ranks (distichous) or in 4 ranks but appearing 2-ranked.

1. Leaf costa long excurrent, 2-3 times longer than lamina length; lower and basal cells linear-rectangular; confined to high, dry areas	<b>Ditrichaceae p.p.</b>
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# Guide to Bryophytes of sub-Saharan Africa

1. Leaf costa subpercurrent to short excurrent (rarely long excurrent), lower and basal cells quadrate to rectangular; lowland to high montane	2
2. Leaves exhibiting an extended dorsal and ventral lamina from a sheath-like leaf base (vaginant laminae)	<b>Fissidentaceae</b>
2. Leaves lacking an extended dorsal and ventral lamina from a sheath-like base	3
3. Leaves folded, conduplicate	4
3. Leaves flat, not folded; laminal cells smooth	5
4. Laminal cells pluripapillose; leaves short oblong-ovate, less than 1 mm long	<b>Eustichiaceae</b>
4. Laminal cells smooth; leaves oblong-lanceolate, mostly 2-3 mm	<b>Bryoxiphiaceae</b>
5. Stems spreading or creeping; leaves elliptical, bordered	<b>Mniaceae p.p.</b>
5. Stems erect; leaves ovate, lacking a bordered	<b>Rhizogoniaceae p.p.</b>

## Section 4. Plants acrocarpous. Leaves in 3 or more rows. Laminal cells papillose or mammillose (cells often isodiametric or shortly elongate).

1. Basal portion of leaf exhibiting a cancellinae (enlarged clear cells), strongly differentiated from basal margin and distal cells; marginal or intramarginal border often present; laminal cells above isodiametric, gemmae nearly always present on leaves, particularly leaf tips; plants mostly epiphytic	<b>Calymperaceae p.p.</b>
1. Basal portion of leaf lacking a cancellinae, cells either similar to distal cells or gradually differentiated toward base, if differentiated then leaf border lacking; gemmae absent from leaves	2
2. Leaves ecostate; mostly on rocks	3
2. Leaves costate; on various substrate including rocks	4
3. Leaf margins plane; laminal cells unipapillose on back; plants small, deep dark red or blackish, in montane areas; capsules opening by 4 (division throughout) or 8 (distal tip) slits or valves	<b>Andreaeaceae p.p.</b>
3. Leaf margins recurved; laminal cells 1-several papillose, papillae in a row; plants	<b>Hedwigiaceae</b>

# Guide to Bryophytes of sub-Saharan Africa

medium sized, dark green to brown, or greyish; mid-montane; capsules operculate, lacking a peristome	
4. Leaves completely to partially bistratose distally	5
4. Leaves unistratose or only partially bistratose, particularly restricted to margins	8
5. Peristome teeth of 16 teeth in 8 pairs; leaves spatulate, apex acute to apiculate	<b>Rhachithecaceae p.p.</b>
5. Peristome teeth of 16 unpaired teeth; leaves mostly ovate-lanceolate to lanceolate, if spatulate then costa excurrent	6
6. Laminal cells subquadrate to short rectangular, appearing bipapillose	<b>Ditrichaceae p.p.</b>
6. Laminal cells rounded, mammillose	7
7. Leaf margins uni-, bi- or tristratose; perichaetial leaf costa long excurrent with distal lamina erose or fimbriate; sporophytes immersed; seta short; capsules strongly asymmetric, obliquely and broadly ovoid below, narrow toward mouth; peristome double; plants found on rock or soil	<b>Diphysciaceae</b>
7. Leaf margins bistratose, sometimes incomplete below; perichaetial leaf costae subpercurrent; sporophytes exserted; seta elongate; capsules symmetric; peristome single; plants exclusively found on rocks	<b>Grimmiaceae p.p.</b>
8. Laminal cells stellate, unipapillose, papillae over cell lumen; basal cells inflated; leaf margins recurved nearly throughout; distal stems naked with a few highly reduced leaves; plants of marshes and bogs at high elevations	<b>Aulacomniaceae</b>
8. Laminal cells not stellate, uni- to pluripapillose; basal cells not conspicuously inflated; lacking specialised distal branches or stems (sometimes with deciduous leaves); plants mostly of semi-wet or dry sites	9
9. Laminal cells narrowly to somewhat broadly rectangular with projecting papillae at cell ends (rarely single over cell lumen); leaf margins often coarsely toothed, teeth single or more often double; capsules subglobose, inclined or if erect then immersed	<b>Bartramiaceae</b>
9. Laminal cells mostly isodiametric or short rectangular; papillae mostly over cell lumina or cells mammillose; leaf margins entire, crenulate or a few teeth at apex; capsules ovoid to cylindrical	10



# Guide to Bryophytes of sub-Saharan Africa

10. Laminal cells often bipapillose; capsules immersed to shortly exserted; peristome double or reduced; calyptra campanulate, plicate or not, hairy or naked; epiphytic or rarely on rocks	<b>Orthotrichaceae p.p.</b>
10. Laminal cells uni- or pluripapillose, or mammillose; capsules mostly long, rarely short exserted; calyptra cucullate or if campanulate then long cylindrical, smooth; mostly terrestrial, occasionally epiphytic	11
11. Leaves bordered by few to several rows of hyaline cells, border extending 1/3 from base to near apex; laminal cells uni-, bi- or pluripapillose; alar cells well differentiated	<b>Dicranaceae p. p.</b>
11. Leaves lacking a border; cells variously ornamented; alar cell undifferentiated	12
12. Leaves differentiated, base clasping, limb spreading; plants of wet or moist sites	13
12. Leaves undifferentiated, or if not, then base not clasping stem or if clasping upper laminal cells pluripapillose	14
13. Laminal cells subquadrate, mammillose; costa percurrent	<b>Ditrichaceae p.p.</b>
13. Laminal cells short-rectangular, rounded, papillae projecting at cell ends; costa short excurrent	<b>Dicranaceae p.p.</b>
14. Leaf costa in cross-section little differentiated, well developed stereid band lacking	15
14. Leaf costa in cross-section usually well developed, stereid band present, only below guide cells or both above and below	17
15. Laminal cells mammillose or weakly unipapillose, cells crowded, little space between cell lumens	<b>Dicranaceae p.p.</b>
15. Laminal cells pluripapillose, cells widely spaced, or if crowded, papillae extending between cell lumens	16
16. Leaves spatulate or if narrowly oblong-lanceolate then hyaline basal cells extending upward along margin a short distance; peristome single, teeth 16 in 8 pairs	<b>Rhachithecaceae p.p.</b>
16. Leaves narrowly lanceolate to oblong- or ovate-lanceolate, basal cells uniform across; peristome double or variously reduced, teeth 16 separated or in 8 pairs	<b>Orthotrichaceae p.p.</b>

# Guide to Bryophytes of sub-Saharan Africa

17. Capsules cleistocarpic, immersed, globose to oval	<b>Bryobartramiaceae</b>
17. Capsules stegocarpic, exerted	18
18. Calyptrae long cylindrical-campanulate; leaves oblong-elliptic to -obovate, laminal cells coarsely pluripapillose, papillae usually branched; usually restricted to high elevations	<b>Encalyptaceae</b>
18. Calyptra cucullate; leaves of various shapes; laminal cells uni- to pluripapillose, simple or branched; plants found in all zones	<b>Pottiaceae p.p.</b>

## Section 5. Plants acrocarpous. Leaves in 3 or more rows, ranked or not. Laminal cells smooth.

1. Plants minute, ephemeral or not; leaves costate or ecostate, capsules cleistocarpous or gymnostomous, mostly immersed	2
1. Plants conspicuous, mostly medium sized to large, not ephemeral; leaves costate; capsules stegocarpous or rarely gymnostomous, mostly long exerted	7
2. Laminal cell walls firm, mostly rectangular to subquadrate	3
2. Laminal cell walls lax, short- to long-rhomboidal or hexagonal-rhomboidal	6
3. Leaves oblong to obovate or orbicular, margins entire; annulus well developed	<b>Rhachithecaceae p.p.</b>
3. Leaves mostly lanceolate, if obovate then distal leaf margins usually crenulate or weakly serrulate; annulus absent or well developed	4
4. Spores very large, few	<b>Archidiaceae</b>
4. Spores small, numerous	5
5. Capsules with an elongate neck, often half or more the length of capsule, stomata often numerous in neck region	<b>Bruchiaceae p.p.</b>
5. Capsules with an inconspicuous neck or neck lacking, stomata few or absent	<b>Ditrichaceae p.p.</b>
6. Stems fleshy, partially subterranean; capsules wrinkled or warty, if smooth then exerted and leaves ecostate	<b>Gigaspermaceae</b>
6. Stems from a persistent protonema, not subterranean; capsules smooth or weakly bulging-mammillose, immersed	<b>Ephemeraceae</b>

# Guide to Bryophytes of sub-Saharan Africa

7. Laminal cells narrowly rectangular and strongly sinuose throughout except at basal margin; plants found exclusively on rocks	<b>Grimmiaceae p.p.</b>
7. Laminal cells not sinuose throughout, walls entire, or if sinuose not strongly so and restricted in distribution, not throughout; plants found on various substrates including rocks	8
8. Leaf margins bordered, border extending to apex or ending somewhat below, adjacent inner laminal cells large, often hexagonal-elongate to broadly fusiform or rhomboidal	9
8. Leaf margins lacking a border, or if bordered then confined to leaf base; marginal cells similar to or only slightly differentiated from inner laminal cells	12
9. Laminal cells subquadrate and rounded to oblong-oval, distally obliquely arranged	<b>Mniaceae p.p.</b>
9. Laminal cells rhombic to elongate-hexagonal, not obliquely arranged	10
10. Leaf border consisting of long linear cells; capsules often inclined to pendulous	<b>Bryaceae p.p.</b>
10. Leaf border consisting of large, rectangular to fusiform cells; capsules erect, if inclined or subpendulous then seta hygroscopic	11
11. Capsules with a conspicuously modified, enlarged neck, often inflated or larger than urn; peristome single, 16 teeth united in pairs, or teeth 8, often recurved when dry; plants usually epiphytic, on dung or decaying plant material	<b>Splachnaceae p.p.</b>
11. Capsules with an inconspicuous or narrowed neck; peristome absent, single and represented by an exostome of 16 teeth, or double, teeth incurved when wet; plants mostly on soil	<b>Funariaceae</b>
12. Alar cells differentiated, quadrate to oblong or oval, often dark coloured, yellow to red	13
12. Alar cells undifferentiated	14
13. Alar cells dark red; low, somewhat irregular membrane formed around and external to peristome; plants on rocks associated with streams, mostly at high elevations	<b>Seligeriaceae p.p.</b>
13. Alar cells often reddish-brown or golden; low, external membrane lacking; plants on various substrates and low to high elevations	<b>Dicranaceae p.p.</b>

# Guide to Bryophytes of sub-Saharan Africa

14. Leaves appearing 3-ranked; seta conspicuously elongate (to 10 cm long or more); exostome reduced, endostome well developed; plants of mid to high elevations in boggy sites	<b>Meesiaceae</b>
14. Leaves spirally arranged, or more than 3-ranked; seta usually shorter; peristome various; plants either of drier sites or aquatic, rarely of boggy sites	15
15. Laminal cells distally linear-oblong or -fusiform and flexuous or not; capsules inclined to more often pendulous; peristome double, endostomial cilia often present, or represented by only an hyaline endostome with a low membrane	<b>Bryaceae p.p.</b>
15. Laminal cells isodiametric to short or long rectangular; capsules mostly erect to inclined; peristome single or double (Rhizogoniaceae)	16
16. Laminal cells above base isodiametric, small, thick-walled; plants often dark green, reddish-brown or blackish	17
16. Laminal cells often short to long rectangular, or distally grading into subquadrate cells, walls thin to rather thick-walled; plant mostly light to dark green	19
17. Costa in cross-section generally well developed, stereids above and below guide cells or only below, upper and lower epidermal cells differentiated or not; capsules often long exserted; peristome teeth often divided into 32 filaments; plants on soil or rocks, dry or wet sites, at all elevations	<b>Pottiaceae p.p.</b>
17. Costa in cross-section little or not differentiated; capsules short exserted or immersed, 4-valved or with peristome teeth perforate or divided only distally; plants confined to rocks and at very high elevations (páramo or puna)	18
18. Capsules 4-valved (peristome and operculum lacking); leaves strongly subulate from an ovate base or ovate with a very broad, diffuse costa to ca. 1/2 lamina length	<b>Andreaeaceae p.p.</b>
18. Capsules with peristome, teeth often perforate or divided above; leaves percurrent to excurrent as a hyaline awn	<b>Grimmiaceae p.p.</b>
19. Leaves elliptic, obovate spathulate, obtuse to rounded; peristome either with 16 teeth in 8 pairs or exostome extremely reduced	20
19. Leaves mostly ovate-lanceolate to narrowly lanceolate; margins entire to serrate; peristome with teeth when present not paired nor with exostome extremely reduced	22
20. Leaves mostly 2 mm long or more; capsules with a modified, enlarged neck, often	<b>Splachnaceae p.p.</b>

# Guide to Bryophytes of sub-Saharan Africa

inflated or larger/long than urn	
20. Leaves mostly 1.2 mm long or less; capsules lacking a modified neck	21
21. Leaves obovate to elliptic, leaf apices not apiculate; perichaetial leaves similar to stem leaves, not long sheathing; capsules smooth	<b>Splachnobryaceae</b>
21. Leaves obovate to spatulate, leaf apices apiculate (most leaves); perichaetial leaves strongly differentiated from stem leaves, long sheathing; capsules 8-ribbed	<b>Rhachithecaceae p.p.</b>
22. Capsule neck elongate, 1.5-3 times longer than urn, stomata numerous in neck region; peristome absent or single (vertically striate below); costa subpercurrent; plants of disturbed sites, rather uncommon	<b>Bruchiaceae</b>
22. Capsule neck distinctly shorter than urn, or absent; peristome double or single (and often divided above); costa subpercurrent to excurrent; plants of various habitats	23
23. Perichaetia at mid stem or base; leaf margins bistratose and doubly toothed, if singly toothed then distal stem tips with cylindrical, papillose gemmae; plants epiphytic or terrestrial	<b>Rhizogoniaceae p.p.</b>
23. Perichaetia terminal on stems; lacking the above combinations of characters; plants on soil or rocks	24
24. Capsules ribbed; annulus compound, exceeding or nearly so the length of the peristome; leaves setaceous from an ovate base; plants rare	<b>Seligeriaceae p.p.</b>
24. Plants lacking the above combination of characters	25
25. Peristome teeth terete, often divided to near base, into 32 filaments	<b>Ditrichaceae p.p.</b>
25. Peristome teeth flat below, entire or divided above	<b>Dicranaceae p.p.</b>

# Guide to Bryophytes of sub-Saharan Africa

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## FAMILY ACCOUNTS

### ADELOTHECIAEAE

(M.J. Wigginton, October 2006)

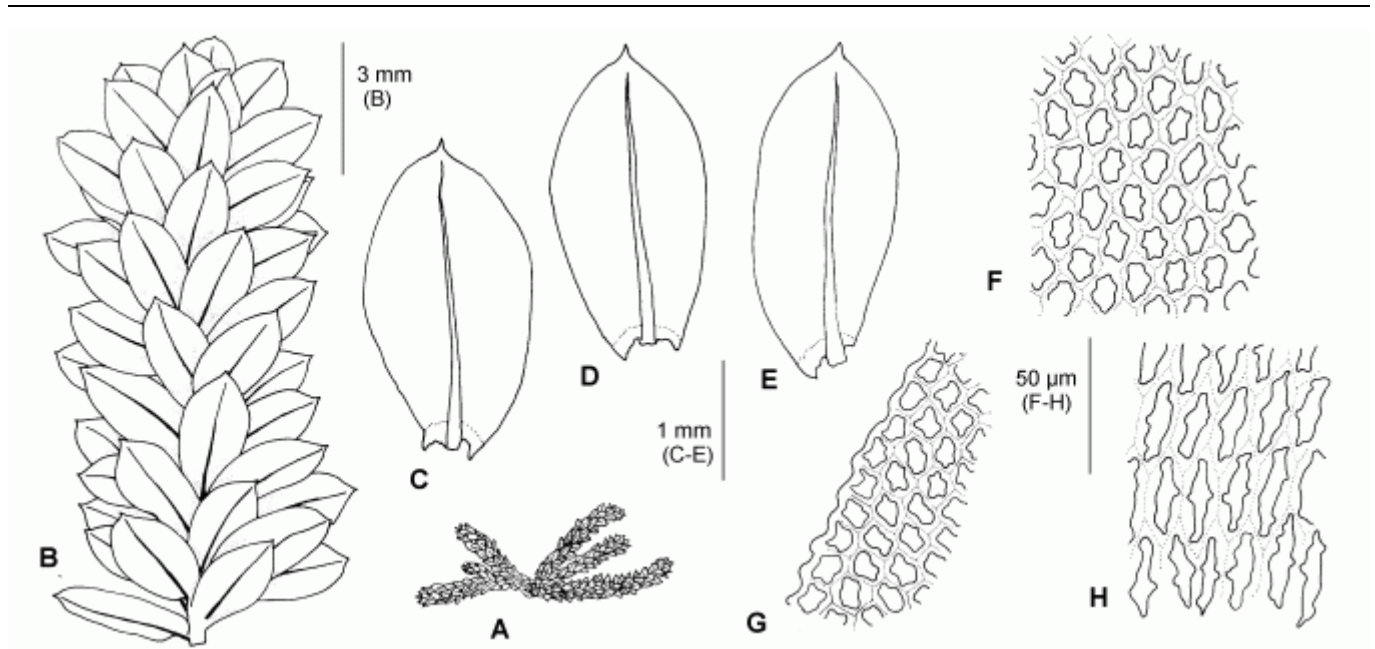
A monogeneric family in the Hookeriales.

#### ***Adelothecium*** Mitt.

A monospecific genus. The single species, *A. bogotense* (Hampe) Mitt., is apparently very rare in Africa, and currently known only from Tanzania and Madagascar. It is, however, rather widespread in the montane regions of the neotropics.

**Plants** medium-sized to robust, dull to slightly glossy, in dense, light green, yellowish, golden to brownish mats, sub-pendent. **Primary stems** short, creeping, the lower part densely covered with a tomentum of smooth, brown, branched rhizoids. **Secondary stems** and branches spreading, often horizontally on twigs and branches; leafy shoots complanate, to 7-8 mm wide. **Stems** in transverse section with 3-4 rows of very thick-walled cortical cells with tiny lumens surrounding large, thick-walled medullary cells; central strand absent; **axillary hairs** of 10 or more cells. **Stem leaves** complanate, in 8 ranks, shrunken and often curved downwards when dry, margins plane; costa single, strong, (70-)100-150(-200)  $\mu\text{m}$  wide at base, gradually tapering, ceasing below apex; dorsal and ventral leaves 2.2-3.5 mm long, symmetrical, broadly ovate to obovate, abruptly narrowed to a short triangular apiculus, shortly decurrent; lateral leaves 3-4 mm long, somewhat asymmetric and undulate, broadly oval to obovate, apex rounded and apiculate, slightly decurrent, crenulate-dentate; **branch leaves** smaller, gradually attenuated distally, leaves reduced in size; **leaf cells** thick-walled; apical cells linear-fusiform, porose; median cells stellate, smooth to bulging; basal cells fusiform to irregularly rectangular and porose, golden brown; marginal cells narrow and smaller. **Gemmae** short-cylindrical to clavate, ca 40-70  $\mu\text{m}$  long, on axillary stalks of highly reduced leaves (on microphyllous branchlets). Gametangia unknown in African material, but in neotropical collections: **Dioicous**. **Sporophytes** lateral; perichaetial leaves elongate, ovate-lanceolate or -subulate. **Seta** erect, short, ca 2 mm long, smooth to weakly papillose. **Capsule** erect, urn ovoid. **Operculum** rostrate. **Peristome** double, exostome teeth 16, cross-striate, appearing furrowed with a hyaline border; endostome basal membrane low, segments 16, keeled and perforate, cilia absent. **Calyptra** mitrate, base weakly lobed, densely covered by long capillary hairs, plicate. **Spores** spherical, papillose-granulose.

# Guide to Bryophytes of sub-Saharan Africa



***Adelothecium bogotense*** (Hampe) Mitt. **A:** habit. **B:** portion of shoot. **C-E:** leaves. **F:** median cells. **G:** marginal cells near apex of leaf. **H:** cells near leaf base.

*Habitat.* Epiphytic, on the twigs and branches of trees (including *Podocarpus milanjanus*), and on shrubs, in montane forest; 1200-1330 m in Madagascar, and 2250-2300 m in Tanzania.

*Discussion.* *A. bogotense* is a large moss characterised by 1) complanate, often horizontally-spreading shoots, 2) obovate leaves with single strong costa, 3) stellate, porose leaf cells, 4) often microphyllous, gemmiferous branch tips. These features should separate this taxon from all other montane epiphytes. Sporophytes are not known from Africa and are exceedingly rare in the neotropics, and reproduction must be mostly by gemmae. The relationships of this taxon within the Hookeriales is debated.

*Literature.* **Buck, W.R. 1998.** Pleurocarpous mosses of the West Indies. Bronx: New York Botanical Garden. **Demaret, F. 1955.** Étude préliminaire des Hookeriaceae africaines intertropicale. Bulletin du Jardin Botanique de l'Etat à Bruxelles 25: 375-390. **Ochyra, R., Bednarek-Ochyra, H., Pócs, T., & Crosby, M.R. 1992.** The moss *Adelothecium bogotense* in continental Africa, with a review of its world range. Bryologist 95: 287-295. **Whittemore, A. & Allen, B. 1989.** The systematic position of *Adelothecium* Mitt. and the familial classification of the Hookeriales (Musci). Bryologist 92: 261-272.

## ANDREAEACEAE

(N.G. Hodgetts, May 2005)

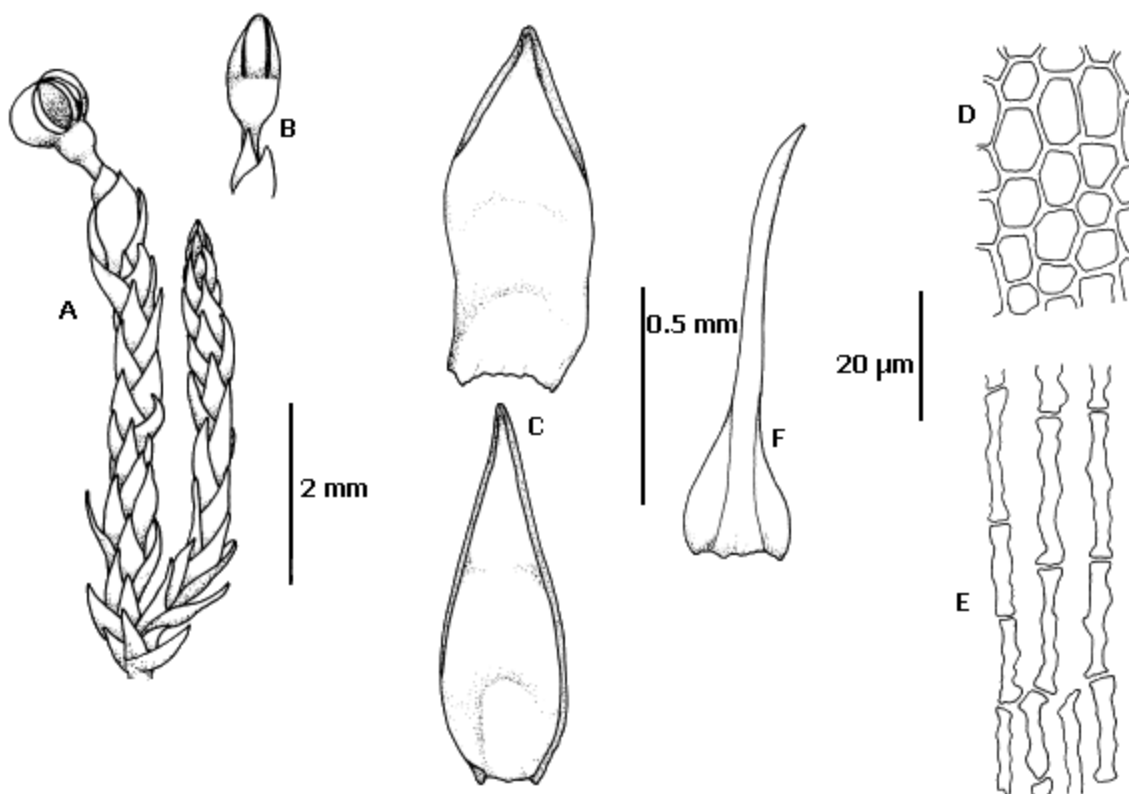
A monogeneric family in the class Andreaeopsida.

***Andreaea*** Hedw.

Fourteen species are recorded from sub-Saharan Africa. There are about 50 species worldwide (Murray 1988). A key was provided to the costate species by Schultze-Motel (1970).

# Guide to Bryophytes of sub-Saharan Africa

**Plants** mostly small to medium sized, forming readily-disintegrating tufts or mats, dark brown, reddish-brown or black, stem and branch tips green or yellowish green. **Stems** erect to somewhat spreading, few to several branched; in cross-section cells thick-walled, outer 2-4 rows of cells small, inner cells larger, central strand absent. **Leaves** loosely erect to appressed, occasionally contorted when dry, erect-spreading when wet, oblong-lanceolate to subulate, broadly oblong-ovate to panduriform, or broadly elliptical, to 3 mm long, concave, slightly clasping stem, often channeled above, apex narrowly to broadly acute or acuminate, or broadly obtuse and apiculate, base subauriculate or not; margins plane, erect to enrolled or reflexed to recurved, entire or crenulate by bulging cell walls; ecostate or costate, if costa present then single, either short and broad (1/2 or more leaf width at base) or filling acumen; laminal cells thick-walled, often sinuose and porose, upper and median cells  $\pm$  hexagonal or quadrate to shortly rectangular, smooth to papillose; lower and basal cells shortly to longly rectangular. **Autoicous or dioicous**. **Perichaetia** terminal, leaves differentiated, large, 2 or more times longer than stem leaves, often sheathing the pseudopodium. **Pseudopodium** (seta-like structure)  $\pm$  short to elongate, to 5 mm long. **Capsule** erect, ovoid to cylindrical, 0.5-2.0 mm long, splitting nearly the full length of the capsule by 4 slits or valves; true peristome and operculum absent. **Calyptra** mitrate-campanulate. Spores spherical, papillose.



***Andreaea alpestris* Thed. (A-E)**

Lesotho: Duckett, Hodgetts & Matcham 3600g (Hb. N.G. Hodgetts)

A: stems with sporophyte (dry); B: sporophyte wet; C: leaves; D: mid-leaf cells; E: basal cells.

***Andreaea subulata* Harv. in Hook. (F)**

Malawi: Hodgetts 2424e (E)

F: leaf.

**Habitat.** On acidic rocks, in open exposed sites or in streams; confined to montane areas, 1400-5000 m.

**Discussion.** *Andreaea*, a characteristic component of the tropical alpine life zone, is recognised by its black to reddish-black gametophytes, with costate or ecostate leaves exhibiting thick-walled and often sinuose laminal cells, which are frequently papillose on the distal abaxial surface; when fertile the pseudopodium and 4-valved capsule are diagnostic. *Andreaea* requires a critical revision in Africa: B. Murray is currently preparing a worldwide revision of the genus. Until this is available, useful references include Demaret (1943), De Sloover (1977), Hodgetts et al. (1999) and Magill (1981).



# Guide to Bryophytes of sub-Saharan Africa

*Literature.* **Demaret, F. 1943.** Le genre *Andreaea* en Afrique centrale et orientale. Bulletin du Jardin Botanique de l'État à Bruxelles 17: 33-48. **De Sloover, J.L. 1977.** Note de bryologie africaine IX. *Andreaea*, *Racomitrium*, *Gymnostomiella*, *Thuidium*. Bulletin du Jardin Botanique National de Belgique 47: 155-181. **Hodgetts, N.G., Matcham, H.W. & Duckett, J.G. 1999.** Bryophytes collected in Lesotho, the Natal Drakensberg and the Orange Free State, southern Africa. Journal of Bryology 21: 133-155. **Magill, R.E. 1981.** - see general refs. **Murray, B.M. 1988.** The genus *Andreaea* in Britain and Ireland. Journal of Bryology 15: 17-82. **Schultze-Motel, W. 1970.** Monographie der Laubmoosgattung *Andreaea*. 1. Die costaten Arten. Willdenowia 6: 25-110.

## ANOMODONTACEAE

(B.J. O'Shea, April 2000)

**Plants** small to medium sized, forming mats, often coarsely so, dark green to yellowish-brown. **Stems** undifferentiated and foliate, or primary stems creeping, leaves reduced and scale-like, with secondary stems spreading to erect, mostly short, terete; flagellate branches occasional. **Leaves** crowded, erect to appressed when dry, erect to wide-spreading, complanate or terete when wet, broadly ovate, ovate-lanceolate, ovate-ligulate or -oblong, apex obtuse-rounded to narrowly, tips fragile or not, base broadly decurrent or not; margins plane to recurved, crenulate to coarsely toothed; costa single, strong below, mostly 2/3 lamina length to ending below leaf acumen; laminal cells subquadrate to rhombic or hexagonal, thin- to thick-walled, smooth or pluripapillose; basal cells adjoining costa oblong, smooth, thick-walled. **Dioicous.** **Perichaetia** lateral, leaves differentiated. **Seta** elongate. **Capsule** erect, urn cylindrical to ovoid or ovoid-cylindrical, smooth to faintly wrinkled when dry; annulus absent or well developed in 1-2 rows, deciduous in fragments. **Operculum** conic-rostrate. **Peristome** double, exostome teeth 16, short or well developed, papillose or cross-striate to smooth below; endostome finely papillose, represented only by a low membrane, segments somewhat to notably rudimentary and adhering to exostome, or narrow, keeled, perforate or not, cilia absent or rudimentary. **Calyptra** cucullate, smooth and naked or with a few erect hairs. **Spores** spherical, appearing smooth to finely papillose.

*Discussion.* The Anomodontaceae contain five genera and about 25 species with only two genera in sub-Saharan Africa, containing three species. Members of this family have previously been aligned with the Thuidiaceae, and still are treated as such by some authors.

*Literature.* **Granzow-de la Cerda, I. 1992.** Análisis cladístico de la familia Anomodontaceae. Tropical Bryology, 6: 95-104. **Granzow-de la Cerda, I. 1997.** Revision and phylogeny of *Anomodon* and *Herpetineuron* (Anomodontaceae, Musci). Contributions from the University of Michigan Herbarium, 21: 205-275 [keys, illustrations, maps].

1. Leaves entire to crenulate by projected papillose cell walls; laminal cells pluripapillose, costa ± straight	<i>Anomodon</i>
1. Leaves irregularly serrate; laminal cells smooth, costa often flexuose towards apex	<i>Herpetineuron</i>

**Anomodon** Hook. & Taylor

# Guide to Bryophytes of sub-Saharan Africa

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Two species in sub-Saharan Africa (*A. pseudotristis* (Müll.Hal.) Kindb. and *A. tristis* (Ces. in De Not.) Sull. & Lesq.) (O'Shea 2000); a genus of about 18 species mostly associated with the north temperate regions.

**Plants** slender, forming loose to dense mats, dark green to yellowish-brown. **Primary stems** creeping, leaves reduced and scale-like. **Secondary stems** spreading to erect-ascending, mostly short, terete; flagellate branches occasional. **Leaves** crowded, erect-appressed to loosely erect when dry, erect to wide-spreading, somewhat complanate when wet, ovate-ligulate, apex obtuse-rounded; margins plane to revolute, crenulate; costa short and weak to extending beyond mid-leaf; laminal cells rounded-hexagonal, thin-walled, pluripapillose, papillae few to several over cell lumen; basal cells adjoining costa oblong, smooth, thick-walled. **Perichaetial** leaves differentiated, elongate, sheathing at base, cells elongate, smooth. **Seta** to 25--30 mm long. **Capsule** erect, symmetric, oblong-ovate, to 1 mm long, smooth to faintly wrinkled when dry; annulus well developed in 1-2 rows, deciduous in fragments. **Operculum** conic-rostrate, oblique. **Peristome** with exostome teeth smooth below, papillose above; endostome without segments or cilia. **Calyptra** papillate with a few erect hairs. **Spores** to 22µm, finely papillose.

**Habitat.** On soil, rocks, base and trunk of trees; montane forests, often associated with calcareous sites, 350-1800 m.

**Discussion.** Characteristics of the genus include the spreading to ascending secondary stems, absence of paraphyllia, leaves ligulate to gradually acuminate from an ovate base, entire or crenulate margins, laminal cells pluripapillose, isodiametric. The African species were previously assigned to *Haplohymenium*, but Granzow-de la Cerda (1992, 1997) has demonstrated that *Haplohymenium* is derived within *Anomodon*, and treated it as a section within that genus. It is known in Africa from Kenya, Tanzania, South Africa and the Mascarenes (Réunion, Rodrigues and Mauritius), and is well distributed around the Indian Ocean, in E Asia and the SW Pacific. Collections named *A. tristis* may be mis-identifications, as all the specimens so named seen by the author have been *A. pseudotristis* (O'Shea 2000), with the only exception of genuine material found recently in Réunion. The species differ in that the shoots of *A. tristis* are about twice the width of those of *A. pseudotristis*, and have many leaves with broken tips, particularly towards the base of the stem.

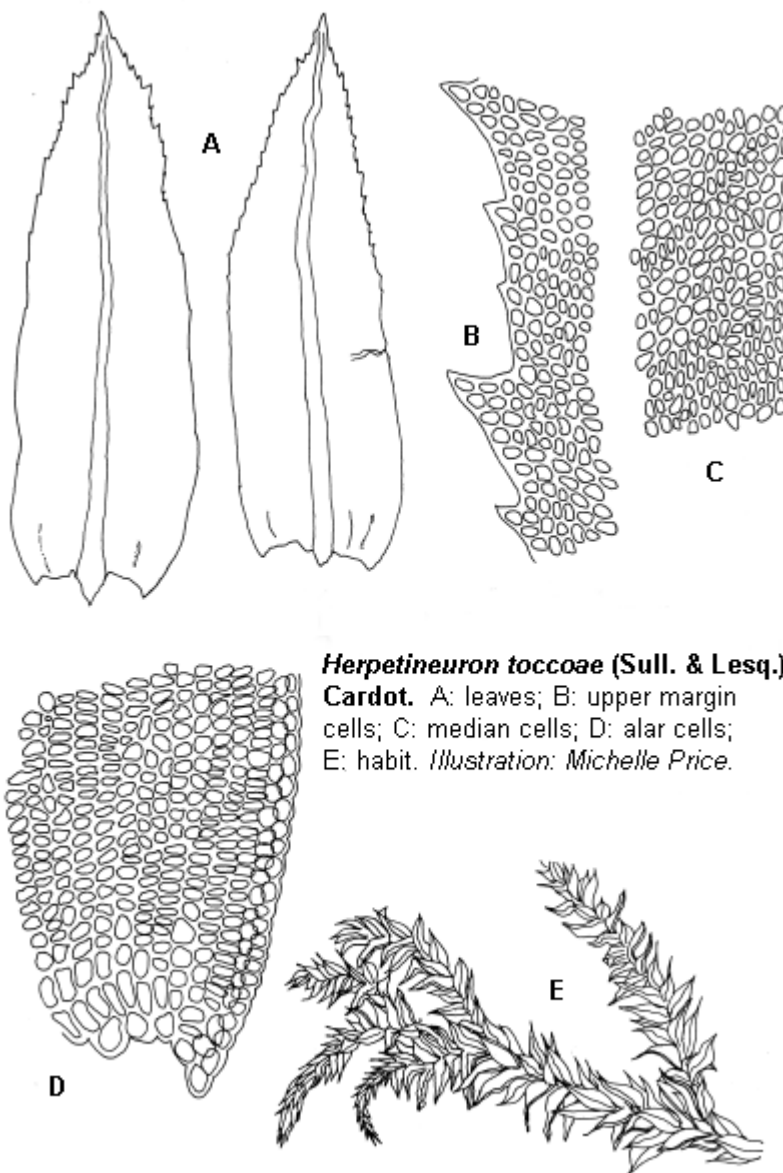
**Literature.** Granzow-de la Cerda, I. 1992, 1997 - see family ref. O'Shea, B.J. 2000. Taxonomic notes on *Anomodon* (Anomodontaceae, Bryopsida) in Africa. *Journal of Bryology* 22: 241-242.

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## ***Herpetineuron*** (Müll.Hal.) Cardot

One species in Africa, *H. toccoae* (Sull. & Lesq.) Cardot, recorded from Guinea, Central African Republic, Ethiopia, Tanzania, Malawi, South Africa and Madagascar (also the southeastern United States south to southern Brazil and S Asia down to New Caledonia, and N to Japan); a genus of two species, rather widespread, at high elevations in the tropics.

# Guide to Bryophytes of sub-Saharan Africa



*Herpetineuron toccoe* (Sull. & Lesq.)  
**Cardot.** A: leaves; B: upper margin cells; C: median cells; D: alar cells; E: habit. *Illustration: Michelle Price.*

**Plants** medium sized. **Primary stems** creeping, leaves scale-like. **Secondary stems** erect, irregularly branched, often arcuate or circinate, attenuated branches usually present; in cross-section outer 2-3 rows of cells thick-walled, inner cells larger, firm-walled, central strand present. **Leaves** erect when dry, erect-spreading when moist, oblong-ovate to ovate short-lanceolate, to 2.5 mm long, concave to weakly keeled, indistinctly biplicate or not, apex narrowly acute, margins plane or recurved at base, distal 1/3 coarsely serrate; costa strong below, flexuose or straight distally; laminal cells rather thick-walled, subquadrate, smooth. **Perichaetial** leaves erect, subulate from a sheathing base. **Seta** to 15 mm long. **Capsule** with urn ovoid-cylindrical, to 3 mm long; stomata at urn base, superficial; annulus well developed. **Operculum** conic, rostrate. **Peristome** double, exostome teeth densely papillose, perforate; endostome basal membrane high, segments stoutly linear. **Calyptra** smooth and naked. **Spores** finely papillose.

**Habitat.** On soil, rocks, logs and tree trunks; open montane forests, at elevations from 700-2000 m.

**Discussion.** The genus is characterized by brownish-green, erect secondary stems with attenuate branches usually present, the tips of stems often arched over to one side, leaves with a narrowly acute apex and

irregularly serrate margins, the costa snake-like towards the tip, and smooth laminal cells. Sporophytes are uncommon. Reproduction is likely by the flagellate-attenuate branches.

**Literature.** Granzow-de la Cerda, I. 1992, 1997 - see family ref.

## ARCHIDIACEAE

(T. Arts, April 2000)

A monotypic family comprising a natural group of species which share a unique development of the sporophyte. Usually placed in a separate order Archidiales in the subclass Bryidae, but by some authors in a separate subclass, Archidiidae (e.g. Brown & Lemmon, 1985). The Archidiaceae have formerly been placed in the

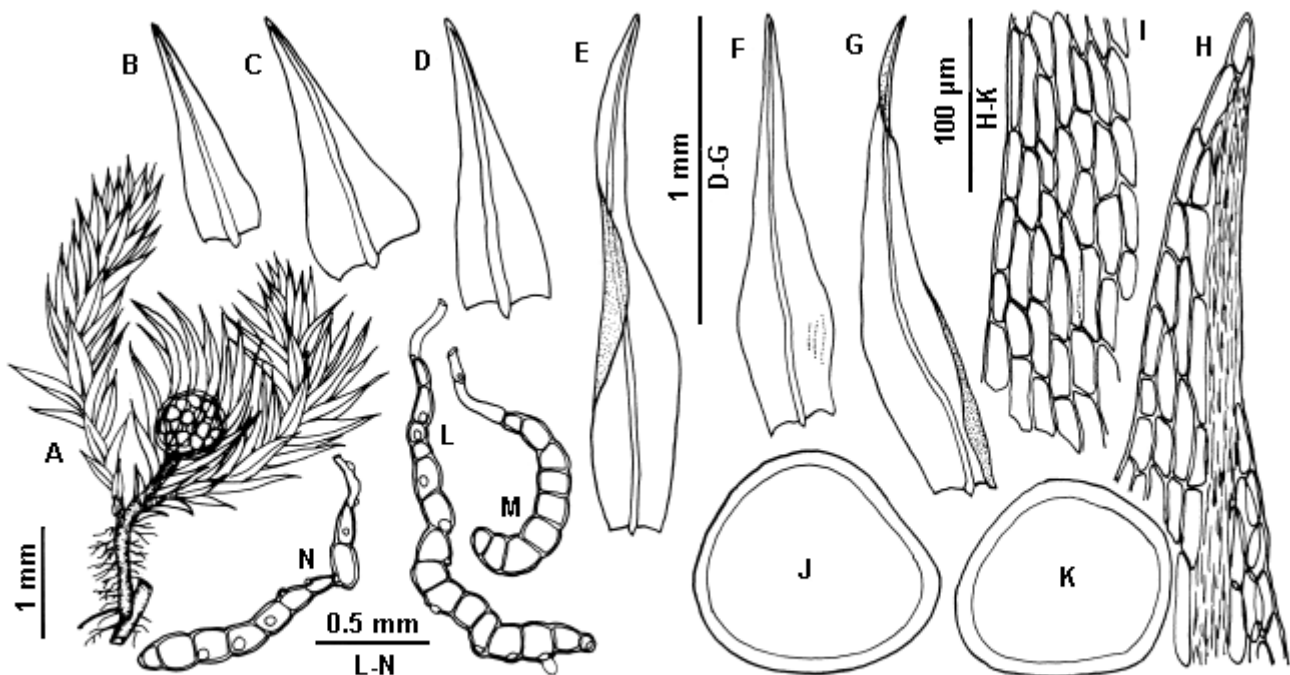
# Guide to Bryophytes of sub-Saharan Africa

Dicranales, because gametophytically, it exhibits features associated with the cleistocarpous genus *Pleuridium* (Ditrichaceae).

## **Archidium** Brid.

A genus of 34 species, rather widely distributed. The greatest diversity is found in Africa with 13 accepted species, mostly from Southern Africa. Ten species are endemic to Africa and four species to the South African Cape.

**Plants** small, in loose or dense tufts, occasionally gregarious, green to yellowish-green. **Stems** usually erect, simple or branched, fertile stems or branches short, leaves crowded; sterile branches elongate with distantly placed leaves, both developed by innovations, old sterile innovations frequently prostrate and stoloniferous. **Leaves** erect-spreading to spreading, to 1.7 mm long, ovate, oblong-ovate to linear-lanceolate, apex acuminate to subulate or obtuse-rounded, base clasping; margins entire to weakly serrulate above; costa single, strong, subpercurrent to strongly excurrent; laminal cells thin- to thick-walled, smooth, median cells varying from irregularly quadrate or rectangular to rhomboidal; basal cells rectangular; alar region differentiated by a few rows of quadrate cells; marginal cells along base short rectangular, frequently hyaline. **Asexual reproduction** by large, moniliform, hyaline to yellowish rhizoidal tubers when present. **Autoicous, paroicous or synoicous**. **Perichaetia** lateral, subsessile to sessile in axil of stem leaves, or terminal on short fertile stems; perichaetial leaves often differentiated, smaller or larger than stem leaves, concave at the base, often distally serrulate, median cells linear-rhomboidal, basal cells firm to lax, thin-walled. **Seta** absent. **Capsule** immersed, sessile, globose, 0.20-0.75 mm in diameter, walls yellowish, semi-transparent, irregularly rupturing at maturity; stomata and annulus absent. **Operculum and peristome** absent. **Calyptra** only slightly differentiated as a thin membrane attached to the vaginula. **Spores** few ca. 8-30 per capsule, sphaerical to polyhedral, large, 110-310  $\mu\text{m}$  in diameter, smooth to granulose or densely papillose.



### ***Archidium ohioense* Schimp. ex Mull.Hal.**

A: plant with sporophyte; B-D: stem leaves; E-G: perichaetial leaves; H: cells of leaf apex; I: marginal and mid-leaf cells; J-K: spores; L-N: rhizoidal gemmae.

**Habitat.** Terrestrial plants from sandy or loamy soils in exposed sites, often amongst grass.

# Guide to Bryophytes of sub-Saharan Africa

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*Discussion.* Mostly perennial species, mainly reproducing by subsequent innovations and disintegration of the older stem parts; the innovations form rhizoids at the stem base or in the leaf axils when buried by soil. The plants often show seasonal growth and regenerate from old stems or rhizoidal tubers. Sterile plants may be difficult to name even to genus: the narrow leaved species are likely to be confused with various genera in the Ditrichaceae, the broad leaved species are difficult to distinguish from sterile Bryaceae. However, the presence of sessile sporophytes with few, but exceedingly large, spores are diagnostic and the occurrence of characteristic rhizoidal tubers may facilitate identification of sterile plants.

*Literature.* **Arts, T. 1998.** A contribution to the moss flora of the Cape Provinces (South Africa). *Journal of Bryology* 20: 429-447 [rhizoidal tubers]. **Brown R.C. & Lemmon, B.E. 1985.** Phylogenetic aspects of sporogenesis in *Archidium*. *Monographs in Systematic Botany from the Missouri Botanical Garden* 11: 25-40. **Magill, R.E. 1981.** - see General refs. [keys, illustrations]. **Snider, J. A. 1975.** A revision of the genus *Archidium* (Musci). *Journal of the Hattori Botanical Laboratory* 39: 105-201 [keys, illustrations].

## AULACOMNIACEAE

(B.J. O'Shea, April 2003)

A monotypic family.

### ***Aulacomnium* Schwaegr.**

Probably only two species in our area: *A. palustre* (Hedw.) Schwägr. from Ethiopia, Kenya and Uganda, and *A. turgidum* Wahlenb. from Kenya; a mostly north temperate genus of seven species.

**Plants** medium sized to somewhat large, forming loose to dense tufts, yellowish-green or -brown. **Stems** erect, few branched, densely tomentose, very finely papillose/punctate; in cross-section central strand present. **Leaves** imbricate to contorted and twisted when dry, erect-spreading when wet, narrowly lanceolate to oblong-lanceolate to obovate, 4-5.2 mm long, to 1 mm wide, apex short acuminate or acute to obtuse, base weakly decurrent; margins recurved, crenulate and distally serrulate to entire; costa single, strong, very finely papillose/punctate on both surfaces, ending below apex, flexuose; basal cells inflated, 2-3-stratose, thick-walled, reddish-brown; median cells rounded, rounded-hexagonal or quadrate, lumens rounded to  $\pm$  stellate and collenchymatous, unipapillose, papillae over cell lumen, to not or scarcely papillose. **Propagula** often present, clustered terminally on nearly naked elongate stems with a few scale-like leaves. **Dioicous**. [**Sporophytes** terminal. **Seta** elongate, 25-40 mm long, smooth. **Capsule** inclined to horizontal, urn oblong or ovoid-cylindrical, 2.5-4 mm long, asymmetric and curved, plicate and constricted below urn mouth when dry; annulus revoluble. **Operculum** conic to short-rostrate and oblique. **Peristome** double, exostome teeth 16, papillose, endostome basal membrane high, segments 16, keeled and perforate, cilia 2-4. **Calyptra** cucullate, naked and smooth. **Spores** spherical, smooth.]

*Habitat.* Boggy or moist ground, or on wet rocks, 3600-4500 m.

*Discussion.* This genus is characterized by the recurved leaf margins, stellate and papillose or rounded and smooth laminal cells, reddish-brown, thick-walled, enlarged basal cells. All species of *Aulacomnium* examined (5 species) were found by H.W. Matcham (pers. comm.) to exhibit very finely papillose or punctate cells on the stem cortex and on both dorsal and ventral surfaces of the costa. This appears to be a character unique to the family. Sporophytes have not been reported from Africa, and are comparatively rare worldwide. *Aulacomnium abyssinicum* Schimp. ex Paris, *nom. nud.*, reported for Ethiopia, is likely to be a synonym of *A. palustre*. *Aulacomnium turgidum* has leaves imbricate when dry, ovate to obovate, almost smooth laminal cells with star-shaped lumens, whereas *A. palustre*

# Guide to Bryophytes of sub-Saharan Africa

has leaves usually crisped or twisted when dry, more or less lanceolate, with more strongly papillose cells with rounded lumens.

## BRUCHIACEAE

(J.-P. Frahm, April 2000)

**Plants** very small to medium sized, solitary or forming short tufts. **Stems** short, simple or few branched by innovations. **Leaves** mostly progressively larger distally, lanceolate to narrowly lanceolate or subulate from an oblong or oblong-ovate base; margins plane, entire or distal tips serrulate; costa single, subpercurrent to short excurrent; laminal cells smooth. **Asexual structures** absent. **Autoicous**. **Sporophytes** terminal; perichaetial leaves often larger and longer. **Seta** short to elongate, erect, smooth. **Capsule** immersed to exserted, urn pyriform with a neck distinctly elongate, occasionally as long as or much longer than the urn; stomata numerous in neck region, superficial; annulus often well developed. **Operculum** absent or present and rostrate. **Peristome** absent or single with 16 teeth. **Calyptra** cucullate or mitrate. **Spores** papillose to spinose.

*Discussion.* The Bruchiaceae were originally included as a subfamily (Trematodontoideae) in the Dicranaceae but re-established as a family by Buck (1979). It includes four genera: *Bruchia*, *Pringleella* (3 species), *Eobruchia* (2 species) and *Trematodon*, of which only *Bruchia* and *Trematodon* are represented in Africa. Magill (1981) includes also *Cladophascum* in this group, which is treated here in the Dicranaceae. The family contains more than 100 species worldwide.

*Literature.* **Buck, W. R. 1979.** A re-evaluation of the Bruchiaceae with the description of a new genus. *Brittonia* 31: 469-473. **Magill, R.E. 1981.** - see General refs.

1. Capsule cleistocarpous (without operculum, annulus, and peristome), immersed in the leaves	<b><i>Bruchia</i></b>
1. Capsule stegocarpous (the operculum falling off, peristome present or absent), exserted on a long seta	<b><i>Trematodon</i></b>

### ***Bruchia* Schwägr.**

A genus of about 17 species, which are mainly distributed in the northern hemisphere, especially in North America. Only 3 species are known from Africa, *Bruchia brevipes* Harv. ex Hook. and *B. eckloniana* Müll.Hal. from South Africa and *B. queenslandica* I.G.Stone (*B. foveolata* Magill) from Namibia, which are keyed out and illustrated by Magill (1981 - see General refs.).

**Plants** very small, scattered or in small groups. **Stems** short, to 5 mm tall, simple. **Leaves** erect to erect spreading, larger above, from an ovate or oblong base lanceolate or linear-lanceolate, subulate, 1-2 mm long, acute to acuminate; margins plane, entire or serrulate; costa subpercurrent to short excurrent, rather weak; upper laminal cells narrowly rectangular, thick-walled; basal cells broader, oblong-rectangular, rather lax. **Perichaetial leaves** larger than stem leaves. **Seta** short, 0.3-0.4 mm long. **Capsule** immersed, urn pyriform, 1 mm long, neck distinct, 1/4-1/3 of the length of the urn, with numerous phaneropore stomata, lid with short beak. **Operculum and peristome** absent. **Calyptra** mitrate, smooth, base lobed. **Spores** large, 25-45 µm, papillose to spinose.

# Guide to Bryophytes of sub-Saharan Africa

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*Habitat.* On open soil, together with other ephemeral mosses.

*Discussion.* Plants of this genus are characterised by their small size, cleistocarpous capsule (lacking an operculum and peristome) immersed in the leaves. They are distinguished from other cleistocarpous short-lived mosses by the differentiated neck with numerous stomata.

*Literature.* **Rushing, A. E. 1985.** Spore morphology in the genus *Bruchia* Schwaegr. (Musci). *American Journal of Botany* 72: 75-85. **Rushing, A. E. 1986.** A revision of the genus *Bruchia* Schwaegr. (Musci). *Journal of the Hattori Botanical Laboratory* 60: 35-83 [keys, illustrations].

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## ***Trematodon* Michx.**

A genus much in need of a revision in which 81 species have been described, of which one third were described once and never reported again. Twenty-six species are known from Africa, of which only a few species are widespread.

**Plants** gregarious or forming low, loose tufts, green to yellowish-green. **Stems** mostly short and erect, 1-2 mm long, in some species up to 8 mm long, radiculose. **Leaves** flexuose or contorted when dry, erect to erect-spreading when wet, lanceolate to broadly subulate from an ovate or oblong sheathing base, 1.5-4.0 mm long, apex acute to subobtuse; margins plane, entire or with a few teeth at apices; costa subpercurrent; upper laminal cells subquadrate or rectangular above leaf shoulders, uni- or bistratose; lower and basal cells rectangular to oblong hexagonal, lax. **Perichaetial leaves** convolute, longer than stem leaves. **Seta** elongate, 2-20 mm long, slender, yellowish. **Capsule** erect to inclined, urn cylindrical, 1.2-3.0 mm long, sometimes strumose, with a distinct neck equal to or much longer than urn. **Operculum** long rostrate, oblique, 0.5 – 1.5 mm long. **Peristome** present and single, rudimentary (consisting of a basal membrane) or absent; teeth vertical-striate, perforate. **Calyptra cucullate**, naked. **Spores** 20 – 30 µm, papillose.

*Habitat.* On open soil, often in disturbed sites in villages or along roadside banks; from the lowland to 2500 m.

*Discussion.* The genus is characterised by capsules with a conspicuously long neck, which is otherwise only found (rarely) in Bryaceae.

## BRYACEAE

(D. Holyoak, April 2003)

**Plants** small to large and robust, growing as scattered plants or forming dense tufts. **Stems** erect, solitary or few-branched by innovations, or stems connected by stolons (*Rhodobryum*), usually radiculose, occasionally densely tomentose; in cross-section central strand present. **Leaves** spirally arranged, often small and distant below, equally spaced or distally rosulate, variously shaped, lanceolate, ovate, oblong, obovate, to broadly ovate or occasionally orbicular, apex broadly acute to acuminate, occasionally obtuse or rounded, base sometimes decurrent; margins plane to recurved or reflexed, entire to serrate distally, often sharply so, limbate or elimbate; costa single,

# Guide to Bryophytes of sub-Saharan Africa

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evanescent to excurrent; laminal cells smooth (rarely slightly prorate), median cells typically short to long hexagonal or rhomboidal, sometimes linear and sinuose (*Anomobryum*), walls  $\pm$  firm, porose or not; basal cells quadrate or short to long rectangular, lax- or firm-walled; alar region usually undifferentiated; marginal cells similar or long to linear if forming a border. **Asexual propagules** regularly present in some species, as rhizoidal tubers, as bulbils or cylindrical gemmae in leaf axils, or as protonemal tubers or gemmae. **Autoicous, dioicous or synoicous. Perigonia** bud-like. **Perichaetia** terminal (rarely appearing lateral when overtopped by subperichaetial innovations), bracts usually little differentiated, some larger than stem leaves but innermost often much smaller. **Seta** elongate, single or occasionally several together, smooth. **Capsule** exserted, mostly pendulous, but mainly erect or suberect in some genera, urn ovoid to obloid, or more often pyriform, usually with a distinct short or long neck; exothecial cells mostly elongate, firm and thick-walled, stomata at base of urn, superficial; annulus often large and revoluble, or absent. **Operculum** conic, conic-apiculate or shortly rostrate. **Peristome** mostly double or variously reduced or single; typically, exostome teeth 16, papillose and trabeculate; endostome basal membrane present, segments 16, keeled, hyaline or yellowish, cilia 2 or 3. **Calyptra** cucullate, naked and smooth. **Spores** spherical, usually lightly papillose.

*Discussion.* The genera *Epipterygium*, *Mielichhoferia* and *Pohlia* have recently been transferred to the Mniaceae, *Orthodontium* to the Orthodontiaceae, and *Leptobryum* to the Meesiaceae, mainly on the basis of DNA-sequence data (Cox & Hedderson 1999, Buck & Goffinet 2000). Following these transfers of genera to other families, the Bryaceae contains about 11 genera and almost 1000 species; in sub-Saharan Africa there are 6 genera and about 142 species.

Recent studies of phylogenetic relationships within the Bryaceae based on chloroplast DNA evidence (Cox & Hedderson 2003, Pedersen et al. 2003) show that *Bryum* and *Brachymenium* are not monophyletic groups and that *Anomobryum*, *Plagiobryum* and *Rhodobryum* also belong to the same clade as these. Indeed, *Anomobryum* and *Plagiobryum* appear to be recent derivatives within the radiation of species of *Bryum sensu lato*, and hence unworthy of generic separation. At least for *Anomobryum* and *Rhodobryum*, these conclusions were anticipated to some extent by Ochi (1972, 1992) and some other taxonomists who made detailed morphological studies. There is thus a strong argument for placing all Bryaceae in *Bryum*, but the usual generic divisions are maintained here to prevent *Bryum* becoming an even larger and more unwieldy genus and because the merger of *Brachymenium* in *Bryum* would require new nomenclatural combinations. Comprehensive rearrangement of the generic taxonomy of Bryaceae seems inevitable in future but it is not attempted in this Guide because too few taxa have as yet been subject to detailed studies of DNA sequences and morphology. *Rosulabryum* (Spence 1996) is not treated as a separate genus from *Bryum* here because it is not monophyletic (Cox & Hedderson 2003: 38, Pedersen et al. 2003).

*Study guide.* The family is notoriously difficult and numerous taxonomic problems remain unresolved among its African species. While many of the species are distinct and readily recognisable given some experience, features of the peristome are critical in the identification of many taxa so that collections lacking mature capsules are frequently difficult or impossible to name. Ochi (1972) has provided an illustrated synoptical treatment that covers most of the Afrotropical Bryaceae.

Species of *Bryum* often grow intermixed and they sometimes hybridise. Care is therefore needed to ensure that leaves and capsules are studied from the same plant. Stem leaves provide many of the essential features needed for identifying species. Sections of the costa should be made in the lowest one-third of the leaf. As noted above, characters of the intact peristome are often also needed, especially in *Bryum* and *Brachymenium*. 'Perfect peristomes' have the endostome fully developed with processes  $\pm$  as long as exostome teeth and two or three long appendiculate cilia between each pair of processes. 'Reduced' endostomes have cilia short to rudimentary and the processes may also be shorter. Determining the sexuality of *Bryum* may be difficult because inflorescences are often partly decayed by the time capsules mature and the antheridia often decay without trace before the remnants of unused archegonia disappear.



# Guide to Bryophytes of sub-Saharan Africa

Species of *Pohlia* (Mniaceae) may show strong superficial similarity to *Bryum* spp., but these differ in (1) usually having relatively longer, narrower leaf cells, (2) often having the upper half of the leaf  $\pm$  denticulate or toothed, (3) in always lacking a leaf border of narrow cells, and (4) the leaf section usually has several large median guide cells with stereids both above and below them (whereas *Bryum* lacks large guide cells and typically shows only a single dorsal band of stereids). One or another of those characters occurs in various species of *Bryum*, but rarely two or three together, except sometimes in *Bryum alpinum* which is probably the species of *Bryum* most prone to confusion with *Pohlia* spp., although it usually differs from them in having strong red pigmentation. Other characters helpful in separating *Pohlia* from *Bryum* are that the former genus has the costa ending in or below the leaf apex (costa often excurrent in *Bryum*), relatively longer perichaetial bracts in many species, and cilia rudimentary to long but not appendiculate as in some *Bryum*. *Mielichhoferia* (Mniaceae) differs from Bryaceae in the sporophytes quickly becoming lateral through elongation of a subperichaetial innovation and in the pyriform capsule having rudimentary exostome teeth much shorter than the endostome segments.

**Literature.** **Buck, W.R. & Goffinet, B. 2000.** Morphology and classification of mosses. Pp. 71-123, in Shaw, A.J. & Goffinet, B. Bryophyte Biology. Cambridge: Cambridge University Press. **Cox, C.J. & Hedderson, T.A.J. 1999.** Phylogenetic relationships among the ciliate arthrodontous mosses: evidence from chloroplast and nuclear DNA sequences. *Plant Systematics and Evolution* 215: 119-139. **Cox, C.J. & Hedderson, T.A.J. 2003.** Phylogenetic relationships within the moss family Bryaceae based on chloroplast DNA evidence. *Journal of Bryology* 25: 31-40. **Ochi, H. 1972.** A revision of the African Bryoideae, Musci (First part). *Journal of the Faculty of Education, Tottori University, Natural Science* 23: 1-126 [keys, illustrations]. **Ochi, H. 1973.** A revision of African Bryoideae (Second Part). *Journal of the Faculty of Education, Tottori University, Natural Science* 24: 23-50. **Ochi, H. 1992.** A revised infrageneric classification of the genus *Bryum* and related genera (Bryaceae, Musci). *Bryobrothera* 1: 231-244. **Pedersen, N., Cox, C.J. & Hedenäs, L. 2003.** Phylogeny of the moss family Bryaceae inferred from chloroplast DNA sequences and morphology. *Systematic Botany* 28: 471-482. **Shaw, J. 1985.** The correlation between taxonomy and peristome structure in the Bryaceae. *Journal of the Hattori Botanical Laboratory* 59: 79-100. **Shaw, J. 1987.** Systematic studies on the Bryaceae. *Memoirs of the New York Botanical Garden* 45: 682-690. **Spence, J.R. 1996.** *Rosulabryum* genus novum (Bryaceae). *Bryologist* 99: 221-225. **Van Rooy, J. & Magill, R.E. 1987.** Bryaceae, pp. 335-393, in Magill, R.E., *Flora of Southern Africa. Bryophyta. Part 1 Mosses, Fascicle 2 Gigaspermaceae - Bartramiaceae.* Dept. of Agriculture and Water Supply, Republic of South Africa [keys, illustrations].

1. Leaves rosulate, upper leaves large (>5 mm), lower leaves much smaller; stolons commonly present; costa in cross-section with ventral cells in 3 or more rows and dorsal stereid or substereid band small or absent; often polysetous	<b><i>Rhodobryum</i></b>
1. Leaves rosulate or not, small or large; stolons absent; costa in cross section with 1-2 rows of ventral cells and dorsal stereid band well developed or not; rarely polysetous	<b>2</b>
2. Small plants with $\pm$ broadly ovate leaves and lax thin-walled leaf cells; capsules clavate and strong asymmetrical; exostome teeth shorter than endostome segments	<b><i>Plagiobryum</i></b>
2. Small or large plants; leaves of various shapes; cells lax or firm; capsules not clavate or strongly asymmetrical; peristome reduced or not, but if reduced exostome teeth subequal to or longer than endostome segments	<b>3</b>
3. Mid-leaf cells elongate, length:breadth mostly >4:1, often sinuose; leaves imbricate, equidistant; stems frequently julaceous; red pigment lacking; leaves small, <2 mm	<b><i>Anomobryum</i> <i>p.p.</i></b>
3. Mid-leaf cell length:breadth mostly <4:1; if longer, cells not sinuose; leaves imbricate or not, equidistant or rosulate; stems julaceous or not; red pigment often present; leaves small or large	<b>4</b>

# Guide to Bryophytes of sub-Saharan Africa

4. Leaves imbricate, equidistant, concave; costa evanescent to excurrent; small, slender ± julaceous plants, lacking red pigment	<b>5</b>
4. This combination of characters lacking	<b>6</b>
5. Leaves chlorophyllose throughout, so plants not whitish	<b>Anomobryum p.p.</b>
5. Leaves with upper lamina cells lacking chlorophyll, so plants whitish	<b>Bryum argenteum p.p.</b>
6. Capsules erect to horizontal, with small mouth; endostome ± reduced (segments narrow to rudimentary, cilia absent or reduced)	<b>Brachymenium</b>
6. Capsules normally cernuous to pendulous (but sometimes horizontal when plants grow on vertical substrata); capsule mouth narrow to wide; endostome perfect or reduced	<b>7</b>
7. Endostome processes with two branches, one uniseriate and as long as exostome, the other a rudiment; small reddish moss known only from Cape Verde Islands	<b>Perssonia</b>
7. Endostome reduced or not, but processes never consisting of two branches differing greatly in length; widespread genus with many species of widely varying appearance	<b>Bryum</b>

## **Anomobryum Schimp.**

Eight species in sub-Saharan Africa; worldwide there are about 25-30 species, many widely distributed.

**Plants** small and slender, gregarious or forming short tufts, lustrous, light green or yellowish, to golden-brown. **Stems** erect, simple or few branched, julaceous; in cross-section central strand present. **Leaves** appressed, ovate, obovate, ovate-oblong to short lanceolate, ca 1-2 mm long, concave, apex acute to obtuse or rounded, base slightly decurrent; margins plane, occasionally reflexed below, entire to finely serrulate; costa usually strong, subpercurrent to short excurrent; apical cells often short, rhomboidal; median cells linear to rhomboidal, often sinuose or vermicular, thin- or thick-walled; lower and basal cells enlarged, rectangular, thin-walled and lax; marginal cells not or ± weakly differentiated as a border of narrow elongate cells. **Dioicous**. **Perichaetia** terminal. **Seta** to 30 mm long, usually slender. **Capsule** inclined to pendulous, urn pyriform-cylindrical, neck short. **Operculum** conic, blunt to apiculate. **Peristome** double, rarely reduced, exostome teeth joined at base; endostome basal membrane high, segments keeled and perforate, cilia appendiculate. **Spores** spherical, finely papillose.

**Habitat.** On soil or rock ledges, often in wet or flushed sites, lowland to >3000 m.

**Discussion.** The julaceous stems and branches, and appressed leaves are similar to those of *Bryum argenteum*, but that common species differs in lacking chlorophyll in the upper parts of the leaves so the plants are whitish. The long, sinuose to vermicular upper lamina cells of several *Anomobryum* are distinctive in the Bryaceae, but other species have short (length:width <4:1) rhomboidal to hexagonal cells. Ochi (1980) placed *Anomobryum* as a subgenus in *Bryum*.

**Literature.** Ochi, H. 1972 (see family ref.). Shaw, J. & Fife, A.J. 1984. The evolutionary and taxonomic significance of peristome morphology in *Anomobryum* (Bryaceae, Musci). *Journal of the Hattori Botanical Laboratory* 57: 285-298. Van Rooy, J. & Magill, R.E. 1987 (see family ref.).

# Guide to Bryophytes of sub-Saharan Africa

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## ***Brachymenium* Schwägr.**

33 species recorded for sub-Saharan Africa; a genus containing well over 100 species distributed in the tropics and extending into sub-temperate regions worldwide.

**Plants** small to large (2-35 mm), forming dense tufts, light or yellow-green to dark or brownish-green, often lustrous. **Stems** erect, simple to few branched, radiculose, occasionally tomentose; in cross-section central strand present. Leaves equidistant or rosulate, crispate to  $\pm$  flexuose and erect to erect-spreading when dry, erect-spreading to spreading when wet, lanceolate, oblong-lanceolate, ovate or obovate-oblong, apex short to long acuminate, base slightly decurrent or not; margins limbate, plane above, often reflexed to recurved in lower 1/2, entire to more commonly serrulate or serrate; costa usually strong, short to long excurrent, rarely subpercurrent, in section with weak dorsal stereid band; awn smooth or toothed; median cells mostly thin-walled, broadly hexagonal or short to long rhomboidal-hexagonal, rhomboidal toward margin and apex; lower and basal cells short rectangular; apical cells occasionally differentiated, hyaline; marginal border cells linear and thick-walled, 1-4 rows. **Propagula** often present, as axillary bulbils in some species. **Autoicous, synoicous or dioicous.** **Perichaetia** terminal but often overgrown by subperichaetial innovations, bracts often larger than leaves. **Seta** 10-40 mm long, erect to weakly flexuose, slender to stout. **Capsule** suberect to commonly erect, less often inclined or horizontal, urn pyriform to cylindrical-pyriform or clavate, slightly asymmetrical, neck usually distinct, phaneropore stomata present on neck, mouth small to medium sized. **Operculum** short and hemispherical to long conic, rarely rostrate. **Peristome** double, exostome teeth with trabeculae well developed; endostome basal membrane low to high, segments rudimentary or well developed and narrowly perforated, cilia absent or rudimentary. **Spores** small or large, spherical, lightly papillose.

*Habitat.* Epiphytic on trees and shrubs, some species also on logs, humus, soil and rocks; lowland to at least 2800 m.

*Discussion.* Usually distinct from *Bryum* in the erect to suberect capsules and reduced endostome. Plants lacking capsules are often unidentifiable.

*Literature.* **Ochi, H. 1972** (see family ref.). **Van Rooy, J. & Magill, R.E. 1987** (see family ref.).

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## ***Bryum* Hedw.**

About 93 species are reported for sub-Saharan Africa, in this, the largest genus of the family. It is estimated that *Bryum* comprises nearly 800 species distributed worldwide but much taxonomic reassessment is needed.

**Plants** small to large and robust (2-100 mm), growing as scattered stems or more often forming loose to dense tufts, pale to dark green, reddish, brownish, yellowish, golden, blackish or  $\pm$  bright red throughout. **Stems** erect, few to several branched by innovations,  $\pm$  radiculose, occasionally densely tomentose; in cross-section central strand present. **Leaves** equidistant to more commonly crowded, sometimes rosulate, when dry plane to contorted or crispate, erect-appressed to erect, when wet erect-spreading or spreading, lanceolate, ovate, obovate, oblong,

# Guide to Bryophytes of sub-Saharan Africa

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elliptical, or suborbicular, 0.5-7 mm long, apex acute to acuminate, less often rounded, base decurrent in some species; margins usually reflexed to recurved, less often plane, entire to more commonly serrulate or serrate at mid-leaf or above; costa evanescent or subpercurrent to  $\pm$  long excurrent; upper and median laminal cells rhomboidal-hexagonal or hexagonal, rarely long-rectangular, porous or not; lower and basal cells quadrate to oblong or rectangular, thin to  $\pm$  thick-walled, occasionally lax; marginal cells commonly forming a distinct border of incrassate linear cells. **Asexual propagules** regularly present in some species, as rhizoidal tubers, as bulbils or cylindrical gemmae in leaf axils, or as protonemal tubers or gemmae. **Dioicous, autoicous or synoicous.** **Perigonia** usually bud-like. **Perichaetia** terminal, bracts differentiated or not. **Seta** 8-50 mm long. **Capsule** inclined or pendulous (less often suberect or horizontal, but usually only in poorly grown plants or those on steep substrata), urn short to long oblong, cylindrical or pyriform, 1-5 mm long; neck short or long; phaneropore stomata at urn base; annulus compound, revoluble. **Operculum** convex-conic or conic-apiculate to shortly rostrate. **Peristome** double, exostome teeth joined at base, mostly papillose, distally smooth, trabeculate; endostome lightly papillose, basal membrane  $\pm$  high, segments keeled and perforate, cilia appendiculate or nodose, sometimes rudimentary or absent. **Spores** spherical,  $\pm$  weakly papillose.

*Habitat.* Commonly on soil, humus and rocks, less often epiphytic (but frequently so in the widespread *B. capillare*) or on logs; from lowlands to 4920 m. Some species tolerate seasonally dry soils in savannas, others are confined to permanently wet habitats in mires or beside springs or streams.

*Discussion.* A large and highly variable genus, both gametophytically and sporophytically. Some species can be identified from non-fertile specimens but others require study of undamaged peristomes and mature spores. *Bryum* is one of the most difficult genera of mosses, partly because of morphological plasticity of some species and partly because of hybridisation. A modern worldwide revision might result in half of the number of species currently recognised.

*Literature.* **Mohamed, M.R.1979.** A taxonomic study of *Bryum billardieri* Schwaegr. and related species. Journal of Bryology 10: 401-465 [keys, illustrations]. *Ochi, H.* 1972 (see family ref.). *Van Rooy, J. & Magill, R.E.* 1987 (see family ref.).

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## *Perssonia* Bizot

One species, *P. sanguinea* Bizot, known only from Cape Verde Islands.

**Plants** small (2-5 mm) in lax red tufts. **Stems** erect, with slender branches, not tomentose. **Leaves**  $\pm$  equidistant, erect-spreading and flexuose when dry, spreading when moist, ovate-lanceolate, slightly concave, entire, margins plane, costa excurrent; few basal cells sub-quadrate, cells above uniformly hexagonal, narrower at margins but leaves not bordered. **Apparently dioicous.** **Seta** erect, 20 mm long. **Capsule** horizontal to cernuous, 3 mm long, with long neck; exothecial cells in middle of urn rectangular,  $\pm$  sinuose; phaneropore stomata at urn base; annulus compound, persistent or perhaps caducous. **Operculum** conical. **Peristome** double, exostome teeth narrow, densely papillose on both surfaces, trabeculate; endostome reduced, basal membrane short (1/8 height of exostome teeth) hyaline, slightly papillose, and apparently adherent to exostome, processes divided into two branches, one branch red-brown, as long as exostome teeth, uniseriate, nodulose at articulations, the other a short rudiment; cilia lacking. **Immature spores** smooth.

*Habitat.* Collected at 450-1200 m; habitat and substratum not reported.

# Guide to Bryophytes of sub-Saharan Africa

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*Discussion.* This monotypic genus is recognised as distinct from *Bryum* only because of the peculiar asymmetrical reduction of each of its endostome segments. The Neotropical *Acidodontium* also has forked segments but they have two branches of  $\pm$  equal length. Nevertheless, further study seems likely to show that *Perssonia* is a member of the same clade as *Bryum* and *Brachymenium*.

*Literature.* **Bizot, M. 1969.** Mousses des Iles du Cap Vert. Svensk Botanisk Tidskrift 63: 441-454 [illustrations].

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## ***Plagiobryum* Lindb.**

Three species recorded for sub-Saharan Africa; worldwide there are six species, four in the Northern and two in Southern Hemisphere.

**Plants** small (4-10 mm), forming dense soft tufts or mats, light green to hyaline with reddish tint, sparsely radiculose below. **Stems** erect, few or several branched by innovations, branches julaceous. **Leaves** imbricate, erect when wet and dry,  $\pm$  broadly ovate, concave, 0.6-1.0 mm long; apex acute, hyaline; margins plane or slightly reflexed, entire to weakly toothed distally; costa evanescent or subpercurrent to excurrent, somewhat flexuose; laminal cells thin-walled, lax, hyaline, upper and median cells rhomboidal to rhomboid-hexagonal (2-4:1); upper marginal cells narrower, not forming distinct border; basal cells shorter. **Dioicous.** **Perigonia** terminal or lateral through innovation. **Perichaetia** terminal, frequently overgrown by subperichaetial innovations; perichaetial bracts longer than leaves, ovate-lanceolate. **Seta** rather short, 3-10 mm long, stout, curved distally, smooth. **Capsule** horizontal to pendulous, clavate or gibbous, to 5 mm long, asymmetric, mouth oblique, narrowed, neck differentiated, 1-2 mm long; phaneropore stomata numerous on neck; annulus revoluble. **Operculum** conic. **Peristome** double, exostome teeth rather short, shorter than endostome, weakly papillose or cross-striate below, distally smooth; endostome adhering somewhat to exostome, basal membrane rather high, segments irregular, narrowly keeled, perforate above, cilia rudimentary. **Spores** rather large, ellipsoidal, forming tetrads until maturity, coarsely papillose.

**Habitat.** At high altitudes, on soil on cliff faces or in rock crevices.

*Discussion.* The small whitish or silvery plants are rather similar to those of *Bryum argenteum*, from which non-fertile material can be distinguished by the lax upper laminal cells and pinkish lower parts of the plants. *Plagiobryum* with capsules are easily separated from *B. argenteum* by the distally curved, short seta, clavate capsule that is asymmetrical with an obliquely oriented mouth, weakly ornamented short exostome teeth (less than 250  $\mu$ m), and endostome exceeding the exostome.

*Literature.* **Ochi, H. 1972.** (see family ref.). **Shaw, A.J. 1982.** *Plagiobryum zieri* (Hedw.) Lindb. disjunct in Guatemala, with phytogeographic notes. Bryologist 85: 243-250 [illustrations]. **Van Rooy, J. & Magill, R.E. 1987.** (see family ref.).

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# Guide to Bryophytes of sub-Saharan Africa

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## ***Rhodobryum* (Schimp.) Limpr.**

Four species in sub-Saharan Africa; a genus containing some 40 species widely distributed in cool temperate regions, in the tropics largely confined to the highlands.

**Plants** large to more often robust, to 70 mm tall, forming loose to dense tufts, dark green to reddish-brown. **Stems** erect, often connected by underground stolons, few to several branched by innovations, radiculose, often densely tomentose. **Leaves** rosulate, with large leaves distally or interruptedly in crowded rosettes, or  $\pm$  equally spaced small leaves, mostly erect to erect-spreading and  $\pm$  crispate when dry, erect-spreading to wide-spreading when wet, oblong-obovate to oblong, mostly 7-12 mm long, to 5 mm wide, apex obtuse to acute and often apiculate, rarely acuminate, base usually shortly decurrent; margins distally plane, below plane or narrowly reflexed or recurved, occasionally undulate, limbate, serrate, often sharply so, or serrulate; costa strong below and usually weak distally, short excurrent, in cross-section with ventral cells in 3 or more rows and dorsal stereid or substereid band small or absent; upper and median cells rhomboidal to hexagonal, thin- to  $\pm$  thick-walled, often weakly to strongly porose; basal cells long-rectangular; marginal border cells linear to linear-rhomboidal, 2-6 rows,  $\pm$  thick-walled. **Dioicous. Perigonia and perichaetia** terminal. **Seta** 1 or 2, 20-80 mm long, rather stout. **Capsule** horizontal to pendulous, urn long cylindrical or cylindrical-pyriform, frequently curved, 4-6 mm long, neck short, frequently wrinkled when dry; stomata open. **Operculum** conic-apiculate. **Peristome** double, exostome teeth lightly papillose, trabeculate; endostome basal membrane high, segments perforate and keeled, cilia well developed, appendiculate. **Spores** lightly papillose.

*Habitat.* On soil or humus; in the tropics mostly in premontane to montane forests (ranging from at least 1200-3500 m), but in the lowlands in southernmost Africa.

*Discussion.* The genus is recognized by the large plants, with rosulate leaves often 7->10 mm long, and usually with weakly to strongly bordered margins. Distinction from the largest species of *Bryum* also relies on the presence of stolons and the cross-section of the costa (see key). Ochi (1972), among other authors, treats *Rhodobryum* as a subgenus of *Bryum*.

*Literature.* Ochi, H. 1972. (see family ref.). Van Rooy, J. & Magill, R.E. 1987. (see family ref.).

## BRYOBARTRAMIACEAE

(R.E. Magill, June 2003)

The family is monotypic, found only in Australia and South Africa. The family shows similarities to both the Pottiaceae and Encalyptaceae but is maintained as a separate family based on its persistent epigonium.

### ***Bryobartramia* Sainsbury**

The genus has a single species (*B. novae-valesiae* (Broth.) I.G.Stone & G.A.M.Scott) found in southern Australia and the southwestern Cape of South Africa.

**Plants** small, scattered or in small groups, green to yellow-green. **Stems** erect to 3 mm tall, occasionally branched above; in cross-section without a central strand. **Leaves** erect-spreading, ligulate, lingulate or lanceolate, 0.3-0.5 mm long; apex broadly acute to obtuse; margins plane, entire; costa subpercurrent or ending below apex: in section guide cells 2, ventral cells large, in single row, dorsal stereid or substereid band 2-3 cells thick; upper leaf cells quadrate to subhexagonal, weakly thickened, with 2-4 C-shaped papillae; basal cells rectangular, thin-walled,

# Guide to Bryophytes of sub-Saharan Africa

smooth; alar cells not differentiated. **Parioicous**. **Perichaetia** terminal, leaves linear-lanceolate, 1.8-2.0 mm long. **Seta** 0.2-0.4 mm long. **Capsules** cleistocarpic, immersed, globose to oval, apiculate, 0.8 mm long; exothecial cells isodiametric thin-walled, stomata phaneroporic, scattered over urn; epigonia persistent, oval-rostrate, 1.7-2.2 mm long, cells below beak prorate. **Spores** subround, 35-40  $\mu\text{m}$ , warty, yellow-brown.

*Habitat.* On clay or sandy soil in open, arid shrubland.

*Discussion.* The genus might be confused with *Goniomitrium*, but the narrow papillose leaves and persistent epigonium will help separate *Bryobartramia*. The epigonium of most mosses splits into two parts as the sporophyte develops, however in *Bryobartramia*, the epigonium continues to enlarge to accommodate the entire sporophyte. Spores are only released when both the epigonium and capsule walls break down. The epigonium frequently outlasts the capsule.

*Literature.* **Magill, R.E., 1981.** Flora of Southern Africa. Part 1 Mosses. Fascicle 1: 269-270. **Stone, I.G. 1977.** Some morphological and anatomical features of the monotypic genus *Bryobartramia* Sainsbury (Musci). Australian Journal of Botany 25: 141-157.

## BRYOXIPHIACEAE

(B.J. O'Shea, 2005)

A monotypic family, placed in its own order, the Bryoxiphiales.

### ***Bryoxiphium* Mitt.**

One species in Africa, *Bryoxiphium norvegicum* (Brid.) Mitt., which was collected in Mauritius in 1980, but only published recently (Kimura & Seto 2003). The genus is widespread, but locally infrequent, in the Northern Hemisphere, but is known also from Japan, Korea and Taiwan.

**Plants** medium sized, forming loose tufts, glossy light green to golden-brown. **Stems** often perpendicular to substrate, stiffly erect to subpendent, to 2 cm long, simple or few branched, the bulb-like base with numerous brown rhizoids. **Leaves** gradually and progressively larger and longer distally, ca 2-3 mm long, strongly 2-ranked (distichous), crowded, oblong-lanceolate, strongly conduplicate-keeled, apex of lower leaves bluntly rounded, distally apiculate; margins plane, entire; costa single, subpercurrent to percurrent; lamina unistratose; laminal cells smooth, firm-walled, upper cells linear; median cells oblong or rhomboidal to subquadrate; basal cells oblong-short rectangular to subquadrate; marginal cells elongate and forming quite a wide border. Perichaetial leaves terminal; leaves larger, to 8 mm long or longer, costa long excurrent. **Perigonia** and **sporophytes** not seen. [Elsewhere in its range, the following apply: **Dioicous**. **Seta** short, erect or slightly curved, smooth. **Capsule** immersed, urn subglobose. **Operculum** short rostrate, somewhat oblique, remaining attached to columella for short period. **Peristome** absent. **Calyptra** cucullate, smooth and naked. **Spores** spherical.]

*Habitat.* On vertical cliffs, often in moist, shaded sites; altitude not given for the African collection, but elsewhere it is montane, at elevations from 1000-4100 m.

*Discussion.* *Bryoxiphium* is characterised by the growth habit, with stems perpendicular or subpendent from a vertical or inclined substrate, leaves 2-ranked and strongly keeled, and perichaetial leaves distinctly elongate with the costa long excurrent, and distal portion of stems with leaves exhibiting lamellae of several rows of cells on the back of the costa near the leaf tips. The African collection overlaps the subspecies *norvegicum* (North America,

# Guide to Bryophytes of sub-Saharan Africa

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Greenland and Iceland) and *japonicum* (Far East Russia, Japan, Korea, Taiwan) and Kimura & Seto (2003) sensibly suggested that infraspecific distinctions had little value.

*Literature.* Kimura, M. & Seto, K. 2003. *Bryoxiphium norvegicum* (Bryopsida: Bryoxiphiaceae), newly found in Mauritius. Bulletin of the Osaka Museum of Natural History 57: 33-37. Löve, A. & D. Löve. 1953. Studies in *Bryoxiphium*. Bryologist 52: 73-94, 183-203.

## CATAGONIACEAE

(B.J. O'Shea, April 2000)

A monotypic family (Buck & Ireland 1985) placed in the Leucodontales.

### ***Catagonium* Müll.Hal. in Broth.**

One species with two varieties in Africa: *C. nitens* var. *nitens* (Brid.) Cardot recorded from East Africa (Tanzania and Uganda), Swaziland and the Indian Ocean islands (Comores, Madagascar, Mauritius and Réunion), and *C. nitens* var. *maritimum* (Hook.) S.H.Lin recorded from South Africa (Cape, Natal and Transvaal) and Swaziland. A genus of four species with a circum-Antarctic distribution, extending into the mountainous tropics.

**Plants** small to medium sized, forming dense soft mats, yellowish-green to golden. **Primary stems** short, creeping, secondary stems spreading or pendent, 4-15 cm long, irregularly branched, often bearing papillose rhizoids. **Leaves** complanate, appearing 2-ranked, ovate-oblong, conduplicate or deeply concave, 1.0-2.5 mm long, apex obtuse-rounded and short piliferous to mucronate, tips often reflexed, base slightly auriculate; margins plane, entire; costae variable, absent or short forked; median cells linear-vermicular, rather thick-walled, smooth; alar region undifferentiated. **Dioicous.** **Perichaetia** lateral. Seta to 2.5 mm long, smooth. **Capsule** inclined to nodding, oblong-cylindrical, 1.6-3.2 mm long,  $\pm$  asymmetric. **Operculum** short-rostrate. **Peristome** double, exostome teeth 16, cross-striate below, papillose distally; endostome lightly papillose, basal membrane high, segments 16, keeled and perforate, cilia 1-3. **Calyptra** cucullate, smooth and naked. **Spores** spherical, smooth to finely papillose.

*Habitat.* Rocks, damp shaded cliffs, earth, or soil banks, rarely on tree trunks, decayed logs or tree bases; mostly from forests, 180-2200 m.

*Discussion.* *Catagonium* is characterized by the soft glossy mats, leaves strongly complanate, 2-ranked and oblong-ovate with short piliferous to mucronate apices, subauriculate leaf bases and short, mostly forked or occasionally single costae. Sporophytes are rare. Given the rather fragile nature of the stems and leaves, reproduction is likely asexual via propagula. The two African species can be differentiated by the following: *C. nitens* var. *nitens* - leaves conduplicate and complanate, and leaf apices piliferous, and *C. nitens* var. *maritimum* - leaves concave and sometimes terete and leaf apices mucronate.

*Literature.* Buck, W. R & Ireland, R. R. 1985. A reclassification of the Plagiotheciaceae. Nova Hedwigia 41: 89-125. Lin, S.-H. 1984. A taxonomic revision of Phyllogoniaceae (Bryopsida). Part II. Journal of the Taiwan Museum 37(2): 1-54 [keys, detailed descriptions, illustrations, maps].

## CRYPHAEACEAE



# Guide to Bryophytes of sub-Saharan Africa

(B.J. O'Shea, May 2000)

**Plants** medium sized, forming loose to dense tufts. **Primary stems** mostly short, creeping, leaves scale-like, often eroded and absent; radiculose. **Secondary stems** usually stiffly erect, irregularly to regularly pinnately branched. **Leaves** appressed to imbricate to spreading when dry, erect to erect-spreading when wet, widely ovate- to narrowly-lanceolate, apex acute to acuminate; margins plane to reflexed or recurved, entire to distally serrulate or serrate; costa single, strong; apical cells oval to oblong, median cells oval to oblong or rhomboidal, smooth to slightly prorate, thick-walled; alar region differentiated, cells numerous, quadrate to short rectangular and oblate. **Gemmae** absent. **Autoicous**. **Perichaetia** lateral, leaves differentiated, usually conspicuously longer than stem leaves, sheathing capsules, oblong to obovate and awned. **Seta** very short, erect, smooth. **Capsule** immersed, erect, ovoid-cylindrical to broadly ovoid or subglobose, symmetric to asymmetric. **Operculum** conic-mammillate or -rostrate. **Peristome** double or single, exostome teeth 16, papillose; endostome absent or present, basal membrane low, segments 16, narrow, keeled and lightly papillose, cilia absent or reduced. **Calyptra** cucullate or conic-mitrate, smooth or roughened. **Spores** unicellular, spherical to ovoid, papillose.

*Discussion.* The Cryphaeaceae contain ten genera and about 80 species of mostly tropical to subtemperate regions; in Africa with two genera and 6 species. Members of the family are commonly epiphytic in montane forests. Distinguishing features include the rather stiffly erect, irregularly branched secondary stems, thick-walled, oval to oblong laminal cells, well differentiated alar cells, and immersed capsules on terminal branches or appearing sessile along lateral stems. Their appearance is quite distinctive, with slender, erect, terete shoots arising from a creeping main stem, on tree trunks or branches, usually with abundant sporogonia. They usually appear as tufts or as a loose mat.

Sporophytes borne laterally on short branches; peristome double	<i>Cryphaea</i>
Sporophytes borne terminally on short branches and stems; peristome single	<i>Schoenobryum</i>

## ***Cryphaea* Mohr in F.Weber**

Five species in Africa, three endemic (Rao 2001b), and about 30 worldwide (Rao 2001a); distributed in the tropical highlands and extending into temperate regions at much lower altitudes.

**Plants** forming loose to dense tufts, mostly dark green, occasionally yellowish-green. **Secondary stems** stiff, to 10 cm long, regularly to irregularly pinnately branched, branches often short, flagellate branches occasional; in cross-section outer 2-5 rows of cells small, thick-walled, inner cells larger,  $\pm$  thin-walled, central strand absent; pseudoparaphyllia filamentous, uniseriate, to 180  $\mu$  m. **Leaves** ovate to short oblong-lanceolate, 1.5-2.5 mm long, to 1.4 mm wide, apex acute to more often short or long acuminate, base usually slightly clasping stem; margins plane or strongly recurved, entire to serrulate or coarsely and irregularly serrate distally; costa extending just beyond mid-leaf to ending in acumen; upper marginal cells often longer; median cells oval to oblong-oval, smooth or slightly prorate, thick-walled; alar cells subquadrate, thick-walled. **Perigonia** solitary in leaf axils, bud-like. **Perichaetia** lateral and appearing sessile, often several in a row on one side of stem, leaves oblong, concave convolute, awn short to long piliferous. **Seta** very short, to 0.35 mm long. **Capsule** with urn obloid-cylindrical to cylindrical or ellipsoid, 1.4-2.0 mm long. **Operculum** conic-short rostrate. **Peristome** double, exostome usually papillose throughout or smooth at base; endostome basal membrane low, segments finely to coarsely papillose, cilia absent. **Calyptra** cucullate, smooth or distally papillose-roughened. **Spores** unicellular, usually papillose.

# Guide to Bryophytes of sub-Saharan Africa

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*Habitat.* Epiphytic, on trunks, branches or exposed roots of trees and shrubs; usually preferring a humid, cool, relatively high light environment, so most frequent in Africa in montane forests, 1200-3225 m.

*Discussion.* The genus is characterized by the typically epiphytic, erect habit, the several to somewhat numerous sporophytes borne laterally on very short branches. In practice, it is not always easy to distinguish this genus from *Schoenobryum*, as the perianth-bearing branches in *Schoenobryum* are often very short, making them appear lateral, but there will usually be some that are clearly terminal. An additional character is that the perianths in *Cryphaea* are usually cylindrical, as opposed to oval in *Schoenobryum*, and *Cryphaea* is usually much more slender. Plants without sporogonia may be difficult to allocate to genus.

*Literature.* Rao, P. 2001a. A synopsis of the genus *Cryphaea* (Cryphaeaceae, Bryopsida). Bryobrothera 7: 1-35. Rao, P. 2001b. Taxonomic studies on *Cryphaea* (Cryphaeaceae, Bryopsida) 3. Revision of European, African, Australian and Oceanian, and American species. Bryobrothera 7: 37-112 [key to all species + illustrations].

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## ***Schoenobryum* Dozy & Molk.**

Only one species in Africa (*S. concavifolium* (Griff.) Gangulee); a genus of probably only 2 species worldwide, with a pantropical distribution.

**Plants** small to medium sized, forming short loose tufts, light green to yellowish-green or golden. **Secondary stems** erect, usually regularly pinnate branched, branches short, usually julaceous; in cross-section outer 2-3 rows of cells small, thick-walled, inner cells larger, firm-walled, central strand absent. **Leaves** closely appressed or sometimes patent, ovate-acuminate (sometimes broadly so), 1.0-1.5 mm long, apex often abruptly short acuminate, base slightly decurrent and clasping at base; margins sometimes flat but usually strongly recurved, entire or weakly dentate-serrulate at apex; costa strong, 1/2-2/3 lamina length, sometimes distally forked; laminal cells thick-walled, apical marginal cells oblong elongate, median cells oval to oblong-oval; inner lower and basal cells elongate, oblong to linear, usually porose, golden-yellow; alar cells irregularly-subquadrate. **Perigonia** lateral, bud-like, leaves ovate to ovate-short lanceolate. **Perichaetia** terminal on branch or stem, leaves obovate- to oblong-lanceolate, short to long piliferous. **Seta** very short. **Capsule** subglobose-ovoid, 1.2-1.8 mm long, somewhat asymmetric at base; exothecial cells irregularly subquadrate to rectangular, thin-walled; stomata at neck, superficial; annulus revoluble. **Operculum** rostrate. **Peristome** single, exostome teeth narrowly lanceolate, papillose. **Calyptra** mitrate, scabrous, distal cell angles projecting. **Spores** unicellular, spherical to ovoid, papillose.

*Habitat.* Occasionally on rock but usually epiphytic on branches, twigs or trunks of trees; usually in the open or light forest, or in denser forests often found on fallen twigs and branches, suggesting an origin in the canopy; 1000-3500 m.

*Discussion.* The feature of sporophytes borne terminally on stems and branches distinguish this genus from *Cryphaea*. The name *Acrocryphaea* was previously applied to the genus. A recent revision (O'Shea, 2003) concluded that only one specimen was present in Africa.

*Literature.* O'Shea, B.J. 2003. A revision of *Schoenobryum* (Cryphaeaceae, Bryopsida) in Africa. Tropical Bryology 24: 147-159.

# Guide to Bryophytes of sub-Saharan Africa

## DALTONIACEAE

(M.J. Wigginton, October 2006)

**Plants** small to medium sized, forming tufts or mats, green to yellowish-green or golden, sometimes glossy. **Primary stems** short and inconspicuous, or conspicuous and creeping to spreading. **Secondary stems** erect to ascending, or stems and branches spreading or sub-ascending, radiculose below; paraphyllia and pseudoparaphyllia absent; axillary hairs usually 3-4-celled; stems lacking central strand. **Leaves** spirally arranged or complanate, ovate- to oblong-lanceolate or obovate-oblong, symmetric or asymmetric, apex acuminate, acute or obtuse-apiculate; margins plane to recurved, entire to bluntly or sharply serrate or ciliate, limbate; costa single, usually 0.5-0.75 lamina length (in *Calyptrochaeta*, short and forked); laminal cells either short to  $\pm$  long hexagonal and walls thin, or cells oval to rhomboidal and walls thickened; alar region undifferentiated; border of narrow, elongate cells often present (occasionally border cells at base numerous and extend part or fully across to costa). **Gemmae** absent or present in leaf axils, short to long cylindrical. **Autoicous, rarely dioicous**. **Perichaetia** lateral, leaves differentiated, usually smaller than stem leaves. **Seta** elongate, slender to rather stout, smooth, papillose distally or throughout, or setose/ciliate distally. **Capsule** exserted, erect to inclined or pendulous, urn ovoid, neck distinct or not; exothecial cells collenchymatous; stomata present, at base of urn or on neck; annulus usually persistent, cells little differentiated. **Operculum** conic-rostrate. **Peristome** double, exostome teeth 16, papillose or striate and furrowed; endostome basal membrane low or high, segments 16, cilia reduced or absent. **Calyptra** mitrate or campanulate, smooth or sparsely hairy, base fringed. **Spores** lightly to densely papillose, rarely smooth.

*Discussion.* This account follows Buck & Goffinet (2000) in placing 9 genera (and more than 200 species) in the Daltoniaceae, of which 4 genera and about 29 species have been described from Africa. It has a mostly pantropical distribution, with few species found in temperate regions. However, there is no general consensus as to the limits of the family, and recent molecular and other studies of the Hookeriales have variously suggested that either fewer or more genera should be assigned to the Daltoniaceae.

*Literature.* **Buck, W.R. 1998.** Pleurocarpous mosses of the West Indies. Bronx: New York Botanical Garden. **Buck, W.R. & Goffinet, B. 2000,** in **Shaw, A.J. & Goffinet, B.** - (see general references).

1	Costa short, forked, 0.2 or less lamina length; seta setose/ciliate distally	<i>Calyptrochaeta</i>
	Costa longer, (0.4-)0.5 or more lamina length; seta smooth or papillose distally or throughout	2
2	Leaves mostly lanceolate, spirally arranged, similar; apices usually gradually acuminate	<i>Daltonia</i>
	Leaves broadly ovate to obovate, $\pm$ complanate, often dimorphic; apices rounded, mucronate or apiculate	3
3	Cells in upper part of leaf $\pm$ isodiametric, hexagonal-rounded, usually uniformly thick-walled; peristome with exostome teeth transversely striate, basal membrane high	<i>Distichophyllum</i>
	Cells in upper part of leaf elongate-hexagonal, usually thin-walled; peristome with exostome teeth lacking transverse striations, basal membrane low	<i>Distichophyllidium</i>

***Calyptrochaeta* Desv.**

# Guide to Bryophytes of sub-Saharan Africa

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A mainly pantropical genus and southern hemisphere genus of fewer than 30 species, two of which are known from Africa: *C. asplenioides* (Brid.) Crosby recorded in South Africa, Tanzania, Madagascar, Réunion and the Comoro Islands, and *C. cristata* (Hedw.) Desv. in Mauritius.

**Plants** medium sized to rather large, forming turfs, light green to dark green, usually ± glossy. **Stems** suberect, central strand present; branching sparse. **Leaves** somewhat complanate, erect-spreading, somewhat asymmetrical, broadly oblanceolate, obovate or ovate, 2.0-6.0 mm long, larger above, apex short to rather long acuminate, base slightly decurrent on lateral leaves; margins plane, limbate, sharply to rather bluntly serrate; costa single, short and unequally bifurcate; laminal cells smooth, median cells broadly to narrowly hexagonal, c. 70-110 x 25-56 µm; marginal cells linear forming a border of 1-4(-6) rows. **Autoicous or dioicous**. **Perichaetial leaves** small, ovate-lanceolate. **Seta** 2-5 mm long, rather stout, papillose to spinose, and setose/ciliate distally with multicellular hairs (to 1 mm long). **Capsule** pendulous, urn ovoid, to ca 0.8 mm long, neck distinct. **Operculum** convex-rostrate, 0.5 mm long. **Peristome** double, yellow; exostome teeth striate below, papillose above; endostome membrane high, segments narrow, keeled and perforate, lightly papillose, cilia reduced. **Calyptra** cucullate, rough when young, fringed at base. **Spores** 12-17 µm, weakly granulose, yellow-brown.

**HABITAT.** On rock and humic soil in forests or other moist shaded places, including by streams and under rock overhangs; lowland to montane regions.

**DISCUSSION.** *Calypstrochaeta* is easily recognised by the complanate-foliate plants with plane, bordered leaves with a toothed margin, the short, single costa that is forked distally, and the distally spinose/ciliate seta.

**LITERATURE.** **Demaret, F. 1955.** Étude préliminaire des Hookeriaceae africaines intertropicale. Bulletin du Jardin Botanique de l'Etat à Bruxelles 25: 375-390. **De Sloover, J.L. 1975.** Note de bryologie africaine II. *Cyclodictyon*, *Eriopus*, *Hookeriopsis*, *Lepidopilidium*, *Lepidopilum*, *Oreoweisia*. Bulletin du Jardin Botanique National de Belgique 45: 103-124. **Magill, R.E. & Van Rooy, J. 1998.** Bryophyta. Part 1. Musci. Fascicle 3. Erpodiaceae - Hookeriaceae, In: O.A.Leistner, Flora of Southern Africa. Pretoria: National Botanical Institute, pp. 601-604.

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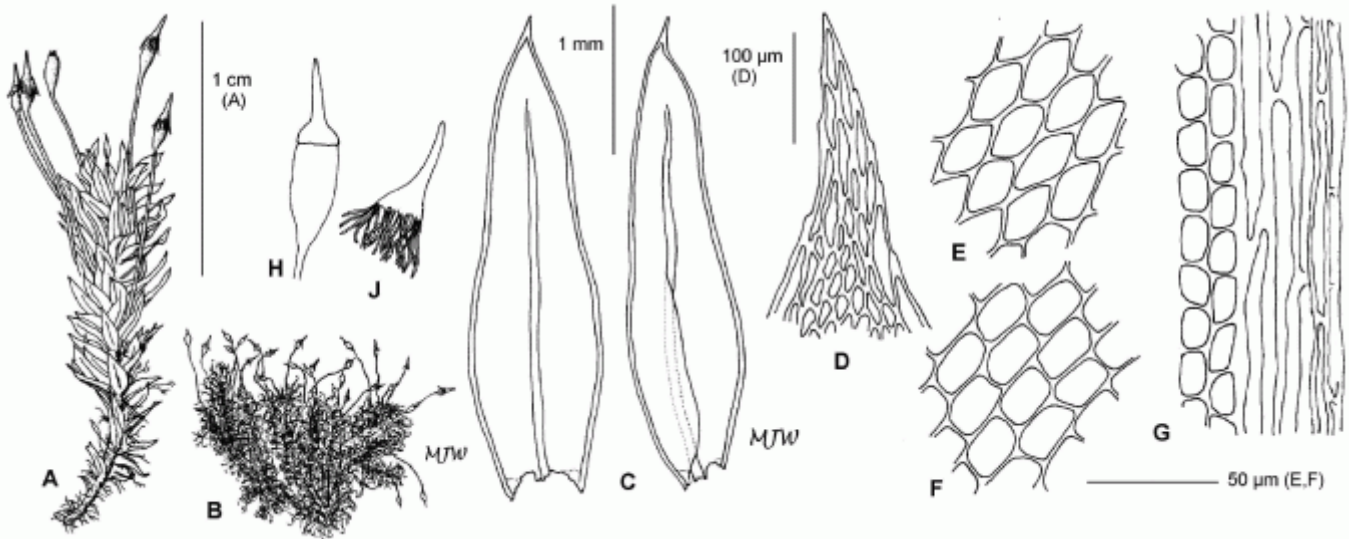
## ***Daltonia* Hook. & Taylor**

A genus of about 60 species, primarily pantropical in distribution; 16 species and 2 additional varieties have been recorded in sub-Saharan Africa.

**Plants** mostly rather small, usually forming small tufts, glossy pale green to dark green or golden-brown or yellowish. **Primary stems** short, creeping, inconspicuous. **Secondary stems** usually erect or suberect (sometimes spreading or even sub-pendent, ca 1.5-3.0 cm tall, branched, radiculose below. **Leaves** crowded, ± straight or slightly twisted when moist, flexuose, curled or crisped when dry, sometimes carinate (therefore with a median fold near the costa), broadly lanceolate to linear-lanceolate, mostly 2-4 mm long, apex acuminate, base rounded; margins plane or recurved on one or both sides, usually entire throughout, weakly to strongly limbate; costa single, 0.5-0.8 lamina length; laminal cells smooth, upper and median cells oval, rhomboid, oblong or fusiform, thick-walled, with distinct trigones; basal and insertion cells linear to oblong, sometimes yellowish or brownish; marginal cells linear, forming a distinct border of few to many rows. **Autoicous**. **Perichaetial leaves** much smaller than stem leaves, oblong- to ovate-short lanceolate. **Seta** 7-10 mm long, smooth to more commonly papillose-roughened throughout or distally. **Capsule** erect to suberect, urn ovoid; exothecial cells collenchymatous, or walls equally thickened; stomata phaneropore, on neck or urn base. **Operculum** conic-short rostrate. **Peristome** with exostome

# Guide to Bryophytes of sub-Saharan Africa

teeth narrowly lanceolate, papillose, not furrowed; endostome basal membrane low, segments linear, lightly to strongly papillose, keeled and perforate. **Calyptra** campanulate, base fimbriate. Spores smooth to finely papillose.



**Daltonia** sp. **A**: moist shoot. **B**: dry tuft, with crisped leaves. **C**: leaves. **D**: leaf apex. **E,F**: median cells from different leaves. **G**: marginal cells and reflexed margin. **H**: capsule. **J**: calyptra

**HABITAT.** Epiphytic, usually on twigs and small branches of trees and shrubs, and commonly on the nodes of bamboo; rarely on rocks. Most frequent in montane cloud forest but also at lower elevations; 700-3800 m.

**DISCUSSION.** *Daltonia* is rather easily recognised by the rather small size of the plants and usually tufted habit, the oblong-lanceolate to linear-lanceolate leaves with weakly to strongly bordered margins, the thick-walled short median leaf cells, and the distinctive fringed calyptra. Although the genus is widespread in tropical Africa, there are relatively few collections, especially from West Africa. This may be because it invariably occurs in small populations (sometimes a single tuft), and can be easily overlooked. Sometimes species can grow intermixed. A revision of African species is required, and several of the 18 taxa known from the continent have been described from only one collection.

**LITERATURE.** Demaret, F. 1955. Étude préliminaire des Hookeriaceae africaines intertropicale. Bulletin du Jardin Botanique de l'Etat à Bruxelles 25: 375-390 [key to most African species]. Kis, G. 1996. Taxonomic results of the BRYOTROP-Expedition to Zaire and Rwanda. 31. The Andean *Daltonia latolimbata* Broth. in Herzog in Africa. Tropical Bryology 12: 35-40.

## ***Distichophyllidium* M.Fleisch.**

A small genus with 1 species, *D. africanum* Demaret & P.de la Varde, in Africa (known from D.R. Congo, Rwanda and Tanzania), and 3-5 other species from New Guinea, Seram and New Caledonia.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** delicate, fragile, laxly caespitose, creeping or spreading. **Stems** flexuose, ca. 5 mm long, lacking a central strand, cortical cells lax; axillary hairs present, 250-350  $\mu\text{m}$  long. **Leaves** heterophyllous to weakly dimorphic, complanate, ca 0.9 x 0.3 mm, ovate to ovate-lanceolate, tapering gradually to an acuminate apex (broadly spatulate with rounded apex in other non-African species), margin entire, with conspicuous border of elongate cells; costa single, flexuose, short to long (to 0.75 leaf length in *D. africanum*); cells smooth, thin-walled; upper and median cells longer than wide, ca 25-50 x 15-25  $\mu\text{m}$ ; basal cells elongate-hexagonal to elongate-rectangular, 30-50 x ca 10  $\mu\text{m}$ , the basal marginal cells to 80 x 3-4  $\mu\text{m}$ . **Seta** smooth or papillose. **Capsule** small, usually inclined, sub-pyriform, the neck swollen, epidermal cells roundish, thick-walled; stomata phaneropore. **Operculum** rostrate. **Peristome** double, whitish-hyaline; exostome papillose, lacking striations on outer surface, median line zig-zag; endostome papillose, basal membrane low, cilia lacking. **Calyptra** mitrate, glabrous, fringed.

**HABITAT.** Epiphytic on trees and shrubs in montane forest or subalpine scrub, and epiphyllous in montane mossy forest; 1600-3100 m.

**DISCUSSION.** *Distichophyllidium* can resemble species of *Distichophyllum*, but the exostome teeth lack striations on the outer plates, and the endostome has a low basal membrane. The thin-walled, elongate leaf cells also seem to differentiate *Distichophyllidium africanum* from *Distichophyllum*, the upper and median cells of which are more regularly isodiametric hexagonal-rounded and usually uniformly thick-walled. Most African collections lack mature sporophytes, including the type from D.R. Congo.

**LITERATURE.** **Demaret, F. 1955.** Étude préliminaire des Hookeriaceae africaines intertropicales. Bulletin du Jardin Botanique de l'Etat à Bruxelles 25: 375-390. **Demaret, F. & Potier de la Varde, R. 1955.** Deux Hookeriaceae nouvelles du Ruwenzori (Congo Belge). Bulletin du Jardin Botanique de l'Etat à Bruxelles 25: 353-357.

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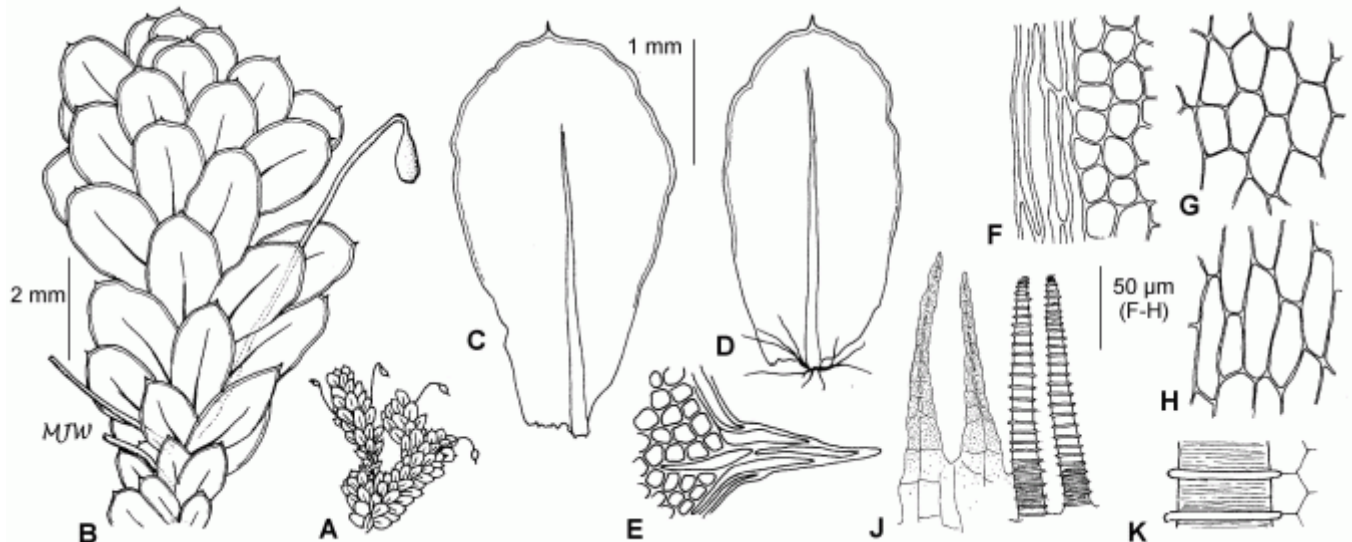
## *Distichophyllum* Dozy & Molk.

A genus in which about 107 species have been described, mainly from tropical and sub-tropical palaeotropic regions, and absent from the neotropics. However, the genus is badly in need of a revision, and it seems likely that the number of good species will be far fewer (more than half the species have been described from only one country or island). *Distichophyllum* is poorly represented in Africa, with only 6 species recorded (and two additional subtaxa), most of them from very few locations.

**Plants** small to medium-sized, laxly caespitose, creeping or spreading, sparingly branched, green to yellowish-green. **Stems** flexuose, ca 5 mm long, lacking a central strand, cortical cells lax; axillary hairs present, 250-350  $\mu\text{m}$  long. **Leaves** in 6 or 8 ranks, symmetrical, heterophyllous to weakly dimorphic, complanate, ovate to broadly spatulate, apex widely acute to rounded, mucronate or shortly apiculate, margin entire to weakly toothed or crenate, sometimes unevenly undulate; costa single, sometimes flexuose, thin, (0.4-)0.5-0.75 leaf length; heterophyllous plants with lateral leaves broadly spatulate, 1.8-3.8 mm long, dorsal leaves broadly oval, 1.2-1.5 mm long; cells smooth, the walls usually uniformly thickened; upper cells regularly rounded-hexagonal, 25-35  $\mu\text{m}$ ; becoming more elongate in lower and basal leaf, to 45-70  $\mu\text{m}$  long x 25-35  $\mu\text{m}$  wide; border of linear cells sometimes present (cells 80-150  $\mu\text{m}$  long x 3-5  $\mu\text{m}$  wide, in 1-3 rows). **Dioicous, autoicous or synoicous.** **Seta** smooth, mamillate or papillose. **Capsule** small, usually inclined, ovoid or sub-pyriform to globose, the neck swollen, epidermal cells roundish, thick-walled; stomata phaneropore; operculum conical with long beak. **Peristome** double; exostome with the outer plates transversely striate, not papillose (or papillose only towards the

# Guide to Bryophytes of sub-Saharan Africa

apex); endostome papillose or not, basal membrane high, cilia absent or rudimentary. **Calyptra** mitrate, mamilllose, glabrous or papillose, the base longly ciliate.



***Distichophyllum rigidicaule* var. *rigidicaule*** (Dusén) Broth. **A:** habit. **B:** shoot. **C,D:** leaves. **E:** leaf apex. **F:** distal leaf margin. **G:** cells near costa in distal half of leaf. **H:** basal cells of leaf. **J:** peristome teeth, showing high basal membrane of endostome. **K:** outer surface of exostome showing striations.

**HABITAT.** On logs, stems of tree ferns, and on rock, in primary lowland to low-montane forest, 100-1100 m.

**DISCUSSION.** *Distichophyllum* is closely related and similar gametophytically to the mainly neotropical *Leskeodon*, which differs in peristomial features (e.g., a papillose exostome, endostome with low basal membrane and perforate segments).

**LITERATURE.** **Crosby, M.R. 1976.** Trois mousses (Hookeriaceés) nouvelles pour la flore Malagache. *Revue bryologie et lichénologie* 42: 711-714. **Demaret, F. 1955.** Étude préliminaire des Hookeriaceae africaines intertropicale. *Bulletin du Jardin Botanique de l'Etat à Bruxelles* 25: 375-390. **De Sloover, J.L. 1976.** Note de bryologie africaine VII. *Antitrichia, Bryohumbertia, Distichophyllum, Eucladium, Lindigia, Pseudephemerum, Pterogonium, Ptychomitrium, Rhachithecium, Streptopogon.* *Bulletin du Jardin Botanique National de Belgique*, 46: 427-447. **Magill, R.E. & Van Rooy, J. 1998.** (see general references), pp. 612-614.

## DICRANACEAE

(J.-P. Frahm, April 2000)

**Plants** variable in size and appearance, from a few mm to more than 10 cm tall, in loose to dense tufts. **Stems** erect, simple, rarely branched, radiculose, sometimes densely tomentose; rhizoids reddish-brown to whitish. **Leaves** erect-patent, sometimes curled when dry or falcate (sometimes erect and falcate expressions in the same species), short to longly lanceolate, often subulate; margins entire or serrate at leaf tips; costa single, percurrent to short excurrent, sometimes hyaline excurrent, filling 1/6 to 4/5 of leaf width, in transverse-section with median deuter cells and dorsal stereids, rarely hyalocysts, ventrally either stereids or more rarely hyalocysts; laminal cells usually smooth, occasionally bulging mamilllose, cell walls smooth; alar cells differentiated or not, when distinct,

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# Guide to Bryophytes of sub-Saharan Africa

hyaline or reddish brown, inflated, thin-walled or incrassate, basal laminal cells mostly rectangular, thin-walled or incrassate, occasionally pitted, upper laminal cells quadrate to rectangular or oval, leaf border present in some taxa. **Vegetative propagation** by microphyllous branches, deciduous leaves or stem tips, or anisophyllous brood leaves in the axils of the upper leaves. **Dioicous or autoicous**. **Perichaetia** terminal, or occasionally pseudolateral by stem innovations, perichaetial leaves often different in shape, from sheathing base subulate. **Seta** mostly elongate (1-4 cm), rarely short (<1 cm) or almost absent, erect, in few genera flexuose, cygneously curved and twisted. **Capsule** immersed to more commonly exserted, inclined to suberect or erect, symmetric to asymmetric, urn short long cylindrical to ovoid-cylindrical or ovoid, smooth or furrowed when dry and empty; stomata present or absent; annulus present or absent. **Operculum** conical to long-rostrate. **Peristome** single, teeth 16, mostly divided 1/2 or more toward base, vertically striate below, distally papillose to papillose throughout. **Calyptra** cucullate, smooth, naked, base entire or ciliate. **Spores** almost smooth to coarsely papillose.

*Discussion.* The Dicranaceae consist worldwide of about 50 genera with more than 1000 species; they are represented in tropical Africa by 26 genera and about 218 species, of which 90 belong to *Leucoloma* and 39 to *Campylopus*. The species grow on open soil, rotten wood, peat, and rocks, preferably at higher altitudes in upper montane and subalpine regions; most species are characteristic for acidic substrates. The family is closely related to Ditrichaceae, from which it is difficult to separate.

Many species in some genera are known only in sterile condition; therefore the determination is usually based on leaf characters. Identification of some genera and species requires transverse sections of the costa.

A recent molecular-systematic study (Stech, 1999) revealed that the subfamilies Dicranoideae and Campylopodioideae are monophyletic whereas Rhabdoweisioideae and Dicranelloideae appear as polyphyletic. A subfamily Paraleucobryoideae is not supported by the molecular data.

*Literature.* **Frahm, J.-P. 1993.** Taxonomic Results of the BRYOTROP Expedition to Zaire and Rwanda. 17. Andreaeaceae, Bruchiaceae, Dicranaceae, Rhizogoniaceae, Bartramiaceae, Rhacocarpaceae, Hedwigiaceae, Cryphaeaceae, Leucodontaceae. Tropical Bryology 8: 153-170. **Stech, M. 1999.** A reclassification of Dicranaceae (Bryopsida) based on non-coding cpDNA sequence data. Journal of the Hattori Botanical Laboratory 86: 137-159.

Please note: there are *three* options for couplet 9.

1. Alar cells not differentiated	2
1. Alar cells differentiated	12
2. Seta 1 mm long, capsule cleistocarpous, immersed in perichaetial leaves	<i>Pseudephemerum</i>
2. Seta longer, capsule stegocarpous	3
3. Leaves erect spreading when moist	4
3. Leaves appressed to the stem	10
4. Leaf bases longly decurrent	<i>Pocsiella</i>
4. Leaf bases not decurrent	5
5. Leaf base widened and suddenly contracted into the subula	6
5. Leaf gradually narrowed	8
6. Seta cygneous	<i>Microcampylopus</i>



# Guide to Bryophytes of sub-Saharan Africa

6. Seta straight	7
7. Walls of laminal cells smooth	<i>Anisothecium</i>
7. Leaf bases not longly decurrent, walls of laminal cells sinuose	<i>Symblepharis</i>
8. Costa in transverse section with median stereids and dorsal and ventral hyalocysts	<i>Bryotestua</i>
8. Costa in transverse section with different structure	9
9. Peristome teeth triangular, verticillate striate	<i>Dicranella</i>
9. Peristome teeth reduced in length (<150 µm), papillose	<i>Leptotrichella</i>
9. Leaves appressed to the stem	10
10. Capsules with peristome	<i>Aongstroemia</i>
10. Capsule without peristome	11
11. Capsule without neck	<i>Aongstroemiopsis</i>
11. Capsule with neck	<i>Cladophascum</i>
12. Upper laminal cells mammillose or papillose	13
12. Upper laminal cells pluripapillose	<i>Leucoloma</i>
13. Back of the costa strongly mammillose	<i>Platyneurum</i>
13. Back of the costa not mammillose, smooth or rarely denticulate	14
14. Costa narrow, filling 1/5 or less of the leaf width	15
14. Costa filling 1/3 of leaf width or more	17
15. Leaves bordered by narrow hyaline cells	<i>Dicranoloma</i>
15. Leaves not bordered	16
16. Perichaetial leaves sheathing the seta	<i>Holomitrium</i>
16. Perichaetial laves not sheathing the seta	<i>Dicranum</i>
17. Costa in transverse section with ventral and dorsal hyalocysts	18
17. Costa in transverse section with dorsal steroids	19
18. Clusters of brood leaves in the axils of the upper leaves	<i>Brothera</i>
18. Plants without brood leaves	<i>Paraleucobryum</i>
19. Seta cygneous when moist, twisted	20
19. Seta straight when moist	22

# Guide to Bryophytes of sub-Saharan Africa

20. Operculum as long as the urn, adaxial side of peristome teeth smooth	<i>Bryohumbertia</i>
20. Operculum shorter than the urn, adaxial side of peristome teeth papillose	21
21. Capsule globose, immersed in perichaetial leaves, spores 21 µm in diameter	<i>Sphaerothecium</i>
21. Capsule ovoid or short cylindrical, exserted, spores 13 µm in diameter	<i>Campylopus</i>
22. Perichaetial leaves not sheathing the seta	<i>Atractylocarpus</i>
22. Perichaetial leaves sheathing the seta	<i>Pilopogon</i>

## *Anisothecium* Mitt.

A genus of about 40 species of which half of the number is little known. The genus is often included in *Dicranella*, from which it differs by sheathing leaf bases which are suddenly contracted into a long acumen. Three species are known from tropical Africa: *A. ugandae* P.de la Varde from Central Africa (Potier de la Varde, 1926), *A. horridum* P.de la Varde from Central African Republic (Potier de la Varde, 1935) and *A. madagassum* Thér. from Madagascar (Thériot, 1930).

**Plants** mostly small, forming loose to dense tufts, less often gregarious, green, yellowish-green or brown. **Stems** erect, few branched by innovations, occasionally radiculose below; central strand present. **Leaves** small and ± distant below, distally larger and crowded, erect to erect-spreading flexuose, secund or not, often only slightly more spreading when wet, oblong- to ovate- or triangular-lanceolate to narrowly lanceolate-subulate, 1-4 mm long, apex acute to bluntly obtuse; margins plane to reflexed below, subula inflexed, incurved or channelled, entire to distally dentate-serrulate; costa subpercurrent or percurrent, rarely excurrent, 1/3 or less width of leaf base; laminal cells thick-walled, upper cells rectangular to quadrate or subquadrate, smooth or bulging papillose; lower and basal cells long rectangular, smooth; alar cells undifferentiated. **Dioicous**. **Perichaetia** terminal, leaves larger, subsheathing to convolute. **Seta** elongate, 5-15 mm long, erect, smooth. **Capsule** erect or occasionally inclined, symmetric or asymmetric and curved, urn subglobose to ovoid-cylindrical, 0.7-1.5 mm long, smooth or furrowed, neck sometimes distinct, occasionally gibbous. **Operculum** conic-short to long rostrate. **Peristome** teeth divided ca. 1/2 or slightly more into 2-3 segments, vertically striate-pitted below, distally papillose or spiculose. **Calyptra** cucullate, smooth and naked, base entire. **Spores** lightly to coarsely papillose.

**Habitat.** On bare soil and soil covered rocks in open sites, from the lowland to high montane belt.

**Discussion.** Sterile plants can be confused with *Microcampylopus*, which differs in its cygneous setae but is almost indistinguishable when sterile.

**Literature.** **Potier de la Varde, R. 1926.** Mousses récoltées par M. le Dr. Olov Hedberg, en Afrique orientale, au cours de la mission suédoise de 1948. Arkiv för Botanik utgivet av K. Svenska Vetenskapsakademien 3(8): 125-204. [illustration of *A. ugandae*]. **Potier de la Varde, R. 1935.** Recoltes bryologiques aux environs de Bozoum (Deuxieme note.). Revue Bryologique et Lichénologique 7: 226-237. **Thériot, I. 1930.** Septième contribution à la flore bryologique de Madagascar. Recueil des Publications de la Société Havraise d'Études Diverses 1929: 99-121.

# Guide to Bryophytes of sub-Saharan Africa

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## ***Aongstroemia* Bruch, Schimp. & W.Gümbel**

A genus of 7 species mainly in the arctic or at higher elevations. Two species in tropical Africa: *A. filiformis* (P.Beauv.) Wijk & Margad. and *A. julacea* (Hook.) Mitt. (Both in SE Africa and also in the Neotropics, *A. julacea* also in Eurasia).

**Plants** small, slender, loosely caespitose or growing scattered, yellow-green. **Stems** erect and slender, julaceous, usually unbranched. **Leaves** oval to oblong, apex obtuse or broadly acute, densely appressed, 0.5-1.5 mm long; margins plane, entire or denticulate; costa ending before leaf apex or shortly excurrent in lower leaves and longly excurrent in upper leaves; upper laminal cells smooth, rhomboidal to vermicular, incrassate, basal laminal cells larger, rectangular to subquadrate, walls thickened; alar cells undifferentiated. **Sporophytes** not known in Africa.

*Habitat.* On open soil, *A. filiformis* in forest, *A. julacea* in grassland above the forest line.

*Discussion.* The genus is easily recognised by small, slender plants with julaceous stems and leaves closely appressed whether dry or wet, narrow costa, thick-walled upper laminal cells, and undifferentiated alar cells. *Aongstroemia julacea* has rounded leaves with dentate upper margins, *A. filiformis* has oblong leaves with shortly excurrent costa and entire margins.

*Literature.* Magill, R.E. 1981 - see general ref. [key, illustrations].

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## ***Aongstroemiopsis* M.Fleisch.**

A monotypic genus with only *A. julacea* (Dozy & Molk.) M.Fleisch. This species occurs in the Himalaya, southern China and Malesia and was said to be endemic to SE Asia, but has since been recorded from Lesotho.

**Plants** small, consisting of scattered julaceous plants with shoots less than 8 mm long. **Stems** simple. **Leaves** broadly lanceolate, about 0.5 mm wide and 1 mm long, entire, quickly narrowed into a blunt apex; costa stout, percurrent; upper laminal cells quadrate to shortly rectangular, thin-walled, narrower at margins; basal laminal cells longer; alar cells not differentiated. **Monoicous**. **Sporophytes** small. **Seta** 3 mm long, sinuate. **Capsule** 1.5 mm long, almost erect, somewhat curved, shortly cylindrical. **Operculum** short, blunt. **Peristome** lacking. **Spores** 18-20 µm in diameter.

*Habitat.* On soil at the base of boulders in a moist alpine meadow 2860m.

*Discussion.* This genus differs from *Aongstroemia* in its eperistomate capsules and conical lid. The capsules and setae are said to be smaller and the spores larger in the African plants as compared with material from SE Asia.

*Literature.* Magill, R.E. 1987. Musci austro-Africana III. Alpine mosses of Lesotho. Journal of Bryology 14: 527-530.

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# Guide to Bryophytes of sub-Saharan Africa

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## ***Atractylocarpus* Schimp. ex Milde**

A genus of 9 species worldwide, mostly in subalpine and alpine regions of the tropical mountains, only *A. alpinus* in Europe. Two species in Africa, of which *A. madagascariensis* (Thér.) Padberg & J.-P.Frahm is confined to southern Africa and East African islands and *A. alticaulis* (Broth.) R.S.Williams to Central Africa.

**Plants** slender, in dense tufts, dark green. **Stems** erect, almost unbranched, to 6 cm high, tomentose; central strand present. **Leaves** equally foliate, erect-spreading when wet, rarely falcate-secund, from an ovate base longly setaceous, 4-10 mm long; margins entire below, dentate at tips; costa broad, filling half of leaf base, in transverse section with dorsal and ventral stereids and median guide cells; laminal cells smooth, upper laminal cells rectangular, elongate rectangular and thin-walled at base; alar cells weakly differentiated. **Autoicous or Dioicous**. **Perichaetia** terminal, leaves similar but smaller. **Seta** elongate, 10-28 mm long, twisted in the upper part, golden-yellow. **Capsule** erect, symmetric, urn short cylindrical, 1-2 mm long, furrowed when dry: stomata absent; annulus absent. **Operculum** longly rostrate, as long as the urn. **Peristome** teeth divided ca. 2/3, outer surface vertically to obliquely striate at base, papillose at tips, inner surface coarsely papillose. **Calyptra** cucullate, naked, entire at base. **Spores** papillose, 14-18 µm.

*Habitat.* *Atractylocarpus alticaulis* grows on humus and rotten logs in high montane forests and subalpine forests (2500-)3000-3300(-4000?) m and *A. madagascariensis* grows on humus, soil, rocks (including lava) and living and dead trees, from (610-)1800-2270 m.

*Discussion.* All species are keyed, described and illustrated in Padberg & Frahm (1985). The genus resembles *Dicranodontium* vegetatively, but has a longer, straight seta which is only twisted in the upper part but not sinuose and curved, and a long cylindrical and not ovoid urn.

The name *Atractylocarpus* was conserved against *Metzleria* although described later in the same year. However, the type species of the genus *Atractylocarpus* proved to differ from all other species included in the genus and belongs to the genus *Campylopodia*. To save the use of *Atractylocarpus*, a proposal to amend this genus was made by Frahm & Isoviita (1988), and this was eventually accepted.

Allen (1994), in agreement with Williams (1913), included *Atractylocarpus* in *Dicranodontium*, based on the similarity of the gametophyte.

*Literature.* **Allen, B. 1994.** Moss Flora of Central America. Part 1. Sphagnaceae-Calympereaceae. Monographs in Systematic Botany vol. 49: 1-242. **Frahm, J.-P. & Isoviita, P. 1988.** Proposal to amend *Atractylocarpus*, nom. cons. (Musci, Dicranaceae). Taxon 37:967-969. **Padberg, M. & Frahm, J.-P. 1985.** Monographie der Gattung *Atractylocarpus* Mitt. (Dicranaceae). Cryptogamie, Bryologie. Lichénologie 6: 315-341 [keys, illustrations]. **Williams, R.S. 1913.** Dicranaceae, Leucobryaceae (Bryales). North American Flora 15(2): 77-166.

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## ***Brothera* Müll.Hal.**

A monotypic genus. The only species, *B. leana* (Sull.) Müll.Hal., was known from North America, Mexico and Asia and was recently found in Malawi (Pócs 1993).

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** small, less than 1 cm tall, in dense tufts, pale green or yellow. **Stems** usually simple. **Leaves** erect-flexuose, linear-lanceolate, to 3 mm long, concave below, subtubulose above; margins incurved, entire, toothed at apex; costa long excurrent, ca. 1/3 width of leaf base, rarely more; in transverse-section with a layer of median chlorocysts and ventral and dorsal rows of hyalocysts; upper laminal cells long rectangular; basal cells rectangular; alar cells not differentiated. **Vegetative propagation** by clusters of small brood leaves in the axils of the upper stem leaves. **Dioicous**. **Sporophytes** not known from Africa.

*Habitat.* On shady granite cliff in forest at 1730 m altitude.

*Discussion.* The genus is recognised by small pale plants with clusters of brood leaves in the axils of the upper stem leaves, in habit similar to *Campylopus fragilis*, and a very typical transverse section of the costa with median chlorocysts and ventral and dorsal rows of hyalocysts.

*Literature.* Müller, P. & Frahm, J.-P. 1987. A review of the Paraleucobryoideae (Dicranaceae). Nova Hedwigia 45: 283-314. [illustration] Pócs, T. 1993. *Brothera leana* (Sull.) C. Müll., a Laurasian species in tropical Africa. Bulletin du Jardin Botanique National de Belgique 62: 221-224.

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## ***Bryohumbertia* P.de la Varde & Thér.**

A pantropical genus of three species, which is represented in tropical Africa mainly by *B. flavicoma* (Hornsch.) J.-P.Frahm. *B. filifolia* (Hornsch.) J.-P.Frahm, widespread in the Neotropics, is only rarely recorded from Madagascar, Réunion and Mauritius.

**Plants** small or robust, in loose short to tall tufts, dark green. **Stems** erect, mostly single, young plants comose foliate, older ones verticillate foliate, the leaf whorls often indistinct in *B. flavicoma* but very distinct and in 3-6 in *B. filifolia*. **Leaves** spreading to erect or appressed, from a short concave ovate base long subulate, 4-12 mm long, apex long acuminate; margins serrate in the upper part; costa strong, filling 1/3 of leaf width, percurrent or excurrent; basal laminal cells rectangular, incrassate, upper laminal cells shortly rectangular; alar cells oval-short rectangular, incrassate, dark rusty-red. **Dioicous**. **Seta** elongate, 9-14 mm long, usually erect but sinuose when dry, flexuose and curved when wet, yellowish. **Capsule** asymmetric, urn cylindrical, 1.5-2 mm long, curved, furrowed when dry and empty, strumose; annulus present. **Operculum** long rostrate, as long as the urn, oblique. **Peristome** teeth on outer surface striate, inner smooth. **Calyptra** cucullate, 2.5-3 mm long, smooth, base fringed with long hairs. **Spores** about 13 µm, slightly papillose.

*Habitat.* On soil, humus and logs in forests; from the lowlands to the high montane belt (2700 m).

*Discussion.* The genus *Bryohumbertia* resembles certain species of *Campylopus* but differs in the longer setae, a longly rostrate operculum and a smooth inner surface of the peristome teeth. Recent preliminary molecular studies reveal that *Bryohumbertia* (represented by *B. flavicoma*) is not separated at genus level (Stech, 1999).

*Literature.* De Sloover, J.L. 1976. Note de bryologie africaine. VII. *Pseudephemerum*, *Bryohumbertia*, *Eucladium*, *Streptopogon*, *Ptychomitrium*, *Rhachithecium*, *Antitrichia*, *Pterogonium*, *Lindigia*, *Distichophyllum*. Bulletin du Jardin Botanique de l'Etat 46: 427-447. [illustration of *B. flavicoma*] Frahm, J.-P. 1982. A reinterpretation of *Bryohumbertia* P. de la Varde et Thér. Cryptogamie, Bryologie. Lichénologie 3: 365-369 [key]. Stech, M. 1999 - see family ref.

# Guide to Bryophytes of sub-Saharan Africa

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## ***Bryotestua* Thér. & P.de la Varde**

A genus with 2 species (*B. brevicuspis* Thér. & P.de la Varde and *B. longicuspis* Thér. & P.de la Varde), so far known only from the type localities in the Central African Republic.

**Plants** 10 mm tall, in dense tufts. **Stems** erect, tomentose below; in transverse section with large lax cells, without central strand. **Leaves** erect patent, lanceolate, from an ovate or lanceolate base subulate, apex longly acuminate; margins entire or slightly dentate in the uppermost apex, plane below and revolute in the upper part; costa filling 1/6-1/4 width of leaf base, excurrent, in transverse-section with groups of median stereidal cells and ventral and dorsal layers of large, empty cells; alar cells lacking; basal laminal cells rectangular, 5 times longer than broad, smooth, upper laminal cells shorter, hexagonal. **Dioicous**. **Perichaetia** terminal, perichaetial leaves not differentiated.

*Habitat.* On soil (!) in arid habitats

*Discussion.* The genus is mainly characterised by the transverse section of the costa, which makes it probable that the plants belong to the Dicranaceae. The structure of the costa much resembles *Campylopodia*, a genus known from tropical America and the Himalayas. The authors placed *Bryotestua* tentatively in the Anisothecioideae.

*Literature.* **Potier de la Varde, R. 1937.** *Bryotestua* Thér. et P. de la V., genus novum familiae Dicranacearum. Bulletin de la Société Botanique de France 84: 558-562. [key, illustration]

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## ***Campylopus* Brid.**

A genus in which the Index Muscorum listed more than 700 legitimate species worldwide, which have been reduced to about 150 species. Thirty-nine species occur in Africa south of the Sahara.

**Plants** from a few mm to 10 cm tall, in tufts, light to dark green, yellow or golden, occasionally blackish-brown. **Stems** erect, rarely branched, often densely tomentose; central strand present; rhizoids reddish-brown or occasionally whitish, smooth or papillose. **Leaves** erect patent to appressed, lanceolate, from an ovate or lanceolate base subulate, apex longly acuminate; margins entire, in some species serrulate to serrate in the upper part; costa strong, filling 1/3-4/5 width of leaf base, percurrent to commonly long excurrent, excurrent tips concolorous or hyaline, smooth, ribbed or lamellose at back, in transverse-section with ventral stereids or hyalocysts, median deuter cells and dorsal stereidal or non-stereidal cells; alar cells usually differentiated, hyaline or reddish, inflated or not; laminal cells smooth, basal laminal cells hyaline and thin-walled or incrassate, sometimes with pitted walls, sometimes narrower at margins, upper laminal cells quadrate to shortly rectangular, oval or rhomboid to elongate rhomboid. **Vegetative propagation** by microphyllous deciduous branches, deciduous leaf or stem tips, clusters of brood leaves in the axils of the upper leaves or rhizoidal gemmae. **Dioicous**. **Perichaetia** terminal, perichaetial leaves differentiated and forming comal tufts or not differentiated, not forming

# Guide to Bryophytes of sub-Saharan Africa

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comal tufts. **Seta** 5-15 mm long, smooth, sinuose when dry and cygneous when wet, twisted. **Capsule** exerted, urn ovoid to short cylindrical, erect or curved, often strumose at base; exothecial cells thick-walled, stomata absent; annulus present. **Operculum** rostrate. **Peristome** teeth divided half way, outer surface striate at base and papillose at tips or divided to the base and papillose throughout. **Calyptra** cucullate, smooth, base entire or fringed with long hairs. **Spores** papillose, about 13 µm in diameter.

*Habitat.* On soil, humus, rotten log, rocks, a few species also epiphytic; from lowlands, dry savannahs and semi-deserts to wet montane and subalpine forests and alpine regions to more than 4000 m; most species occur at higher elevations.

*Discussion.* The genus is characterised by the broad costa and the cygneous, twisted setae which produce uncoiling movements when wetted. The anatomy of the costa is very different and probably an adaptation to different habitats. Large ventral hyalocysts function for storing water in humid habitats but ventral stereids provide stability against shrinking in arid environments. Therefore transverse sections of the costa are required for the identification of many species. There are even species pairs which differ mainly by the structure of the costa, the presence or absence of dorsal lamellae or the presence or absence of stereidal cells. Several species are not known with sporophytes but propagate by various kinds of brood organs.

Certain species of *Campylopus* vegetatively resemble *Pilopogon*, *Dicranodontium* and *Atractylocarpus* and can hardly be differentiated from the latter genus without experience. The setae of *Pilopogon* are straight whereas those of *Campylopus* are cygneous.

*Literature.* **Frahm, J.-P. 1985.** Afrikanische *Campylopus*-Arten (Dicranaceae, Musci). Bryophytorum Bibliotheca 31: 1-216. [key, illustrations] The nomenclature of this monograph of the African species is outdated in some respects because of later revisions and must be checked against: **Frahm, J.-P. 1999.** A type catalogue of Campyloporioideae and Paraleucobryoideae (Musci, Dicranaceae), Part II, *Campylopus*. Tropical Bryology 16: 17-102.

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## ***Cladophascum* Dixon ex Sim**

A monotypic genus with only *C. gymnomitrioides*, which was originally described in *Aongstroemia*.

**Plants** small, forming loose tufts, green to yellowish green. **Stems** to 1 cm tall, julaceous, little and irregularly branched. **Leaves** oval, concave, closely appressed to the stem, giving the plant an appearance of *Aongstroemia* or *Plagiobryum*, only 0.2-0.4 mm long, apex obtuse to broadly rounded, margins entire; costa reaching to midleaf; upper laminal cells almost quadrate, incrassate, hyaline and thin-walled at margins, forming a border 2-3 cells wide; basal laminal cells larger, quadrate or short rectangular. **Synicous.** **Perichaetia** lateral, large, perichaetial leaves oval but suddenly cuspidate, with excurrent costa. **Seta** only 0.1 mm long. **Capsule** erect, pyriform, with short neck, 0.8 mm long, with numerous stomata. **Operculum** conic-long rostrate, oblique. **Peristome** lacking. **Calyptra** mitriform. **Spores** highly papillose, 52-57 µm.

*Habitat.* On soil in grassland in Namibia, Zimbabwe, adjacent parts of the Republic of South Africa, and Tanzania.

*Discussion.* The genus differs from *Aongstroemia* by the stegocarpous capsules. Magill (1981) placed the genus in the Trematodontoideae (here Bruchiaceae) based on the capsule morphology.

# Guide to Bryophytes of sub-Saharan Africa

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*Literature.* Magill, R.E. 1981. - see general ref. [illustration]

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## ***Dicranella* (Müll.Hal.) Schimp.**

A genus of almost a 100 species worldwide, of which 27 are recorded from tropical Africa. *Anisothecium*, which is included by some authors in *Dicranella*, is treated here separately.

**Plants** small, in loose or dense tufts, light to dark green or yellowish-green. **Stems** erect, rarely branched, with central stand. **Leaves** smaller below, larger and comose above, erect-spreading, flexuose, or homomalous, oblong, obovate to lanceolate or narrowly lanceolate, 1-4 mm long, apex subulate; margins plane, entire; costa percurrent or excurrent, 1/3 or less width of leaf base; upper laminal cells thick-walled, rectangular to quadrate or subquadrate, ± smooth; basal laminal cells rectangular, smooth; alar cells not differentiated. **Dioicous**. **Perichaetia** terminal, leaves similar to stem leaves but larger, with sheathing bases. **Seta** 5-15 mm long, straight, yellow or red. **Capsule** erect and symmetric or inclined or asymmetric and curved, urn subglobose to ovoid-cylindrical, 0.7-1.5 mm long, smooth or furrowed when dry, neck sometimes distinct, occasionally strumose. **Operculum** short to long rostrate. **Peristome** teeth divided ca. 1/2 or slightly more into 2-3 segments, vertically striate-pitted below, distally papillose or spiculose. **Calyptra** cucullate, smooth, entire at base. **Spores** lightly to coarsely papillose.

*Habitat.* On soil or soil covered rocks in open sites, from the lowland (in southern Africa) to the alpine belt, in Central Africa from 1800 to 4400 m.

*Discussion.* The genus much resembles *Anisothecium*, which differs by leaves with sheathing leaf bases which are suddenly contracted into the subula. The sporophytes are identical. *Anisothecium* is therefore commonly included in or treated as a subgenus of *Dicranella*, although Brotherus (1924) placed both genera in different subfamilies. *Microdus* resembles *Dicranella* vegetatively and is therefore also included in *Dicranella* by some authors but has a different peristome architecture.

*Literature.* Brotherus, V.F. 1924. - see general ref.

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## ***Dicranoloma* (Renauld) Renauld**

A genus with more than 100 species distributed in the Southern Hemisphere, mainly in Australasia. Five species occur in tropical Africa, four of which have been described from Africa and are known only locally. Only *D. billardierei* is more widespread, from South Africa to the mountains of Central Africa.



# Guide to Bryophytes of sub-Saharan Africa

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**Plants** large, in tufts or cushions, yellow. **Stems** erect, to more than 10 cm tall, simple or somewhat branched. **Leaves** falcate-secund, from ovate base narrowly lanceolate, to 7 mm long, concave; margins sharply serrate in the upper third, limbate in the lower 2/3; costa narrow, percurrent; upper laminal cells smooth and thick-walled, elongate-oval, weakly porose or not; basal laminal cells oblong-linear, strongly porose; marginal cells forming a border of 3-4 rows of elongate, hyaline cells; alar cells large, rectangular, reddish brown. **Autoicous**. **Perichaetia** terminal. **Perichaetial leaves** sheathing, with obtuse apex. **Seta** 15–20 mm long. **Capsule** curved, asymmetric, strumose, reddish, 3 mm long; annulus persistent. **Operculum** long rostrate. **Peristome** teeth vertically striate-papillose, cleft nearly to the middle. **Calyptra** cucullate, smooth. **Spores** spherical, papillose, 12-15 µm.

*Habitat.* On humus or soil in montane forests. *D. billardierei* grows epiphytically and forms huge 'mossballs' 1-2 m in diameter (!) on stems and branches in humid habitats at elevations between 1800 and 3200 m.

*Discussion.* *Dicranoloma* in appearance resembles *Dicranum*, from which it is distinguished by the absence of a central stand, presence of a narrow costa, and a narrow border of elongate hyaline cells along the leaf margin. It can easily be confused with *Dicranum johnstonii*, with which it can grow intermixed, from which it is distinguished in addition to the characters mentioned by the elongate pitted laminal cells.

Norris and Koponen (1989) confined the use of the name *Dicranoloma* to 6 species in northern Australia and New Caledonia; in their opinion all other species should be combined into *Dicranum*, with the consequence that *Dicranum* would not be a holarctic genus anymore but bicentric in distribution. Klazenga (1999) disagreed with this view in a wide-ranging revision of the genus in Malesia, and reverted to a concept similar to Renauld's original description of the genus, which is supported here.

*Literature.* **Klazenga, N. 1999.** A revision of the Malesian species of *Dicranoloma* (Dicranaceae, Musci). *Journal of the Hattori Botanical Laboratory* 87: 1-130. **Norris, D.H., Koponen, T. 1989.** Typification of *Dicranoloma* Ren., a small genus of mosses from Northern Australia and New Caledonia. *Acta Bryolichenologica Asiatica* 1: 1-14.

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## *Dicranum* Hedw.

Six species in tropical Africa, of which 4 are insufficiently known. The genus includes almost 100 species, mainly distributed in cool temperate regions of the northern hemisphere.

**Plants** tall, robust, in tufts, light to dark green or golden-yellow. **Stems** erect or rarely branched, usually densely tomentose with whitish to red-brown rhizoids. **Leaves** spreading, flexuose, or falcate-secund, lanceolate, ending in a narrow, long acumen, 5-13 mm long, margins entire or serrate in the upper third of the leaf; costa percurrent to short excurrent, ca. 1/5 or less the width of leaf base, entire or toothed at back in the apex, in cross-section with a median band of guide cells and ventral and dorsal bands of stereids; upper laminal cells quadrate, oval or short elongate, sometimes slightly pitted, smooth; basal laminal cells rectangular, large, usually strongly pitted; alar cells well developed, quadrate or inflated, hyaline or reddish. **Dioicous**. **Perigonia** bud like (dwarf males), attached to tomentum. **Perichaetia** terminal, leaves convolute, usually differentiated from stem leaves. **Seta** 1 to often 2-4 per perichaetium, elongate, 20-60 mm long, smooth. **Capsule** inclined and curved, urn cylindrical, 3-5 mm long, annulus absent or present and persistent. **Operculum** long rostrate, often equal to urn length. **Peristome** teeth divided to ca. 1/2, vertically striate-pitted below, papillose above. **Calyptra** cucullate, naked. **Spores** spherical, papillose.

# Guide to Bryophytes of sub-Saharan Africa

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*Habitat.* On soil, humus and rotten wood in montane and subalpine forests, 1800-3850 m.

*Discussion.* The genus resembles *Dicranoloma*, from which it is distinguished by the lack of a row of elongate cells along the leaf margins. Only two species are at all common, *D. acanthoneuron* Müll.Hal. and *D. johnstonii* Mitt., which are widely distributed in the high montane and subalpine regions of Central Africa.

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## **Holomitrium** Brid.

A genus of about 50 species worldwide, mainly epiphytes in tropical regions, of which 12 have been reported or described from tropical Africa. The species are concentrated in East Africa and the East African islands: 8 of the 12 species are reported from Madagascar. The others are confined to the southern part of tropical Africa (Angola, Zimbabwe), with only two found in Central Africa.

**Plants** medium sized to large, forming dense tufts, dark green, to light green or yellowish-brown. **Stems** erect, frequently branched, densely tomentose below; central strand present. **Leaves** squarrose or flexuose when dry, erect-spreading when wet, from an ovate base narrowly lanceolate, keeled or channelled above, concave below; margins plane, serrate, dentate, crenulate or entire; costa strong, percurrent to short excurrent, ca. 1/4 or less width of leaf base, often toothed distally on back, in cross-section with a median band of guide cells and ventral and dorsal stereids; upper laminal cells quadrate, basal laminal cells elongate and strongly porose; alar cells enlarged, red-brown. **Pseudautoicous**. **Perigonia** bud-like, attached to stem or leaf tomentum. **Perichaetia** terminal, leaves usually very long, from broad base abruptly acuminate, convolute, sheathing the seta. **Seta** 1(-2) per perichaetium, erect. **Capsule** erect, urn short to long cylindrical, phaneroporous stomata at base of urn; annulus absent. **Operculum** rostrate. **Peristome** teeth inserted below urn mouth, perforated or cleft to the base, papillose. **Calyptra** cucullate. **Spores** lightly papillose.

*Habitat.* Epiphytic on branches and trunks of trees and shrubs, 800 to 2500 m.

*Discussion.* The species of *Holomitrium* resemble in appearance those of *Symblepharis* or *Pseudosymblepharis* (Pottiaceae), which grow in similar habitats. They are distinguished from *Pseudosymblepharis* by smooth, not papillose, upper laminal cells and from *Symblepharis* by the long, convolute perichaetial leaves.

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## **Leptotrichella** (Müll.Hal.) Lindb.

A genus in which over 60 species were recognised, of which 11 occur in tropical Africa. The 'Checklist of Mosses' (Crosby et al. 1999) enumerates only 11 species worldwide, 2 of them from tropical Africa. Until recently (Ochyra 1997) this genus was known as *Microdus*.

**Plants** small, loosely caespitose. **Stems** 2-4 mm high, erect. **Leaves** erect spreading when wet, appressed when dry, oblong to lanceolate, 1-2 mm long, apex acute to obtuse-rounded, entire, dentate or serrate; margins plane; costa strong, ending below apex, 1/4-1/5 width of leaf base; upper laminal cells quadrate to short rectangular, smooth, incrassate, basal laminal cells larger, rectangular, thin-walled; alar cells lacking. **Dioicous**. **Perichaetia** terminal, leaves larger but not differentiated. **Seta** erect, elongate, to 4 mm long. **Capsule** erect or suberect; urn oval to short cylindrical, 0.6-1 mm long; annulus present. **Peristome** teeth irregular, cleft or perforated, usually

# Guide to Bryophytes of sub-Saharan Africa

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short, 50–150 µm long, rudimentary, rarely absent, papillose. **Calyptra** cucullate, naked and smooth, base entire. **Spores** ca. 20 µm, papillose.

*Habitat.* On open soil in grasslands, on road banks, often in disturbed sites; 700–2000 m.

*Discussion.* The genus is a small *Dicranella* in most respects and is therefore not distinguished by some authors (as with *Anisothecium*) but differs in its short, papillose peristome.

*Literature.* Crosby, M.R., Magill, R.E., Allen, B. & He, S. 1999. - see general refs. Ochyra, R. 1997. *Leptotrichella* replaces *Microdus* (Musci, Dicranaceae). *Fragmenta Floristica et Geobotanica* 42: 559-565.

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## ***Leucoloma* Brid.**

A revision of the genus (La Farge, 1998) revealed 112 species worldwide of which 77 are found in tropical Africa, most of them concentrated in SE Africa and especially the East African Islands. In contrast, there are only 14 species recorded for the Neotropics.

**Plants** small to large, in loose to dense tufts, dark green to yellowish-green. **Stems** erect to suberect, to 6 cm high, little branched; central strand absent. **Leaves** erect-spreading when wet, flexuose or falcate when dry, from ovate base lanceolate, subulate to setaceous, margins involute, entire to serrulate in the upper part, bordered from base to half or nearly the full length of the lamina; costa narrow, ending in apex; alar cells enlarged, coloured; basal laminal cells elongate to rectangular, smooth; upper laminal cells oblong-oval to quadrate, strongly papillose; marginal cells linear, hyaline, forming a border of several rows. **Dioicous**. **Perichaetia** terminal. **Seta** erect, elongate. **Capsule** straight, urn cylindrical; annulus absent. **Operculum** rostrate. **Peristome** teeth divided ca. 1/2, trabeculate below, papillose at tips. **Calyptra** cucullate. **Spores** smooth, weakly papillose or granulate.

*Habitat.* Epiphytic, also pendant from branches, in montane forests 800-2100 m.

*Discussion.* The genus is related to *Dicranoloma*, with which it shares the border of hyaline cells along leaf margins, but is distinguished by the short, pluripapillose upper laminal cells.

*Literature.* La Farge-England, C. 1998. The infrageneric phylogeny, classification, and phytogeography of *Leucoloma* (Dicranaceae, Bryopsida). *Bryologist* 101: 181-220.

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## ***Microcampylopus* (Müll.Hal.) M.Fleisch.**

A genus of three species, of which *M. laevigatus* (Thér.) Giese & J.-P.Frahm occurs in tropical Africa.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** 5-10 mm tall, gregarious or in loose tufts, yellow-green. **Stems** erect, mostly unbranched, loosely foliate. **Leaves** with broad sheathing base appressed to the stem and narrow, long erect-spreading or erect spreading subula, 2.5-4 mm long; margins entire (except at apex); costa long excurrent in the subula, ca. 1/3 width of leaf base; basal laminal cells enlarged, lanceolate, thin walled, upper laminal cells shorter and more incrassate; alar cells undifferentiated. **Dioicous**. **Seta** curved and twisted, to 6 mm long. **Capsule** ca. 1 mm long, two times longer than broad; deeply furrowed when dry and empty; annulus present. **Operculum** conic-rostrate, oblique. **Peristome** teeth vertically striate below, divided ca. 2/3 and perforate, rusty-red below, yellowish and papillose above. **Calyptra** cucullate, naked, base  $\pm$  entire. **Spores** coarsely papillose, papillae large, 6-8 in diameter.

*Habitat.* On open loamy or lateritic soil, often along roadsides, from submontane to high montane areas (500 to 2500 m).

*Discussion.* The genus is vegetatively similar to small species of *Anisothecium* with broad sheathing leaf bases which are abruptly contracted into a long subula and can only be distinguished from the latter by the cygneous setae.

*Literature.* **Giese, M. & Frahm, J.-P. 1985.** A revision of *Microcampylopus* (C. Muell.) Fleisch. *Lindbergia* 11: 114-124 [illustration].

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## ***Paraleucobryum* (Limpr.) Loeske**

A holarctic genus with 3 species. Only *P. longifolium* ssp. *brasiliense* (Broth.) P.Müller & J.-P.Frahm occurs in the tropics; it is known from one collection in each of SE Brazil and D.R. Congo.

**Plants** medium sized, in dense tufts, greyish green. **Stems** erect, to 2.5 cm tall, little branched, radiculose below. **Leaves** long lanceolate, hamate, 8-13 mm long, subtubulose at tips, apex gradually acuminate; margins entire, serrate at tips; costa excurrent, filling 3/4 width of leaf base, smooth or slightly ridged at back, in transverse-section with a median and dorsal band of hyalocysts and a ventral and dorsal band of chlorocysts (the latter alternating with the hyalocysts), stereids absent; upper laminal cells narrow, long rectangular, basal cells larger, rectangular, weakly porose; alar cells well developed, cells inflated. **Dioicous**. **Perichaetia** terminal, leaves sheathing from a broad ovate base. **Seta** erect, 20-25 mm long, twisted. **Capsule** erect, urn cylindrical, 2-2.5 mm long; exothecial cells thick-walled; phaneroporous stomata at the base of the urn; annulus lacking. **Operculum** long rostrate. **Peristome** teeth divided to 1/2 or more, perforated below, striate below, papillose above. **Calyptra** cucullate, entire at base. **Spores** varying much in size, verrucose.

*Habitat.* Epiphytic, 3200 m.

*Discussion.* The genus resembles other genera such as *Campylopus*, *Pilopogon*, or *Atractyllocarpus* in the very broad costa, but is distinguished by the absence of stereids in transverse section of the costa, the presence of chlorocysts between upper and lower hyalocysts, and elongate and narrow upper laminal cells. In appearance it looks like a species of *Dicranum*, and the shape of the capsule also resembles that of some *Dicranum* species.

*Literature.* **Müller, P. & Frahm, J.-P. 1987.** A review of the Paraleucobryoideae (Dicranaceae). *Nova Hedwigia* 45: 283-314. [keys, illustrations].

# Guide to Bryophytes of sub-Saharan Africa

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## ***Pilopogon* Brid.**

Eight species worldwide, 7 of them in the neotropics, in Africa only *P. africanus* Broth.

**Plants** 1-4 cm tall, in loose to dense tufts, yellowish-green to golden-brown. **Stems** erect and slender, rarely branched; central strand present. **Leaves** erect to appressed when dry, slightly erect-spreading when wet, from a lanceolate or oblong base subulate, acute and serrate; margins entire; costa strong, short to long excurrent, filling 1/2 width of leaf base, in transverse-section with ventral and dorsal stereids and median guide cells, ribbed on back; upper laminal cells thick-walled, oval; basal laminal cells sharply delimited from the upper ones, long rectangular, thin-walled; alar cells weakly differentiated. **Dioicous. Perichaetia** terminal, leaves sheathing seta for 1/2 or more length of seta. **Seta** elongate, erect, 1-2 cm tall. **Capsule** erect, urn short cylindrical, stomata absent; annulus present. **Operculum** long rostrate, erect. **Peristome** teeth divided half of their length, striate below, papillose above. **Calyptra** cucullate, smooth and naked, base fringed with long hairs (ciliate). **Spores** slightly papillose.

**Habitat.** Exposed soil and rock, mainly in secondary habitats such as roadside banks, gravel and sand along roads and trails, 1500 – 4200 m.

**Discussion.** Vegetatively, the genus resembles *Campylopus*, but is distinguished by the straight seta, erect, cylindrical urn and long sheathing perichaetial leaves. The differentiation between these genera is straightforward, because *Pilopogon* species usually produce sporophytes abundantly.

**Literature.** **Frahm, J.-P. 1983.** A monograph of *Pilopogon* Brid. *Lindbergia* 9: 99-116 [keys, illustrations, maps].

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## ***Platyneuron* (Cardot) Broth. in Engl. & Prantl**

A monotypic genus with the only species *Platyneuron praealtum* (Mitt.) Ochyra & Bednarek-Ochyra. (*Dicranum laticostatum* Cardot). The African taxon was described by Magill (1981) from the Cape Province of South Africa as *Chorisodontium falcatum* but regarded as synonymous with *Platyneuron laticostatum* by Frahm (1989) and subsequently synonymised with *P. praealtum* by Ochyra (1997). *Platyneuron* differs from *Chorisodontium* by the absence of stereids in the transverse section of the costa and the back of the costa being coarsely mammillose.

**Plants** robust, greenish above, darker below, in dense mats. **Stems** erect, rarely branched, erect, tomentose with whitish or reddish tomentum, 3-7 cm tall. **Leaves** falcate secund when wet, flexuose or crowded when dry, 6-9 mm long, from oblong base narrowed into a narrow channelled subula; margin serrate in the upper part of the leaf; costa broad, filling 1/3 of leaf width at leaf base, filling the subula, strongly mammillose at back, the tips of mammillae thickened, in transverse section with a median band of deuter cells and 1-2 rows of thick walled dorsal and one row of substereoidal ventral cells; laminal cells in the lower part of the leaf rectangular, thick walled, porose,

# Guide to Bryophytes of sub-Saharan Africa

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shortly rectangular to oval or quadrate in the upper part; alar cells quadrate, incrassate, brownish or reddish. **Sporophyte** not known from South Africa.

*Habitat.* On rock.

*Discussion.* The only species of the genus is widely distributed in southern South America in the Nothofagus zone (Ochyra & Bednarek-Ochyra 1997) and has also been collected on Kerguelen Islands and South Georgia (Frahm 1989). It is easily distinguished by the broad costa filling the subula, which is mammillose at the back.

*Literature.* **Frahm, J.-P. 1989.** The genus *Chorisodontium* (Dicranaceae, Musci) in the Neotropics. Tropical Bryology 1:11-24. **Magill, R.E. 1981.** - see general refs. [illustration]. **Ochyra, R. & Bednarek-Ochyra, H. 1997.** The type specimen of *Leptotrichum praealtum* (Musci, Ditrichaceae). Fragmenta Floristica et Geobotanica 42: 567-570.

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## ***Pocsiella* Bizot**

A monotypic genus with only *P. hydrogonioides* endemic to Mt. Kilimanjaro.

**Plants** laxly caespitose, greenish above, chestnut brown below. **Stems** erect, 1.5-2 cm tall, rarely branched. **Leaves** distant, flexuose when dry, suberect when wet, from broad base ligulate, shortly acuminate, longly decurrent; costa strong, vanishing shortly below the apex; upper laminal cells irregular, isodiametric, 20 µm in diameter, basal laminal cells short rectangular. **Dioicous** (?). **Perichaetia** terminal, perichaetial leaves not differentiated. **Seta** erect, 7 mm long. **Capsule** erect, urn ovate, widest at mouth, 1.5 mm long. **Operculum** not known. **Peristome** teeth reddish, smooth, irregularly cleft. **Calyptra** not known. **Spores** smooth, 18-20 µm.

*Habitat.* On shady rocks in *Erica arborea* forest 2800-2900 m.

*Discussion.* The species is very conspicuous by the distant, longly decurrent leaves, which are compared by the author with *Bryum weigellii*. It resembles *Oreoweisia*, but differs by the non-papillose peristome teeth and the smooth laminal cells.

*Literature.* **Bizot, M. 1980.** Enumeratio muscorum novorum III. Cryptogamie, Bryologie. Lichénologie 1: 423-430. [illustration].

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## ***Pseudephemerum* (Lindb.) I.Hagen**

Only one species, *P. nitidum* (Hedw.) Reimers, worldwide including northern and Central Africa.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** small, yellow green. **Stems** erect, a few mm high. **Leaves** erect patent when dry, sinuose when wet, narrow lanceolate, longly acuminate, margins serrulate at tips; costa weak, vanishing before leaf apex; laminal cells rectangular, smooth, thin-walled, larger at leaf base. **Synoicous**. **Perichaetia** terminal, antheridia naked in the axils of the perichaetial leaves, perichaetial leaves similar to normal leaves. **Seta** minute, 1 mm long. **Capsule** immersed in upper stem leaves, oval, cleistocarpous. **Operculum** shortly obliquely rostrate. **Calyptra** small, cucullate. Spores papillose, 25-30  $\mu\text{m}$ .

*Habitat.* On wet soil along banks of streams, in man-made habitats, in ditches, plantations, 1600–2900 m.

*Discussion.* The genus is distinguished by the small plants with cleistocarpous capsules, not unlike Archidium.

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## ***Sphaerothecium* Hampe**

A genus of three species worldwide, of which *S. phascoides* (Hampe) Hampe is only known from the vicinity of Bogotá, Colombia, *S. reconditum* Thwaites & Mitt. is known from Sri Lanka and *S. subchlorophyllosum* (Müll.Hal.) J.-P.Frahm is known from South Africa.

**Plants** small, to 15 mm high, in loose tufts, yellowish-green. **Stems** equally foliate, appressed when dry, erect patent when moist; central strand present. **Leaves** from an ovate base narrowly lanceolate, to 4 mm long, ending in a channelled subulate apex; margins entire; costa excurrent in a short hyaline hairpoint, filling 3/4 of leaf base, in transverse section with ventral and dorsal stereid bands and a median band of guide cells, ridged or shortly lamellose at back; upper laminal cells oval, incrassate, basal laminal cells rectangular, incrassate, alar cells weakly differentiated. **Dioicous**. **Perichaetia** terminal. **Seta** 4-5 mm long, curved, yellowish-brown. **Capsule** immersed in upper leaves, urn subglobose to ovoid, 1 mm long; annulus large, reddish-brown, dehiscent. **Operculum** obliquely short-rostrate. **Peristome** teeth reduced, basal membrane low, equal to or just exceeding mouth. **Calyptra** cucullate, naked and smooth, base ciliate. **Spores** finely papillose, 21  $\mu\text{m}$  in diameter.

*Habitat.* On open soil in exposed sites; known only from a few collections in South Africa.

*Discussion.* Vegetatively *Sphaerothecium* resembles a small *Campylopus*, but differs from the latter by immersed sporophytes, subglobose capsules, enlarged annulus, short peristome, and larger spores. Included in Magill (1981) as *Campylopus subchlorophyllosum*.

*Literature.* **Frahm, J.-P. 1986.** A review of *Sphaerothecium* Hampe. *The Bryologist* 89: 152-154. [illustration].  
**Magill, R.E. 1981.** - see general refs. [description, illustration].

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## ***Symblepharis* Mont.**

**Excluded: the only record for Africa was found not to belong to this genus.**

# Guide to Bryophytes of sub-Saharan Africa

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*Literature.* **Dixon, H.N. 1933.** Mosses collected on Mt. Cameroon by Miss Steele. *Annales Bryologici* 6: 20-30. [description, but no illustration].

## ENCALYPTACEAE

(B.J. O'Shea, April 2003)

The Encalyptaceae contain two genera and about 20 species primarily distributed in the Northern Hemisphere, in the tropics confined to montane regions.

### ***Encalypta* Schreb. ex Hedw.**

Six species in tropical Africa; 19 species primarily of the Northern Hemisphere.

**Plants** medium sized, forming tufts, dark green to yellowish-brown. **Stems** erect, solitary or few branched; central strand absent or weak. **Leaves** contorted and incurved when dry, erect-spreading when wet, ovate-oblong, oblong-elliptic to obovate, 1.8-5.0 mm long, occasionally undulate, apex broadly acute to obtuse,  $\pm$  cucullate, mucronate or apiculate; margins plane, erect or inflexed distally, usually reflexed below; costa single, usually strong, subpercurrent to percurrent or short excurrent, back usually projecting; upper and median cells subquadrate, strongly pluripapillose, papillae branched; lower and basal cells large and short rectangular, smooth, walls dark brownish-orange; basal margin cells usually differentiated. **Autoicous** (gonioautoicous). **Perichaetia** terminal, leaves little differentiated. **Seta** elongate, (1-)2-10 mm long, erect to  $\pm$  flexuose, rather stout, smooth, often distally twisted. **Capsule** erect, urn usually long cylindrical, 1.2-4.0 mm long, smooth to furrowed and  $\pm$  twisted; stomata present and superficial at base of urn; annulus undifferentiated. **Operculum** rostrate from a plano-convex base. **Peristome** absent or present, teeth vertically-striate papillose, often fragile and deciduous. **Calyptra** mitrate-long cylindrical, apex constricted and rostrate, base fringed and lobed or not. **Spores** variously ornamented.

*Habitat.* On soil, rock crevices and on rocks in open high montane areas, 2900-4800 m.

*Discussion.* *Encalypta* is recognized by the cylindrical-campanulate calyptra and oblong-rectangular laminal cells at the base, smooth with cross walls thickened, and upper cells pluripapillose; the two former features may assist in separating various Pottiaceae from *Encalypta* with which it is likely to be confused. Of the six African taxa, *Encalypta vulgaris* Hedw. is most frequent in southern Africa and *E. ciliata* Hedw. is found in montane areas in eastern and southern Africa. Three species are known only from Ethiopia/Eritrea. Two of our species (*E. cuspidata* and *E. hedbergii*) are treated as 'problematical' in the revision by Horton (1983). A full revision of the family has been published by Horton (1982, 1983) and Horton (1983) includes keys and illustrations.

*Literature.* **Horton, D.G. 1982.** A revision of the Encalyptac **GBA online**

## ERPODIACEAE

(N.G. Hodgetts, April 2000)

Since the recent revision of the family (Stone 1997), the Erpodiaceae contain the single genus *Erpodium* and some 35 species of mostly tropical and south temperate distribution. The family is placed in the Orthotrichales.

### ***Erpodium* (Brid.) Müll.Hal.**

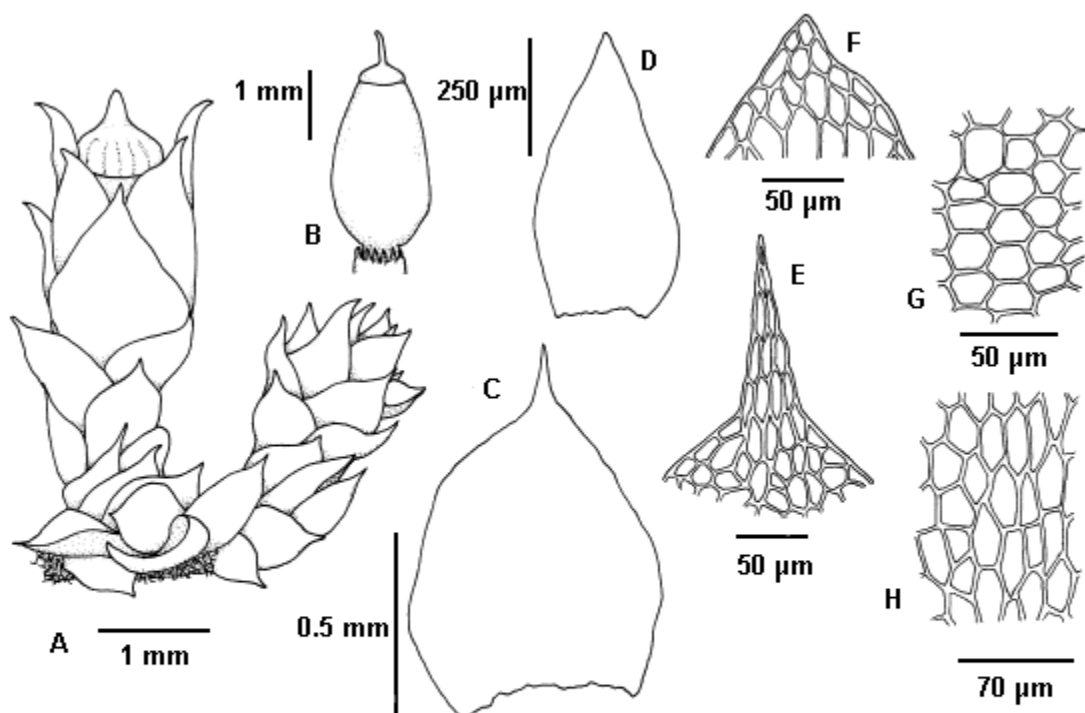


# Guide to Bryophytes of sub-Saharan Africa

Twelve species in sub-Saharan Africa; about 35 species widely distributed in tropical and subtropical regions.

ae (Musci), with particular reference to the North American taxa. Part I. Journal of the Hattori Botanical Laboratory 53: 365-418. **Horton, D.G. 1983.** A revision of the Encalyptaceae (Musci), with particular reference to the North American taxa. Part II. Journal of the Hattori Botanical Laboratory 54: 353-532 [keys, illustrations, maps].

**Plants** small to medium-sized, in loose to dense mats, dull light to dark green. **Stems** creeping, to 10 mm long, irregularly pinnately branched, terminal stems and branches often spreading to ascending and curled, radiculose beneath. **Leaves** appressed to weakly complanate, occasionally appearing 4-ranked, ovate, ovate-oblong to nearly orbicular, 0.5-1.2 mm long, symmetric to asymmetric, concave, apex acuminate to acute or rounded, apiculate or piliferous; margins plane, entire; laminal cells smooth or pluripapillose, apical cells elongate or isodiametric; median cells quadrate- to hexagonal-rounded and horizontally arranged or oblate; alar region differentiated, cells oblong, oblatly arranged. **Perichaetial leaves** often enveloping sporophyte, oval to oblong. **Seta** short, 0.2-0.8 mm long. **Capsule** immersed to shortly exserted, erect to subinclined, urn short-cylindrical, 0.8-1.5 mm long; stomata absent or several at base of urn, superficial; annulus absent or compound and persistent. **Operculum** conic-rostrate. **Peristome** absent or poorly developed, papillose. **Calyptra** mitrate-short campanulate or elongate and twisted, plicate and lobed at base, or appearing cucullate, roughened or not. **Spores** smooth to lightly papillose.



***Erpodium coronatum* var. *coronatum* (Hook. & Wilson) Mitt.**

Malawi: Hodgetts 2700a (E) [C, E, G] & De Sloover 18203 (BR) [A, B]

A: stems, with sporophyte (with calyptra); B: sporophyte (without calyptra); C, D: leaves; E, F: leaf apices; G, H: mid-leaf cells.

***Erpodium grossirete* Müll.Hal.**

Malawi: Hodgetts 2699a (E) [D, F, H]

**Habitat.** Usually epiphytic, on tree trunks and exposed roots or logs, in shaded or partially exposed sites; semi-arid forests and isolated trees (e.g. on roadsides, in gardens), from near sea level to 1700 m.

**Discussion.** The genus is characterised by its usually epiphytic habitat, opaque leaves and the smooth or pluripapillose laminal cells. The plants are often closely appressed to the substrate, sometimes (non-piliferous

# Guide to Bryophytes of sub-Saharan Africa

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species) superficially resembling a liverwort such as *Frullania*. Crum (1972) provided an account of the family as a whole. Further information for the family in Africa, including keys, was provided by Egunyomi (1980), Hodgetts (1997) and Magill & van Rooy (1998).

*Literature.* **Crum, H. 1972.** A taxonomic account of the Erpodiaceae. *Nova Hedwigia* 23: 201-224. **Egunyomi, A. 1980.** Mosses from Nigeria III: new records from the Middle-Belt area. *Journal of the Hattori Botanical Laboratory* 48: 187-193. **Hodgetts, N.G. 1997.** British Bryological Society expedition to Mulanje Mountain, Malawi 3. Erpodiaceae (Musci). *Journal of Bryology* 19: 113-118. **Magill, R.E. & van Rooy, J. 1998.** - see general ref. **Stone, I.G. 1997.** A revision of Erpodiaceae with particular reference to Australian taxa. *Journal of Bryology* 19: 485-502.

## EUSTICHIACEAE

(B.J. O'Shea, April 2000)

A monotypic family.

### *Eustichia* (Brid.) Brid.

There is only one species worldwide in this genus, *E. longirostris* (Brid.) Brid., which is distributed at high altitudes in central and south America, and in southern Africa (South Africa and Lesotho) and in the southern ocean islands of Marion and Tristan da Cunha. Records for Madagascar and Réunion were errors based on the Tristan collections.

**Plants** slender and small, forming loose to rather dense tufts, light to olive green. **Stems** erect, to 5 cm tall, freely branched, radiculose below, with only the top 1-2 cm above ground; in cross-section central strand present. **Leaves** 2-ranked above, spirally arranged scale-like leaves at stem base, erect to erect-spreading, little altered when dry, conduplicate to carinate-concave, short oblong-ovate, 0.5-0.8 mm long, apex inwardly hooked, short acuminate; margins plane, erose-denticulate throughout except at base; costa single, short excurrent; laminal cells thick-walled, median cells subquadrate to short oblong-quadrate, 3-4 low, blunt papillae on dorsal surface, ventral surface smooth; basal cells short rectangular, smooth; marginal cells appearing mostly smooth; spirally arranged leaves on lower stems and branches ovate-short lanceolate, acuminate, costa rather long excurrent. **Dioicous.** [**Perichaetia** appearing lateral, leaves convolute, oblong, apex abruptly narrow acuminate; costa rather long excurrent; laminal cells elongate. **Seta** elongate, to 15 mm long, smooth. **Capsule** mostly erect, urn short obloid, 0.8-1.2 mm long, when deoperculate usually ribbed with mouth flared; exothelial cells irregularly elongate; thick-walled, stomata several at base of urn, superficial. **Operculum** conic-long rostrate. **Peristome** single, teeth 16, joined at base, usually reduced, vertically striate-papillose. **Calyptra** cucullate, naked and smooth. **Spores** lightly papillose.]

*Habitat.* On soil among rocks in the sub-alpine grasslands and shaded banks and dripping rock faces in ravine woodland of the Drakensberg mountains of Lesotho and South Africa (Natal and Orange Free State), 900-3100 m.

*Discussion.* *Eustichia* is characterized by the strongly 2-ranked leaves with pluripapillose laminal cells and a short excurrent costa that is slightly incurved. The stem is often quite long, with more than half of the stem buried. The sporophyte is not known in Africa. Further investigations are needed to elucidate its phylogenetic position of the family. Magill (1987) has a good description and illustration of South African material, with distribution map.

*References.* **Allen, B. 2002.** Moss Flora of Central America Part 2. Encalyptaceae-Orthotrichaceae. Monographs in Systematic Botany of the Missouri Botanical Garden 90: 1-699 [p. 451-453: description, illustration]. **Magill, R.E.**

# Guide to Bryophytes of sub-Saharan Africa

1987. Bryophyta. Part I. Mosses. Fasc II. Gigaspermaceae - Bartramiaceae. In: O.A. Leistner (ed.) Flora of Southern Africa. Pretoria: Botanical Research Institute [p. 399: description, illustration, map].

## FISSIDENTACEAE

(M.A. Bruggeman-Nannenga, June 2000)

A monotypic family, placed in the order Fissidentales.

### *Fissidens* Hedw.

About 90 species in Africa, estimated at 450 species distributed worldwide but absent in arid regions.

**Plants** very small to large, 0.3-10 cm long, mostly erect, forming mats, tufts or growing scattered, dull to bright green, reddish- or brownish-green, rarely, blackish- green. **Stems** simple to branched; in cross-section central strand present or absent. **Leaves** 2-ranked (distichous), median and upper leaves elliptico-lanceolate, oblong-lanceolate, less often lingulate, 0.4 -7 mm long, composed of vaginant laminae (sheathing), dorsal (extending the length of the back part of leaf), and ventral or apical (above the vaginant laminae) lamina, (in *Fissidens gladiolus* dorsal and ventral laminae can be lacking); margins entire, crenulate, denticulate or serrulate to irregularly sharply serrate or even spinose, elimbate or limbate, when limbate the limbidium uni- to multistratose, marginal or (partly) intralaminar and present on all laminae to restricted to (part of) the vaginant laminae of all or some leaves; costa single, usually strong, sometimes branched at apex,  $\frac{1}{2}$ - $\frac{2}{3}$  of the leaf length to percurrent or short to long excurrent, lacking or weak in some species, sometimes obscured by overlying chlorophyllose cells; laminal cells flat, convex, conical, sometimes lenticularly thickened, smooth or uni- or multipapillose, border cells when present linear and smooth. **Gemmae** mostly absent or present in leaf axils, on leaf tips or one the rhizoids. **Autoicous, synoicous or dioicous**, often polyoicous. **Perichaetia** terminal, occasionally lateral, leaves often differentiated. **Seta** usually 1 per perichaetium, 0.1-10 mm long, erect or variously curved, smooth, infrequently papillose. **Capsule** exserted, rarely emergent or immersed, erect to horizontal, urn ovoid to cylindrical, 0.3-2.0 mm long; annulus absent; exothecial cells short to long rectangular, often collenchymatous, longitudinal walls often thickened; stomata at urn base, superficial. **Operculum** conic, short to long rostrate. Peristome single, teeth 16, divided to half or more below, occasionally undivided or imperfectly divided, striate or papillose. **Calyptra** cucullate or short mitrate, naked, smooth or roughened. **Spores** oblate, smooth or papillose.

**Habitat.** Mostly in shaded, moist places in forests, entrances of caves, spray of waterfalls and along rivers, a few species truly aquatic, growing on soil, rocks, termite mounds, lower trunks of trees, branches, dead wood, rarely epiphyllous, in moist or wet lowland to high montane forests from near sea level to 3600 m.

**Discussion.** The distichous leaf arrangement and distinctive morphology of the leaves exhibiting vaginant laminae and dorsal and ventral laminae is diagnostic for the genus. Confusion with other genera is not likely, except in the case of *Fissidens gladiolus* Mitt. in which the dorsal and ventral lamina may be absent; in that state it has been described in *Anisothecium* (Dicranaceae). It can be recognized as a *Fissidens* by its peristome. Moreover, examination of more plants will usually reveal the presence of some leaves with traces of a dorsal lamina. The recent treatment by Magill (1981, see general references) will help to identify southern species. Other recent publications that will assist are Bruggeman-Nannenga (1993, 1979 and 1999).

**Study guide.** Leaf features are most important for identifying species. An important character is the presence or absence of a limbidium and its extension. In some species perichaetial leaves must be present to determine if a border is present. Further features to note include the ornamentation of cell walls (smooth, lenticularly thickened,

# Guide to Bryophytes of sub-Saharan Africa

mammillose, unipapillose or multipapillose), the presence or absence of large axillary nodules, guttulae in the leaf cells and the type of peristome. A cross-section of leaves is desirable, including the vaginant lamina, to determine cell ornamentation and if the limbidium is uni-, bi- or multistratose (the number of border cell layers and the ornamentation can, with practice, be determined simply by focusing up-and-down at high power on an intact leaf).

*Literature.* **Bruggeman-Nannenga, M.A. 1993.** Taxonomic results of the BRYOTROP expedition to Zaire and Rwanda 15. Fissidentaceae. *Tropical Bryology* 8: 141-148. **Bruggeman-Nannenga, M.A. 1997.** Notes on *Fissidens* VI. New Synonyms, new combinations and validation of some names. *Journal of the Hattori Botanical Laboratory* 81: 155-173. **Bruggeman-Nannenga, M.A. 1999.** Notes on Seychelles Mosses. 2 A revision of Fissidentaceae. *Bryobrothera* 5: 65-75. **Bruggeman-Nannenga, M.A. & W. Berendsen. 1990.** On the peristome types found in the Fissidentaceae and their importance for the classification. *Journal of the Hattori Botanical Laboratory* 68: 193-234. **Bruggeman-Nannenga, M. A. & R. A. Pursell. 1990.** The *Fissidens radicans* complex (Section Amblyothallia) in the Neotropics and Palaeotropic. *The Bryologist* 93: 332-340. **Bruggeman-Nannenga, M. A. & R.A. Pursell. 1995.** Notes on *Fissidens* V. *Lindbergia* 20: 49-55. **Bruggeman-Nannenga, M.A., Pursell, R.A. & Z. Iwatsuki. 1994.** A re-evaluation of *Fissidens* subgenus *Serridium* section *Amblyothallia*. *Journal of the Hattori Botanical Laboratory* 77: 255-271. **Pursell, R.A. 1987.** A taxonomic revision of *Fissidens* subgenus *Octodicerias* (Fissidentaceae). *Memoirs of the New York Botanical Garden* 45: 639-660. **Pursell, R.A., Bruggeman-Nannenga, M.A. & Z. Iwatsuki. 1992.** Species of *Fissidens* (Fissidentaceae, Musci) common to the Neotropics, Asia and Africa. *Bryobrothera* 1: 49-55. **Pursell, R.A., Bruggeman-Nannenga, M.A. and Z. Iwatsuki. 1993.** The identity of *Fissidens gardneri* and *Fissidens minutus*. *Bryologist* 96: 626-628.

## FONTINALACEAE

(R.D. Porley, April 2000)

The Fontinalaceae comprise 3 genera and about 30 species, mostly of the north temperate region with only one genus in sub-Saharan Africa, *Fontinalis*. The family is placed in the order Leucodontales.

### **Fontinalis L. in Hedw.**

Four taxa are known in the region, restricted to the South African Cape, Eritrea and Ethiopia. About 20 species are known worldwide, largely from the Northern Hemisphere.

**Plants** aquatic, forming loose floating mats, trailing from a single point of attachment, light to dark green. **Stems** usually elongate (to 50 cm long or more), frequently denuded below, irregularly pinnately branched; in cross-section outer 4-5 rows of cells small, thick-walled, inner cortical cells large, thin-walled, central strand absent. **Leaves** unistratose, rather flaccid, 3-ranked or appearing 2-ranked, loosely spreading, ovate-lanceolate, 3.5-5 mm long, to 2.2 mm wide, flat, concave or carinate, apex obtuse-rounded, occasionally somewhat cucullate, base rounded to subauriculate; margins plane, entire; costa absent, but a bistratose region in extreme leaf base may be present; laminal cells thin-walled, smooth, upper and median cells fusiform to broadly linear; basal cells rectangular-rounded; insertion cells often yellow or golden-brown; alar cells strongly differentiated, enlarged, thin-walled, subhexagonal to subquadrate. **Diocious.** **Seta** very short. **Capsule** immersed to emergent, oval cylindrical. **Operculum** long conical. **Peristome** double, exostome occasionally united in pairs at apex. **Calyptra** mitrate to rostrate, smooth, naked. **Spores** spherical, smooth or finely papillose. (Sporophytes are not reported from Africa; description is taken from European and North American plants).

# Guide to Bryophytes of sub-Saharan Africa

*Habitat.* Usually attached to submerged rocks and wood in slow to fast flowing streams or in ponds, but may be exposed for short periods when water levels drop. South African plants are believed to be introductions from Europe (Magill & van Rooy 1998).

*Discussion.* *Fontinalis* is distinguished by its aquatic habitat, 3-ranked, ecostate leaves, thin-walled elongate cells, and immersed capsules. Sporophytes are however unknown in sub-Saharan Africa, and dispersal is probably by fragmentation of leafy stems and branches. Buck and Allen (1997) suggested that the Fontinalaceae belong to the Leucodontales based on branching pattern, rhizoid-associated anatomy and axillary hairs. The four taxa can be separated as follows: *Fontinalis antipyretica* Hedw. var. *antipyretica*, known from Eritrea, is distinguished from the other species by keeled or deeply channelled leaves when wet. *F. antipyretica* var. *gracilis* (Lindb.) Schimp., known from Western Cape (South Africa), is more slender than the type with smaller leaves and cell dimensions. *F. hypnoides* var. *duriaei* (Schimp.) Husn., known from Eritrea and Ethiopia, has well-spaced, soft, broad ovate-lanceolate, nearly flat leaves. *F. squamosa* Hedw. var. *squamosa*, known from the South African Cape, has concave leaves with 1-3 marginal rows of slightly narrow, yellowish cells.

*Literature.* **Buck, W.R. & Allen, B. 1997.** Ordinal placement of the Fontinalaceae. *Cryptogamie: Bryologie, Lichénologie* 18: 227-234. **Magill, R.E. & van Rooy, J. 1998.** - see general ref. **Welch, W.H. 1960.** A monograph of the Fontinalaceae. The Hague: Nijhoff. [keys, illustrations].

## FUNARIACEAE

(F. Müller, June 2000)

**Plants** minute to medium-sized, gregarious or forming loose tufts, usually growing on soil, light-green or yellow, short-lived (annual or biennial). **Stems** erect, short, simple or with a few branches, often weakly radiculose below; in cross-section central strand present. **Leaves** reduced below, usually larger and more crowded above, often comose, usually contorted when dry, ovate- to oblong-lanceolate, obovate, oblanceolate or seldom linear-lanceolate, usually  $\pm$  concave, apex obtuse to acuminate, seldom aristate; margins plane to somewhat incurved, entire to rather crenulate, bluntly or sharply serrate, limbate or elimbate; costa single, narrow, 4/5 the lamina length to short or seldom long excurrent; laminal cells smooth, large, rather thin-walled, rather lax, poorly chlorophyllose, upper and median cells broadly rhombic to hexagonal; lower and basal cells oblong to rectangular; alar region undifferentiated. **Axillary filaments** present, with long-cylindric terminal cells. **Asexual structures** absent. **Autoicous**, rarely **paroicous**. **Perigonia** terminal, mostly bud-like, apex of paraphyses club-shaped. **Perichaetia** terminal, leaves somewhat enlarged. **Seta** elongate or very short, erect or somewhat curved and hygroscopic, seldom arcuate, smooth or rarely papillose. **Capsules** usually common, immersed to long-exserted, erect or curved, stegocarpous or cleistocarpous, symmetric and  $\pm$  smooth to asymmetric and striate when dry, urn pyriform or cupulate; annulus present or absent; stomata 1-celled, restricted to neck, usually superficial, seldom immersed; exothecial cells thick or thin-walled. **Operculum** present or not, if present, than flat, conic-rounded to short apiculate. **Peristome** double, single, rudimentary or absent, when double, exostome teeth 16, papillose-striolate or striate, trabeculate on adaxial surface; endostome segments 16, cilia absent, or when peristome single to reduced, represented by the exostome. **Calyptra** deciduous or persistent, mitrate or cucullate, smooth and naked, usually longly rostrate and inflated at base. **Spores** spherical or subreniform, reddish or golden-brown, seldom yellowish, variously ornamented or smooth, small to very large.

*Discussion.* The Funariaceae contain some 13 genera and approaching 300 species. It is a cosmopolitan moss family; in sub-Saharan Africa eight genera and about 50 species are present. The family is placed in the order Funariales. The majority of species are found in disturbed or open sites on bare soil. The family placement of sterile material is usually straightforward: the broad, concave, soft leaves with large, lax leaf cells with flattened ends are very characteristic. Sterile plants are not readily identified to genus or species level; only a few species

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

exhibit distinctive vegetative features that allows one to name them. Fortunately most members of the Funariaceae are autoicous and frequently fertile.

*Literature. Fife, A. J. 1985.* A generic revision of the Funariaceae (Bryophyta: Musci). Part 1. Journal of the Hattori Botanical Laboratory 58: 149-196.

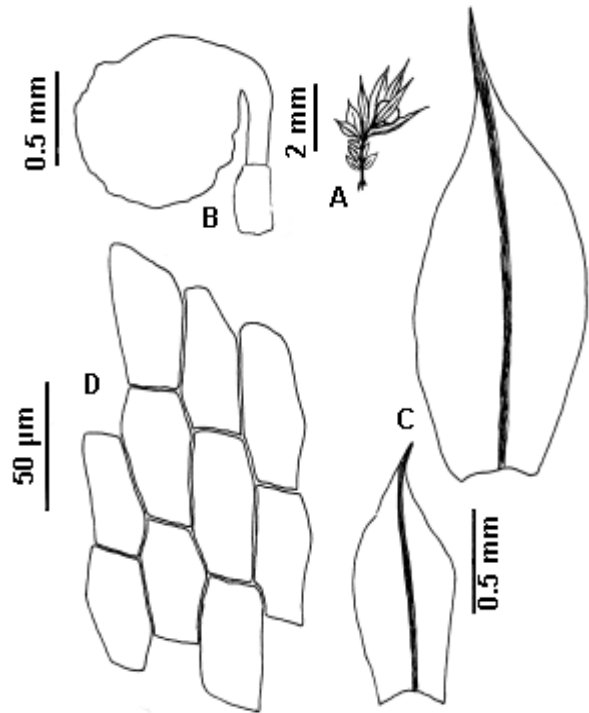
1. Capsules immersed to emergent	<b>2</b>
1. Capsules exerted on long seta	<b>7</b>
2. Capsule cleistocarpic, operculum not differentiated	<b>3</b>
2. Capsule stegocarpic, operculum differentiated and falling off; mouth broad	<b>5</b>
3. Plants bulbiform; perichaetial leaves large, strongly concave, completely enclosing sporophyte; capsule pyriform, pendent, neck cygneous	<b><i>Cygnicollum</i></b>
3. Plants with erect to spreading leaves; perichaetial leaves spreading, exposing sporophyte; capsule elliptical, erect, neck not cygneous	<b>4</b>
4. Calyptra large, enclosing capsule, mitrate-rostrate, inflated below; neck present; capsules globose to elliptical, often longer than broad; exothelial cells firmer walled	<b><i>Physcomitrellopsis</i></b>
4. Calyptra minute, covering only the beak and the uppermost part of capsule; neck absent; capsules globose; exothelial cells extremely delicate	<b><i>Physcomitrella</i></b>
5. Calyptra cucullate, lacking a rostrum; leaves linear-lanceolate, acuminate-aristate; seta slender and flexuose to curved; capsule horizontal to pendent; operculum plane	<b><i>Loiseaubryum</i></b>
5. Calyptra mitrate, short rostrate; leaves obovate-acuminate to -cuspidate; seta robust, erect; capsule erect; operculum plano-convex or plano-apiculate to short rostrate	<b>6</b>
6. Calyptra with 8 longitudinal plications; spores large (50-90 µm)	<b><i>Goniomitrium</i></b>
6. Calyptra smooth; spores smaller than 50 µm	<b><i>Physcomitrium</i></b>
7. Capsules sulcate when dry, asymmetric, variously inclined to subpendent; peristome double, endostome well developed or somewhat rudimentary; annulus compound and revoluble	<b><i>Funaria</i></b>
7. Capsules smooth when dry, mostly symmetric and erect; peristome either single, rudimentary or absent; annulus not compound and revoluble	<b>8</b>
8. Operculum stoutly to slenderly rostrate; capsule cupulate, mouth often flared when deoperculate, neck very short; exothelial cells isodiametric, with firm-walled cells; peristome absent; calyptra mitrate, base with three broad lobes; spores spinate	<b><i>Physcomitrium</i></b>
8. Operculum plane, convex, conic, very rarely slightly rostrate; capsule cylindrical to pyriform, mouth not flared when deoperculate, neck long; exothelial cells linear-oblong, oblong or very rarely isodiametric, with firm- to thick-walled cells; peristome present, single, rudimentary or occasionally absent; calyptra cucullate and inflated; spores variously ornamented, but not spinate	<b><i>Entosthodon</i></b>

# Guide to Bryophytes of sub-Saharan Africa

## *Cygnicollum* Fife & Magill

A genus with only one species worldwide, *C. immersum* Fife & Magill, which is probably endemic to South Africa.

**Plants** minute to small, bulbiform, solitary, light green. **Stems** simple, to 1 mm high; in section round, small central strand present. **Leaves** obovate-acuminate, concave, erect-spreading wet, little altered dry; leaves larger above, lower leaves obovate-apiculate, to 1.5 mm long, upper leaves oblong-obovate, acuminate, 1.5-3.0 mm long; margins plane, entire below, crenulate to bluntly serrate above; costa ending below apex in lower leaves and subpercurrent to short-excurrent in upper leaves; upper laminal cells rhomboidal to oblong-rhomboidal, thin-walled; upper marginal cells narrower, long-rectangular, but not forming distinct border; basal cells lax, rectangular. **Autoicous**. **Perichaetia** terminal, perichaetial leaves large, conspicuous, strongly concave, completely enclosing sporophyte. **Seta** short, erect, 0.7-1.0 mm long, yellowish. **Capsule** cleistocarpous, broadly pyriform, pendent because of cygneous neck, 1.0-1.3 mm long, yellowish-brown; exothecial cells quadrate to rectangular or occasionally rhomboidal, thin-walled; stomata present on neck, phaneropore. **Calyptra** small, narrowly campanulate, 0.6 mm long, smooth. **Spores** subreniform, 25-35  $\mu\text{m}$ , yellowish, irregularly papillose.



### *Cygnicollum immersum* Fife & Magill

(Republic of South Africa: Vanrhys Pass, hb MO 2848345)

A: plant; B: capsule; C: leaves; D: mid-leaf cells.

**Habitat.** Terricolous on soil in small open areas in shrublands. Only known from one locality in the north western Cape region, in an area with high rainfall at elevations of ca. 800 m.

**Discussion.** The family placement is uncertain. A monotypic genera, which is very distinct in the bulbiferous habit and the completely enclosed, pendent, cleistocarpous capsules. The genus appears distinct from other genera of the Funariaceae.

**Literature.** Fife, A.J. & Magill, R.E. 1982. *Cygnicollum immersum*, a new genus and species of Funariaceae from the Cape of Good Hope. *Bryologist* 85: 99-103 [description, illustration]. Magill, R.E. 1987. - see general ref. [description, illustration].

## *Entosthodon* Schwägr.

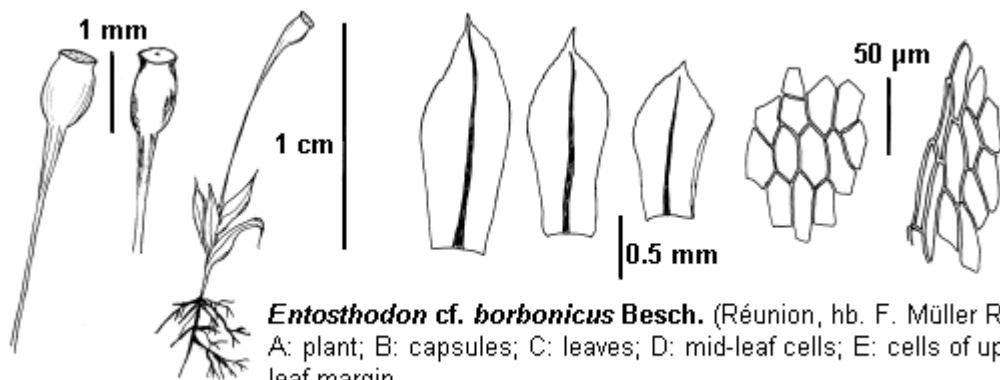
Over 20 species in the area, many of them needing confirmation. A taxonomic treatment for the genus is not available, except for the southern African taxa (Magill 1987).

**Plants** small, solitary or forming small tufts, glossy green to golden-reddish brown. **Stems** erect, simple or few branched by innovations. **Leaves** distally comose, lower stem parts leafless or with few leaves, leaves ovate,

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

oblong, or obovate, 0.8-3.5 mm long, apex acute, short acuminate or obtuse; margins plane, entire or bluntly to rather sharply serrate above; costa ending below the apex to subpercurrent or short excurrent; upper and median cells large, broadly rhombic, short to long hexagonal; lower and basal cells oblong to rectangular, lax; marginal cells forming a border of longer cells or not. **Autoicous**. **Perichaetia** terminal, leaves similar or somewhat larger. **Seta** elongate, 3-20 mm long, smooth or papillose distally or throughout. **Capsule** erect to inclined, symmetric, 1-4 mm long, narrowly pyriform, with a well-marked neck up to twice as long as the urn; annulus absent; exothecial cells linear-oblong, oblong or very rarely isodiametric, with firm- to thick-walled cells. **Operculum** flat to convex-conic. **Peristome** absent or present with exostome teeth straight or sigmoid; endostome usually not well developed, often peristome reduced and usually inserted well below the mouth. **Calyptra** cucullate, long-rostrate, inflated at base, smooth. **Spores** spherical, variously ornamented.



*Entosthodon cf. borbonicus* Besch. (Réunion, hb. F. Müller R 452)

A: plant; B: capsules; C: leaves; D: mid-leaf cells; E: cells of upper leaf margin.

A, B: del. T. Lautenschläger

**Habitat.** Terricolous on exposed soil, especially in moist open areas, e.g. slopes, peat banks, banks of streams; from sea level to 4200 m.

**Discussion.** The genus is characterised by an erect and elongate seta, a symmetric, pyriform capsule with the mouth little altered when deoperculate, a flat or convex operculum, when present a single rather well developed or rudimentary peristome inserted well below the mouth, and an inflated, cucullate calyptra. The separation of *Entosthodon* and *Funaria* is not altogether clear. An apparent gradation in peristome reduction is evident. For that reason, the genus has been, and still is, placed in *Funaria* by some authors. The treatment here follows that of Fife (1985).

**Literature.** Fife, A.J. 1985. - see family ref. Magill, R.E. 1987. - see general refs. [descriptions, illustrations (as *Funaria* species)].

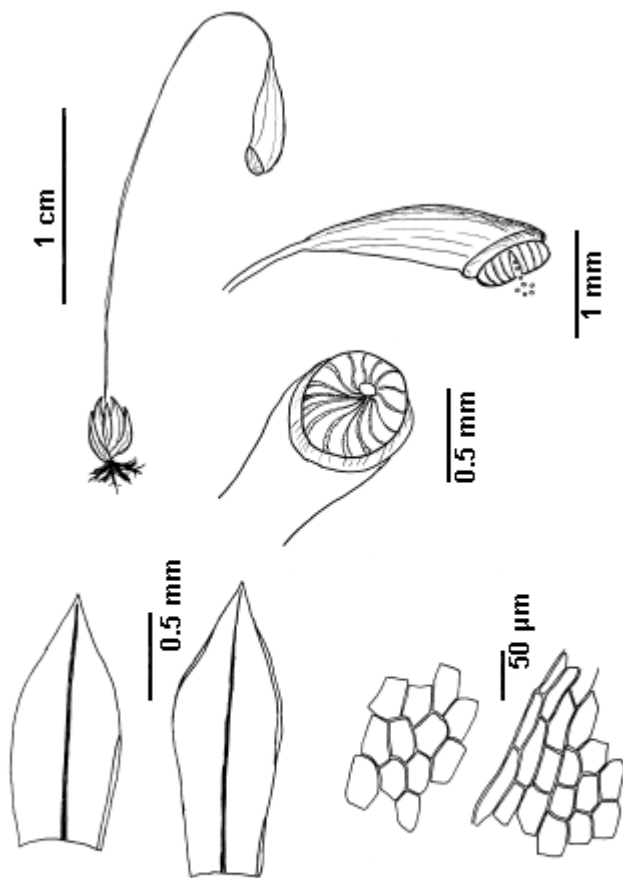
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## *Funaria* Hedw.

About 18 species recorded for the area, probably far fewer in fact. A taxonomic revision of the African species is needed.



# Guide to Bryophytes of sub-Saharan Africa



***Funaria hygrometrica* var. *calvescens* (Schwägr.)**

**Kindb.** (D.R. Congo, hb. F. Müller Z 244)

A: plant; B: capsule; C: detail of capsule; D: leaves;  
E: mid-leaf cells; F: cells of leaf margin in upper part  
of leaves. [A-C: del. T. Lautenschläger]

**Plants** small to medium sized, gregarious or forming loose tufts, green to yellowish-green or brown. **Stems** erect, to 1.5 cm tall, simple or with a few branches, dark red, radiculose; in cross-section hyalodermis present, outer cortical layer of 1-2 rows of smaller, incrassate cells, inner cortical cells thin-walled, central strand well developed; rhizoids appearing smooth. **Leaves** contorted when dry, patent to widespreading when wet; larger above and comose distally, often leafless below, loosely erect, oblong- to obovate-lanceolate, to 4 mm long, to 1.5 mm wide, concave, apex short acuminate to acute; margins plane or rather broadly incurved, entire to bluntly or strongly serrulate distally; costa ending below apex to percurrent, occasionally excurrent; median laminal cells large, rectangular to short or long oblong-hexagonal, lax, smooth; basal cells oblong-rectangular; marginal cells generally narrower, forming a somewhat distinct border. **Autoicous**. **Perigonia** on lateral branches or not, leaves smaller. **Perichaetia** terminal. **Seta** single, elongate, 5-55 mm long, yellow or golden-yellow, smooth, slender and wiry, usually hygroscopic. **Capsule** exserted, inclined to subpendent, strongly curved-asymmetric or rarely suberect, dark red or reddish-brown, 1.5-3.5 mm long, urn pyriform, strongly asymmetric, widest at mouth, deeply striate, mouth oblique, neck rather long, ± flattened; exothecial cells oblong-rectangular, thick-walled; stomata in neck region, superficial; annulus revoluble. **Operculum** low convex or conic. **Peristome** double, exostome teeth broadly lanceolate, slightly curved and joined at tip by a central disk, oblique or vertically striate-papillose below, distally papillose, strongly appendiculate and trabeculate on back; endostome hyaline, lightly papillose, basal

membrane high, segments narrowly lanceolate, keeled. **Calyptra** rostrate-cucullate, inflated at base, smooth. **Spores** spherical, smooth or variously ornamented.

**Habitat.** On soil, on rocks and cliffs covered with thin soil, frequent in disturbed or open sites, including those recently burnt; in subtemperate areas in lowland and premontane zone, in tropical areas restricted to montane and subalpine altitudes, from near sea level to 4000 m.

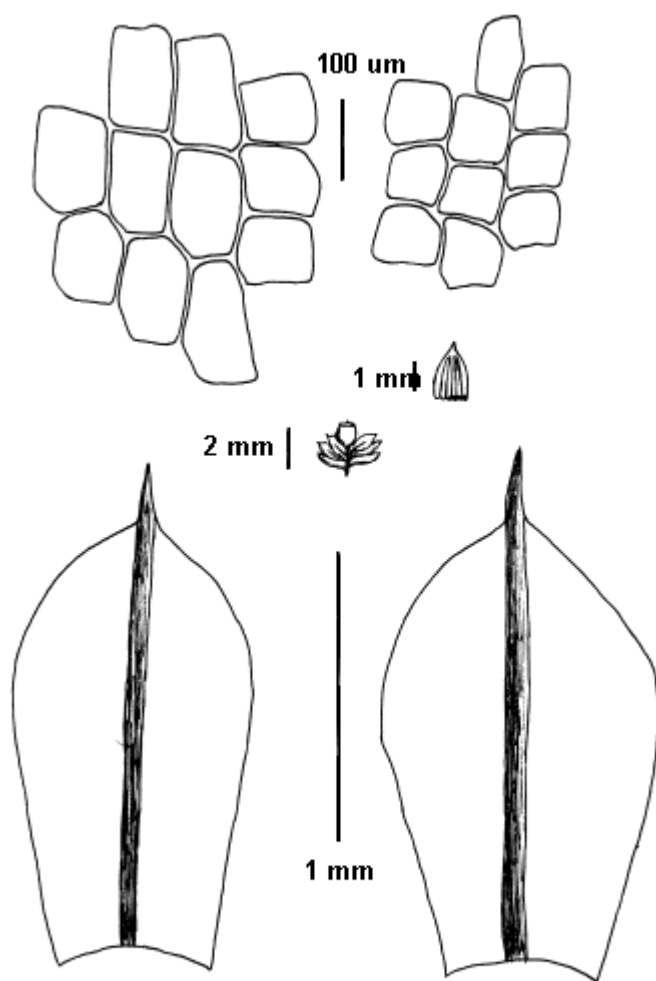
**Discussion.** The genus is characterised by a long, slender, often hygroscopic seta, often a striate, subpendent to inclined, asymmetric capsule, often oblique mouth, double peristome with a well developed or slightly rudimentary endostome, and rostrate-cucullate, inflated calyptra. *Funaria hygrometrica* Hedw., the commonest species in the area, is present in the region in two varieties, which are separated by several authors at species level: var. *hygrometrica* and var. *calvescens* (Schwägr.) Mont. (= *F. calvescens* Schwägr.) The two taxa can be separated by the following sporophytic characters: var. *calvescens* - capsules suberect to inclined, nearly straight or only slightly curved, neck often flattened (compressed), setae straight and erect, not or very little arcuate and var. *hygrometrica* - capsules horizontal to pendent, clearly curved, neck not flattened, setae slender, often strongly curved-flexuose.

**Literature.** Magill, R.E. 1987. - see general refs. [description, illustration (Southern Africa species only)].

# Guide to Bryophytes of sub-Saharan Africa

## *Goniomitrium* Wilson

One species in Africa, *G. africanum* (Müll.Hal.) Broth., which is restricted to the south (South Africa, Namibia, Lesotho). An additional African taxon, *G. speluncae* P.de la Varde, was described on the basis of sterile material from the Central African Republic (Potier de la Varde 1946). The description and illustrations in the original paper indicate that the taxon does not belong to *Goniomitrium*.



*Goniomitrium acuminatum* ssp. *africanum* (Müll.Hal.) Fife  
(Republic of South Africa: E of POince Albert, hb BM  
000662549)

A: plant; B: calyptra; C: leaf cells (left: basal, right: mid-leaf);  
D: leaves

leaves. Fife (1985) reduced the African taxa *G. africanum* (Müll.Hal.) Broth. to a subspecies of the Australian *G. acuminatum* Hook. & Wilson, but this is not always accepted. The genus is easy to overlook and is probably undercollected in the area.

**Plants** small, scattered or gregarious, dark green. **Stems** short, simple, 1-2 mm high; in section round, weak central strand present. **Leaves** crowded and larger above, infolded and appressed when dry, erect-spreading when wet, broadly elliptical to obovate or subspathulate, 1.5-2.5 mm long, lower leaves smaller than upper ones; margins plane, entire; apex apiculate to cuspidate; costa short-excurrent; upper laminal cells hexagonal to rhomboidal, thin-walled; marginal cells smaller and longer; basal cells quadrate to rectangular. **Paroicous**. **Perichaetia** terminal, perichaetial leaves slightly larger. **Seta** short, 0.5-2.0 mm long. **Capsule** emergent to exerted, erect, stegocarpic, gymnostomous, globose to somewhat pyriform with broad mouth, 1 mm long, neck weakly developed, irregularly sulcate when dry, reddish below; exothecial cells quadrate to rectangular, thin-walled, with 5-6 rows of transversely rectangular cells just below mouth; stomata present at base of urn, phaneropore. **Peristome** absent. **Operculum** plano-convex, 0.7-0.8 mm in diameter, apiculate. **Calyptra** mitrate, vesiculose-campanulate, rostrate, 1.5 mm long, 8-plicate. **Spores** ovoid, large (50--75 µm), golden-brown, minutely verrucate.

**Habitat.** Terricolous on open soil in dry rocky regions, forming large patches after periods of rain; from sea level to 1800 m.

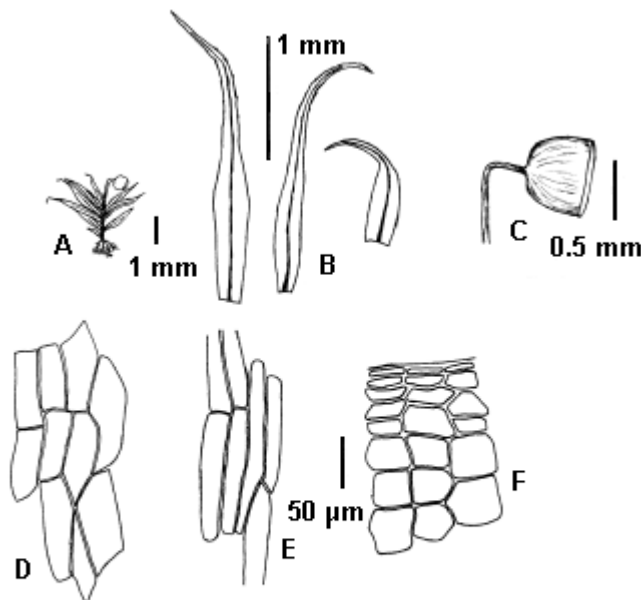
**Discussion.** The genus is recognised in the field by large-mouthed capsules, large, 8-sided, plicate calyptra and spreading, dark green, cuspidate

# Guide to Bryophytes of sub-Saharan Africa

*Literature.* Fife, A.L. 1985. - see family ref. Magill, R.E. 1987. - see general refs. [description, illustration] Potier de la Varde, R. 1946. Bryophyta nova. Revue Bryologique et Lichénologique 15: 141-146.

## *Loiseaubryum* Bizot

A monotypic genus consisting only of *L. nutans* (Wilson ex Mitt.) Fife, only known in Africa from Chad and Nigeria in the surroundings of Lake Chad and from Sudan. Outside the African continent there are additional records from India and Bangladesh.



*Loiseaubryum nutans* (Wilson ex Mitt.) Fife (Nigeria, hb. KRAM 770).

A: plant; B: leaves; C: capsule; D: mid-leaf cells; E: mid-leaf cells of perichaetial leaves; F: exothecial cells

**Plants** minute, bright green to green, gregarious or scattered, protonema persistent, ephemeral. **Stems** erect, 1.5-2.5 mm high, radiculose below, rhizoids smooth, central strand present. **Leaves** around ten per stem, lanceolate to linear-lanceolate, acuminate-aristate, 0.3-0.5 x 1.5-2 mm, smaller in the lower part, larger and more clustered in the upper part, irregularly shrunken when dry, erect to erect-spreading when wet; perichaetial leaves forming terminal rosette, linear-lanceolate, the apex tapering into a long, capillary point; costa ending below the base of the acumen in vegetative leaves and reaching up to the slender acumen in perichaetial leaves; margin plane, bluntly serrate to serrulate towards apex, lower margins entire; cells laxly oblong-hexagonal to rectangular, 20-40 x 100-140 µm, thin-walled, narrower towards margin and larger and more elongated near base. **Autoicous.** **Seta** pale-brown, 0.7-2 mm, very slender and flexuose, arcuate. **Capsule** exserted, hemispheric, lacking a neck, operculate, gymnostomous, horizontal to pendent by the curvature of the seta, 0.5-0.8 mm in diameter, wide-mouthed, light brown in color; exothecial cells delicate, quadrate to rounded-hexagonal, thin-walled,

40-75 x 47-62 µm, oblate in 2-5 rows near mouth; stomata present near base; annulus and peristome lacking. **Operculum** plane. **Calyptra** very small, covering only the uppermost portion of the capsules, short-rostrate, cucullate, not inflated, lacking a rostrum, slightly split into two lobes at base. **Spores** reddish-brown, ellipsoidal to spherical, 27-42 µm, densely papillose-spinose.

*Habitat.* On wet mud soil and on silt on banks of waters (rivers, creeks, ditches, ponds etc.), often associated with *Riccia* species; 300-320 m.

*Discussion.* *Loiseaubryum* is the most phenetically distinctive genus in the Funariaceae. Probably undercollected because of its small size and short life cycle.

*Literature.* Bizot, M. 1976. Enumeratio muscorum novarum, II. Revue Bryologique et Lichénologique 42: 843-855

# Guide to Bryophytes of sub-Saharan Africa

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[description (in French), illustration]. **Ochyra, R. 1983.** The rediscovery of *Loiseaubryum ephemeroides* Bizot (Musci: Funariaceae) in Nigeria. Acta Botanica Hungarica 29: 173-179 [description, illustration].

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## ***Physcomitrella*** Bruch, Schimp. & W.Gümbel

One taxon in Africa, *P. patens* (Hedw.) Schimp. ssp. *magdalenae* (De Sloover) B.C.Tan. The taxon is rare, and is known only from three localities (Rwanda, Uganda, Zaire). Because of the very small size the taxon is probably overlooked and therefore undercollected in the area.

**Plants** small, gregarious, growing in small isolated tufts, green. **Stems** erect, ca. 3 mm high, branched at the base, with numerous brown red, finely papillose rhizoids; central strand present. **Leaves** about 10 per stem, plane to weakly concave, obovate to spatulate, acumen short; in upper 1/2 or 1/3 leaf margin serrate to serrulate; lower leaves about 2 x 0.8 mm, nerve reaching 2/3 of leaf length, margin plane; upper leaves up to 4-6 x 2.2 mm, nerve percurrent, margin revolute in the lower half; cells lax, walls thin and smooth; upper cells irregular hexagonal, 35-60 x 20-40 µm, marginal cells 70-120 x 25 µm; lower leaf cells rectangular, 120-190 x 35 µm. **Autoicous**. **Seta** c. 0.25 mm long. **Capsule** erect, immersed to short emergent, cleistocarpic, globose, 0.8-1.2 mm in diameter, neck lacking, brown in mature condition; capsule beak strong, 0.3-0.45 mm long; exothecial cells irregular, 20-45 µm, thin-walled, stomata present near the base, phaneroporous. **Operculum** not developed. **Calyptra** 0.7-1.1 mm, covering the capsule beak and upper 1/4 of the capsule, split to lobe at base. **Spores** globose, ferruginous brown, strongly papillose, papillae mostly echinate, 25--30 µm.

**Habitat.** On open, wet to moist habitats, e.g. on recent alluvium, on compacted bare soil of forest tracks and roadside banks; 1100-2100 m.

**Discussion.** The main differences of the African subspecies from the northern hemispheric ssp. *patens* are: the African subspecies is in all features bigger (stem leaves, capsule diameter, calyptra); the capsules beak is more strongly developed. The presence of spores with many echinae, papillae or processes is another unique character for ssp. *magdalenae*.

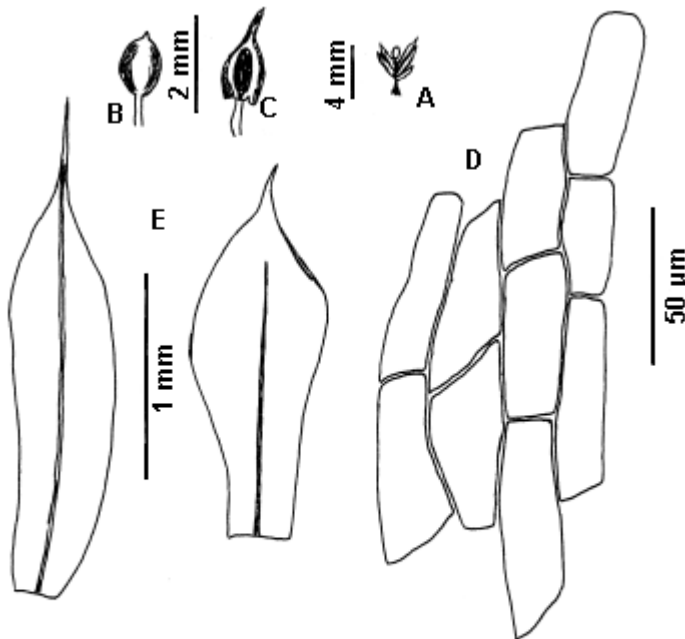
**Literature.** **De Sloover, J.L. 1975.** Note de bryologie africaine III. - *Physcomitrella magdalenae* sp. nov. Bulletin du Jardin Botanique National Belgique 45: 131-135 [key to genus, description (in French), illustration]. **Tan, B.C. 1979.** A new classification for the genus *Physcomitrella* B.S.G. Journal of the Hattori Botanical Laboratory 46: 327-336 [review of genus, key to subspecies].

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## ***Physcomitrellopsis*** Broth. & Wager in Dixon

One species in Africa, *P. africana* Broth. & Wager in Dixon, restricted to Cape and Natal regions of South Africa and with some doubt also reported from one locality in Tanzania.

# Guide to Bryophytes of sub-Saharan Africa



***Physcomitrellopsis africana* Broth. & Wager in Dixon**  
(Republic of South Africa: Natal, hb BM 000662541)  
A: plant; B: capsule; C: young capsule with calyptra;  
D: mid-leaf cells; E: leaves.

**Plants** small, gregarious, green. **Stems** erect, unbranched, 1.0-2.0 mm; central strand small. **Leaves** crowded above, spreading wet, weakly contorted dry; spatulate-acuminate, 4-5 mm long; margins plane, entire below, strongly serrulate to bluntly serrate above base; costa ending just below apex to subpercurrent; laminal cells lax, rectangular below to oblong-rhomboidal above, smooth. **Autoicous**. **Perichaetia** terminal, leaves larger. **Seta** 0.5-0.8 mm long, yellowish. **Capsule** exposed, sessile, erect, cleistocarpic, globose to elliptical, 1.0-1.2 mm long, smooth, with very short, obtuse tip, reddish yellow; exothecial cells angular, subquadrate to hexagonal; stomata at base of urn, phaneropore. **Operculum** not differentiated. **Calyptra** large, swollen, completely enclosing capsule, smooth, mitrate-rostrate, 1.3 mm long. **Spores** rounded, weakly papillose, 30 µm.

**Habitat.** Terricolous. In Natal and Transkei it was found at the edge of coastal forests. The Tanzanian plants were growing in a montane forest at elevations of 1800-2050 m.

**Discussion.** A monotypic genus, the only species restricted to Africa. The lax, spatulate-acuminate leaves with dentate margins are good features in sterile condition. Fertile material is easily recognised by the short seta, exposed, globose to elliptical, cleistocarpous capsules and large calyptra. Dry specimens are easily overlooked.

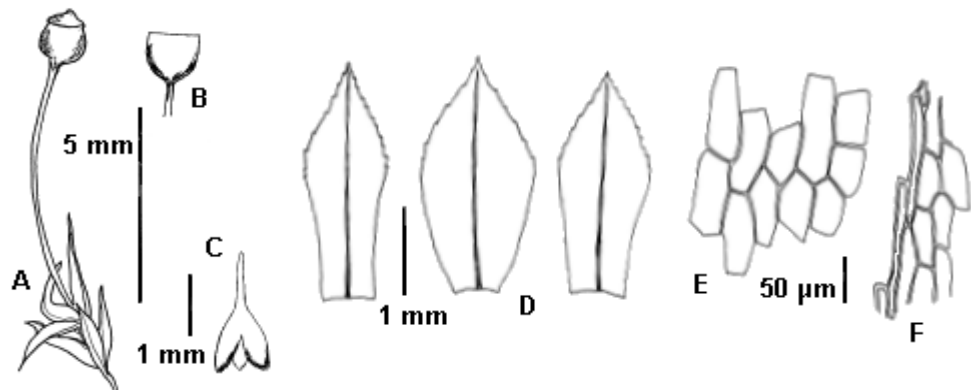
**Literature.** Magill, R.E. 1987. - see general refs. [description, illustration].

## ***Physcomitrium* (Brid.) Fűrnr.**

Ten species are recorded for the area, but possibly only 5 or fewer are valid; 80 species worldwide, mostly associated with temperate moist regions.

# Guide to Bryophytes of sub-Saharan Africa

**Plants** mostly small, solitary or forming loose tufts, light green to yellowish-green. **Stems** erect, to ca. 10 mm, with a few branches, radiculose below; in cross-section outer 1-2 rows of cells slightly differentiated, somewhat smaller, firm-walled, inner cells large, thin-walled, central strand mostly weak. **Leaves**



progressively larger distally, often crispate when dry, erect-spreading to spreading when wet, oblong

**Physcomitrium spathulatum (Hornsch.) Müll.Hal.** (Réunion, hb. F. Müller R 205)

A: plant; B: mature capsule; C: calyptra; D: leaves; E: mid-leaf cells; F: cells of upper leaf margin.

A: del. T. Lautenschläger.

to obovate-oblong, mostly 1-4.5 mm long, acuminate to acute or acute-rounded; margins plane or erect below, entire to more commonly serrate, limbate or elimbate; costa rather strong, ending well below apex to percurrent or short excurrent; laminal cells large, smooth, mostly thin-walled, median cells rectangular to oblong-hexagonal; basal cells more elongate, lax; margins

sometimes differentiated by narrower cells. **Autoicous**. **Perichaetia** terminal, leaves similar to stem leaves but often larger. **Seta** very short to elongate, to 10 mm long, smooth. **Capsule** immersed to long-exserted, erect, symmetrical, urn cupulate, mostly 1-2 mm long (including neck), often flared at mouth when dry, neck usually distinct, short; stomata in neck region, superficial; exothelial cells isodiametric; annulus persistent or not. **Operculum** apiculate or shortly to moderately rostrate. **Peristome** absent. **Calyptra** mitrate, inflated or not below, long beaked above, base irregularly lobed, smooth and naked. **Spores** spherical to subreniform, coarsely papillose or spiculose.

**Habitat.** On exposed soil, often associated with wet sites, e.g., along streams or rivers, by lakes, in swamps, on alluvial mud and river banks; from near sea level to ca. 2500 m.

**Discussion.** The genus is characterised by an elongate, erect, cupulate capsule, often flared at the mouth when deoperculate, mitrate calyptra and the absence of a peristome. The African species can be separated into two subgenera. The members of these two subgenera are habitually very different. The species of subgenus *Cryptopyxis* (Müll.Hal.) Broth. are characterised by immersed capsules, which in dry conditions are cyathiform with little or no neck; the exothelial cells are thin-walled and delicate in the lower portions and not markedly thickened in corners. The species of subgenus *Physcomitrium* have exserted, hemispheric or pyriform capsules with a distinct neck, the exothelial cells are firm-walled throughout and have thickened corners.

**Literature.** Magill, R.E. 1987. - see general refs. [description, illustration (Southern Africa taxa)].

## GIGASPERMACEAE

(R.E. Magill, June 2003)

**Plants** small, scattered and gregarious, glaucous green to light or dark green. **Stems** arising from a long aphyllous rhizome; in section with central strand weak or absent. **Leaves** appressed or erect spreading, concave, broader

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

above, orbicular to broadly elliptical or obovate; apex rounded and abruptly apiculate or awned; margins plane and entire; costa absent or if present, short or long excurrent; leaf cells small, smooth, angular or quadrate to hexagonal; thin walled. **Gemmae** uncommon at leaf apex, lenticular. **Autoicous or dioicous** with dwarf males. **Perichaetia** terminal, leaves somewhat distinct, larger. **Seta** very short or elongate. **Capsule** immersed or exserted, cleistocarpic and subspherical or stegocarpic, gymnostomous, cupulate to short cylindrical; exothecial cells lax; stomata present at base of urn. **Operculum** plano-convex, apiculate. **Calyptra** very small. **Spores** large, granulate, reddish brown.

*Discussion.* The Gigaspermaceae contain 4 genera, only the American genus *Lorentziella* not known from Africa. The other three genera are restricted to the dry shrublands of southern Africa; *Oedipodiella* has been reported from Europe and *Gigaspermum* from Australia and New Zealand. *Gigaspermum* and *Chamaebryum* both exhibit short, bulb-shaped gametophytes scattered on relatively open soil. The exposed plants arise from a long creeping rhizome that lies just below the surface or is closely appressed to rock in more exposed area. The plants are most often collected along small, dry water courses or on soil crusts under short shrubs. *Oedipodiella* is found on soil in wooded canyons in savanna habitats.

*Literature.* **Magill, R. E. 1987.** Flora of Southern Africa. Part 1. Mosses. Fascicle 2: 299-303.

1. Leaves ecostate	<b><i>Gigaspermum</i></b>
1. Leaves costate	<b>2</b>
2. Costae long excurrent as smooth, hyaline awn; capsules exserted	<b><i>Chamaebryum</i></b>
2. Costae cuspidate or short excurrent, green; capsules immersed	<b><i>Oedipodiella</i></b>

## ***Chamaebryum* Thér. & Dixon**

One species endemic to southern Africa, *C. pottioides* Thér. & Dixon.

**Plants** small, light green, caespitose. **Stems** erect, 2-6 mm high from a highly branched, creeping rhizome; central strand absent. **Leaves** crowded above, obovate to orbicular, 0.8-1.2 mm long; apex obtuse, cuspidate to piliferous; costa percurrent in lower leaves, short or long excurrent in upper leaves forming smooth, hyaline awn, to 0.5 mm long; leaf cells angular to quadrate, basal cells short rectangular. **Gemmae** rare, at apex of sterile plants, bulging lenticular, to 0.2 mm long, with pronounced, hyaline, distal apiculus, cells hexagonal. **Monoicous.** **Perichaetia** terminal, leaves somewhat larger. **Seta** erect, 0.6-1.8 mm long. **Capsule** exserted, gymnostomous, short cylindrical, 1.0-1.3 mm long, mouth narrow; exothecial cells lax, subhexagonal. **Operculum** remaining attached to columella when capsule first opens. **Spores** round, 50-55 µm.

*Habitat.* The genus is endemic to dry, rocky areas of southern Africa.

*Discussion.* The creeping rhizome, concave and piliferous leaves, and exserted, small mouthed capsule will serve to identify this taxon. The plants frequently have a greyish colouration when dry much like some *Grimmias*, but *Chamaebryum* occupies a different habitat and the size and habit are quite distinct.

*Literature.* **Magill, R. E. 1987.** - see family ref.

# Guide to Bryophytes of sub-Saharan Africa

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## ***Gigaspermum* Lindb.**

One species found in southern Africa, *G. repens* (Hook.) Lindb.

**Plants** small, light green or glaucous, scattered or loosely caespitose. **Stems** erect, 2--5 mm high, from a creeping, aphyllous rhizome; central strand weak. **Leaves** distant, erect-spreading, orbicular, apiculate, 0.5-0.8 mm long; ecostate; leaf cells quadrate to subhexagonal, smooth. **Autoicous**. **Perichaetia** terminal; leaves differentiated, elliptical and long acuminate, 2.0-2.5 mm long. **Seta** very short, 0.3-0.5 mm long. **Capsule** immersed, gymnostomous, cupulate, 0.8-1.0 mm long; mouth very broad; exothecial cells lax, quadrate to hexagonal. **Calyptra** small, campanulate. **Spores** round to angular, 80-100  $\mu$ m.

*Habitat.* On poor, rocky soils in open shrublands of the desert southwest, but should be expected in grasslands and shrublands of northern Africa.

*Discussion.* Scattered, sterile plants are difficult to detect, but the larger perichaetial leaves and wide-mouthed capsules with red-brown spores make the plants more obvious. The short and broad, ecostate leaves will also help to identify this taxon.

*Literature.* Magill, R. E., 1987. - see family ref.

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## ***Oedipodiella* Dixon**

One species in Africa, *O. australis* (Wager & Dixon) Dixon.

**Plants** small to medium sized, scattered or in loose cushions, dark green. **Stems** erect, 2-5 mm long from branching, aphyllous rhizome; central strand absent or not well defined. **Leaves** crowded above, wide spreading, obovate to spatulate or broadly elliptical, 2-4 mm long; apex rounded and abruptly apiculate; costae short excurrent; leaf cells subquadrate to hexagonal, basal cells longer, short rectangular. **Gemmae** at stem apex, lenticular, 0.3-0.6 mm across. cells quadrate to short rectangular. **Dioicous**. **Perichaetia** terminal; leaves spatulate to lingulate, 3.0-3.5 mm long; apex rounded, apiculate; costae ending below apex. **Seta** very short. **Capsules** immersed, cleistocarpic, subglobose, beaked, 1.0-1.5 mm long; exothecial cells lax, quadrate to subhexagonal. **Spores** round, 45-50  $\mu$ m.

*Habitat.* On soil in wooded areas of otherwise open grasslands.

*Discussion.* The plants have an appearance of some broad-leaved Pottiaceae, but the frequently produced, lens-shaped gemmae will help to place *Oedipodiella*. The small, immersed, subglobose, cleistocarpic capsules and branching rhizome will also be useful in identifying this genus.



# Guide to Bryophytes of sub-Saharan Africa

Literature. Magill, R. E. 1987. - see family ref.

## HEDWIGIACEAE

(B.J. O'Shea, May 2000)

**Plants** medium sized, forming tufts or cushions, glaucous to dark green, brown to yellowish. **Stems** spreading to ascending or erect, several branched, weakly radiculose at base; central strand absent or weak; pseudoparaphyllia filamentous. **Leaves** imbricate, spirally arranged, appressed to erect when dry, spreading to wide-spreading or squarrose when wet, ovate, obovate, narrowly to broadly lanceolate or oblong-short lanceolate, apex acute to acuminate, hyaline or not; margins plane to recurved below or throughout, entire or dentate at apex, elimbate; costa none; laminal cells quadrate to short rectangular, papillose, walls sinuose; insertion cells elongate and sinuose, papillae in rows, often golden-brown. **Autoicous**, rarely synoicous or polyoicous. **Perichaetia** terminal but appearing lateral, leaves elongate, broadly to rather narrowly lanceolate, margins ciliate or not. **Seta** short or elongate, smooth. **Capsule** immersed or exserted, erect, short cylindrical to ellipsoid or subglobose, often striate or ribbed when dry. **Operculum** plano-mammillate to short rostrate. **Peristome** absent. **Calyptra** cucullate or short and mitrate. **Spores** spherical, papillose, rarely multicellular.

**Discussion.** The Hedwigiaceae contain four genera and about 20 species; in sub-Saharan Africa, three genera and ten species. The family is recognized by the ecostate leaves, papillose laminal cells that are sinuose, and capsules that lack a peristome. *Rhacocarpus* was in the past placed in the Hedwigiaceae but is now placed in its own family, the Rhacocarpaceae; see discussion and review by De Luna (1990b).

**Literature.** De Luna, E. 1990a. Developmental evidence of acrocarpy in *Hedwigia ciliata* (Musci: Hedwigiaceae). Tropical Bryology 2: 53-60. De Luna, E. 1990b. Protonemal development in the Hedwigiaceae (Musci), and its systematic significance. Systematic Botany 15: 192-204. De Luna, E. 1992. Developmental and systematic studies in the Hedwigiaceae (Musci). Ph.D. thesis. Ann Arbor: University Microfilms International. De Luna, E. 1995. The circumscription and phylogenetic relationships of the Hedwigiaceae. Systematic Botany 20: 347-373.

1. Leaf apex hyaline, to 1/4 of apex; margins plane or indistinctly recurved; margins of perichaetial leaf ciliate	<b>Hedwigia</b>
1. Leaf apex concolorous or weakly hyaline at tips; margins recurved; margins of perichaetial leaf not ciliate	<b>2</b>
2. Seta elongate, to 5-18 mm long; capsule exserted; leaves often distinctly plicate; plants saxicolous or epiphytic	<b>Braunia</b>
2. Seta short, 0.8-1.2 mm long, capsule immersed; leaves indistinctly plicate or not at all; plants saxicolous	<b>Hedwigidium</b>

### **Braunia** Bruch, Schimp. & W.Gümbel

Eight species and one variety are recorded for Africa, although this number may be reduced to seven (De Luna 1992) following revision; a genus containing 16 species.

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** medium sized, forming loose to dense coarse mats or tufts, dull yellowish-brown to golden. **Stems** creeping, leaves mostly reduced, scale-like, appressed with tips spreading to recurved, frequently eroded from stem, distal stems and branches mostly ascending, several branched; pseudoparaphyllia foliose. **Leaves** imbricate, appressed with apices reflexed when dry, erect-spreading to spreading or squarrose when wet, ovate, obovate to oblong-ovate or lanceolate, 1.5-2.0 mm long, flat to concave, weakly to strongly plicate, apex short acuminate to abruptly long acuminate; margins entire below, apices irregularly dentate, erect to recurved throughout or partially, rarely plane; laminal cells thick-walled, upper and median cells short to long and narrowly rectangular,  $\pm$  sinuose, papillose; lower middle and basal cells long rectangular, sinuose, papillose, papillae in single row; alar region differentiated, subquadrate to short-rectangular and oblate, walls rounded. **Synoicous**. **Perichaetia** appearing lateral, leaves elongate, narrowly- oblong-lanceolate. **Seta** elongate, (3-)5-18 mm long, smooth, often twisted. **Capsule** exserted or emergent, erect to suberect, urn ovoid, cylindrical or ellipsoid to subglobose, 1.3-2.2 mm long, wrinkled or furrowed when dry, mouth slightly constricted. **Operculum** long rostrate, oblique. **Peristome** absent. **Calyptra** cucullate, smooth and naked. **Spores** spherical or multicellular, papillose.

*Habitat.* Epiphytic on tree trunks or branches, and on rocks; open to forested montane to alpine, (500-)1350-3500 m.

*Discussion.* *Braunia* is readily distinguished from the two remaining genera of the family by the elongate seta and well exserted capsule. In the absence of sporophytes, however, the genera are difficult to distinguish, particularly *Braunia* and *Hedwigidium*. *Braunia* is found on rocks as well as shrubs and trees, whereas *Hedwigia* and *Hedwigidium* are almost always restricted to rocks. De Luna's thesis (1992) has not resulted in any taxonomic publications regarding African *Braunia*, although many herbarium specimens show his annotations. The most commonly reported species in Africa (*B. secunda*) is said by De Luna (1992) to be exclusively American, so much African material will need to be re-identified.

*Literature.* De Luna, E. 1992. - see family ref.

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## ***Hedwigia* P.Beauv.**

A single species in the area, *H. ciliata* (Hedw.) Ehrh. ex P.Beauv., with varieties *ciliata* (Cape Verde Islands, DR Congo (Zaire), East and Southern Africa and Madagascar) and *leucophaea* Bruch Schimp. & W.Gümbel (East Africa); the genus contains three or four species.

**Plants** medium sized, forming loose to dense tufts or cushions, grayish-green. **Stems** spreading to suberect; pseudoparaphyllia filamentous. **Leaves** appressed to erect when dry with distal apices spreading or recurved, spreading to erect-spreading when wet, ovate-lanceolate, 2.0-2.3 mm long, apex acuminate, upper 1/4 of apices hyaline and distinctly papillose; margins plane or slightly recurved below; costa absent; apical cells elongate, hyaline and indistinct, papillae in single row, to 8 or more; median cells short rectangular or quadrate, appearing sinuose, papillose, papillae 1-3, simple or branched; upper basal centre cells long rectangular, papillae 3-6; lower basal centre and insertion cells smooth, porose, often golden-brown. **Perigonia** bud-like, appearing lateral. **Perichaetia** on short terminal branches, appearing lateral, leaves narrowly lanceolate, distal margins long ciliate, cilia long and short branched, hyaline. **Seta** very short, 0.25-0.50 mm long, smooth. **Capsule** immersed, erect, urn short cylindrical, subglobose when deoperculate, 1.0-1.2 mm long, smooth. **Operculum** plano-mammillate. **Peristome** absent. **Calyptra** small, mitrate, smooth and hairy. **Spores** with trilete lines, coarsely rugose-papillose.

# Guide to Bryophytes of sub-Saharan Africa

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*Habitat.* On rocks, very occasionally reported from tree bases; open montane to alpine areas, (500-)1800-3700 m.

*Discussion.* The hyaline leaf tips, ciliate margins of the perichaetial leaves, and immersed and rather smooth capsules, in combination with the shared family features, distinguishes *Hedwigia*.

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## *Hedwigidium* Bruch, Schimp. & W.Gümbel

A monotypic genus represented by *H. integrifolium* (P.Beauv.) Dixon in C.E.O.Jensen, found in our area in Cameroon, East and Southern Africa and Réunion. (also Western Europe, pantropical at high elevations, Australia and New Zealand).

**Plants** medium sized, forming tufts or mats, green to dark reddish-brown. **Stems** erect or spreading; central strand absent; pseudoparaphyllia foliose. **Leaves** appressed, spreading to wide-spreading when wet, ovate to oblong-ovate, 1.5-2.2 mm long, weakly plicate or not, apex acute or short acuminate; margins strongly recurved, entire below, distally dentate or crenulate, occasionally weakly toothed; costa absent; apical cells elongate, median cells short rectangular to subquadrate, sinuose, papillose, papillae several along margin, appearing over lumen; central upper basal cells rectangular, porose, papillae few to several (7 or more) in single row (rarely double row); insertion cells at center smooth, golden-brown or yellow; cells of alar region quadrate, smooth. **Perichaetia** appearing lateral, but on terminal branches, leaves broadly lanceolate to oblong-lanceolate, to 5 mm long, plicate, short acuminate, upper margins not ciliate. **Seta** short, 0.8-1.2 mm long. **Capsule** immersed, erect, short obloid, 1-2 mm long, furrowed when dry or wet. **Operculum** short rostrate, oblique. **Peristome** absent. **Calyptra** small mitrate, smooth and naked. **Spores** with trilete lines, rugose-papillose.

*Habitat.* On rocks; open montane to alpine, 1600--3900 m.

*Discussion.* The genus is characterized by the concolorous leaves, elongate, eciliate perichaetial leaves, furrowed and immersed capsules. Without sporophytes, *H. integrifolium* is difficult to distinguish from *Braunia* growing on rock, so always look carefully for sporophytes (which are quite often present).

## HYLOCOMIACEAE

(B.J. O'Shea, February 2001)

**Plants** medium sized to large and robust, forming loose to dense mats or tufts. **Stems** spreading to ascending or erect, rarely subpendent, regularly to irregularly pinnately branched; in cross-section central strand present or absent; paraphyllia and pseudoparaphyllia present or absent. **Branch leaves** in some genera sometimes smaller than the stem leaves, often narrower, more strongly toothed and with a stronger costa; in other genera similar to the stem leaves. **Stem leaves** erect to wide-spreading, falcate or not, oblong-lanceolate or broadly ovate to nearly oval, concave, plicate, smooth or rugose, apex broadly acute to rounded or gradually to abruptly acuminate, base cordate-auriculate or not; margins plane or recurved, entire to serrate or serrulate; costae double, 1/4-1/3(-1/2)

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

lamina length or single; laminal cells smooth or prorate, median cells oblong-linear, fusiform or linear, weakly porose or not; lower and basal cells elongate, strongly porose; alar cells differentiated or not. **Dioicous**. **Perichaetia** lateral. **Seta** elongate, smooth. **Capsule** erect to inclined or horizontal, urn ovoid-cylindrical to ellipsoid, ± curved and asymmetric. **Operculum** conic to conic-apiculate or rostrate and oblique. **Peristome** double, exostome teeth 16, smooth or cross-striate below, distally papillose, trabeculate on back; endostome lightly papillose, basal membrane high, segments 16, keeled and perforate, cilia 1-4, or absent to rudimentary. **Calyptra** cucullate, naked and smooth. **Spores** spherical, finely papillose.

*Discussion.* The Hylocomiaceae, order Hypnales, contain 12 genera and about 25 species distributed worldwide but largely in the temperate to subarctic regions; in the tropics the family is restricted to montane habitats. In Africa there are (four or) five genera each with one species, but all species are quite rare. Following Rohrer (1985a), the family Rhytidiaceae is included within Hylocomiaceae. There are more recent proposals (e.g. Chiang & Schaal, 2000) that the genera included within the family should be reconsidered, but as yet there seems no consensus on this matter. Descriptions and illustrations of most of these taxa are found in northern temperate floras, such as Smith (1978) or Crum & Anderson (1981).

*Literature.* **Chiang, T.-Y. & Schaal, B.A. 2000.** Molecular evolution in the *atpB-rbcL* non-coding spacer of chloroplast DNA in the moss family Hylocomiaceae. *Botanical Bulletin of the Academia Sinica* 41: 85-92. **Crum, H.A. & Anderson, L.E. 1981.** [descriptions, illustrations]. **Rohrer, J. R. 1985a.** A phenetic and phylogenetic analysis of the Hylocomiaceae and Rhytidiaceae. *Journal of the Hattori Botanical Laboratory* 59: 185-240. **Rohrer, J. R. 1985b.** A generic revision of the Hylocomiaceae. *Journal of the Hattori Botanical Laboratory* 59: 241-278. **Smith, A.J.E. 1978.** [descriptions, illustrations]

1. Costa single; leaves rugose when dry; some laminal cells on back of leaf with strongly projecting spine-like papillae	<b><i>Rhytidium</i></b>
1. Costa double or occasionally absent; leaves smooth to weakly undulate or plicate when dry; laminal cells smooth or if papillose then papillae weak, rounded	<b>2</b>
2. Growth strongly sympodial, giving a stair-step habit, regularly 2-3-pinnate; paraphyllia present on stems; laminal cells prorate (with projecting cell ends)	<b><i>Hylocomium</i></b>
2. Growth form monopodial to irregular, not or 1-2-pinnate; paraphyllia present or not; laminal cells smooth	<b>3</b>
3. Stem leaves broadly clasping at base; paraphyllia present on stem; alar cells not differentiated	<b><i>Loeskeobryum</i></b>
3. Stem leaves not clasping stem; paraphyllia absent from stem; alar cells differentiated	<b>4</b>
4. Leaf margins serrulate to serrate above base; alar cells lax, thin-walled, hyaline	<b><i>Leptohymenium</i></b>
4. Leaf margins entire or faintly serrulate at apex; alar cells firm, thick-walled reddish-brown	<b><i>Pleurozium</i></b>

***Hylocomium* Bruch, Schimp. & W. Gumbel**

# Guide to Bryophytes of sub-Saharan Africa

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A monotypic genus (*H. splendens* (Hedw.) Bruch, Schimp. & W. Gümbel), mainly of the temperate regions but also in tropical America and Africa. It occurs occasionally in the mountains of North, Central and East Africa and also (probably introduced) on St. Helena.

**Plants** medium sized to robust, in loose wefts, usually yellow- to olive-green. **Stems** bright red, prostrate, usually with ascending, arching innovations, giving a layered, 'stair step' appearance (caused by its sympodial growth pattern), regularly 1-3-pinnate, often frondose; in cross-section with no central strand; paraphyllia numerous on the stems and primary branches, fewer on the branchlets, branching from a multi-seriate base into several long strands, uniseriate towards the tips. **Stem leaves** ovate-oblong, slightly concave, abruptly narrowed to obtuse to acute, channeled acumen, a little plicate below, slightly decurrent, margin sometimes recurved near base, otherwise plane, denticulate or dentate; nerve double, sometimes weak but usually to at least half leaf length; basal cells narrow, rhomboidal, thick-walled, porose, orange brown, alar cells not differentiated, medial cells linear, 7-14 times longer than wide, smooth to finely papillose because of projecting cell ends, to 80 µm. **Branch leaves** smaller than stem leaves, erect to spreading rather than imbricate, with the leaves at the branch tips much smaller, ovate-lanceolate, acute. **Dioicous**. **Perichaetia** restricted to stems. **Seta** elongate, red-brown, smooth. **Capsule** inclined to pendent, bent above the neck, asymmetric ovoid to ellipsoid with distinct neck, gibbous, occasionally wrinkled when dry, exothecial cells mostly isodiametric, with unevenly thickened walls. Operculum strongly oblique, long-rostrate from a conic base. **Peristome** double, exostome teeth yellow-brown, reticulate becoming papillose above, endostome teeth yellow, smooth, keeled, usually split into one large perforation, cilia 2-4, nodulose. **Calyptra** cucullate, smooth, naked. **Spores** 10-18 µm, very finely papillose.

*Habitat.* On soil, in turf on banks or on soil-covered rocks, calcifuge, in subalpine to alpine areas, 2600-4100 m.

*Discussion.* Characterised by dull to glossy yellowish-green to -brown patches in coarse wefts normally exhibiting a layered habit with frondose branching, dense 'deer-horn' paraphyllia on the stems and prorate leaf cells. Although it seldom produces sporophytes, the capsules with a distinct neck and reticulate exostome, gaping splits in the endostome and an obliquely long-rostrate lid are also distinctive. It is known, sometimes in some quantity, from Mts. Kilimanjaro and Meru, and also from Mt. Kenya, Mt. Elgon, and the Rwenzori-Virunga range.

*Literature.* See family refs.

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## ***Leptohymenium* Schwägr.**

A single species has been reported for Africa, *L. stramineum* (Muell.Hal.) A.Jaeger, from Ethiopia, otherwise only known from Himalayas. There is some doubt about this record - see discussion below. A genus with three species.

**Plants** medium sized, forming coarse mats, glossy yellowish- to golden-green or golden-brown. **Stems** spreading with ascending and arching stems, 1-2 pinnately branched; paraphyllia absent; pseudoparaphyllia ovate to deltoid. **Stem leaves** loosely erect-spreading to squarrose, broadly ovate, to 1.5 mm long, concave, smooth to irregularly and weakly plicate, apex acute to short acuminate or obtuse, base short decurrent; margins plane, reflexed at base, serrulate to serrate distally, serrulate or entire at base; costae double, very short to 1/2 lamina length, separated at base, slightly diverging; median cells oblong-linear, smooth to weakly papillose by projecting distal cell angles; basal cells larger, porose; alar region differentiated, cells enlarged, oval to oblong, lax and thin-walled. **Branch leaves** erect to spreading, ovate to elliptic, to 1.1 mm long, slightly decurrent; alar cells less differentiated. **Dioicous**. **Perichaetia** lateral. **Seta** to 23 mm long, smooth. **Capsule** erect, urn cylindrical to ovoid-cylindrical, to

# Guide to Bryophytes of sub-Saharan Africa

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3.5 mm long, smooth or weakly wrinkled. **Operculum** long conic to obliquely rostrate. **Peristome** double, inserted below mouth, exostome teeth  $\pm$  smooth; endostome smooth, basal membrane high, segments short, keeled and perforate, cilia absent or rudimentary. **Calyptra** unknown. **Spores** finely papillose.

*Habitat.* African habitat not known, but elsewhere epiphytic on branches and trunks of trees, also on moist rocks and soil; montane forests (*Quercus* and *Pinus*), 1400-2750 m.

*Discussion.* This species was first reported for Ethiopia in Paris' Index Bryologicus in 1895, and all subsequent references are based on this. There is no further information, and the taxon is otherwise known only from the Himalayas. As the Index contains a large amount of information based on provisional and unverified identifications, it is possible that this report was mistaken, and that the genus does not occur in Africa. The description here is therefore not based on African material.

A genus characterized by ascending and arching stems that are 1-2 pinnately branched, squarrose to erect spreading, broadly ovate stem leaves, serrulate to serrate throughout along margin, double costae, thin-walled and lax, enlarged alar cells, erect cylindrical capsules, smooth exostomial teeth, and short endostomial segments set on a high basal membrane. *Leptohymerium* may be confused with members of the Hypnaceae, but the fundamental differences in the peristome separate the two. Further distinctions of help are the combination of broadly, somewhat wrinkled ovate leaves, elongate double costa, and oblong-linear cells that are often weakly projecting at distal cell angles.

*Literature.* See family refs.

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## ***Loeskeobryum* M.Fleisch. ex Broth.**

One species in Africa, *L. brevirostre* (Brid.) M.Fleisch. ex Broth., which has only been recorded once from Réunion, although quite widespread in the Northern Hemisphere. A genus segregated from the more traditional *Hylocomium*, containing three species primarily confined to the Northern Hemisphere.

**Plants** large and robust; forming loose mats, glossy green. **Stems** loosely spreading to subpendent, to 22 cm long, reddish, irregularly pinnately branched; in cross-section central strand absent; paraphyllia numerous, filiform, few to many branched, smooth. **Stem leaves** wide-spreading to squarrose, oval to broadly ovate, nearly as wide as long, 3.0-3.8 mm long, to 3 mm wide,  $\pm$  plicate, apex abruptly narrowly acuminate, base cordate-auriculate, clasping stem; margins plane, coarsely serrate distally, often sharply so, serrulate below; costae double, ca. 1/3 lamina length; median laminal cells oblong-linear, somewhat vermicular, weakly porose; basal and insertion cells oblong-rectangular, strongly porose, golden-yellow or -brown. **Branch leaves** erect-spreading, ovate, 2.3-2.6 mm long, 1.2-1.5 mm wide, concave, apex short acuminate. **Dioicous.** **Perichaetia** lateral. **Seta** elongate, smooth. Capsule inclined, ovoid-short cylindrical. **Operculum** conic-rostrate. **Peristome** double, exostome teeth cross-striate below, distally papillose, trabeculate; endostome papillose, basal membrane high, segments keeled and perforate, cilia 2-3. **Calyptra** cucullate, smooth and naked. **Spores** finely papillose.

*Habitat.* The only collection known from Africa (made by Commerson) was published by Bridel in 1827, and the description contained no mention of habitat, but normally this plant is found on soil, logs or rocks, somewhat pendent from shrubs and over humus; in the tropics it would be expected in mid to high montane forest and scrub.

# Guide to Bryophytes of sub-Saharan Africa

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*Discussion.* The description given here is not from African material (see note on habitat), but the distinguishing features include the large stature of the plants, abundant branching, filiform paraphyllia, leaves clasping stem, abruptly narrow acuminate apex from a broadly ovate leaf base, sharply and coarsely serrate margins, and strong double costae. Sporophytes are unknown in the tropics.

*Literature.* **Bridel, S.E. 1827.** *Bryologia Universa*. Leipzig: J.A. Barth.

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## ***Pleurozium* Mitt.**

A monotypic genus; *P. schreberi* (Brid.) Mitt. is known only from two recent collections in the Ethiopian mountains, and is primarily distributed in the Northern Hemisphere.

**Plants** medium to somewhat large, forming mats or tufts, rather glossy green to yellowish-brown or golden; paraphyllia none. **Stems** spreading to more commonly ascending, to 10 cm or more long, julaceous, dark red, regularly to irregularly pinnately branched; in cross-section outer cell rows small and thick-walled, inner cells larger, thin-walled, central strand present. **Stem leaves** suboval to ovate or oblong-ovate, 2-3 mm long, to 1.7 mm wide, deeply concave, apex broadly acute to rounded, reflexed at base; margins plane, entire; costae short and double, ca. 1/4-1/3 lamina length; median cells fusiform to linear, porose; alar cells inflated, and somewhat excavate, thick-walled, short to long oblong or quadrate, golden-yellow or reddish-brown. **Branch leaves** smaller, ovate, enrolled distally, apex acute; margin entire to weakly serrulate distally. **Dioicous.** **Seta** often twisted. **Capsule** inclined, urn ellipsoid and curved, exothecial cells subquadrate to oblong, ± thick-walled, stomata present at base of urn, superficial; annulus absent. **Operculum** conic. **Peristome** with exostome teeth faintly reticulate; endostome cilia 2-3.

*Habitat.* On humus and soil, in somewhat dry sites, also associated with semi-dry margins of bogs or marshes; mostly high open montane. In Africa, in *Philippia* / *Hagenia* / *Juniperus* scrub forest at 3300-3500 m in the Bale mountains of southern Ethiopia.

*Discussion.* The ascending habit, dark red stems, strong, short and forked leaf costa, and the porose, thick-walled, usually dark reddish-brown alar cells aid in distinguishing *Pleurozium*.

*Literature.* (see family ref.).

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## ***Rhytidium* (Sull.) Kindb.**

A monotypic genus, *R. rugosum* (Hedw.) Kindb. is widespread in the Northern Hemisphere. In Africa it is known only from Mt. Elgon and Mt. Kenya.

**Plants** rather robust, forming loose tufts, somewhat glossy yellowish- to golden-brown. **Stems** stiffly erect-ascending, to 5 cm or more tall, regularly to irregularly pinnately branched, branches short, often oriented towards one side, tips curved or hooked; paraphyllia none. **Leaves** crowded, falcate, loosely erect when dry, erect-

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

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spreading when wet, oblong-lanceolate or elliptic-short lanceolate, to 4 mm long, both plicate and rugose, apex secund, gradually acuminate; margins revolute below apex, distally serrate; costa single, 2/3-3/4 lamina length; laminal cells oblong-linear, flexuose, smooth with some cells papillose at distal angles on back, porose, thick-walled; alar cells subquadrate to short rectangular and oblate, thick-walled, smooth. **Perichaetial leaves** lanceolate with spreading long acuminate apices. Seta to 25 mm long. **Capsule** horizontal, urn obloid-cylindrical, asymmetric, smooth, neck short; annulus in 2-3 rows. **Operculum** conic-apiculate or -short rostrate and oblique. **Peristome** with exostome teeth cross-striate below, papillose distally; endostome cilia 1-2, nodose.

*Habitat.* Exposed sites on rock or thin soil over rock, often associated with escarpments and calcareous habitats; open montane to scrub, 4000-4200 m.

*Discussion.* This is a large, distinctive moss with a robust, ascending habit, falcate, rugose leaves, single costa, smooth median cells with some cells strongly papillose at upper cell angles, and thick-walled, subquadrate alar cells. **Rhytidium** is placed in the Rhytidiaceae by some authors.

*Literature.* (see family ref.).

## HYPOPTERIGIACEAE

(M.J. Wigginton, August 2006)

**Plants** pleurocarpous, medium-sized to large, forming loose frondose tufts, pale- to dark green, yellow or light golden-brown. **Shoots** differentiated into stolons and stems. **Stolons** creeping, branched, radiculose. **Stems** either simple or branched; when simple, not differentiated and  $\pm$  horizontal, when branched usually differentiated into a vertical stipe and a more horizontal branched frond, with ramification pinnate, bipinnate, palmate or umbellate; stems in cross section, with or without central strand. **Branching** lateral, rarely ventral. **Foliation** variable: usually complanate when wet, crispate when dry. **Leaves** of frond dimorphic, in 3 rows, two lateral rows and one ventral row (underleaves); **lateral leaves** incubous, patent, asymmetrical, apex shortly or longly acuminate, base sometimes shortly decurrent on one side; costa distinct, single, 0.3-0.65 leaf length to excurrent; margins plane, entire to coarsely serrate-dentate; leaves with or without a border (limbate); **underleaves** smaller than lateral leaves, variable in shape, erecto-patent to widely patent,  $\pm$  symmetrical; costa ending below apex to longly excurrent. **Branch leaves** usually smaller than stem leaves, otherwise similar. **Monoicous** or **dioicous**. **Gametoecia** usually lateral on main axis, sometimes arising from the axils of underleaves. **Sporophytes** exserted, usually one per perichaetium. **Seta** very short to long, smooth or roughened. **Capsules** erect to pendulous, rather short, ovoid, ellipsoid or cylindrical. **Peristome** double; exostome teeth 16, papillose (at least distally); endostome hyaline, papillose, processes 16, cilia present or absent. **Operculum** short- to long-rostrate. **Calyptra** shortly to longly rostrate. **Gemmae** sometimes present.

*HABITAT.* Decaying logs, and humic soil over tree roots, bases and trunks, on rocks and leaf litter; *Lopidium* usually epiphytic on trees, shrubs and climbers.

*DISCUSSION.* Following Kruijer (2002), the Hypopterygiaceae contain 7 genera and 21 species, with the greatest diversity in eastern Asia and Australasia. Three genera, each containing one species, occur in Africa. The family, previously associated with the Hookeriales, is currently placed in the order Hypnales. Distinguishing features of the African species include the 1) frondose habit, 2) dimorphic, often bordered, leaves in 3 ranks, 3) smooth laminal cells.

*LITERATURE.* Kruijer, H. 1997. British Bryological Expedition to Mulanje Mountain, Malawi. 6. Hypopterygiaceae (Musci). Journal of Bryology 19: 515-520. Kruijer, H. 2002. Hypopterygiaceae of the world. Blumea, Supplement 13: 1-388.



# Guide to Bryophytes of sub-Saharan Africa

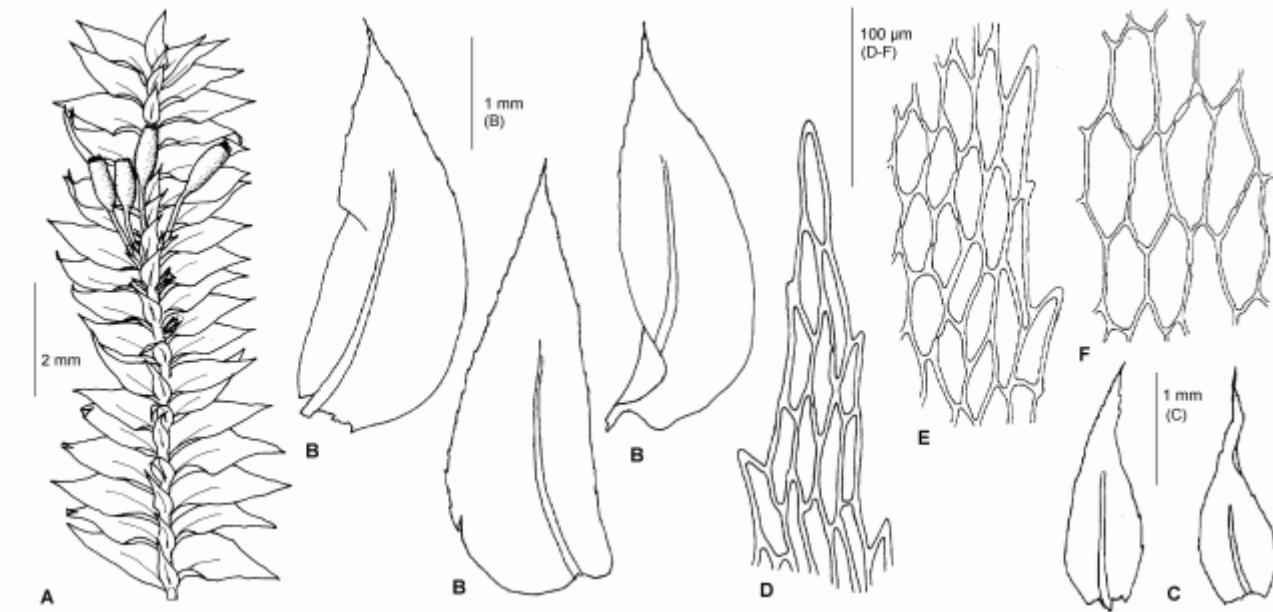
1. Stem simple; lateral leaves longly acuminate; seta 1-2 mm long; sporophytes hidden beneath lateral leaves; operculum shortly-rostrate	<b>Cyathophorum</b>
1. Stem branched; lateral leaves ovate or oblong; seta 4-25 mm long; sporophytes not hidden beneath lateral leaves; operculum longly-rostrate	<b>2</b>
2. Ramification pinnate or bipinnate; laminal leaf cells collenchymatous, walls incrassate; costa of lateral leaves percurrent or nearly so; stem central strand absent; seta papillose; calyptra with paraphyses	<b>Lopidium</b>
2. Ramification mostly palmate or umbellate; laminal leaf cells not collenchymatous, walls thin; costa of lateral leaves reaching 0.8 leaf length at most; stem central strand present; seta smooth; calyptra smooth	<b>Hypopterygium</b>

## **Cyathophorum** P.Beauv.

A small genus of 7 species, with its highest diversity in west Asia. Only one species, *Cyathophorum africanum* Dixon, is known from Africa, occurring disjunctly from Ethiopia to Tanzania. The species was formerly assigned to *Cyathophorella* M.Fleisch.

**Plants** forming open or dense turfs, often in fan-shaped formation. **Stems** simple, straight, mostly ± horizontal to ascending, to 4.5 cm long, rhizoids usually abundant towards base, central strand present or absent. **Leaves** pale to dark green, margins entire in basal part, weakly to strongly serrate distally, and often to near base, border faint to distinct, 1-4 cells wide, interrupted distally; **laminal cells** not collenchymatous, oblong-hexagonal to shortly linear-hexagonal, acumen cells longer; **border cells** shorter or longer than adjacent laminal cells, walls often somewhat incrassate. **Lateral leaves** 2.5-4.5 mm long, ovate, longly acuminate; costa 0.3-0.65 leaf length. **Underleaves** ovate to narrowly lanceolate, 0.5-1.6 mm long; costa reaching 0.65 leaf length to faintly percurrent. **Autoicous. Gametoecia** in the axils of lateral leaves and sometimes underleaves, mostly situated in the middle and distal parts of the shoot, often in the axils of discrete and widely separated groups of about 5-12 pairs of lateral leaves + underleaves along the shoot. **Sporophytes** developing on ventral side of shoot, and therefore hidden beneath the leaves. **Seta** horizontal or directed downwards, 1.2-2 mm long, smooth. **Capsule** erect, cylindrical-ovoid or barrel-shaped, 0.8-1.6 mm long, pale. **Peristome** teeth colourless to pale yellow; narrow, exostome teeth papillose; endostome papillose, basal membrane not exceeding the orifice, cilia absent or rudimentary. **Operculum** shortly rostrate. **Gemmae** absent.

# Guide to Bryophytes of sub-Saharan Africa



*Cyathophorum africanum* Dixon **A**: portion of shoot, ventral view. **B**: lateral leaves. **C**: underleaves. **D**: apex of lateral leaf. **E**: margin of distal part of lateral leaf. **F**: basal cells of lateral leaf.

**HABITAT.** In humid montane and submontane rain forests, epiphytic on tree bases, trunks and branches, also on rock, litter and humic soil; 1200-2500 m.

**DISCUSSION.** *Cyathophorum* is easily distinguished from other superficially similar taxa by the presence of underleaves, together with the rather short, hexagonal laminal cells with thin walls. Some species of *Lepidopilum* and *Lepidopilidium* are somewhat similar at first glance, but they have only two ranks of leaves, and a short, double costa.

**LITERATURE.** Kruijer, H. 2002. - (see family references); Kruijer, H. 1997. - (see family references).

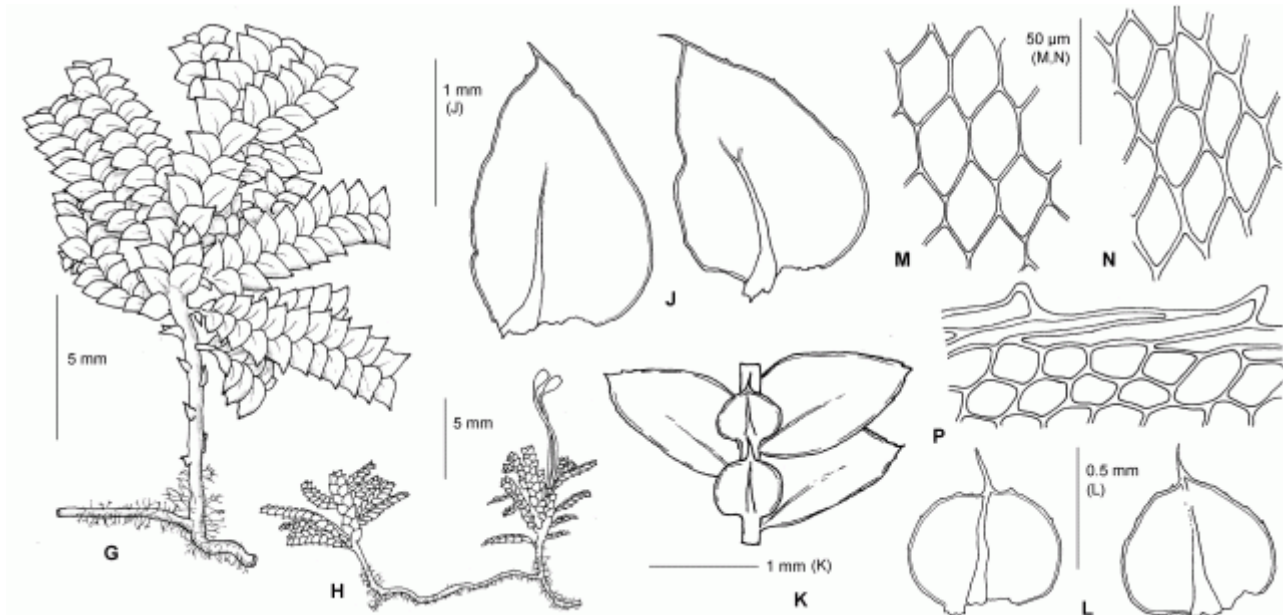
## *Hypopterygium* Brid.

A small genus of 7 species, with one species, *H. tamarisci* (Sw. ex Sw.) Brid. ex Müll.Hal. in Africa, widespread in eastern to southern parts of the continent, with few records west of the Congo Basin. *Hypopterygium tamarisci* has a pantropical, southern temperate distribution, and is the most widespread species of the genus.

**Plants** gregarious in groups of dendroides or fans, medium sized, forming loose frondose tufts, mid- to dark green. **Stipes** ascending or vertical, radiculose below, with central strand; stipe leaves few and distant, often eroded. **Fronds** broad, to 3 cm across, angled from the stipe (i.e. held sub-erect to ? horizontally), palmately branched, with secondary branches; foliation of stems and branches complanate. **Leaves** dimorphic, in 3 ranks, two lateral and one ventral (underleaves), leaves of branches smaller than on main axis, otherwise similar. **Lateral leaves** broadly ovate, to 2 mm long, costa very wide at base, quickly narrowing, 0.65-0.75 lamina length, often forked distally; margins entire to coarsely serrate-dentate, apices gradually to abruptly acuminate. **Underleaves** orbicular, symmetric, ca 1 mm long, apex abruptly and longly cuspidate; margins smooth or sharply serrate distally; costa usually excurrent (sometimes disappearing below apex); border narrow, of 1-2 cell rows. **Cells** of leaves and underleaves shortly rhombic to hexagonal, walls thin or somewhat thickened; basal cells of lateral leaves more elongate, weakly porose. **Heteroicous** or **dioicous**. **Gametoecia** in basal or middle part of frond. **Sporophytes** up

# Guide to Bryophytes of sub-Saharan Africa

to 10 or more per frond, 1 (rarely 2) per perichaetium. **Seta** ascending, to 16 mm long, smooth. **Capsule** inclined to pendulous, ovoid to short cylindrical; exothecial cells rounded; stomata at urn base, appearing immersed. **Peristome** with exostome teeth striate-papillose below, distally papillose, bordered, strongly trabeculate on back; endostome with 2-3 cilia. **Operculum** long-rostrate, oblique. **Calyptra** cucullate, occasionally appearing short mitrate, sparsely hairy.



*Hypopterygium tamarisci* (Hook.) Brid. **G**: habit, dorsal view. **H**: habit, with 2 sporophytes. **J**: lateral leaves of stem. **K**: portion of branch. **L**: underleaves. **M,N**: median leaf cells of different leaves showing variation in wall thickness. **P**: margin of lateral stem leaf.

**HABITAT.** On rotting logs, and on humus over tree bases, tree trunks, rocks (granite, sandstone), and on concrete. Found in shaded, humid places, and near streams, mostly in forests, occasionally in open woodland; 170-4160 m, but in tropical Africa mostly 650-3000 m, and in South Africa 200-1500 m.

**DISCUSSION.** *Hypopterygium tamarisci* is easily recognised by its ascending or vertical stems and broad, spreading fronds, the dimorphic leaves in 3 rows, and a long seta. The presence of endostomial cilia also differentiate it from other species of the Hypopterygiaceae in Africa.

**LITERATURE.** Kruijer, H. 1997. - (see family references); Kruijer, H. 2002. - (see family references). Magill, R.E. & Van Rooy, J. 1998. Bryophyta. Part 1. Musci. Fascicle 3. Erpodiaceae - Hookeriaceae, In: O.A.Leistner, Flora of Southern Africa. Pretoria: National Botanical Institute, pp. 614-617. Pfeiffer, T., Kruijer, J.D., Frey, W. & Stech, M. 2000. Systematics of the *Hypopterygium tamarisci* complex (Hypopterygiaceae, Bryopsida): implications of molecular and morphological data. Journal of the Hattori Botanical Laboratory 89: 55-70.

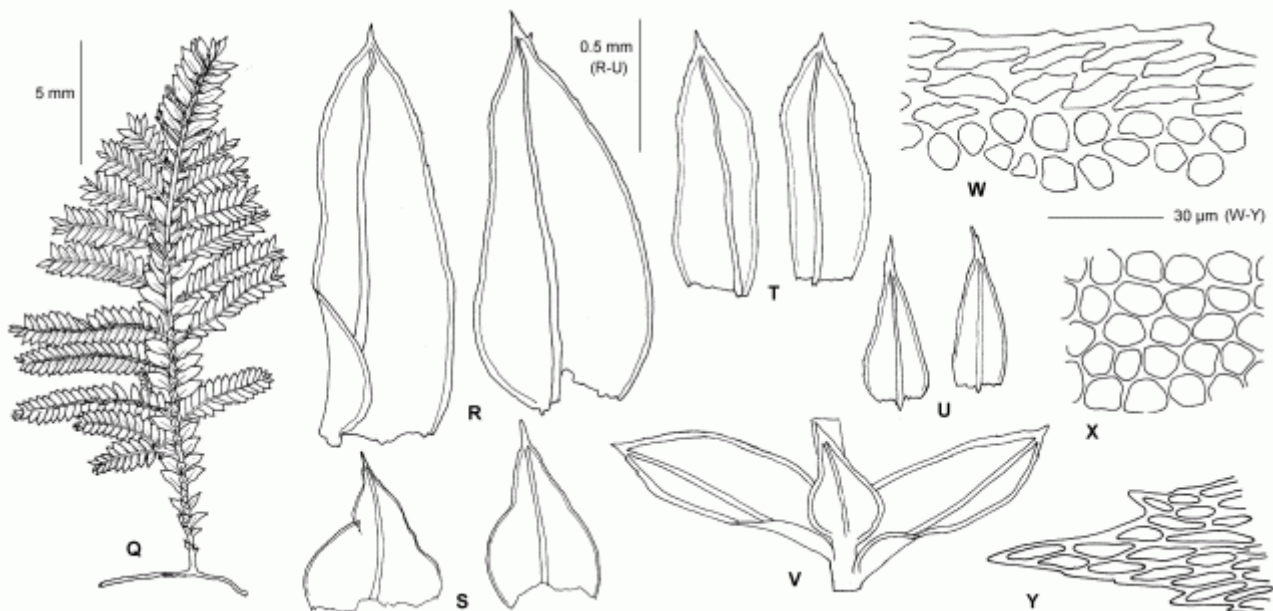
## **Lopidium** Hook. & Wilson

A small southern hemisphere genus of 2 species. One species, *Lopidium struthiopteris* (Brid.) M.Fleisch., occurs in sub-Saharan Africa, including the East African Islands; also widespread in SE Asia, and in tropical Australia and Pacific Ocean islands. The other species, *L. concinnum* (Hook.) Wilson, is found in southern S. America, Tasmania and New Zealand.

# Guide to Bryophytes of sub-Saharan Africa

**Plants** usually gregarious, medium sized to somewhat large, forming loose tufts, rather dark green to yellow or light golden-brown. **Stipes** erect or perpendicular to substrate, with or without central strand (strand lacking in rachis and branches), stipe leaves increasing in size distally. **Fronds** ovate-triangular, 2-8 cm tall/long, branching pinnate or sparsely bipinnate; foliation of main axis and branches complanate. **Leaves** closely set, dimorphic, in 3 ranks, two lateral and one ventral (underleaves). **Lateral leaves** of main axis asymmetrical, ovate to oblong-ovate, 1.5-2.2 mm long, dorsally convex, apex shortly acuminate, base short decurrent, clasping the stem on ventral side; margins serrate distally, serrulation extending further down on acroscopic side; costa strong, often flexuose, shortly excurrent; underleaves of main axis broadly ovate, the basal part often abruptly expanded, costa excurrent. **Lateral leaves** of branches narrower than on main axis, ovate-oblong, margins often sharply serrate; costa disappearing near apex or excurrent; underleaves of branches symmetrical, smaller than on main axis, narrowly triangular or lanceolate. **Cells** rather uniform, irregularly rounded, incrassate, basal cells in 2-4 rows, oblong, strongly porose; marginal border cells linear, thick-walled, porose. **Dioicous**. **Perichaetia** situated in distal half of rachis, sporophytes up to 4 per frond. **Seta** 4 mm or more long. **Capsule** barrel-shaped or cylindrical. **Peristome** with exostome teeth striate distally, becoming papillose above; endostome papillose, basal membrane low.

**Gemmae** clusters frequently present, especially on branches, linear, up to 10 cells long.



*Lopidium struthiopteris* (Brid.) M.Fleisch. **Q**: habit, ventral view (some branches removed, some underleaves not shown). **R**: lateral stem leaves. **S**: underleaves of stem. **T**: lateral leaves of branch. **U**: underleaves of branch. **V**: portion of stem. **W**: margin of lateral leaf. **X**: median cells of lateral leaf. **Y**: apex of lateral leaf.

**HABITAT.** In wet to dry places in forests or sometimes open woodland, in shade or partial shade, occasionally in unshaded places. Usually epiphytic on tree trunks, also on branches, on saplings and shrubs, on rocks, sometimes on rotting logs, rarely terrestrial; 300-3000 m.

**DISCUSSION.** *Lopidium struthiopteris* is easily distinguished by the pinnate or bipinnate, oblong-triangular fronds, the presence of underleaves, the excurrent costa of leaves and underleaves, and a central strand lacking in rachis and branches.

**LITERATURE.** Kruijer, H. 1997. - (see family references). Kruijer, H. 2002. - (see family references). Magill, R.E. & Van Rooy, J. 1998. Bryophyta. Part 1. Musci. Fascicle 3. Erpodiaceae - Hookeriaceae, In: O.A.Leistner, Flora of Southern Africa. Pretoria: National Botanical Institute, pp. 617-618.

# Guide to Bryophytes of sub-Saharan Africa

## LEPTODONTACEAE

(B.J. O'Shea)

**Plants** medium sized, forming mats, dull, green to yellowish-green. **Primary stems** creeping, radiculose beneath; leaves scale-like; rhizoids reddish-brown. **Secondary stems** creeping, pendulous or ascending, stipitate or not, pinnately branched, when dry becoming circinate or curving inwards, distal branches bearing slender microphyllous branches from leaf axils or not; in cross-section outer 3-8 rows of cells small, thick-walled, deeply rusty-red, inner cells larger, thin-walled, pale yellow, central strand absent. **Secondary stem leaves** erect, ovate, apex rounded to apiculate; margins plane to partially recurved, entire to distally weakly denticulate; costa single, 1/2-3/4 lamina length, occasionally forked; median cells oval or elliptic, smooth to indistinctly papillose by projecting cell angles; alar cells usually well developed, quadrate to subquadrate or rounded, oblate; branch leaves similar, smaller, microphyllous branches present or absent. **Dioicous**. **Perichaetia** lateral, leaves lanceolate. Seta short to elongate. **Capsule** immersed to exserted, ovoid. **Peristome** double or single, exostome teeth 16, smooth to granulose; endostome present or reduced. **Calyptra** cucullate. **Spores** smooth to finely papillose.

*Discussion.* The Leptodontaceae contain 4 genera and 8 species rather widely distributed in temperate and tropical forested regions; in Africa there are 3 genera and 5 species. The family is placed in the order Leucodontales. From the resurrection of this family by Buck (1980), its circumscription has been under debate, but a conservative approach is taken here, with the family restricted to three closely related genera. *Forsstroemia*, often treated in this family, is here included within a heterogeneous Leucodontaceae. Enroth (1992) discusses several genera in relation to the scope of the family. Magill & van Rooy (1998) suggest that the family should be viewed as an intermediate between Leucodontaceae/Cryphaeaceae and Neckeraceae.

*Literature.* **Buck, W. R. 1980.** Animadversions on *Pterigynandrum* with special commentary on *Forsstroemia* and *Leptopterigynandrum*. *Bryologist* 83: 451-565. **Enroth, J. 1992.** Corrections to *Cryptoleptodon*, *Forsstroemia* and *Leptodon* (Leptodontaceae, Musci). *Journal of the Hattori Botanical Laboratory* 71: 75-82. **Magill, R.E. & van Rooy, J. 1998.** - see general; refs.

1. Stem with numerous paraphyllia, no pseudoparaphyllia, whole plant usually inrolled when dry	<b>Leptodon</b>
1. Stems with few or no paraphyllia, pseudoparaphyllia present, branches unaffected or circinate only when dry	<b>2</b>
2. End of stems and branches naked due to caducous leaves	<b>Caduciella</b>
2. Leaves not caducous	<b>Cryptoleptodon</b>

### **Caduciella** Enroth

A genus of two species, of which *Caduciella mariei* (Besch.) Enroth occurs in Africa, in the Comores and Tanzania. The genus is known also from India, Indochina, Malaysia, Indonesia, Papua New Guinea, Australia and China.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** small to medium-sized, erect, complanately branched, yellow to dirty green, dull. **Primary stems** creeping, bearing small leaves and tufts of smooth, reddish rhizoids. **Secondary stems** to about 2.5 cm long, erect, distal parts often naked due to caducous leaves, fairly regularly pinnately branched; cross-section oval, with small, very thick-walled epidermal cells, and several rows of thick-walled cortical cells, the cells gradually getting larger and thinner-walled towards the centre, with no central strand. **Branches** usually patent, sometimes branched again, distal parts mostly naked due to caducous leaves; axillary hairs 4- or 5-celled, one or two basal cells short and pigmented; branch primordia covered with embryonic leaves; pseudoparaphyllia numerous, foliose (occasionally filiform), deltoid-lanceolate or lanceolate, to ca. 130 µm long. **Primary stem leaves** usually poorly differentiated. **Secondary stem leaves** 1.0-1.2(-1.3) mm long, imbricate, patent-spreading and fairly complanate, occasionally concave, when dry often with one or two gentle lunate undulations, somewhat asymmetric; broadly oblong or broadly lingulate from a narrowly decurrent, ovate base with the basiscopic side inflexed, apex rounded or broadly obtuse, sometimes truncate. **Branch leaves** similar to stem leaves but smaller; leaf margins plane, mostly entire throughout but sometimes weakly crenate at apex; costa simple, fairly strong, often somewhat sinuous and forked above and/or with a few short lateral spurs; leaf cells incrassate, in interrupted rows running parallel to the leaf margins, upon wetting becoming slightly bulging throughout, at apex and mid-leaf rounded or sub-angular and ca. 6-10 µm in diameter or oval and to 12 µm long, median and basal marginal cells in a few rows mostly ca. 6 µm in diameter, basal laminal and juxtacostal cells rectangular to irregularly angular or oblong to nearly linear, to ca. 35 µm long and with porose walls especially near insertion, alar cells indistinct. **Gametoecia** and **sporophytes** unknown.

*Habitat.* An epiphyte of tropical lowland to sub-montane forests, 400--950 m.

*Discussion.* Although the original collection was by Marie from M'Sapéré and Magi M'Bini, Mayotte (Maore) in the Comoros, it has not been reported from there since the original collections, and otherwise is known in Africa only from the Amani Forest Reserve, East Usambara Mountains, Tanzania. The most distinctive feature of the plant is the naked branches that project from the leafy parts of the plant (in older plants very few leaves may be left), but also its comparatively small size, complanate, pinnate branching and rounded to truncate leaves.

*Literature.* **Enroth, J. 1991.** Notes on the Neckeraceae (Musci). 10. The taxonomic relationships of *Pinnatella mariei*, with the description of *Caduciella* (Leptodontaceae). *Journal of Bryology* 16: 611-618. [description, illustration]

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## ***Cryptoleptodon* Renaud & Cardot**

A genus of three species, two of which occur in Africa: *Cryptoleptodon pluvinii* (Brid.) Broth.) occurs in Ethiopia (also, more frequently, in Nepal, Bhutan and NE India), and *C. longisetus* (Mont.) Enroth is a narrow endemic occurring only in the Canary and Cape Verde islands. The third species occurs only in Pakistan and Kashmir.

**Plants** in loose, dull, dark-green mats, or as creeping stems, shoots circinate when dry. **Primary stems** creeping. **Secondary stems** procumbent to pendulous, flexuose, irregularly pinnately to bipinnately branched; paraphyllia sparse, solitary or in small groups on stems and branches, uniseriate; pseudoparaphyllia sparse, uni- or biseriate. **Stem leaves** regular, ovate, bluntly apiculate or rounded; nerve strong. **Branch leaves** ovate, strongly asymmetric, often recurved on narrower side, narrowed and hollow at base, bluntly apiculate to rounded, when dry transversely undulate; nerve off-centre, about 4 cells wide at base, narrower above, 1/3 to 2/3 or more of leaf length; cells thick-walled, irregular, longer than wide at base and upwards a little way near the nerve, shorter, quadrate-rounded

# Guide to Bryophytes of sub-Saharan Africa

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towards margin and apex, smooth or slightly papillose (especially on dorsal surface), alar cells not usually distinct, small; upper leaf margin smooth to slightly denticulate or papillose. **Dioicous**. **Seta** very short to long. **Capsule** immersed to exserted. **Peristome** double, exostome teeth 16, trabeculate on inner surface; endostome and membrane above the middle teeth long, composed of 16 irregular, fugacious processes split into two. **Calyptra** cucullate, hairy.

*Habitat.* Relatively dry habitats, epiphytic, 400-1200 m.

*Discussion.* This genus was created by Renaud & Cardot (1900) to accommodate *Leptodon flexuosus* (Harv.) A.Jaeger, which they believed was impossible to maintain in *Leptodon* because of its immersed capsule and the presence of an inner peristome; this taxon is now a synonym of *Cryptoleptodon pluvinii* (Enroth 1992). Similar in overall appearance to *Caduciella*, but larger, without the caducous shoots, and possessing paraphyllia; rather like a small, non-complanate *Neckera*. Capsules are often present, so the two species in Africa can be distinguished by the immersed capsules of *C. pluvinii* and the exserted capsules of *C. longisetus*.

*Literature.* **Enroth, J. 1992.** - see family ref. [synonymy, discussion]. **Renaud, F. & Cardot, J. 1900.** Musci exotici novi vel minus cogniti, IX. Bulletin de la Société Royale de Botanique de Belgique 38: 7-48. **Tongiorgi, E. 1939.** Neckeraceae dell'Africa orientale Italiana dalle collezioni del R. Erbario Coloniale di Firenze. Nuovo Giornale Botanico Italiano n.s. 46: 177-196. [description (in Latin and Italian), illustration (as *C. flexuosus*)].

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## ***Leptodon* Mohr.**

A genus of two species, both of which occur in Africa. *Leptodon fuciformis* (Brid.) Enroth is a narrow endemic (Madagascar, Mauritius and Réunion), whilst *L. smithii* (Hedw.) F.Weber & D.Mohr is widespread in Eastern and Southern Africa, as well as in Europe, the Mediterranean area, southern South America, Australia and New Zealand. Pócs (1960) discusses the factors influencing the distribution of *L. smithii*.

**Plants** medium sized, in loose tufts, dark green to yellow green, often forming large mats. **Primary stems** rhizome-like, creeping. **Secondary stems** creeping to ascending, to ca. 2.5 cm long, regularly pinnate or bipinnate, branched in one plane, strongly curved and folded in when dry; small-leaved innovations often present; in section with 3-5 rows of thick-walled outer cells; axillary hairs numerous; paraphyllia numerous, branched, not foliose; pseudoparaphyllia foliose. **Leaves** regularly spaced, spreading when wet, crisped when dry; ovate to elliptical or shortly lingulate, obtuse to acute, rounded and narrowed at insertion; margins plane, entire; stem leaves longer than the branch leaves, to 2 mm long; costa single, slender, extending to mid-leaf or as far as the apex; cells ovoid to rounded hexagonal, smooth, slightly thickened, alar cells quadrate, laminal cells quadrate to rectangular, upper more heterogeneous in shape, to 40 µm long. **Dioicous**. **Perichaetial leaves** longer, acuminate, outer squarrose, inner erect. **Seta** straight or curved, very short. **Capsule** immersed to exserted, ellipsoid. **Peristome double**, inner peristome rudimentary. **Calyptra** cucullate, hairy. **Spores** ca. 16 µm.

*Habitat.* Saxicolous or more commonly corticolous, in woodlands and forests, to 3000 m.

*Discussion.* There is no other moss genus with same characteristic inrolling of the stems and branches when dry, and the extremely rapid response to wetting, revealing the regularly pinnate structure (particularly in *L. smithii*) and the ovate, blunt leaves; it should be noted that there are lax forms of *L. smithii* which are much less inrolled. The numerous paraphyllia on the stem also separate *Leptodon* from other mosses of similar habitats, such as

# Guide to Bryophytes of sub-Saharan Africa

*Forsstroemia* and *Pterogonium*. *Leptodon fuciformis* can be distinguished from *L. smithii* by the leaf apices being narrower, the upper leaf cells rhomboid or oval and mostly longer than wide, the lower cells longer than in *L. smithii*, the mode of branching of the upper part irregular and remote, and the whole plant less strongly inrolled when dry (Enroth 1992). It is also the only *Leptodon* known from the East African islands, where it is endemic.

*Literature.* **Enroth, J. 1992.** - see family ref. [synonymy, discussion, illustration]. **Magill, R.E. 1998.** - see general ref. [description, illustration]. **Pócs, T. 1960.** Die verbreitung von *Leptodon smithii* (Dicks.) Mohr und die Verhältnisse seines Vorkommens. Annales historico-naturales musei nationalis Hungarici 52: 169-176.

## LEUCODONTACEAE

(B.J. O'Shea, September 2009)

**Plants** medium sized to somewhat robust, forming tufts or mats, dark green to yellowish-brown or golden. **Primary stems** creeping; leaves small, scale-like. **Secondary stems** spreading to ascending or erect, curled or not; in cross-section outer few rows of cells small, thick-walled, inner cells larger, firm- or thin-walled, central strand absent or present; pseudoparaphyllia foliose when present. **Leaves** appressed to erect when dry, erect-spreading to spreading when wet, ovate-short lanceolate to  $\pm$  narrowly lanceolate, smooth or distinctly plicate, broadly concave, apex gradually to abruptly short acuminate; margins plane to weakly reflexed at base or occasionally along midleaf margin, entire or weakly serrulate to dentate at apex; costa absent, short and forked or long often with branches; laminal cells smooth, thick-walled, upper ones oblong-linear; median cells oblong-linear or rhomboidal or oval, porose or not; inner basal cells elongate; alar cells few to numerous, subquadrate to irregularly short rectangular and often oblate. **Dioicous or autoicous.** **Perichaetia** lateral, inner leaves elongate, involute, oblong-lanceolate, acute or acuminate. **Seta** erect, short to more commonly elongate, smooth, twisted to the left. **Capsule** immersed to exserted, erect and symmetric to slightly curved and asymmetric, ovoid to cylindrical, neck short, distinct. **Operculum** rostrate, erect or oblique. **Peristome** double or single, exostome absent or teeth 16, smooth to papillose, endostome rudimentary or absent. **Calyptra** cucullate, naked to densely hairy. **Spores** spherical or ellipsoid, uni- or multicellular, smooth to faintly papillose.

*Discussion.* The Leucodontaceae contain possibly six or eight genera and up to 40 species distributed mostly in temperate regions of the Northern Hemisphere, with five genera and seven or eight species in sub-Saharan Africa. Definition and naturalness of the family is currently in question. Akiyama (1994) has presented the most recent discussion of the problems in the classification of the Leucodontaceae, tentatively recognising eight genera.

*Literature.* **Akiyama, H. 1994.** Suggestions for the delimitation of the Leucodontaceae and the infrageneric classification of the genus *Leucodon*. Journal of the Hattori Botanical Laboratory 76:1-12. **Manuel, M. G. 1974 [1975].** A revised classification of the Leucodontaceae and a revision of the subfamily Alsioideae. The Bryologist 77: 531-550.

1. Costa strong, single, c 2/3 leaf length, usually with several (sometimes long) branches from near the costa base, leaves strongly toothed near the apex	<b><i>Antitrichia</i></b>
1. Costa absent or not as above, leaves not toothed	<b>2</b>



# Guide to Bryophytes of sub-Saharan Africa

2. Costa absent	3
2. Costa present	4
3. Leaves smooth; alar cells little differentiated, few; capsules erect, symmetric	<i>Felipponea</i>
3. Leaves weakly to rather strongly plicate; alar cells differentiated, rather numerous; capsule slightly curved and asymmetric	<i>Leucodon</i>
4. Costa single; stems and branches rigidly straight when dry	<i>Forsstroemia</i>
4. Costa split into 2-3(-4) branches; stem and branches curved when dry	<i>Pterogonium</i>

## ***Antitrichia* Brid.**

A genus of 3 species, only *A. kilimandscharica* Broth. recognised here from sub-Saharan Africa, occurring on the higher mountains of central and east tropical Africa.

**Plants** large, rigid, often in large mats, green through yellow-green to (in older parts) brown green, somewhat glossy when dry. **Stems** often distinctly reddish-brown; primary stems creeping, stoloniform; secondary stems irregularly pinnate, no central strand, cortex of 4-6 layers of incrassate cells; pseudoparaphyllia foliose. **Leaves** smaller and narrower on primary stems, on secondary stems erecto-patent to patent, base ovate to widely-ovate, gradually narrowed to an acuminate apex, plicate; costa single, strong, wide at base, ending in upper third of leaf, often with several short branches from the base and sometimes along the length; margin usually recurved apart from at the apex, more or less denticulate throughout, more strongly towards the apex; laminal cells smooth, linear, about 6-12:1, slightly flexuose, incrassate, slightly porose, basal cells more strongly incrassate and porose; alar cells quadrate, short-rectangular to rhomboidal, strongly thickened, forming strong group, decurrent and extending up along leaf margin. **Dioicous**. **Perichaetial leaves** long and sheathing, abruptly subulate, without costa. **Seta** flexuose or arcuate. **Capsule** inclined, ovoid-cylindric. **Spores** 25-35 µm.

**Habitat.** Trees and rocks in mountainous areas, in forests and more open areas above the forest, 2450-4300 m altitude.

**Discussion.** The genus is characterized by the robust habit and the leaves with a branched nerve, strong alar group of small incrassate cells and strong toothing. De Sloover (1976) reviewed the differences between *A. kilimandscharica* and *A. curtispindula*, and concluded that *A. kilimandscharica* was a synonym of *A. curtispindula*. Frahm (1993) identified two more characters, including a spore difference, that seemed to justify retaining *A. kilimandscharica* as a good species. *A. curtispindula* is known from North America, Europe and North Africa (including Canary and Madeira islands), but all tropical mountain specimens seem to belong to *A. kilimandscharica*. The leaves in the African plant are less strongly plicate, the cells are narrower (9-12:1 vs. 6-9:1) and much less thickened, the costa is less branched and the apical margin lacks the prominent, often recurved teeth.

**Literature.** De Sloover, J.L., 1976. Note de bryologie africaine VII. *Pseudephemerum*, *Bryohumbertia*, *Eucladium*, *Streptopogon*, *Ptychomitrium*, *Rhachithecium*, *Antitrichia*, *Pterogonium*, *Lindigia*, *Distichophyllum*. Bulletin du Jardin National de Belgique 46: 427-447. Frahm, J.-P. 1993. Taxonomic Results of the BRYOTROP Expedition to Zaire and Rwanda. 17. Andreaeaceae, Bruchiaceae, Dicranaceae, Rhizogoniaceae, Bartramiaceae, Rhacocarpaceae, Hedwigiaceae, Cryphaeaceae, Leucodontaceae. Tropical Bryology 8: 153-169..

# Guide to Bryophytes of sub-Saharan Africa

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## *Felipponea* Broth.

**NB Please note: the name of this genus is now *Pterogoniadelphus*.**

A genus of four species, only one of which, *F. assimilis* (Müll. Hal.) O'Shea, is known from Africa. In Africa it has traditionally been called *Leucodon assimilis* or *L. maritimus*, and is recorded from eastern and southern Africa, including Réunion and Madagascar. It also occurs in southeast Brazil, Bolivia and Uruguay.

**Plants** medium sized, forming mats, dark green. Stems creeping, to 5 cm long, with leaves scale-like. **Secondary stems and branches** spreading to ascending, julaceous, irregularly pinnately branched; in cross-section outer 2-4 rows of cells small, thick-walled, inner cells large, thin-walled, central strand absent. **Leaves** crowded, appressed with apices spreading when dry, wide-spreading when wet, broadly to narrowly ovate or ovate-oval, to 1.5 mm long, smooth, apex rather abruptly short acuminate or cuspidate; margins plane, entire or apex weakly dentate; cells thick-walled; apical cells oblong-linear; median cells oblong-rhomboidal to -oval; basal cells linear, porose, golden yellow; alar region weakly differentiated, cells oblate oblong-oval. **Perichaetial leaves** sheathing, to ca. 1/2 seta length, oblong-lanceolate, to 3 mm long, apex acute, ecostate, upper laminal cells linear, weakly porose, lower and basal cells rectangular. **Seta** to 4.5 mm long, twisted. **Capsule** erect, urn ovoid-cylindrical, to 1.8 mm long, symmetric, mouth somewhat constricted when dry; exothecial cells thick-walled; annulus absent. **Operculum** long rostrate. Peristome double, whitish, exostome teeth 16, irregular, lanceolate, papillose, partly split; endostome reduced to basal membrane. **Calyptra** cucullate, smooth and naked. Spores rounded, granulate, 25-30 µm.

**Habitat.** On rocks and trees, often associated with streams; in open forests and meadows, at elevations from 150-2300 m.

**Discussion.** The genus is characterized by julaceous branches, smooth, broadly to narrowly ovate or ovate-oval leaves with abruptly acuminate or cuspidate apices, few alar cells, and symmetric, erect capsules. It differs from *Leucodon* in being smaller, with a different growth form, with non-plicate leaves and the alar cells less-well differentiated.

**Literature.** **Akiyama, H. 1988.** Rearrangement of two species of *Leucodon* (Leucodontaceae, Musci) with a note on *Felipponea*. *Journal of Japanese Botany* 63: 265-272. [general review of genus]. **Magill, R.E. & van Rooy, J. 1998.** - see general ref. [illustration, description (as *L. assimilis*)]. **Ochyra, R. & Zijlstra, G. 2004.** *Pterogoniadelphus* M.Fleisch., the correct name for *Felipponea* Broth. (Leucodontaceae). *Taxon* 53: 809-811. **O'Shea, B.J. 2001.** *Felipponea* (Leucodontaceae, Musci), a new genus for Africa, to include '*Leucodon maritimus*' and *L. assimilis*. *Tropical Bryology* 20: 43-49.

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## *Forsstroemia* Lindb.

# Guide to Bryophytes of sub-Saharan Africa

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One species is present in Africa, *F. producta* (Hornsch.) Paris, which is found from Ethiopia southwards in East Africa down to southern Africa. This taxon is also found in N, C and S America, Australia, Himalayas, Korea and China.

**Plants** medium sized, forming tufts. **Primary stems** long, creeping; rhizoids clustered beneath. **Secondary stems** erect or curved, irregularly pinnately branched; in cross-section outer 3-5 rows of cells small, thick-walled; paraphyllia absent; pseudoparaphyllia foliose, narrowly lanceolate. **Stem leaves** crowded, erect to appressed when dry, erect-spreading to spreading when wet, ovate to ovate-short lanceolate, 1-3 mm long, concave, apex apiculate to acuminate, often twisted; margins plane to partially recurved on one or both sides mostly below midleaf, entire to serrulate distally; costa single or mixed with short and forked costae, 1/2-3/4 lamina length, occasionally spurred; apical cells in center of acumen oblong-flexuose or not; median cells oval to elliptic; basal cells weakly porose; alar cells quadrate to subquadrate, extending along margin to ca. 1/3 leaf length. **Propagula** absent. **Branch leaves** similar, smaller, complanate or not when dry. **Autoicous, (gonioautoicous), rarely synoicous or polyoicous.** **Perichaetial leaves** lanceolate, 2-4 mm long. **Seta** relatively short, 0.5-4.5 mm long, smooth, twisted. **Capsule** immersed to exserted, cylindrical, 0.8-2.3 mm long; stomata absent; annulus absent. **Operculum** conic-rostrate, erect or oblique. **Peristome** set below mouth, double or single, exostome teeth smooth and faintly papillose to granulose, occasionally perforate or cribose distally; endostome absent or rudimentary, basal membrane and cilia absent, segments fragmentary, adhering to exostome or not. **Calyptra** sparsely to rather densely hairy. **Spores** spherical, smooth to finely papillose.

*Habitat.* Epiphytic on tree trunks or branches, occasionally on rocks or logs; in subtemperate and montane forests, but also on roadside trees, 100-2600 m.

*Discussion.* The genus is characterised by concave, ovate to short ovate-lanceolate leaves, often twisted, apiculate or acuminate apex, entire to serrulate distal leaf margins, single or mixed short and forked, occasionally spurred, costa, thick-walled, oval to oblong median cells, monoicous sexual condition, shortly exserted, cylindrical capsules, double or single peristome, with exostome smooth and faintly papillose or granulose, endostome segments fragmentary or absent, and absence of a basal membrane and cilia. *Forsstroemia producta* is often quite distinctive in the field, with rather rigid, branched, secondary stems arising erect from the substrate, usually with several visible, exserted sporophytes. The leaves are quite similar to those of *Cryphaea*, but that genus has quite different sporophytes (usually present) with immersed capsules in numerous perichaetia attached to the stem.

*Literature.* **Enroth, J. 1992.** - see family ref. [synonymy, discussion]. **Magill, R.E. 1998.** - see general ref. [description, illustration]. **Stark, L. R. 1987.** A taxonomic monograph of *Forsstroemia* Lindb. (Bryopsida: Leptodontaceae). Journal of the Hattori Botanical Laboratory 63: 133-218 [keys, illustrations, maps].

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## ***Leucodon* Swaegr.**

Six species recorded for Africa, although the genus is in need of revision; a genus containing nearly 40 species of mostly temperate regions, extending into the montane tropics.

**Plants** medium sized to rather robust, forming rather stiff tufts, green or yellowish-brown to golden. **Primary stems** mostly short, creeping; leaves ovate and abruptly narrowly acuminate, some apices piliferous. **Secondary stems** suberect to erect, often curled, julaceous or not when dry, 4-10 cm long; in cross-section outer 3-4 rows of cells small, thick-walled, reddish-orange, inner cells larger, firm-walled, central strand absent or present;

# Guide to Bryophytes of sub-Saharan Africa

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pseudoparaphyllia foliose. **Leaves** appressed to erect, erect-spreading to spreading when wet, ovate to ovate-lanceolate or ± narrowly lanceolate, 1.5-3.5 mm long, distinctly plicate, apex gradually to rather abruptly short acuminate; margins plane to reflexed at base or occasionally along midleaf margin, entire or weakly serrulate at apex; upper and median cells oblong-linear or -rhomboidal, thick-walled, usually porose; inner basal cells elongate; alar region differentiated, cells subquadrate to irregularly short rectangular and often oblate thick-walled; insertion cells golden-red. **Perichaetial leaves** ending below or exceeding the capsule, inner leaves involute, oblong-lanceolate, to 4.5 mm long, acuminate. **Seta** elongate, to 8 mm long, twisted to the left. **Capsule** exerted, suberect to erect, urn ovoid-cylindrical, ca. 1.0-3.5 mm long, puckered at mouth, neck short, distinct. **Operculum** short to long rostrate. **Peristome** with exostome papillose, entire or somewhat perforate; endostome rudimentary or absent. **Calyptra** smooth above, somewhat plicate at base. **Spores** spherical and unicellular or ellipsoid and multicellular, smooth to faintly papillose.

*Habitat.* Epiphytic on tree trunks and branches, logs and occasionally on rocks; montane forests, 940-3400 m.

*Discussion.* The genus is distinguished by erect to curled stems and branches, weakly to strongly plicate leaves, well differentiated alar cells, slightly curved and asymmetric capsules, and peristome double or single, papillose exostome, endostome rudimentary or absent. No treatment including the African species exists.

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## ***Pterogonium* Sw.**

A genus of 2 species, one known only from Brazil, the other (*Pterogonium gracile* (Hedw.) Sm.) being wide spread in North America, Europe, SW Asia and North Africa, as well as sub-Saharan Africa. There are a number of varieties of *P. gracile* described, of which two occur in Africa.

**Plants** small to medium sized, often in large mats, green or brownish. **Primary stems** creeping. **Secondary stems** sub-dendroid, curved strongly downwards, sometimes extending into flagelloid shoots; central strand present with a cortex of 2-6 rows of thick-walled cells, outer cortical cells smaller; paraphyllia and pseudoparaphyllia absent, axillary hairs present. **Stem leaves** of primary stems small, ovate-triangular; those of secondary stems erect-patent to patent, sometimes spreading, when dry erect and imbricate, broadly ovate-acuminate, concave; costa ill-defined, split into several branches from near base, ending half way along leaf, or below; margin plane, entire at base, but increasingly denticulate to dentate towards apex; mid-leaf cells elongate (ca. 1:4), rhomboid to linear, thick-walled; upper cells shorter, often strongly prorate on dorsal surface; basal cells irregularly quadrate to transversely rectangular, more elongate near costa, very thick-walled and porose; alar cells in well marked group extending up leaf margin up to half the leaf length, short-rectangular at base, rounded-quadrate, rectangular or transverse-rectangular above. **Branch leaves** more rounded, and sometimes obtuse to rounded at apex rather than acute. **Dioicous. Perichaetial leaves** long-sheathing, with single costa. **Capsule** exerted, ellipsoidal. **Peristome** double; exostome teeth papillose-striate below; endostome segments short above basal membrane, cilia absent. **Operculum** conical. **Calyptra** cucullate, with a few hairs. **Spores** small, 14-20 µm

*Habitat.* Growing most usually on tree trunks and branches, but also on rocks, in gardens and roadsides as well areas of dry montane evergreen forest, 1200-3300 m.

*Discussion.* Rarely fertile, but when sporophytes are produced they are usually in abundance. Usually recognised by its distinctive habit with the curved, narrowing branches of the secondary stems pointing in the same direction.

# Guide to Bryophytes of sub-Saharan Africa

Literature. Magill, R.E. & van Rooy, J. 1998. - see general ref. [illustration, description].

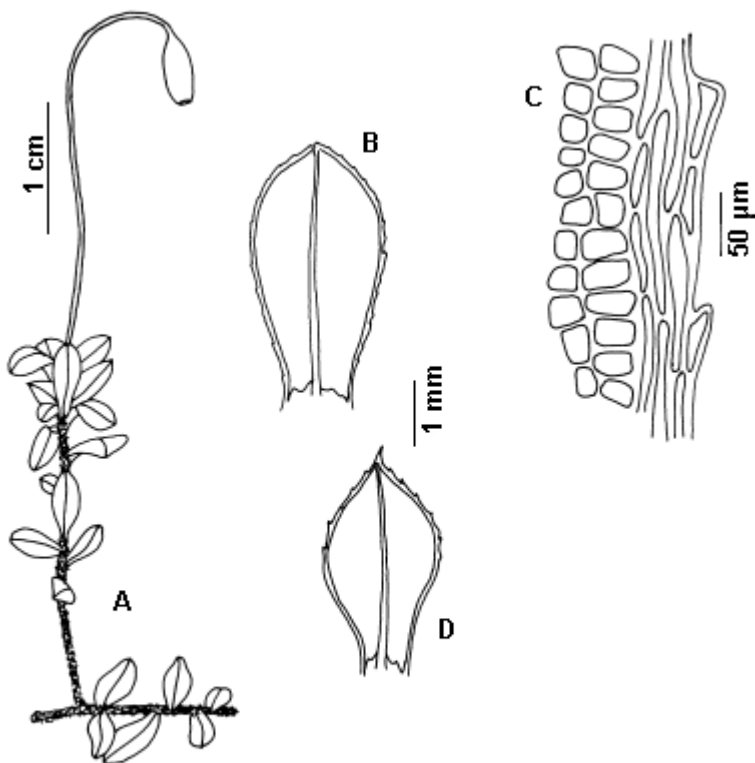
## MNIACEAE

(R.D. Porley, April 2000)

The Mniaceae contain nine genera and about 70 species, the majority distributed in the north temperate region, with one genus, *Plagiomnium*, in sub-Saharan Africa.

***Plagiomnium*** T.J.Kop.

Three species are known from the region. There are about 24 species distributed worldwide in moist, cool, temperate climates.



***Plagiomnium rhynchophorum* (Hook.) T.J.Kop.** A: habit of plant with sporophyte; B: leaf; C: margin of leaf.

***Plagiomnium cuspidatum* (Hedw.) T.J.Kop.** D: leaf.

**Plants** medium sized, forming tufts or loose mats. **Stems** procumbent, creeping or erect, arcuate, stoloniform sterile basal branches with rhizoids, fertile stems often radiculose to tomentose; in cross-section central strand well developed. **Leaves** spirally arranged when erect, when procumbent appearing complanate-foliate, unistratose, undulate or plain, crisped when dry, obovate to oblong or elliptical, apex acute to obtuse-rounded and mucronate or cuspidate, base narrowly decurrent; margins limbate, singly serrate. **Nerve** single, ending in apex to percurrent. **Laminal cells** smooth, upper and median cells hexagonal-rounded to subquadrate, collenchymatous; juxtacostal cells often larger, basal cells rectangular-rounded or oblong; marginal cells linear, forming a border of 2 to several rows. **Dioicous** or synoicous. **Perichaetia** terminal. **Seta** single or clustered, elongate, smooth. **Capsule** exserted, pendent, obloid to obloid-cylindrical, neck short. **Operculum** conic-long rostrate, oblique. **Peristome** double, exostome reddish-orange, teeth 16, finely papillose; endostome basal membrane high, segments 16, keeled, finely papillose, cilia 3 (2-4), nodose. **Calyptra** cucullate, smooth and naked. **Spores**

spherical, finely papillose..

**Habitat.** On soil, humus and decaying logs, epiphytic on larger branches, on tree bases, less often on trunks; on rocks or in damp crevices; in humid often shaded sites in montane to high montane forests, occasionally on roadside banks, 1300--3480 m.

# Guide to Bryophytes of sub-Saharan Africa

*Discussion.* Past reports of *Mnium* in tropical Africa are in error (*Mnium* is distinguished by paired teeth on leaf margins). The three species can be separated as follows: *Plagiomnium cuspidatum* (Hedw.) T.J.Kop. is known from Uganda and Kenya, and is distinguished from all other species by having teeth that extend from mid-leaf to the apex only (in all other species the teeth extend from the leaf base to the apex). *Plagiomnium undulatum* (Hedw.) T.J.Kop. is known from high elevations of Ethiopia, and is the only dioicous species in tropical Africa and the only species to display an erect to arcuate habit. *Plagiomnium rhynchophorum* (Hook.) T.J.Kop. has sterile creeping shoots, but (like *P. undulatum*) has undulate, narrow elliptic to lingulate leaves. It differs from *P. undulatum* in smaller leaf cells, a costa that ends at or somewhat below the apex (in *P. undulatum* the costa is excurrent) and the marginal teeth are small and often blunt. Two varieties are recognised, var. *rhynchophorum* and var. *reidii* (for the differences see Koponen, 1981). In tropical Africa the typical variety seems to be restricted to the higher mountains in the west, east and central part of the continent, and to Madagascar and the Mascarenes; variety *reidii* occurs in southern Africa and the east African mountains.

*Literature.* **Koponen, T. 1980.** A synopsis of Mniaceae (Bryophyta). IV. Taxa in Europe, Macaronesia, NW Africa and the Near East. *Annales Botanici Fennici* 17: 125-162. **Koponen, T. 1981.** A synopsis of Mniaceae (Bryophyta). V. Taxa in Africa south of the Sahara. *Annales Botanici Fennici* 18: 105-111. **Koponen, T. 1992.** Miscellaneous notes on Mniaceae (Bryophyta). XVI. *Plagiomnium undulatum* (Hedw.) T. Kop. in Ethiopia. *Bulletin du Jardin Botanique de l'Etat* 62: 397-402 [includes a key to all sub-Saharan taxa].

## NECKERACEAE

(N.G. Hodgetts, April 2000)

**Plants** medium sized to rather large, forming tufts or mats, light to dark green, yellowish-green to golden-brown. **Primary stems** creeping, leaves scale-like or eroded. **Secondary stems** stipitate, dendroid and frondose to sub-dendroid, ascending or pendent, irregularly to regularly pinnately branched; paraphyllia present or absent; pseudoparaphyllia foliose or absent; distal branch tips sometimes flagelliform. **Stipe leaves**, if present, triangular to ovate-triangular. Leaves of secondary stems often complanate, ovate to oblong-lanceolate, oblong-lingulate, or cultriform, smooth, plicate or undulate, often strongly asymmetric, apex obtuse to acute, truncate or acuminate, base weakly auriculate or not, often shortly decurrent on one side; margins plane, recurved below or folded at base (usually along one side), entire below, distally entire or dentate, serrulate to serrate, often coarsely and irregularly so at apex; costa long and single or short and somewhat forked, occasionally absent; laminal cells smooth or prorate, linear and often vermicular, or rhomboidal to shortly hexagonal, walls firm or porose. **Branch leaves** often differentiated from secondary stem leaves, usually narrower, oblong-ligulate. **Autoicous** or dioicous. **Perichaetia** lateral, leaves usually sheathing, strongly differentiated. **Seta** short to elongate, smooth. **Capsule** immersed or exserted, erect to horizontal, urn ovoid to cylindrical. **Operculum** shortly to longly rostrate, occasionally oblique. **Peristome** double, exostome teeth 16, papillose, or smooth to striate below, distally papillose. **Calyptra** cucullate or mitrate (-campanulate), smooth and naked. **Spores** spherical, usually papillose.

*Discussion.* The Neckeraceae contains about 16 or 17 genera and perhaps more than 300 species; in sub-Saharan Africa 8 genera and 36 species. *Thamnobryum* and related genera are here retained in the Neckeraceae, although some authors (e.g. Magill & van Rooy, 1998) have placed them separately, in Thamnobryaceae. A record of the genus *Homalia* for African has been excluded (see O'Shea & Ochyra, 2000). Most species can be identified by leaves alone; however stems should be examined for the presence of paraphyllia, and sporophytes are important in separating some species of *Neckera*. Leaves from the stipe, secondary stem and branches should all be examined in dendroid plants, such as species of *Porotrichum*. Presence or absence of a central strand in the stem is important in distinguishing between some genera. Enroth & Hodgetts (1996) provided a key to the species known from Malawi. Further useful information about several of the species is provided by Enroth (1993) and Magill & van Rooy (1998).

# Guide to Bryophytes of sub-Saharan Africa

*Literature.* **Enroth, J. 1993.** Taxonomic results of the BRYOTROP expeditions to Zaire and Rwanda. 23. Neckeraceae, Pterobryaceae, Hypopterygiaceae. *Tropical Bryology* 6: 193-198. **Enroth, J. & Hodgetts, N.G. 1996.** British Bryological Society expedition to Mulanje Mountain, Malawi. 5. Neckeraceae (Musci). *Journal of Bryology* 19: 135-141. **Magill, R.E. & van Rooy, J. 1998.** - see general refs. **O'Shea, B.J. & Ochyra, R. 2000.** Families and genera of mosses no longer believed to occur in sub-Saharan Africa. *Tropical Bryology* 18: 119-127.

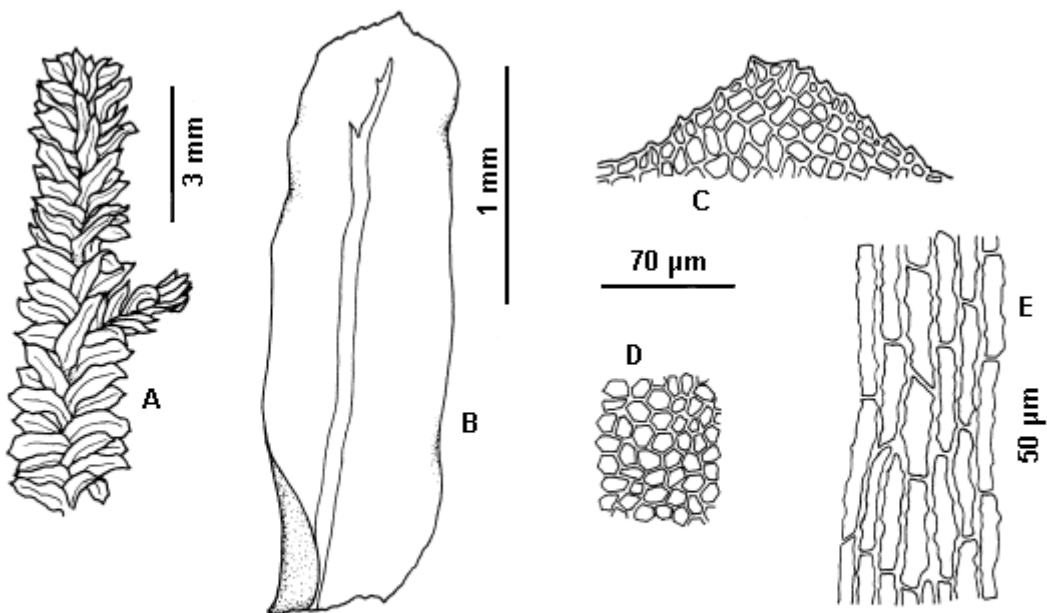
1. Habit not dendroid but irregularly to regularly pinnately branched; leaves complanate, often distinctly and regularly undulate; capsules usually immersed to shortly exerted on short (up to 5 mm) seta	<b>2</b>
1. Habit ± dendroid, with stipe and variously-branched secondary stems; leaves complanate or not, not undulate, capsules usually exerted on long (1-3 cm) seta	<b>4</b>
2. Leaves broadly ovate to ligulate-lanceolate, usually distinctly and regularly undulate with acute to acuminate apex and short, forked costa; linear-ligulate rameta absent	<b><i>Neckera</i></b>
2. Leaves broadly lingulate, ± truncate, apiculate or not, regularly undulate or not, with single costa reaching to 3/4 the length of the lamina or more; linear-ligulate rameta often ( <i>Neckeropsis</i> ) present at base of capsule	<b>3</b>
3. Leaves often regularly undulate, auriculate or not, abruptly truncate, subentire to weakly crenulate-serrulate at apex, occasionally apiculate; leaf arrangement 'pseudotetrastichous'; capsules frequent, immersed, without apophysal stomata	<b><i>Neckeropsis</i></b>
3. Leaves not regularly undulate or auriculate, with relatively less abruptly truncate, more strongly crenulate, apiculate leaf apex; leaf arrangement octastichous; capsules very rare, exerted, with apophysal stomata	<b><i>Himantocladium</i></b>
4. Stipe leaves appressed; costa not terminating in distinct abaxial spine; upper leaf cells regularly shortly rhomboid to oval; central strand of stem absent	<b><i>Homaliodendron</i></b>
4. Stipe leaves various, often patent or squarrose; costa often terminating in distinct abaxial spine; upper leaf cells various but not regularly and shortly rhomboid to oval; central strand of stem present	<b>5</b>
5. Leaf apices nearly entire or crenulate by slightly protruding cell corners (not whole cells); median laminal cells isodiametric or nearly so	<b><i>Pinnatella</i></b>
5. Leaf apices dentate by uni- to multicellular teeth; median laminal cells clearly longer than wide	<b>6</b>
6. Plants often with a distinct metallic lustre; seta deep red, lustrous; exostome teeth striate from base to approximately half their length; endostome with well-developed cilia	<b><i>Porothamnium</i></b>
6. Plants dull or somewhat lustrous but not with a metallic lustre; seta yellow to somewhat reddish, dull; exostome teeth striate from base to well below half their length; endostome with cilia absent or very rudimentary	<b><i>Porotrichum</i></b>

***Himantocladium* (Mitt.) M.Fleisch.**

# Guide to Bryophytes of sub-Saharan Africa

Mainly a genus of S.E. Asia, Australasia and Oceania, with only one species, *H. cyclophyllum* (Müll.Hal.) M.Fleisch. definitely recorded in sub-Saharan Africa, and this confined to the Seychelles. A collection of *H. implanum* (Mitt.) M.Fleisch. nominally from Ascension Island could be regarded as of dubious provenance.

**Plants** medium-sized to large, forming tufts, pale green. **Primary stems** creeping; leaves small, distant. **Secondary stems** remotely, irregularly and complanately, sometimes subpinnately, branched. **Stipe leaves** appressed, small, abruptly narrowing from ovate base to acute acumen. **Secondary stem leaves** lingulate, complanate, spreading, rugose or irregularly undulate, 2.4--2.8 mm long, to 1.2 mm wide, asymmetric, apex truncate, obtuse or rounded, usually apiculate; margins plane, often folded below, irregularly and coarsely crenulate-denticulate at apex; costa strong, single, often forked above, reaching near leaf apex; leaf cells incrassate, mid-leaf and upper cells  $\pm$  hexagonal-rhomboid and isodiametric, basal cells elongate with incrassate, porose longitudinal walls and thin transverse walls; alar cells  $\pm$  undifferentiated; intramarginal limbidium of elongate cells usually extending up both margins. **Branch leaves** similar but smaller. **Diocious**, usually sterile. **Sporophyte** not observed.



***Himantocladium cyclophyllum* (Müll.Hal.) M.Fleisch.**

Seychelles: Norkett 17655 (BM)

A: portion of secondary stem; B: secondary stem leaf; C: leaf apex; D: mid-leaf cells;  
E: basal cells.

**Habitat.** On tree trunks, branches, roots and occasionally rocks in forest.

**Discussion.** *Himantocladium* is closely related to *Neckeropsis*. It may usually be distinguished (Enroth 1992) by the octastichous rather than 'pseudotetrastichous' leaf arrangement, the leaves not being regularly undulate or auriculate, and the less abruptly truncate, more strongly crenulate, apiculate leaf apex. In addition, *Himantocladium* has exerted capsules and apophysal stomata, but unfortunately the capsule is seldom observed in *H. cyclophyllum*. The species was further described and illustrated by Enroth (1989).

**Literature.** Enroth, J. 1989. Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXVII. Neckeraceae (Musci). Acta Botanica Fennica 137: 41-80. Enroth, J. 1992. Notes on the Neckeraceae (Musci). 13. Taxonomy of the genus *Himantocladium*. Annales Botanici Fennici 29: 79-88.



# Guide to Bryophytes of sub-Saharan Africa

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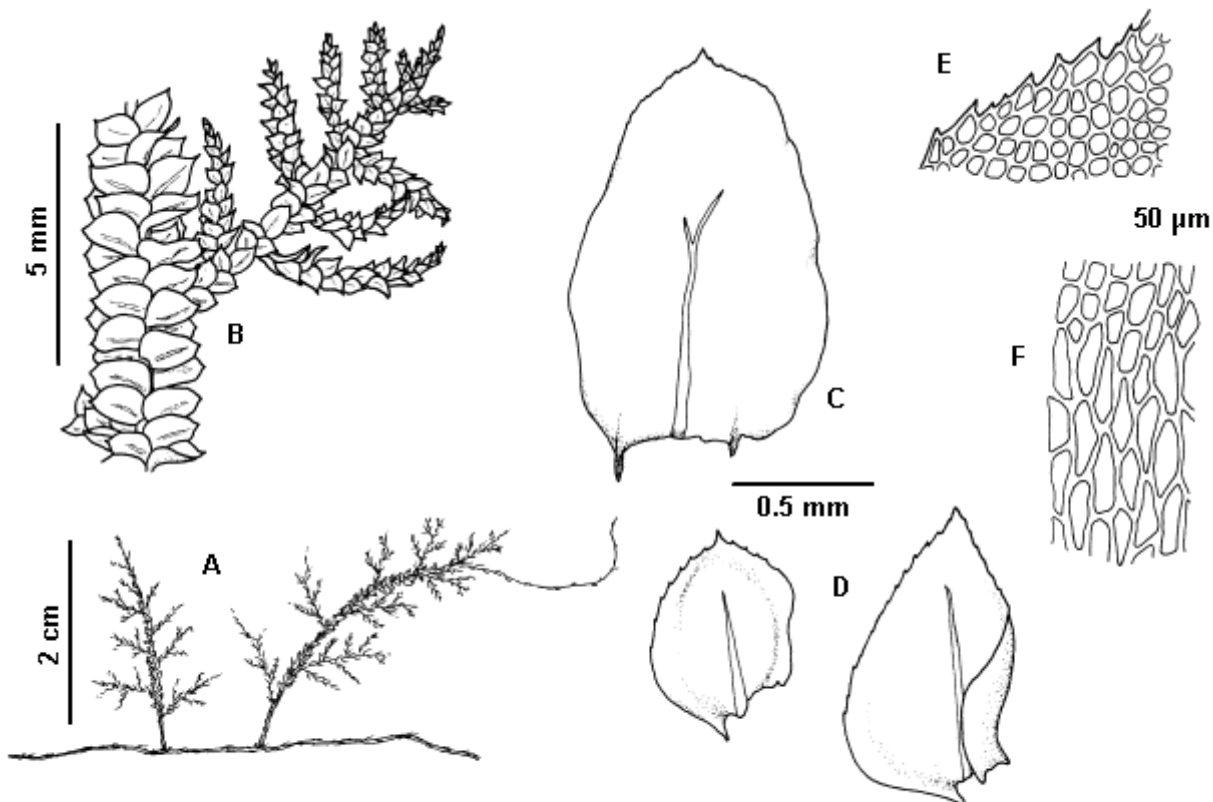
## ***Homaliodendron* M.Fleisch.**

Three species in sub-Saharan Africa, of which only one, *H. piniforme* (Brid.) Enroth, is widespread; about 30 species primarily from Southeast Asia.

**Plants** rather large, forming tufts. **Primary stems** creeping. **Secondary stems** frondose, perpendicular to substrate, to 15 cm tall (but usually much shorter), irregularly pinnately branched, flagellate branches frequent; in cross-section outer rows of cells small, thick-walled, inner cells larger, central strand absent; pseudoparaphyllia foliose. **Stipe** leaves erect-appressed, triangular to lanceolate. **Secondary** stem leaves  $\pm$  complanate, erect-spreading to spreading, oblong-ligulate to obovate, 1.5-3 mm long, to 1 mm wide, apex obtuse and apiculate; margins plane, folded at base or not, denticulate to coarsely and sharply toothed above, teeth uni- or multicellular; costa single, 1/2--3/4 lamina length, rather slender, without terminal abaxial spine; apical cells regularly rhomboid or oval; median cells rhomboidal; basal cells oblong-rectangular; branch leaves similar, 2-3 times smaller, often proportionately shorter and relatively more strongly toothed above. **Dioicous**. **Perichaetia** lateral. **Seta** rather short, 3.6-5.5 mm long. **Capsule** erect, urn ovoid to cylindrical, 1.8--2.4 mm long; stomata superficial; annulus absent. **Operculum** conic. **Peristome** with exostome teeth lanceolate, faintly striate-papillose below, distally papillose; endostome basal membrane moderately high, segments narrow, keeled and narrowly perforate, papillose, cilia absent. **Calyptra** cucullate, hairy. **Spores** spherical, papillose.

# Guide to Bryophytes of sub-Saharan Africa

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***Homaliodendron piniforme* (Brid.) Enroth**

Uganda: Hodgetts 4178a (E)

A: portion of secondary stem; B: secondary stem leaf; C: leaf apex; D: mid-leaf cells; E: basal cells.

*Habitat.* Montane forests, at elevations from 1000-3000 m.

*Discussion.* *Homaliodendron* is distinguished by the frequently flagellate, frondose plants, obtuse to rounded, short oblong-ligulate to obovate leaves, single costa, coarse and sharp teeth along the upper margin, with teeth composed of several cells, and rhombic median cells. Sporophytes of this genus are known in Africa only from one specimen of *H. piniforme* (Brid.) Enroth collected from Cameroon (Enroth 1990); reproduction is by propagula in the form of flagellate branches.

*Literature.* Enroth, J. 1990. Notes on the Neckeraceae (Musci) 3-7. *Homaliodendron piniforme* comb. nov. and new synonyms in *Porotrichum*, *Himantocladium* and *Neolindbergia*. *Nova Hedwigia* 51: 551-559.

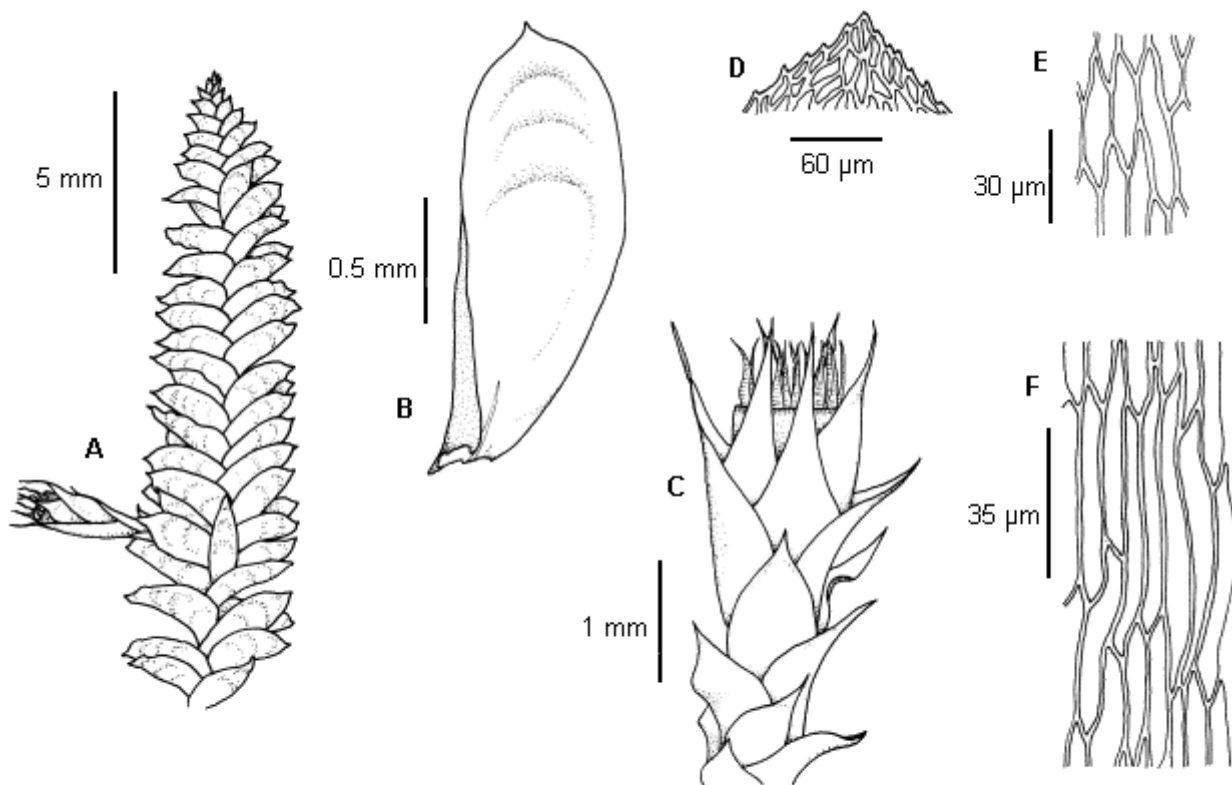
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## ***Neckera* Hedw.**

About 11 species in sub-Saharan Africa; a pantropical genus of some 40-50 species, extending into the temperate regions.

# Guide to Bryophytes of sub-Saharan Africa

**Plants** medium to somewhat robust, forming mats or wefts, glossy olive-green to golden-yellow. **Primary stems** creeping, leaves scale-like. **Secondary stems** spreading to more commonly ascending, often  $\pm$  perpendicular to substrate or pendent, irregularly to regularly pinnately branched; paraphyllia few to abundant or appearing absent; pseudoparaphyllia filamentous to foliose. **Secondary stem leaves** weakly to strongly complanate, suberect to spreading, undulate or occasionally flat, broadly ovate-lanceolate to oblong-ligulate, 2-5.5 mm long, asymmetric, apex obtuse to abruptly acute or short acuminate, base somewhat auriculate on proximal side; margins folded on proximal side at base, serrulate distally, rarely smooth; costae double, usually unequal, one costa much longer, to 1/5-1/3 lamina length; laminal cells smooth, porose or not, apical cells rhombic to fusiform; median cells linear,  $\pm$  vermicular, smooth, insertion cells irregularly rectangular, porose; alar region weakly differentiated, cells subquadrate to short rectangular. **Autoicous or dioicous**. **Perichaetial leaves** broadly lanceolate to oblanceolate, long acuminate to subulate. **Seta** short or somewhat elongate, 0.5-5 mm long, erect or slightly curved. **Capsule** immersed or shortly exserted, erect, urn short-cylindrical or ovoid to subglobose, 1-5 mm long; exothecial cells quadrate to rectangular, thick-walled; stomata at urn base, superficial. **Operculum** short to long rostrate, often oblique. **Peristome** with exostome teeth narrowly lanceolate, finely cross-striate at base, and occasionally just above vertically striate or smooth, distally papillose or smooth; exostome basal membrane low, segments linear, keeled and perforate, papillose. **Calyptra** cucullate or mitrate, smooth. **Spores** rather coarsely papillose.



***Neckera remota* Bruch & Schimp. ex Müll.Hal.**

Uganda: Hodgetts 4531b (E)

A: portion of secondary stem, with sporophyte; B: secondary stem leaf; C: sporophyte; D: leaf apex; E: leaf cells ca. 200  $\mu$ m from apex; F: cells just below middle of leaf.

**Habitat.** Epiphytic on trunks and branches, occasionally on humus, logs or rocks; premontane, becoming more common in montane forests, and extending into the bamboo and ericaceous belts and the Afro-alpine zone, 1100-4500 m.

# Guide to Bryophytes of sub-Saharan Africa

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*Discussion.* The genus is characterized by the complanate, often undulate, broadly ovate- to ligulate-lanceolate leaves, acute to acuminate apex, short and forked costa, and immersed to shortly exerted capsules. Most of the African species were keyed out, and some described and illustrated, by De Sloover (1977).

*Literature.* **De Sloover, J.L. 1977.** Note de bryologie africaine VIII. *Neckera, Neckeropsis*. Bulletin du Jardin Botanique National de Belgique 47: 31-48.

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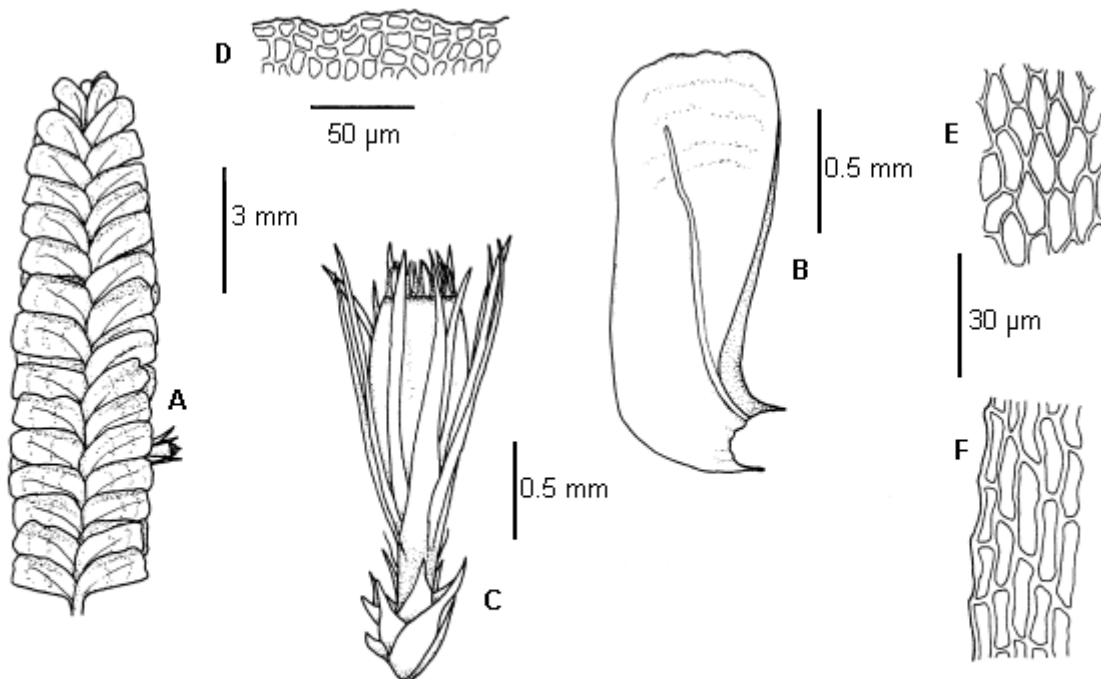
## ***Neckeropsis* Reichardt**

Eight species in sub-Saharan African; a genus of about 25 species with a pantropical distribution.

**Plants** small to medium sized, occasionally robust, forming loose tufts, occasionally mats, light to dark green, occasionally golden-brown to blackish. **Primary stems** creeping, leaves scale-like, ovate-acuminate, base partially clasping; rhizoids clustered beneath. **Secondary stems** ascending, usually perpendicular to substrate, irregularly to regularly pinnately branched, occasionally distally flagellate; in cross-section outer 2-4 rows of cells small, thick-walled, inner cells larger, thin- to  $\pm$  thick-walled, central strand absent; pseudoparaphyllia foliose. **Secondary stem leaves** complanate, smooth to slightly or regularly and strongly undulate, broadly lingulate, 1-2.5 mm long, asymmetric, apex truncate, sometimes with apiculus, base decurrent or not on one side; margins subentire to weakly serrulate at apex, usually entire or subentire below; costa single,  $3/4$ - $4/5$  lamina length; median cells irregularly rhomboidal or hexagonal or longer and sinuose, smooth, often porose. **Branch leaves** similar but smaller. **Synoicous or autoicous.** **Perichaetial leaves** ovate- to oblong-subulate; ramenta (leaf-like paraphyses) positioned along the vaginula, when present narrowly oblong- to linear-ligulate, ca. 2-3 mm long, often as long as or longer than sporophyte. **Seta** short, 0.3-0.7 mm long, smooth. **Capsule** immersed to emergent, erect, short-cylindrical to oblong, 1-2.6 mm long; exothecial cells short rectangular to subquadrate,  $\pm$  thick-walled; stomata absent; annulus absent. **Operculum** conic-long rostrate. **Peristome** with exostome teeth linear-lanceolate, papillose; endostome basal membrane low, segments linear, papillose, cilia absent. **Calyptra** mitrate-campanulate, smooth or with paraphyses. **Spores** papillose.

# Guide to Bryophytes of sub-Saharan Africa

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***Neckeropsis disticha* (Hedw.) Kindb.**

Uganda: Hodgetts 4356a (E)

A: portion of secondary stem, with sporophyte; B: secondary stem leaf; C: sporophyte;  
D: leaf apex; E: leaf cells ca. 100 µm from apex; F: leaf margin near base.

**Habitat.** Epiphytic, on branches and trunks, rarely found on logs or rocks; moist or wet lowland to premontane forests; from sea level to 2000 m.

**Discussion.** The genus is distinguished by the strongly complanate, broadly lingulate, truncate leaves, single costa (3/4 lamina length), linear-ligulate ramenta (when present), and immersed capsules. The most common species of *Neckeropsis*, *N. disticha* and *N. lepineana*, occur in moist or wet lowland forests where both species can grow in proximity to each other; *N. lepineana* can extend into lower montane forests. De Sloover (1977) provided some information on the genus, and later Enroth (1993) monographed *Neckeropsis* in Africa.

**Literature.** Enroth, J. 1993. Notes on the Neckeraceae (Musci). 17. A taxonomic study on the genus *Neckeropsis* in Africa. Journal of the Hattori Botanical Laboratory 73: 159-173. De Sloover, J.L. 1977. (see under *Neckera*).

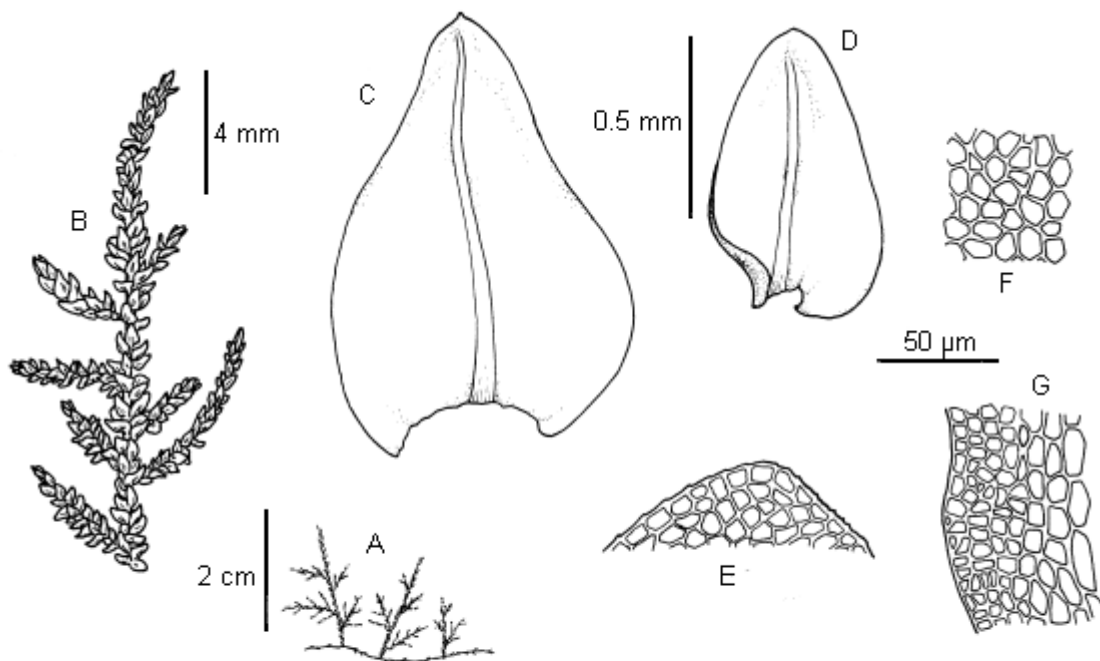
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***Pinnatella* M.Fleisch.**

Two species in sub-Saharan Africa, of which only *P. minuta* (Mitt.) Broth. is widespread (also found in the neotropics and southern India); the other species, *P. mucronata* (Bosch & Sande Lac.) M.Fleisch. is confined, in Africa, to the Seychelles, where it is the only species of the genus to occur. A pantropical genus of 15 species.

# Guide to Bryophytes of sub-Saharan Africa

**Plants** small, forming inconspicuous short tufts. **Primary stems** creeping; leaves ovate-lanceolate, acute, margins crenulate. **Secondary stems** erect to somewhat curved, frondose, 1-2(-4) cm tall, regularly pinnately branched, flagellate branches slender. **Secondary stem leaves** erect-spreading, ovate-short ligulate, 1-1.4 mm long, slightly concave, apex obtuse to broadly acute; margins plane,  $\pm$  entire to crenulate or rarely slightly serrulate; costa single, ca. 3/4 lamina length, usually strong, often notched at the tip; apical and median cells incrassate, oval to irregularly rounded, mostly isodiametric, smooth or unipapillose; basal cells oblong-rectangular, smooth. **Branch leaves** ligulate, smaller. **Diocious**. **Perichaetia** lateral. **Seta** short (2-3 mm long), roughened above. **Capsule** erect, 1.3-1.7 mm long, urn ovoid; stomata superficial; annulus somewhat differentiated. **Operculum** conic-short rostrate. **Peristome** with exostome teeth papillose; endostome basal membrane low, segments papillose, cilia absent. **Calyptra** with paraphyses. **Spores** spherical, papillose.



***Pinnatella minuta* (Mitt.) Broth.**

Uganda: Hodgetts 4442a (E)

A: habit; B: portion of secondary stem with branches; C: secondary stem leaf; D: branch leaf; E: branch leaf apex; F: branch leaf mid-leaf cells; G: margin of branch leaf near base.

**Habitat.** On tree trunks and rocks; moist lowland to premontane forests, from near sea level to 1500 m.

**Discussion.** The genus is readily distinguished by the small habit, obtuse to broadly acute-rounded, ovate, short-ligulate leaves, and unipapillose, rounded upper laminal cells. Sporophytes are rare (Enroth, 1994) but asexual reproduction by flagellate branches can take place.

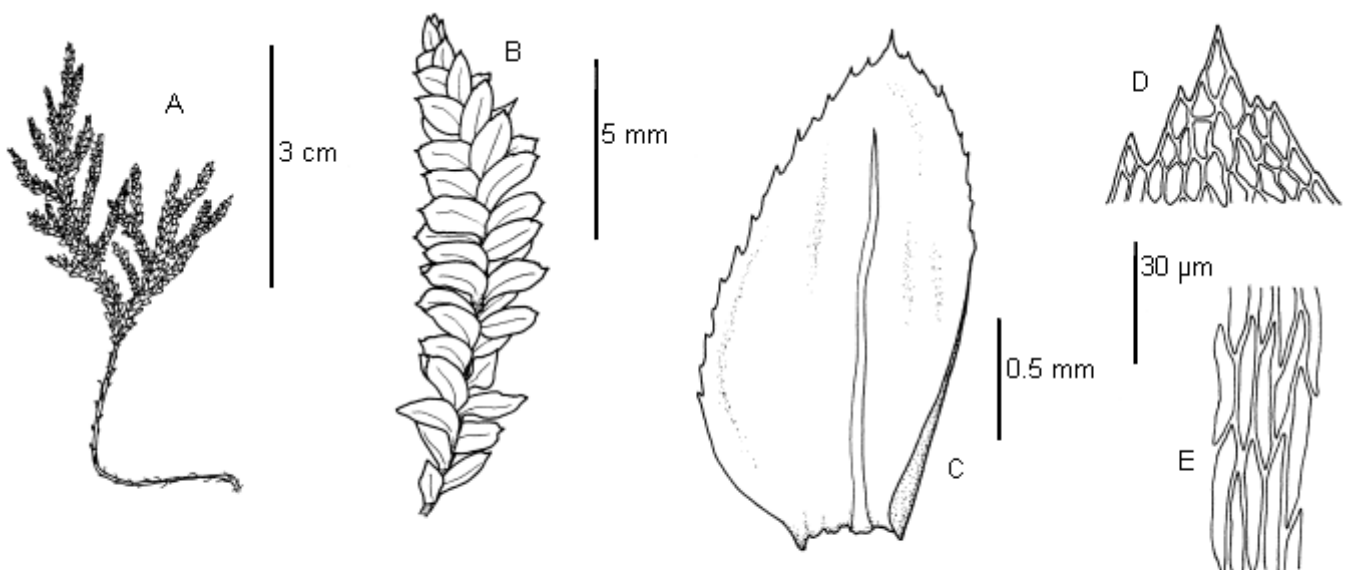
**Literature.** Enroth, J. 1994. A taxonomic monograph of the genus *Pinnatella* (Neckeraceae, Bryopsida). Acta Botanica Fennica 151: 1-90.

# Guide to Bryophytes of sub-Saharan Africa

## *Porothamnium* M.Fleisch.

Two species, of which one, *P. stipitatum* (Mitt.) Touw ex De Sloover, is very common while the other, *P. variifolioides* De Sloover, is much scarcer, though also widespread.

**Plants** medium sized to very robust, forming loose, often dense, tufts, glossy dark green or yellowish-green, usually with a metallic lustre. **Primary stems** creeping, leaves scale-like or eroded, radiculose. **Secondary stems** frondose, 2-12 cm tall, regularly to irregularly pinnately branched, flagelliform branches rare; stipe short to long, leaves clasping to squarrose. **Secondary stem leaves** usually strongly complanate, rather asymmetric, spreading, mostly ovate-oblong or -ligulate, 1.5-3 mm long, apex broadly acute to obtuse, apiculate; margins plane, folded on one side at base, irregularly and usually strongly serrate in distal 1/2 or 3/4 on one side, in distal 1/4 or 1/2 on the other; costa single, 1/2-3/4 lamina length, usually with a terminal abaxial spine; median cells thin or thick-walled, fusiform-rhomboidal to oblong-linear, smooth or nearly so, apical cells elongate rhomboidal or vermicular, basal cells linear to rectangular, alar region  $\pm$  undifferentiated but sometimes porose. **Branch leaves** similar but progressively smaller. **Diocious**. **Perichaetial leaves** oblong- or ovate-subulate. **Seta** elongate, 1.5-2.6 cm long, smooth, deep red, lustrous. **Capsule** erect to inclined, urn cylindrical to nearly globose, 1.5-3 mm long, stomata at urn base. **Operculum** rostrate. **Peristome** with exostome teeth striate in lower half, distally papillose; endostome basal membrane high, segments papillose, cilia well developed. **Calyptra** cucullate, smooth and naked. **Spores** spherical, smooth, finely punctate or papillose.



### *Porothamnium stipitatum* (Mitt.) Touw ex De Sloover

Uganda: Hodgetts 4465a (E)

A: habit; B: portion of branch; C: branch leaf; D: branch leaf apex; E: mid-leaf cells.

**Habitat.** On rocks and banks, especially by streams, occasionally on tree roots and dead wood; more rarely as an epiphyte on trunks and branches. Medium-altitude to montane forest, 300-3500m.

**Discussion.** *Porothamnium* is characterised, and distinguished from *Porotrichum*, by the large, glossy plants with a metallic lustre, the deep red, lustrous seta, the exostome teeth striate from their base to about half their length and the endostome with well-developed cilia. The rarer species, *P. variifolioides*, is distinguished from *P. stipitatum* by the less strongly-toothed leaves, the thicker-walled leaf cells, porose cells in the alar region, and the lack of a distinct abaxial spine at the end of the costa. The species are described in detail and illustrated by De Sloover (1983).

# Guide to Bryophytes of sub-Saharan Africa

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*Literature:* De Sloover, J.L. 1983. Note de bryologie africaine XII. *Porotrichum* et *Porothamnium*. Bulletin du Jardin Botanique National de Belgique 53: 97-152.

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## ***Porotrichum* (Brid.) Hampe**

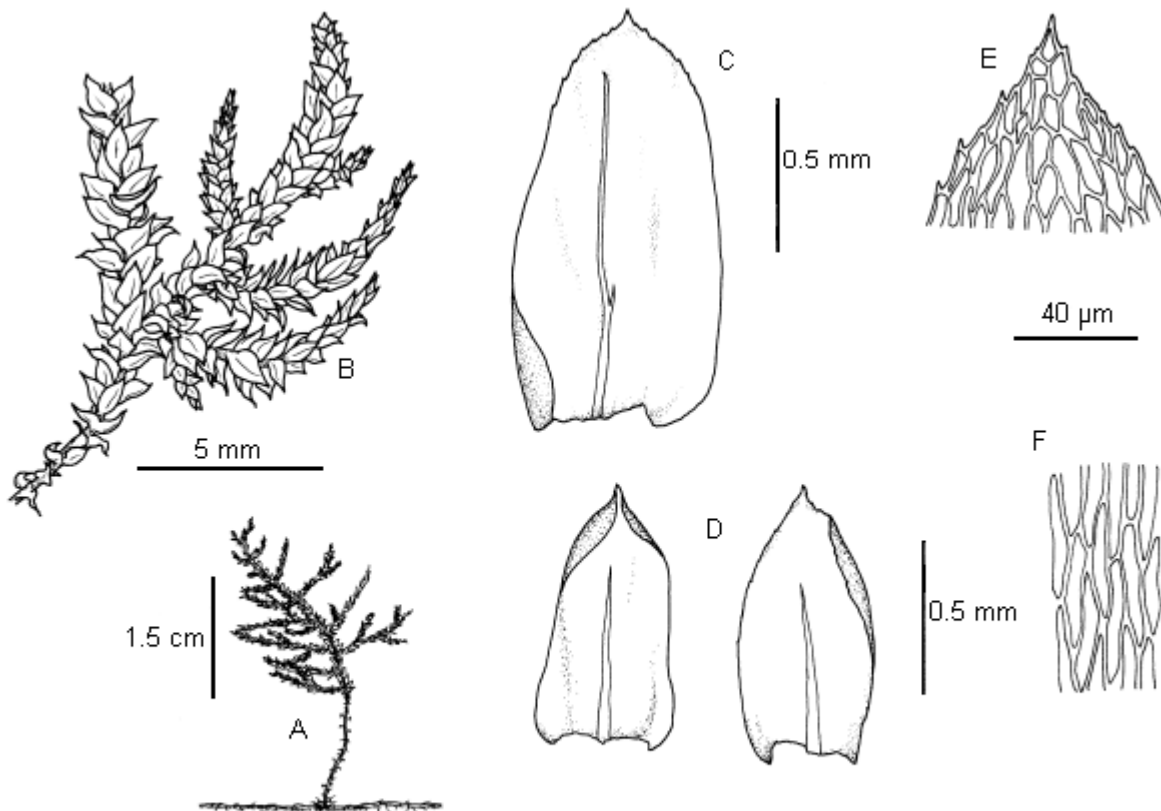
About nine species in sub-Saharan Africa.

**Plants** medium sized to large, forming loose, rarely dense, tufts, glossy to dull green, yellowish-green or golden. **Primary stems** creeping, leaves scale-like or eroded, radiculose. **Secondary stems** frondose, 2-10 cm tall, regularly to irregularly pinnately branched, flagelliform branches common; stipe short to long, leaves clasping to squarrose. **Secondary stem leaves** erect to erect-spreading, mostly ovate-oblong or -ligulate, 1-2.5 mm long, apex mostly broadly acute to obtuse, often apiculate; margins plane to recurved, serrate in distal 3/4 or less, serration often irregular, coarse; costa single, 1/2-3/4 lamina length, often with terminal abaxial spine; median cells fusiform-rhomboidal to oblong-linear, or occasionally shortly rectangular, smooth to papillose, papillae projecting at cell angles, variously porose throughout, or only at base, apical cells almost isodiametric to elongate rhomboidal or fusiform, basal cells linear to rectangular, alar region undifferentiated or differentiated, cells short-rectangular or subquadrate. **Branch leaves** often differentiated, or progressively so, smaller and often narrower. **Dioicous**. **Perichaetial leaves** oblong- or ovate-subulate. **Seta** elongate, 10-20(-30) mm long, smooth, yellow to reddish, dull. **Capsule** erect to horizontal, urn cylindrical, 1.5-2.5 mm long, stomata at urn base. **Operculum** short to long rostrate. **Peristome** with exostome teeth striate below to well under half their length, distally papillose; endostome basal membrane high, segments papillose, perforate, cilia rudimentary or absent. **Calyptra** cucullate, smooth and naked. **Spores** spherical, papillose.



# Guide to Bryophytes of sub-Saharan Africa

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***Porotrichum elongatum* (Welw. & Duby) A. Gepp**

Uganda: Hodgetts 4310a (E)

A: habit; B: portion of secondary stem with branches; C: secondary stem leaf; D: branch leaves;  
E: branch leaf apex; F: branch leaf mid-leaf cells.

*Habitat.* Epiphytic on trunks and branches of trees and saplings, occasionally on rocks or logs, in moist shaded sites; usually occurring in medium-altitude to montane forest, but has a wide altitudinal distribution, from near sea level to 3500 m.

*Discussion.* The genus is characterised by the frondose habit, short to long stipes bearing scale-like leaves, mostly irregularly pinnate with complanate-foliolate branches, mostly symmetric or not strongly asymmetric leaves, marginal serrations of 1(-2) cells, slender costa 1/2-3/4 leaf length, and almost isodiametric to elongate rhomboidal or fusiform apical cells. Sporophytes have only been occasionally observed among herbarium collections or in the field. Undoubtedly the primary means of reproduction and dispersal is by the rather fragile flagellate branches that are usually present. The species are described and illustrated by De Sloover (1983).

*Literature.* De Sloover, J.L. 1983. (see under *Porothamnium*).

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***Thamnobryum*** - to follow (added to this family after the above was written)

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# Guide to Bryophytes of sub-Saharan Africa

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## ORTHOTRICHACEAE

(J. Wilbraham, September 2008)

**Plants** small to robust, tufted or forming mats. **Corticolous**, saxicolous or rarely terricolous. Stems erect or creeping, variously branched, in section with central strand lacking. **Leaves** erect-appressed or variously twisted when dry, spreading to squarrose when wet, variously ovate, oblong or lanceolate, occasionally undulate or rugose, unistratose, bistratose or rarely multistratose; apex variable, rarely fragile; margins generally entire but can be toothed; **costa** always present, single, percurrent to excurrent; **upper laminal cells** usually small, rounded hexagonal or rarely short rectangular, flat to bulging, incrassate, smooth, unipapillose to pluripapillose; **basal laminal cells** quadrate, rectangular or linear, incrassate, smooth, papillose or tuberculate, alar cells not differentiated. **Gemmae** sometimes present. **Diocious or autoicous**. **Perigonia** lateral or terminal, bud-like, leaves strongly differentiated, short, concave. **Perichaetia** terminal on erect branches, leaves differentiated, oblong lanceolate to linear lanceolate. **Seta** short to elongate, usually smooth, often twisted. **Capsules** immersed to exserted, erect, ovoid to cylindrical, smooth or ribbed, stomata superficial or immersed. **Operculum** conic rostrate. **Peristome** single, double, reduced or absent, exostome of 16 teeth, free or fused into 8 pairs or forming a continuous membrane, endostome often reduced, smooth or papillose. **Calyptra** mitrate, campanulate or cucullate, often relatively large, smooth or plicate, lobate or lacerate, naked or hairy. **Spores** spherical, smooth or papillose, isosporous or anisosporous.

*Discussion.* The Orthotrichaceae are a large and diverse family of approximately 600 species which are distributed among 27 genera (Goffinet & Vitt 1998). Members of the family are predominately xerophytic and are usually found as epiphytes or growing on rocks. The Orthotrichaceae have a reduced and highly modified diplolepidous peristome that is variously altered across the family and often appears single due to the suppression of either the exostome or the endostome. Characteristics for the family are the small, isodiametric upper laminal cells which are often ornamented with papillae, the basal cells are usually elongated with the alar cells typically undifferentiated, the central strand of the stem is absent, the capsules are often ribbed and the calyptra is often relatively large, either mitrate, campanulate or cucullate.

The Orthotrichaceae contains the two sub-families Orthotrichoideae and Macromitrioideae, which are treated at family level by some authors (Churchill & Linares 1995).

*Literature.* **Churchill, S.P., Linares, C.E.L. 1995.** Prodrumus Bryologiae Novo-Granatensis. Introduction a la Flora de Musgos de Colombia. Parte 2. Bibliotheca 'Jose Jeronimo Triana' 12: 455–924. **Goffinet, B., Vitt, D.H. 1998.** Revised generic classification of the Orthotrichaceae based on a molecular phylogeny and comparative morphology. pp. 143–159 in Bryology for the twenty-first century. Eds. Bates, J.W., Ashton, N.W., Duckett, J.C. British Bryological Society. **Goffinet, B., Shaw, A.J., Cox, C. J., Wickett, N.J., Boles, S.B. 2004.** Phylogenetic inferences in the Orthotrichoideae (Orthotrichaceae, Bryophyta) based on variation in four loci from all genomes. pp. 270–289 in Molecular systematics of Bryophytes. Eds. Goffinet, B., Hollowell, V., Magill, R. Missouri Botanical Garden Press. **Vitt, D.H. 1982.** The genera of Orthotrichaceae. In P. Geissler & S. W. Greene (eds.), Bryophyte Taxonomy. Beihefte zur Nova Hedwigia 71: 261–268.

1. Plants in loose mats; primary stem prostrate with many erect to ascending branches; sporophytes usually produced on secondary branches (Subfamily Macromitrioideae)	2
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# Guide to Bryophytes of sub-Saharan Africa

1. Plants tufted or in cushions; primary stem erect, simple or sparsely branched; sporophytes produced on primary branches (Subfamily Orthotrichoideae)	7
2. Leaf apex obtuse, margin papillose-crenulate, papillae large, branched; setae twisted clockwise viewed from above	<b><i>Bryomaltaea</i></b>
2. Leaf apex acute, margin not papillose-crenulate, papillae if present small conical; setae twisted anticlockwise viewed from above	3
3. Dry leaves twisted-contorted, linear lanceolate with an ovate base, leaf base with margin of cells differentiated from inner cells	<b><i>Ulota</i></b>
3. Dry leaves crispate to flexuose, base not ovate, without distinct margin of differentiated cells	4
4. Gemmae frequent, on stems or rhizoids; capsule stomata superficial; peristome absent, single or double; calyptra cucullate, rarely hairy	5
4. Gemmae occasional, on leaf lamina or rarely on rhizoids; capsule stomata superficial or immersed; peristome double or rarely single; calyptra mitrate, hairy	6
5. Upper laminal cells papillose; peristome double or single, often rudimentary	<b><i>Zygodon</i></b>
5. Upper laminal cells smooth; peristome double	<b><i>Codonoblepharon</i></b>
6. Branch leaves contorted when dry; perichaetial leaves highly differentiated, hyaline below and enveloping the capsule	<b><i>Stoneobryum</i></b>
6. Branch leaves erect appressed when dry, rarely flexuose; perichaetial leaves not, or only slightly, differentiated, mostly chlorophyllose below	<b><i>Orthotrichum</i></b>
7. Basal laminal cells elongate, usually linear-rectangular, upper laminal cells short and rounded	8
7. Basal laminal cells short and rounded, similar to but somewhat larger than upper laminal cells	10
8. Leaves with a basal margin of elongate cells extending 1/4-1/5 lamina length, inner basal cells quadrate-rounded	<b><i>Groutiella</i></b>
8. Leaves with basal marginal cells similar to inner cells, without a distinct margin	9
9. Mid-leaf cells irregularly oriented or in vertical rows; calyptra mitrate, often plicate, deeply lobed, smooth or hairy; peristome lacking, single or double	<b><i>Macromitrium</i> subgenus <i>Macromitrium</i></b>
9. Mid-leaf cells somewhat rhomboid, in diagonal rows; calyptra campanulate, not plicate; peristome double, well developed	<b><i>Schlotheimia</i></b>
10. Upper laminal cells strongly papillose with tall conical papillae; cells of leaf decurrency large and inflated	<b><i>Cardotiella</i></b>
10. Upper laminal cells smooth to bulging or weakly papillose; cells of leaf decurrency not inflated	11
11. Branch leaves contorted when dry, with adventitious filaments from basal cells;	<b><i>Macromitrium</i> subgenus</b>

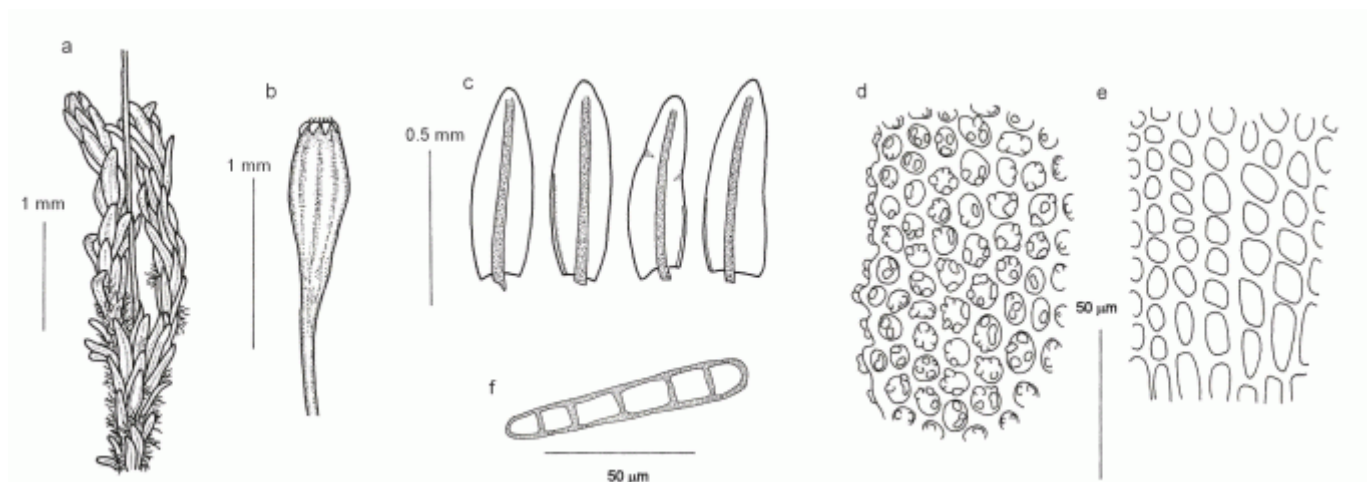
# Guide to Bryophytes of sub-Saharan Africa

seta papillose; capsule urn-like	<b>Cometium</b>
11. Branch leaves erect appressed to loosely twisted when dry, lacking adventitious filaments from basal cells; seta smooth; capsule cylindrical	<b>12</b>
12. Branch leaves with mostly acute apices, upper laminal cells smooth or unipapillose	<b>Macrocoma</b>
12. Branch leaves with mostly rounded, obtuse apices, upper laminal cells unipapillose or with 2 to 3 papillae per cell	<b>Leiomitrium</b>

## **Bryomaltaea** Goffinet

A monospecific genus with *B. obtusifolia* recorded in Africa from Democratic Republic of Congo (former Zaire).

**Plants** small, dark green above, red-brown below, forming dense tufts. **Stems** frequently branched, 5–10 mm tall, rhizoids well developed, red-brown. **Leaves** erect-appressed when dry, erecto-patent when moist, ovate-oblong with obtuse apex, slightly concave, 0.5–0.9 mm long, leaf base not decurrent; margin papillose-crenulate, lower two thirds of leaf often recurved; costa broad, ending below leaf apex, costal guide cells ventral with a few thick walled cells below; upper lamina cells irregular rounded, thick walled, with large, branched papillae; basal laminal cells weakly differentiated, slightly papillose, larger, thinner walled. **Gemmae** often present, 3–6 cells long, ellipsoid, green. **Autoicous**. **Perigonia** bud like, leaves broadly ovate in lower half, upper half lingulate. **Perichaetial** leaves more oblong and slightly longer than stem leaves. **Seta** 3–4 mm long, twisted clockwise when viewed from above. **Capsule** ovoid to cylindrical, < 1 mm, with eight wide ridges. **Calyptra** cucullate, smooth. **Peristome** double, exostome teeth 16 united into 8 teeth pairs. **Spores** densely papillose.



***Bryomaltaea obtusifolia*** (Hook.) Goffinet. **A:** Habit (dry). **B:** Capsule. **C:** Branch leaves **D:** Upper laminal cells. **E:** Basal laminal cells. **F:** Gemma. Drawn from *Touw 9800*, Thailand (BM).

**Habitat.** Epiphytic, or rarely on rocks. Somewhat temperate in distribution and found growing at higher altitudes in the tropics.

# Guide to Bryophytes of sub-Saharan Africa

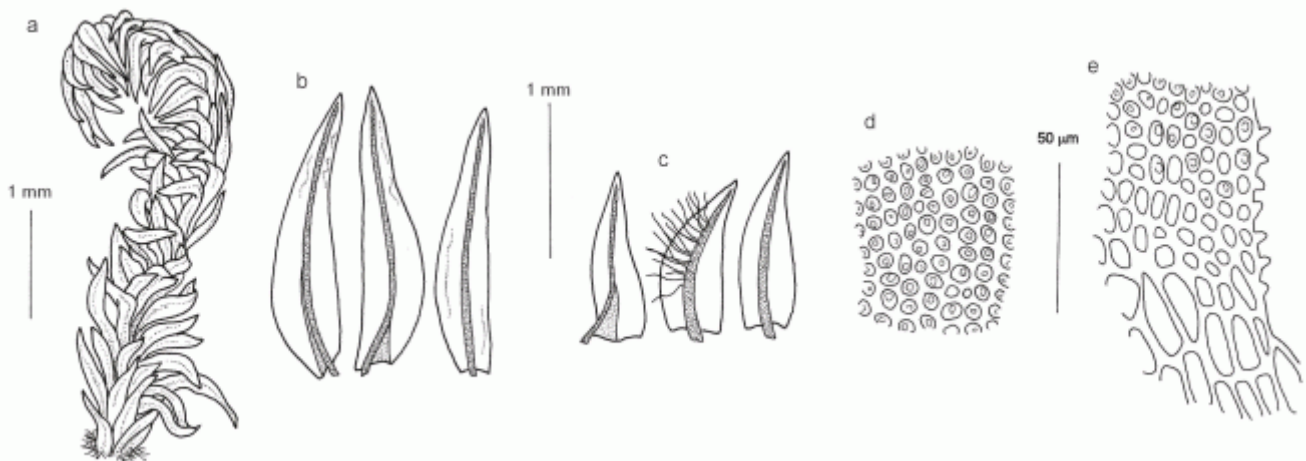
*Discussion.* This distinctive plant is characterised by the small leaves with a broadly obtuse apex and the large, branched papillae of the laminal cells. *Bryomaltaea* is widely distributed from Mexico, Central and South America, Australia and Asia, though only one collection has been recorded in the literature from Africa (Leroy 1947).

*Literature:* Goffinet, B, Vitt, D.H. 1998. Revised generic classification of the Orthotrichaceae based on a molecular phylogeny and comparative morphology. pp. 143–159 in Bates, J.W., Ashton, N.W., Duckett, J.C. 1998. Leroy, V. 1947. Récoltes Bryologiques au Congo Belge et au Ruanda-Urundi. *Bulletin Jardin Botanique Bruxelles* 18: 155–206.

## *Cardotiella* Vitt

A genus of six species, four of which are endemic to the East African islands of Madagascar, Réunion and Mauritius, one is endemic to South Africa and one species is known from the Neotropics.

**Plants** medium sized, forming coarse intertwining mats, green to yellowish or brownish green. **Stems** creeping, tomentose, branches stiff, ascending and curved, rhizoids numerous on older stems and occasionally at leaf bases. **Branch leaves** crowded, erect-appressed, somewhat secund when dry or flexuose, spreading when wet, in 4 or 5 rows, often rugose, ovate-lanceolate, to 2 mm long, apices short acuminate, often bluntly so, long decurrent; margins entire to dentate by projecting cell papillae, recurved below; costa single, strong below, ending below apex, upper laminal cells quadrate-rounded, unipapillose or rarely smooth, incrassate; basal cells similar; decurrency cells inflated, often tuberculate, hyaline. **Stem leaves** smaller, lanceolate. **Sporophytes** rare. **Dioicous.** **Perigonia** lateral, bud like, leaves broadly ovate-apiculate. **Perichaetia** terminal on branches, leaves ovate-subulate to oblong-subulate. **Seta** short, smooth. **Peristome** double, 16 exostome teeth, partly fused to form 8 pairs, somewhat papillose, endostome segments 8-16, alternating with teeth. **Capsule** exserted, erect, elliptic, 8-ribbed; stomata superficial. **Operculum** conic-rostrate. **Calyptra** mitrate-campanulate, lobed at base, smooth to sparsely hairy. **Spores** minutely papillose.



*Cardotiella secunda* (Müll.Hal) Vitt. **A:** Habit (dry). **B:** Branch leaves. **C:** Stem leaves. **D:** Upper laminal cells. **E:** Basal laminal cells. Drawn from *Eddy & Sims 7139*, South Africa (BM).

# Guide to Bryophytes of sub-Saharan Africa

**Habitat.** The South African species *Cardotiella secunda* is known to occur at low altitudes (20–760m), growing on trees or rarely on rocks, in forests of the Fynbos and Savannah (van Rooy & van Wijk 1992). Ecological information on this genus in the East African Islands is somewhat limited.

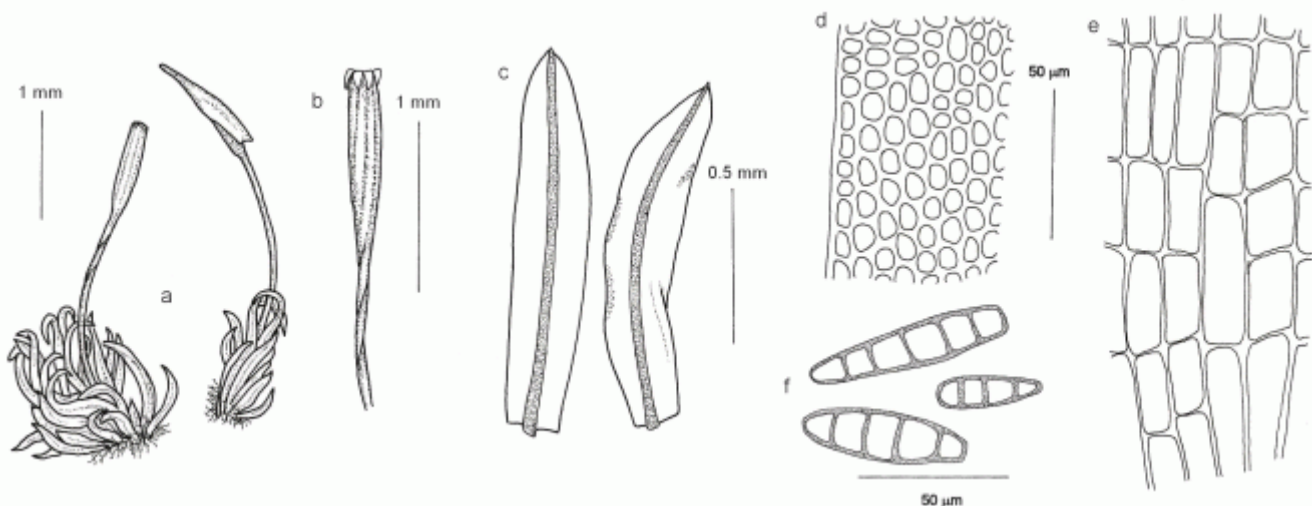
**Discussion.** *Cardotiella* is distinguished by the creeping stems, branch leaves short ovate-lanceolate, laminal cells quadrate-rounded, often unipapillose and with long decurrent leaf bases of inflated, tuberculate cells, the well-developed peristome and the large mitrate, basally lobed calyptra.

**Literature.** Goffinet, B. 1996. *Cardotiella elimbata* (Thér.) Goffinet *comb. nov.* and *C. appendiculata* new to Mauritius (Musci, Orthotrichaceae). *Bryologist* 99: 390–396. Magill, R.E., Van Rooy, J. 1998. Flora of Southern Africa. Bryophyta. Part 1. Mosses. Fasc. III. Erpodiaceae – Hookeriaceae. In: Leistner OA, Flora of Southern Africa. Republic of South Africa: Botanical Research Institute, Department of Agriculture and Fisheries. Van Rooy, J., Van Wijk, A.E. 1992. A conspectus of the Subfamily Macromitrioideae (Bryopsida: Orthotrichaceae) in Southern Africa. *Bryologist* 95(2): 205–215. Vitt, D.H. 1981. The genera *Leiomitrium* and *Cardotiella* gen. nov. (Orthotrichaceae). *Journal of the Hattori Botanical Laboratory* 49: 93–113.

## **Codonoblepharon** Schwägr.

A genus of eight species, three of which are known from Africa.

**Plants** small to medium sized, occasionally robust, forming rather dense tufts, green to reddish or golden-brown. **Stems** mostly erect, occasionally subscending, simple or sparsely branched, rhizoids red-brown. **Leaves** erect to suberect, contorted or slightly crispate when dry, spreading to squarrose-recurved when wet, oblong, elliptical to oblong-lanceolate or -linear, 0.8–2.7 mm long, apex acute to acuminate to apiculate, margins plane or recurved below, entire to distally toothed, often sharply so, not decurrent; costa single, subpercurrent to shortly excurrent; upper laminal cells smooth, quadrate- to hexagonal-rounded; basal laminal cells larger, mostly rectangular, firm-walled or lax and mostly hyaline. **Gemmae** frequently produced, fusiform. **Autoicous**, dioicous or synoicous. **Perichaetia** terminal, leaves little differentiated or much longer than branch leaves. **Seta** smooth, 2.5–6 mm long, twisted anticlockwise when viewed from above. **Capsule** erect, urn subcylindrical to narrowly pyriform, 8-ribbed, neck short tapered; stomata superficial at base; annulus present and persistent. **Operculum** conic-rostrate. **Peristome** double, consisting of 16 paired and reflexed exostome teeth with erect endostomes. **Calyptra** cucullate, naked or sparsely hairy. **Spores** smooth.



**Codonoblepharon microtheca** (Dixon ex Malta) Matcham & O'Shea. **A:** Habit (dry). **B:** Capsule.

# Guide to Bryophytes of sub-Saharan Africa

**C:** Branch leaves. **D:** Upper laminal cells. **E:** Basal laminal cells. **F:** Gemmae. Drawn from *Eddy & Sims, 7104*, South Africa (BM).

*Habitat.* Epiphytic on trees or growing on rocks, often in montane habitats.

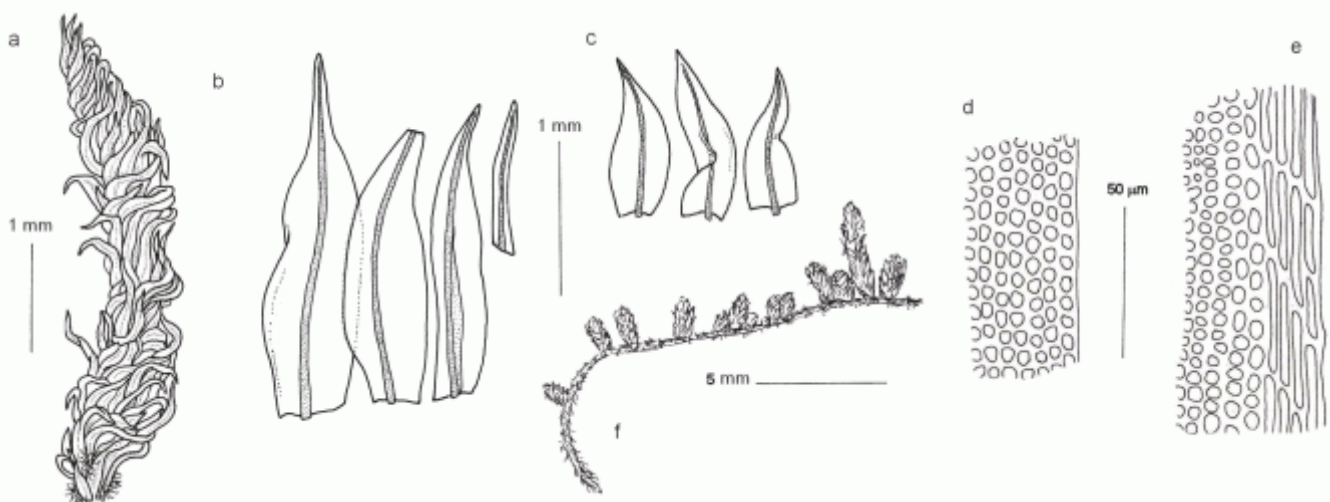
*Discussion.* The genus *Codonoblepharon* was resurrected by Goffinet & Vitt (1998) and incorporates the smooth celled members of *Zygodon* section *Bryoides*. *Codonoblepharon* is distinguished from *Zygodon* by its smooth laminal cells, double peristome and smooth spores. It has a widespread, scattered distribution, with *C. microtheca* being the most common member of this genus in Africa.

*Literature.* **Goffinet, B., Vitt, D.H. 1998.** Revised generic classification of the Orthotrichaceae based on a molecular phylogeny and comparative morphology. pp. 143–159 in *Bryology for the twenty-first century*. Eds. Bates, J. W., Ashton, N. W., Duckett, J. C. British Bryological Society. **Matcham, H.W., O'Shea, B.J. 2005.** A review of the genus *Codonoblepharon* Schwägr. (Bryopsida: Orthotrichaceae). *Journal of Bryology* 27: 129–135

## *Groutiella* Steere

A genus primarily distributed in the Neotropics with only two species recorded for Africa.

**Plants** medium sized, forming dense mats, brownish green to dull green. **Primary stems** creeping with numerous short erect branches, densely tomentose. **Branch leaves** contorted when dry and irregularly twisted around the stem, spreading when wet, oblong-ligulate to oblong-lanceolate, smooth, rugose or undulate, apex obtuse, mucronate or acute to acuminate, or ending in a fragile, deciduous subula; margins plane to undulate, entire; costa single, ending below apex to shortly excurrent; upper laminal cells quadrate-rounded to suboval, smooth or mammillate-bulging, basal laminal cells with a distinct margin of elongated cells, inner basal cells oblong to short rectangular-rounded, often tuberculate. **Stem leaves** differentiated in shape and size from branch leaves. **Sporophytes** rare in Africa. **Dioicous**. **Perichaetia** terminal on branches, leaves usually undifferentiated. **Seta** elongate, stout, smooth. **Capsule** erect, urn ovoid or obloid elongate, neck short; stomata at urn base, superficial. **Operculum** long-rostrate. **Peristome** reduced to a low membrane and papillose, or appearing absent. **Calyptra** mitrate, naked, plicate or smooth. **Spores** isosporous or anisosporous, smooth to densely papillose.



***Groutiella laxotorquata*** (Müll.Hal. ex Besch.) Wijk & Margad. **A, F:** Habit (dry). **B:** Branch leaves.

# Guide to Bryophytes of sub-Saharan Africa

**C:** Stem leaves. **D:** Upper laminal cells. **E:** Basal laminal cells. Drawn from O'Shea U2672a, Uganda (BM).

*Habitat.* On tree trunks, logs, and occasionally on rocks; wet lowland to low montane forests, 1000–2040 m.

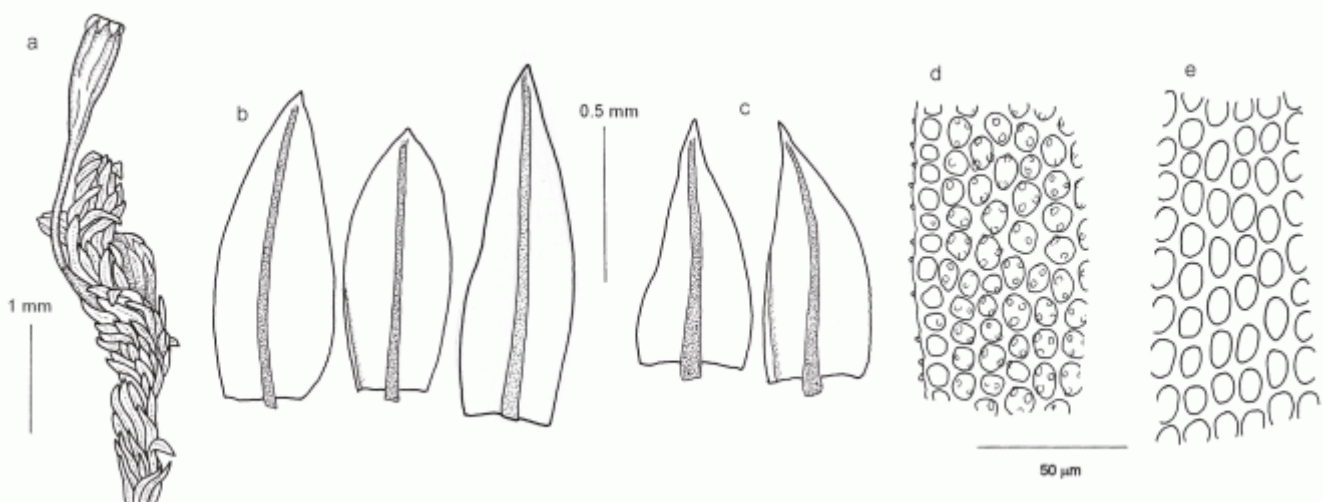
*Discussion.* The elongate laminal cells bordering the lower leaf margins are diagnostic for separating *Groutiella* from other genera in the *Macromitrium* complex. *Groutiella laxotorquata* Besch. is the widespread species of *Groutiella* found in Africa.

*Literature.* Allen, B. 2002. *The Moss flora of Central America, Part 2. Encalyptaceae –Orthotrichaceae*. St Louis: Missouri Botanic Garden [Generic description and illustrations]. Wilbraham, J. 2008. Bryophyte Flora of Uganda. 8. Orthotrichaceae, Part 1. Macromitrioideae. *Journal of Bryology* 30: 201–207.

## *Leiomitrium* Mitt.

Consisting of the single species *Leiomitrium plicatum*, which is restricted to the Mascarene Islands.

**Plants** slender, forming in tangled mats. **Stems** creeping with numerous branches, erect curved to horizontally spreading. **Branch leaves** imbricate, loosely erect to flexuose erect, lanceolate to broadly oblong, obtuse, 0.8–1.5 mm long, occasionally with small mucro, upper laminal cells bulging, unipapillose or with 2–3 papillae per cell, simple or sometimes forked, basal cells rounded, bulging, smooth or unipapillose, costa broad, ending below apex. **Stem leaves** loosely erect to flexuose erect, ovate lanceolate, shortly acuminate to acute, upper laminal cells bulging, smooth, unipapillose or rarely 2–3 papillae per cell, papillae conical or forked, basal cells similar, bulging smooth, costa ending below apex. **Dioicous**. **Perichaetial** leaves similar to vegetative leaves. **Seta** stout, erect, with very long ochrea. **Capsule** exserted, cylindrical, strongly eight ribbed, stomata in lower part of capsule, superficial. **Peristome** diplolepidous, exostome of 8 teeth, often partially divided into 16, reflexed teeth, endostome of 8–16 short segments. **Calyptra** mitrate, plicate, hairy. **Spores** papillose.



*Leiomitrium plicatum* (P.Beauv.) Mitt. **A:** Habit (dry). **B:** Branch leaves. **C:** Stem leaves. **D:** Upper laminal cells. **E:** Basal laminal cells. Drawn from Balfour s.n., Rodriguez (BM).

*Habitat.* Limited ecological information available.



# Guide to Bryophytes of sub-Saharan Africa

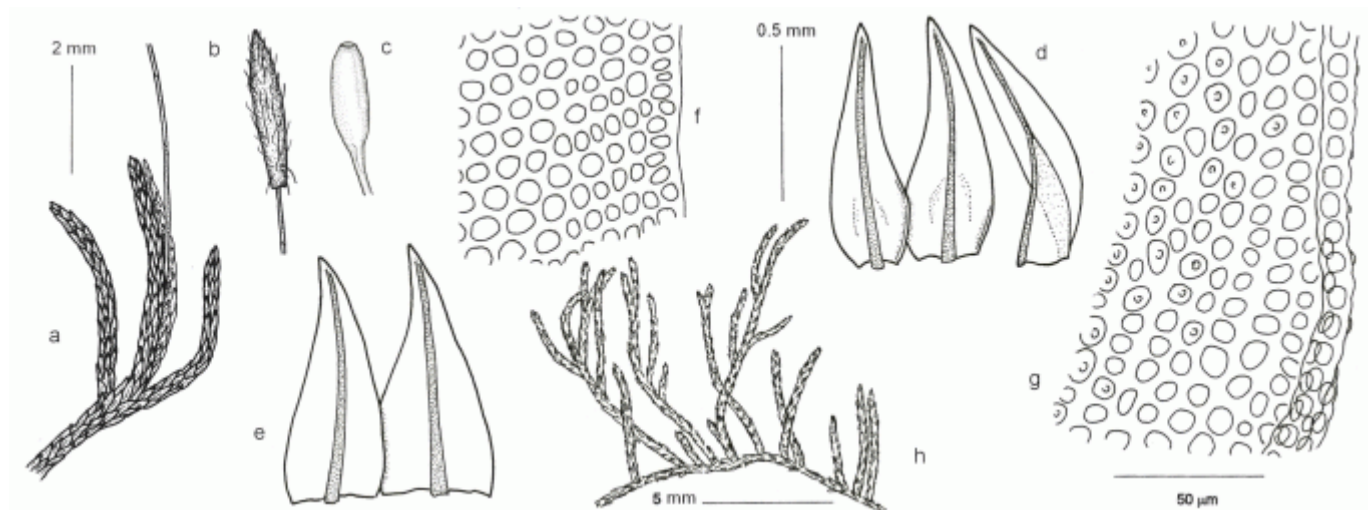
*Discussion.* *Leiomitrium* is closely related to *Macrocoma*, from which it is distinguished by the rounded obtuse branch leaves, and the papillose upper laminal cells. N.B. the shape of the branch leaves can vary greatly even on the same shoot.

*Literature.* Vitt, D.H. 1981. The Genera *Leiomitrium* and *Cardotiella* Gen. Nov. (Orthotrichaceae). *Journal of the Hattori Botanical Laboratory* 49: 93–113.

## **Macrocoma** (Hornsch. ex Müll.Hal.) Grout

A genus of eleven species, five of which are found in Africa. Rather widespread in the subtropics and tropics, extending into the temperate regions of both hemispheres.

**Plants** small to medium-sized, forming mats, dark green to golden-brown. **Stems** creeping, branches erect, slender, irregularly branched. **Branch leaves** closely appressed or occasionally slightly flexuose when dry, not contorted, erect-spreading to squarrose when wet, lanceolate to ovate-lanceolate, unistratose or bistratose; apex narrowly obtuse, acute to acuminate; margins plane often recurved below, entire to crenulate; costa single, prominent, ending below apex; *upper laminal cells* rounded, quadrate, flat or bulging; *basal laminal cells* rounded, short rectangular to elliptic, bulging, often with tuberculae. **Stem leaves** similar to branch leaves or differentiated. **Autoicous** or dioicous. **Perigonia** terminal or lateral, leaves broadly ovate apiculate. **Perichaetia** terminal on short branches, leaves usually oblong lanceolate. Seta elongate, to 8 mm long, smooth. **Capsule** erect, urn cylindrical, smooth or lightly 8-ribbed; stomata at urn base, superficial. **Operculum** conic short to long-rostrate. Peristome double, single or absent, exostome of 16 teeth, usually reduced, endostome of 16 segments, usually forming a low membrane. **Calyptra** large, mitrate, smooth or weakly plicate, naked to densely hairy. **Spores** papillose, isosporous.



**Macrocoma tenuis ssp. tenuis** (Hook. & Grev.) Vitt. **A, H:** Habit (dry). **B:** Capsule with calyptra. **C:** Capsule. **D:** Branch leaves. **E:** Stem leaves. **F:** Upper laminal cells. **G:** Basal laminal cells. Drawn from *Miehe U31-10750-05*, Uganda (BM).

*Habitat.* Epiphytic, on branches and trunks of shrubs and trees, rarely on rocks. *Macrocoma* typically occurs in savannas, woodlands and forests, 900–4000 m.

# Guide to Bryophytes of sub-Saharan Africa

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*Discussion.* The genus is distinguished by the creeping habit with slender branches, costa ending well below apex, upper and lower laminal cells similar, smooth to weakly unipapillose, the mostly rudimentary peristome and the large mitrate calyptra.

*Literature.* **Magill, R.E., Vitt, D.H. 1981.** The phytogeography and ecology of *Macrocoma* (Orthotrichaceae, Musci) in Africa. *Bothalia* 13: 463–466. **Van Rooy, J., Van Wijk, A.E. 1992.** A conspectus of the Subfamily Macromitrioideae (Bryopsida: Orthotrichaceae) in Southern Africa. *Bryologist* 95(2): 205–215. **Vitt, D.H. 1973.** A revisionary study of the genus *Macrocoma*. *Revue Bryologique et Lichénologique* 34: 205–220 [keys, illustrations]. **Vitt, D.H. 1980.** The nomenclature and taxonomy of *Macrocoma lycopodioides* (Schwägr.) Vitt. *Journal of Bryology* 11: 219–229 [includes key to African species of *Macrocoma*]. **Vitt, D.H. 1980a[1981].** The genus *Macrocoma* I. Typification of names and taxonomy of the species. *Bryologist* 83: 405–436. **Vitt, D.H. 1980b[1981].** The genus *Macrocoma* II. Geographical variation in the *Macrocoma tenue* - *M. sullivantii* species complex. *Bryologist* 83: 437–450. **Wilbraham J. 2007.** Taxonomic notes on the pantropical genera *Macromitrium* and *Macrocoma*. *Journal of Bryology* 29: 54–59.

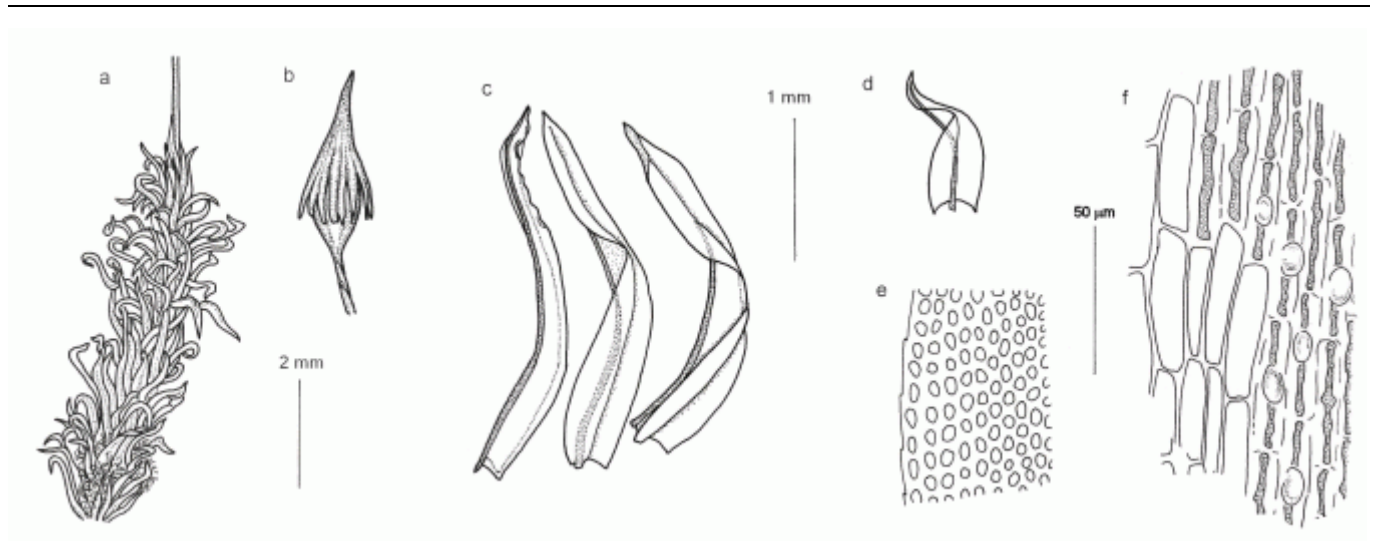
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## **Macromitrium** Brid.

A large genus of about 250 species. Approximately 54 species are recorded for Africa, though it is possible that only half of these are justified names. *Macromitrium* is widely distributed in the tropics and Southern Hemisphere.

**Plants** mostly medium-sized to large and robust, occasionally small, forming loose to dense mats or tufts, dark green to reddish-brown or golden. **Stems** short to long creeping, leaves often inconspicuous and hidden in dense tomentum, branches short to long erect. **Branch leaves** variously contorted, usually crispate and often spirally twisted, erect-spreading to spreading when wet, linear-lanceolate, oblong-lanceolate to lingulate, 1.5–4.8 mm long, apex obtuse or acute to short or long acuminate, rarely fragile; margins plane to recurved below, smooth to dentate at apex; costa single, subpercurrent to shortly excurrent; upper laminal cells thick-walled, median cells oval, rounded-subquadrate or elongate (e.g., in apices), smooth, bulging mammillose or papillose; basal cells often elongate and narrow, often tuberculate or papillose, occasionally smooth, often porose. **Stem leaves** similar to branch leaves or differentiated. **Dioicous** or autoicous, dwarf males occasional. **Perichaetia** terminal on stems or appearing on terminal branches, leaves differentiated or not. **Seta** elongate, erect to slightly flexuose, smooth or roughened. **Capsule** exserted, erect, urn subglobose to ovoid-cylindrical, smooth to furrowed or ribbed; stomata at base, superficial. **Operculum** short- to long-rostrate, erect or oblique. **Peristome** often rudimentary, absent, single or double, exostome often truncate and papillose; endostome membranous. **Calyptra** large, mitrate, base often lacerate, plicate, naked or sparsely to densely hairy. **Spores** papillose, isosporous or anisosporous.

# Guide to Bryophytes of sub-Saharan Africa



**Macromitrium sulcatum** (Hook.) Brid. **A:** Habit (dry). **B:** Capsule with calyptra. **C:** Branch leaves

**D:** Stem leaves. **E:** Upper laminal cells. **F:** Basal laminal cells. Drawn from O'Shea U5447a, Uganda (BM).

*Habitat.* Epiphytic, on trunks and branches of trees and shrubs, frequent in the canopy, occasionally on rocks; wet lowland forest to more montane forests, 500–3000 m.

*Discussion.* *Macromitrium* is distinguished by the creeping primary stem with numerous erect bushy branches, branch leaves variously contorted when dry, elongate basal cells that are often tuberculate, the large mitrate calyptra and reduced peristome. *Macromitrium* sub-genus *Cometium*, represented in Africa by *M. orthostichum*, has many features which differentiate it from other members of *Macromitrium*, such as the slender filiform habit and branch leaves with short basal cells. *Macromitrium sulcatum* is the most commonly found member of the genus in Africa. A critical revision of the African *Macromitrium* is urgently needed and will greatly reduce the number of currently accepted names.

*Literature.* Magill, R.E., Van Rooy, J. 1998. Flora of Southern Africa. Bryophyta. Part 1. Mosses. Fasc. III. Erpodiaceae – Hookeriaceae. In: Leistner OA, Flora of Southern Africa. Republic of South Africa: Botanical Research Institute, Department of Agriculture and Fisheries. Van Rooy, J, Van Wijk, A.E. 1992. A conspectus of the subfamily Macromitrioideae (Bryopsida: Orthotrichaceae) in Southern Africa. *Bryologist* 95(2): 205–215. Van Rooy J. 1990. A new species and a new record of *Macromitrium* (Orthotrichaceae) from southern Africa: *M. lebomboense* sp. nov. and *M. richardii* Schwägr. *Journal of Bryology* 16: 209–214. Wilbraham J. 2007. Taxonomic notes on the pantropical genera *Macromitrium* and *Macrocoma*. *Journal of Bryology* 29: 54–59.

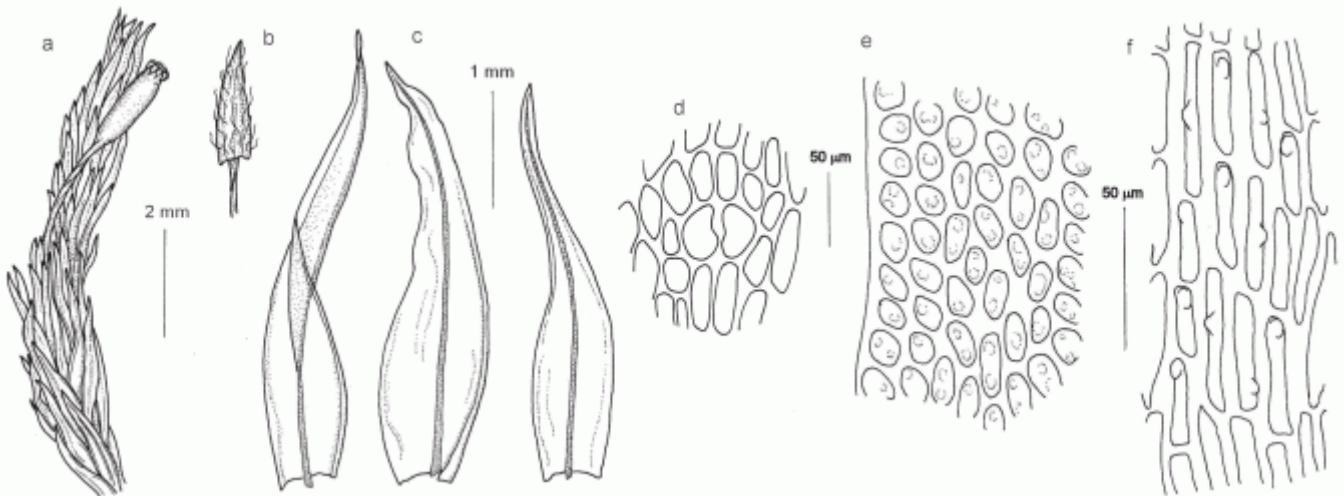
## **Orthotrichum** Hedw.

A widely distributed genus of 116 species, with 15 species known from Africa.

**Plants** mostly medium sized, forming loose to dense tufts, olive- or yellowish-green, brown below. **Stems** erect, sparsely branched, radiculose below. **Leaves** appressed to erect, occasionally flexuose when dry, erect-spreading to spreading when wet, narrowly lanceolate to oblong- or ovate-lanceolate, 0.8–5.5 mm long, often keeled distally, acuminate to acute or rounded, rarely apiculate, base undifferentiated or short decurrent; margins plane to more often recurved, occasionally undulate or flexuose, generally entire or denticulate at apex; costa single, usually strong, ending below apex, rarely excurrent; upper laminal cells mostly thick-walled, apical cells oval to elongate;

# Guide to Bryophytes of sub-Saharan Africa

median cells isodiametric to oblong, entire to nodose, papillose, papillae simple or branched; basal cells short to long rectangular, smooth, thin- to thick-walled, entire, nodose or porose; alar cells rarely differentiated, subquadrate-rounded. **Gemmae** occasionally present on leaves, short cylindrical. **Autoicous**. **Perichaetia** terminal; leaves not, or only slightly, differentiated. **Seta** short to elongate, 0.3–9.0 mm long, smooth, often twisted anticlockwise viewed from above. **Capsule** immersed to somewhat long exserted, erect, urn oblong-ovoid cylindrical, often ribbed; stomata on lower half of urn, immersed or superficial. **Operculum** plano-convex, apiculate. **Peristome** double (rarely reduced and single), erect or reflexed when dry, exostome teeth 8 pairs, often splitting into 16, papillose, rarely smooth; endostome often reduced, 8 or 16 segments, smooth, papillose or striate. **Calyptra** mitrate, mostly plicate, rarely smooth, sparsely to densely hairy, or surface roughened, base entire or sometimes split into separate lobes. **Spores** papillose.



***Orthotrichum arborescens*** Thér. & Naveau. **A:** Habit (dry). **B:** Capsule with calyptra. **C:** Branch leaves. **D:** Superficial stomata in capsule wall. **E:** Upper laminal cells. **F:** Basal laminal cells. Drawn from *Miehe U2610742-02*, Kenya (BM).

**Habitat.** Mostly epiphytic on branches and trunks, occasionally on rocks; at lower latitudes mostly 1000–5000 m.

**Discussion.** The genus is characterized by the erect stems with typically erect - appressed leaves, capsules often ribbed, immersed to shortly exserted, stomata immersed or superficial and the often plicate, mitrate, hairy calyptra. Sporophytes are often essential for the identification of *Orthotrichum* species. An excellent treatment of the genus in Africa is given by Lewinsky (1978).

**Literature.** **Lewinsky, J. 1978.** The genus *Orthotrichum* Hedw. (Musci) in Africa south of the tropic of Cancer. *Botanisk Tidsskrift* 72: 61–85 [Keys, descriptions and illustrations]. **Lewinsky, J., Van Rooy, J. 1990.** New species and a new record of *Orthotrichum* from southern Africa: *O. incurvomarginatum* sp. nov., *O. armatum* sp. nov., *O. oreophilum* sp. nov. and *O. firmum* Vent. *Journal of Bryology* 16: 67–78. **Lewinsky, J. 1993.** A synopsis of the genus *Orthotrichum* Hedw. (Musci, Orthotrichaceae). *Bryobrothera* 2: 1–59.

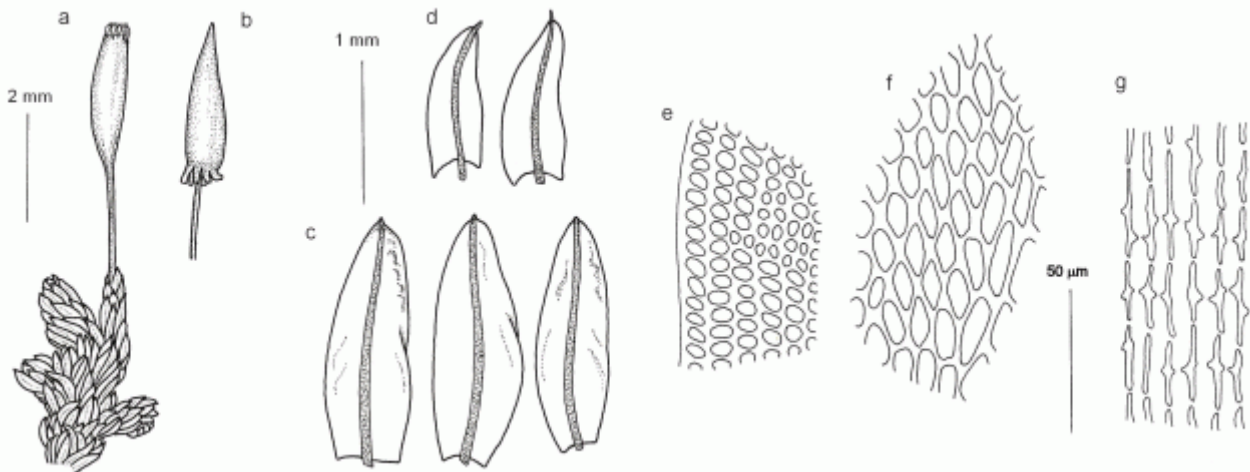
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## ***Schlotheimia*** Brid.

The genus is characterized by the erect stems with typically erect-appressed leaves, capsules often ribbed, immersed to shortly exserted, stomata immersed or superficial and the often plicate, mitrate, hairy calyptra. Sporophytes are often essential for the identification of *Orthotrichum* species. An excellent treatment of the genus in Africa is given by Lewinsky (1978)

# Guide to Bryophytes of sub-Saharan Africa

**Plants** medium sized to large, forming dense mats, greenish brown to rusty brown. **Stems** creeping, with erect bushy branches. **Branch leaves** appressed and often spirally coiled around the stem when dry, erect-spreading when wet, ovate-oblong, ligulate, or oblong-acuminate, unistratose, often rugose; apex rounded-obtuse, acute, cuspidate or mucronate; margins plane or recurved below, entire; costa strong, often channelled, ending below apex to shortly excurrent; upper laminal cells rounded, incrassate, smooth, median cells often rhomboidal; basal laminal cells homogenous, narrowly rectangular, incrassate, pitted. **Stem leaves** usually smaller than branch leaves, ovate-lanceolate, costa percurrent, shortly excurrent or aristate. **Dioicous**, often producing dwarf male plants. **Perigonia** terminal. **Perichaetia** terminal on short lateral branches, leaves often differentiated. **Seta** short to elongate, 2–12 mm long, smooth. **Capsule** exserted, erect, ovoid to ovoid-cylindrical, 1.5–3.0 mm long; stomata at capsule base, superficial, or occasionally appearing immersed. **Operculum** short- to long-rostrate. **Peristome** well developed, double, exostome of 16 teeth, reflexed when dry, papillose, endostome segments alternating with exostome teeth, shorter than exostome. **Calyptra** large, campanulate, covering whole of capsule, naked, lobed below. **Spores** papillose, isosporous or anisosporous.



***Schlotheimia ferruginea*** (Bruch ex Hook. & Grev.) Brid. **A:** Habit (dry). **B:** Capsule with calyptra.

**C:** Branch leaves **D:** Stem leaves. **E:** Upper laminal cells. **F:** Mid-laminal cells. **G:** Basal laminal cells. Drawn from O'Shea U2882a, Uganda, (BM).

**Habitat.** Epiphytic on tree trunks and branches, also on logs and rocks. Occurs in semi-dry to more commonly in wet lowland to mid montane forests, 900–2600 m.

**Discussion.** The genus is characterised by crowded rugose branch leaves that are twisted to spirally twisted around the branch when dry, the large, naked, basally lobed, bell shaped calyptra and the well developed double peristome. Examination of the stem leaves, with regard to the excurrency of the costa, is important for determination of African specimens. *Schlotheimia* is in need of critical study in Africa, particularly on the East African Islands where a large number of names have been described.

**Literature.** Magill, R.E., Van Rooy, J. 1998. Flora of Southern Africa. Bryophyta. Part 1. Mosses. Fasc. III. Erpodiaceae – Hookeriaceae. In: Leistner OA, Flora of Southern Africa. Republic of South Africa: Botanical Research Institute, Department of Agriculture and Fisheries. Van Rooy, J., Van Wijk, A.E. 1992. A conspectus of the subfamily Macromitrioideae (Bryopsida: Orthotrichaceae) in Southern Africa. *Bryologist* 95(2): 205–215. Wilbraham, J. 2008. New synonymy and typification in African *Schlotheimia* (Orthotrichaceae). *Journal of Bryology* 30: 196–200.

# Guide to Bryophytes of sub-Saharan Africa

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**Stoneobryum** D.H.Norris & H.Rob.

Two species have been placed in this genus; *S. mirum* is known only from South Africa and *S. bunyaense* is found in Australia.

**Plants** small, tufted cushions, up to 15 mm tall. **Stems** tomentose below, rhizoids red-brown. **Leaves** larger above, 2.2–3.0 mm long, sheathing base, crispate when dry, oblong to oblong-lingulate; *costa* section scarcely differentiated; *upper laminal cells* rounded-hexagonal, incrassate, smooth to slightly mammillose; *basal cells* rectangular, thin walled to incrassate, smooth, rarely papillose. **Diocious**. **Perigonia** lateral, gemmate. **Perichaetia** terminal, leaves highly differentiated, hyaline, erect, enveloping capsule. **Seta** very short. **Capsule** immersed, ribbed, stomata immersed. **Peristome** double, exostome teeth in 8 pairs, endostome alternating with teeth pairs. **Calyptra** small, mitrate, hairy. **Spores** round, minutely papillose.

[**Stoneobryum mirum** (Lewinsky) D.H. Norris & H. Rob. - Waiting for specimen....]

*Habitat.* Epiphytic.

*Discussion.* *Stoneobryum* is distinguished by the highly differentiated, hyaline perichaetial leaves enveloping the capsule. It is considered close to *Orthotrichum* based on the immersed stomata, though the crispate leaves of *Stoneobryum mirum* give the plant a superficially *Ulota*-like appearance.

*Literature.* **Magill, R.E., Van Rooy, J. 1998.** Flora of Southern Africa. Bryophyta. Part 1. Mosses. Fasc. III. Erpodiaceae – Hookeriaceae. In: Leistner OA, Flora of Southern Africa. Republic of South Africa: Botanical Research Institute, Department of Agriculture and Fisheries. **Norris, D.H, Robinson, H. 1981.** *Stoneobryum*, a new genus of Orthotrichaceae from South Africa and southern Queensland. *Bryologist* 84: 95–99.

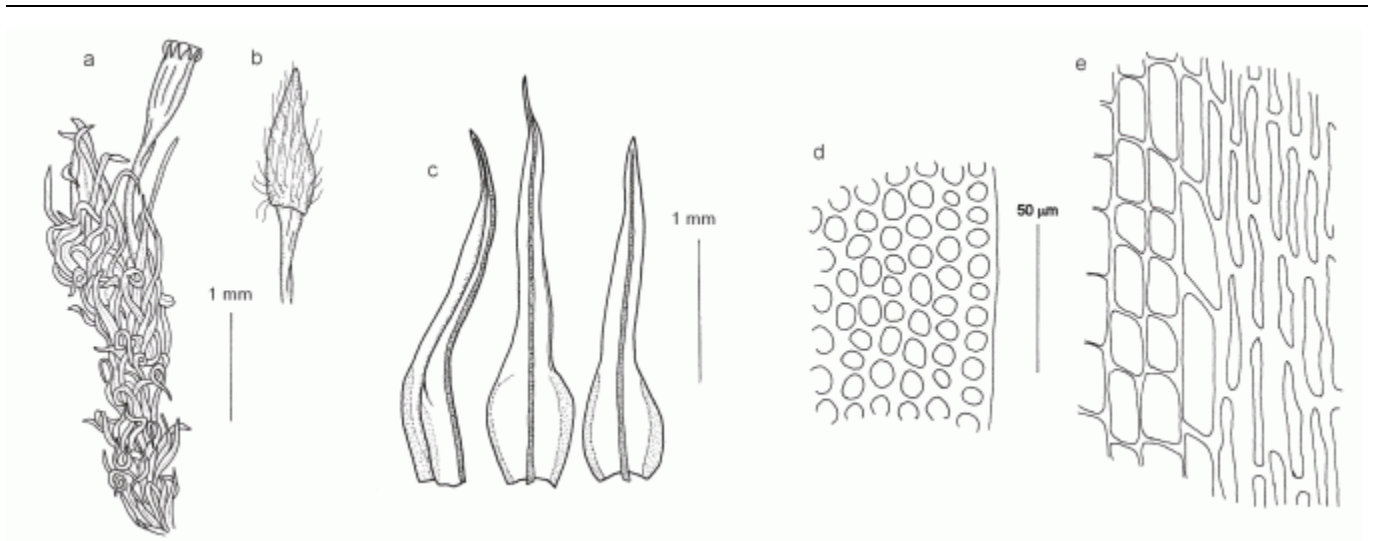
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**Ulota** D.Mohr.

A genus of 50–60 species primarily distributed in temperate regions, with only 4 species recorded from sub-Saharan Africa.

**Plants** small, forming cushions. **Stems** simple, erect to ascending. **Leaves** crisped when dry, erect spreading when wet, linear-lanceolate above an oval or ovate base, ca 1.5–3.0 mm long, apex acute to acuminate, base sheathing; *costa* ending below apex; *upper laminal cells* irregularly rounded, smooth to weakly papillose; *basal cells* rectangular or rhomboidal, marginal basal cells differentiated from inner cells, quadrate, hyaline, thick walled. **Autoicous**. **Perigonia** terminal on short branches. **Perichaetia** terminal, leaves weakly differentiated. **Seta** smooth, twisted anticlockwise viewed from above. **Capsule** oval, contracted below mouth when dry, 8-ribbed, stomata superficial. **Operculum** conic rostrate. **Peristome** double, exostome of 16 teeth in 8 pairs, endostome segments alternate with exostome teeth. **Calyptra** mitrate, hairy. **Spores** granulate, isosporous.

# Guide to Bryophytes of sub-Saharan Africa



***Ulota ecklonii*** (Hornsch.) A.Jaeger. **A:** Habit (dry). **B:** Capsule with calyptra. **C:** Branch leaves.

**D:** Upper laminal cells. **E:** Basal laminal cells. Drawn from O'Shea 99A31, South Africa (Priv. Herb. O'Shea).

*Habitat.* Epiphytic, saxicolous or rarely terricolous, mostly distributed in moist temperate forest and recorded up to 4800 m a.s.l. in Africa.

*Discussion.* The genus is distinguished by the twisted-contorted leaves which are linear lanceolate with an ovate base, rounded upper laminal cells, capsule ribbed with a double peristome and hairy calyptra.

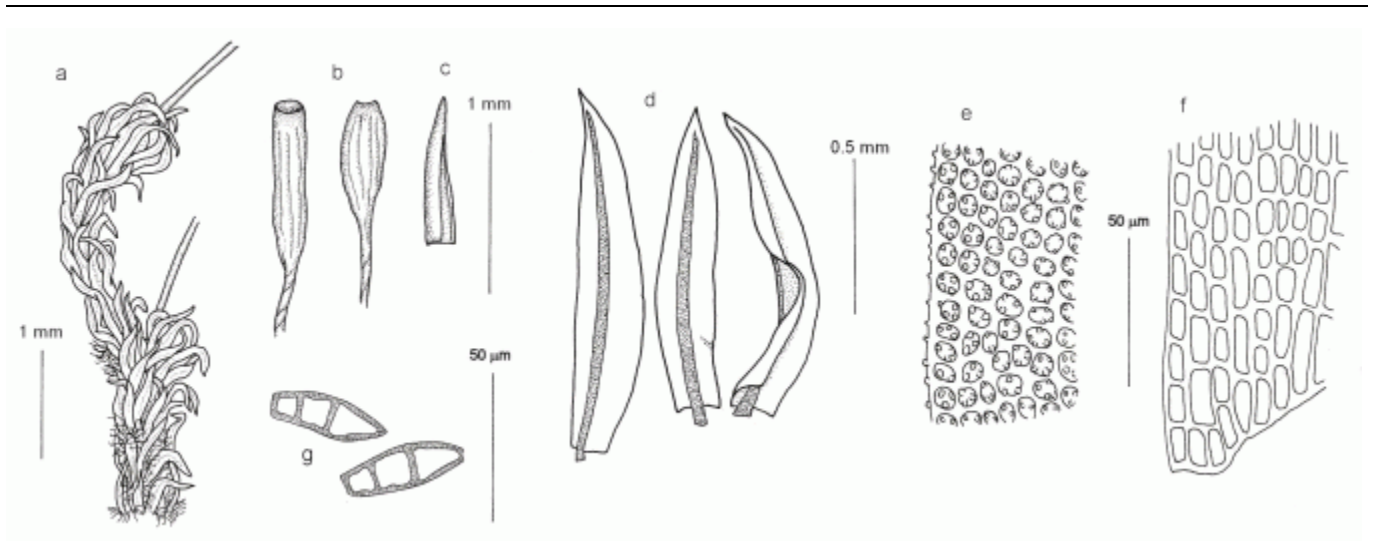
*Literature.* Magill, R.E., Van Rooy, J. 1998. Orthotrichaceae, *Ulota*: pp 504-505. Flora of Southern Africa. Bryophyta. Part 1. Mosses. Fasc. III. Erpodiaceae – Hookeriaceae. In: Leistner, O.A., Flora of Southern Africa. Republic of South Africa: Botanical Research Institute, Department of Agriculture and Fisheries.

## ***Zygodon*** Hook. & Taylor

A genus of 50 or more species primarily distributed in the tropics and subtropics, extending into the temperate regions of both hemispheres. Approximately 25 species have been recorded in Africa, though this number may be reduced with further taxonomic work.

**Plants** small to medium sized, occasionally robust, forming rather dense tufts, green to reddish- or golden-brown. **Stems** mostly erect, occasionally subscending, simple or with few branches; often tomentose below. **Leaves** erect to suberect, twisted or crispate when dry, spreading to squarrose-recurved when wet, oblong, elliptical to oblong-lanceolate or linear, ca 1.0–3.5 mm long, apex acute to acuminate, margins plane or recurved below, entire to distally toothed above; costa single, strong, subpercurrent to short excurrent; upper laminal cells hexagonal-rounded, pluripapillose, papillae small, conical; basal laminal cells larger, mostly rectangular, smooth or weakly papillose, firm-walled or lax and mostly hyaline. **Gemmae** frequently produced on rhizoids or in leaf axils, clavate or ellipsoid. **Autoicous** or dioicous. **Perichaetia** terminal, leaves little differentiated. **Seta** elongate, twisted anticlockwise viewed from above, 2–13 mm long, erect, smooth. **Capsule** erect, symmetrical, urn subcylindrical to narrowly pyriform, 8-ribbed, neck short tapered; stomata superficial at base. **Operculum** conic-rostrate. **Peristome** double or single, rudimentary or absent, exostome teeth 16, joined in 8 pairs, papillose to papillose-striate; endostome segments 8 or 16, narrow, lightly papillose, striate or smooth. **Calyptra** cucullate, naked or sparsely hairy. **Spores** papillose.

# Guide to Bryophytes of sub-Saharan Africa



***Zygodon intermedius*** Bruch & Schimp. **A:** Habit (dry). **B:** Capsules. **C:** Calyptra. **D:** Branch leaves.

**E:** Upper laminal cells. **F:** Basal laminal cells. **G:** Gemmae. All drawn from *Magombo M4391a*, Malawi (BM).

*Habitat.* Epiphytic, on branches and trunks of shrubs and trees, occasionally on rocks and in rock crevices, shaded to exposed sites, 1000–4800 m.

*Discussion.* The genus is characterized by the twisted to secund, or erect to appressed leaves when dry, finely pluripapillose laminal cells with papillae often minute and centric over the lumen and the smooth, usually naked, cucullate calyptra. Gemmae are often present and provide useful aides to identification. The genus *Leptodontiopsis* has recently been placed into *Zygodon* by Goffinet *et al.* (2004).

Literature. **Goffinet, B., Shaw, A. J., Cox, C.J., Wickett, N.J., Boles, S.B. 2004.** Phylogenetic inferences in the Orthotrichioideae (Orthotrichaceae, Bryophyta) based on variation in four loci from all genomes. pp. 270–289 in Goffinet, B., Hollowell, V., Magill, R. 2004. **Magill, R.E., Van Rooy, J. 1998.** Flora of Southern Africa. Bryophyta. Part 1. Mosses. Fasc. III. Erpodiaceae – Hookeriaceae. In: Leistner, O.A., Flora of Southern Africa. Republic of South Africa: Botanical Research Institute, Department of Agriculture and Fisheries. **Malta, N. 1926.** The genus *Zygodon* Hook. et Tayl. *Latvijas Universitātes Botaniskā Dārza Darbi* 1: 1-185 [dated, some keys and illustrations].

## PHYLLOGONIACEAE

(B.J. O'Shea, May 2005)

A monotypic family.

### ***Phyllogonium* Brid.**

Three species in Africa: *P. fulgens* (Hedw.) Brid. (Réunion, and also South Atlantic islands (Tristan da Cunha, Gough), Mexico, West Indies, Surinam, tropical Andes), *P. viride* Brid. (Réunion, and also South Atlantic islands (Tristan da Cunha), Mexico, West Indies, Surinam, Bolivia, SE Brazil), *P. viscosum* (P. Beauv.) Mitt. (South Africa, Madagascar, possibly Mauritius, Réunion and also South Atlantic islands (Tristan da Cunha), Mexico, tropical Andes); the genus exhibits a tropical American-African distribution.



# Guide to Bryophytes of sub-Saharan Africa

**Plants** medium sized to rather large, forming long pendent strands from loose mats, glossy green, yellowish-green or golden-brown. **Primary stems** creeping; leaves scale-like. **Secondary stems** usually pendulous, to 50 cm or more, irregularly pinnately branched, few to many; in cross-section outer 2-4 rows of cells small, thick-walled, inner cells larger, rather thick-walled, central strand absent; pseudoparaphyllia foliose. **Leaves** loosely imbricate, usually appearing 2-ranked, ovate-oblong to oblong, 2.5-4.5 mm long, deeply concave and compressed laterally, smooth or undulate, apex rounded or truncate, apiculate and recurved or erect, base auriculate; margins plane, entire; costae absent or short and forked; laminal cells smooth and strongly porose throughout, median cells linear to oblong-rectangular; alar cells differentiated, shortly rectangular to subquadrate-rounded, strongly porose, usually rusty-red. **Dioicous**. **Perichaetia** lateral, leaves differentiated, abruptly long acuminate from an broadly ovate base. **Seta** short to somewhat elongate, 0.5-3.5 mm long, equal to or longer than capsule, smooth. **Capsule** shortly exserted or immersed, suberect, urn oblong-cylindrical to ovoid, 1.2-2.5 mm; exothecial cells mostly quadrate, ± thick-walled; stomata present or absent; annulus absent. **Operculum** conic-rostrate, oblique. **Prostome** present, represented by 1-3 layers adnate to the exostome. **Peristome** single or double, exostome teeth 16, smooth; endostome absent or if present represented only by a low, hyaline basal membrane. **Calyptra** mitrate or cucullate, sparsely to densely hairy. **Spores** spherical, papillose.

*Habitat.* Commonly epiphytic on branches and occasionally trunks of trees, treelets and shrubs, less often on humus or leaf litter, particularly on steep banks; lowland adjoining montane or premontane to more commonly in mid and high montane forests, 150-4200 m.

*Discussion.* *Phyllogonium* is characterised by the pendent habit, 2-ranked, oblong or oblong-ovate, conduplicate leaves, apiculate or truncate apex, auriculate base, short and forked costae, and strongly porose laminal cells. The genus is typically found in montane forests, and is one of the more conspicuous pendent mosses. The species can be distinguished by the following features:

- |   |                    |
|---|--------------------|
| a. Leaves undulate, 3.8-4.7 mm long, apex truncate      | <i>P. viscosum</i> |
| a. Leaves smooth, less than 3.8 mm long, apex cuspidate | b                  |
| b. Leaves ca. 3.6 mm long, apex cuspidate-recurved      | <i>P. viride</i>   |
| b. Leaves ca. 3.0 mm long, apex cuspidate-erect         | <i>P. fulgens</i>  |

The African distribution of this genus needs further study: for instance Lin (1983) mentions no collections from Madagascar despite there being a number of published collections, and also there seems some discrepancies amongst early authors about which islands were visited by which collectors.

*Literature.* **Lin, S.-H. 1983.** A taxonomic revision of Phyllogoniaceae (Bryopsida). Part I. Journal of the Taiwan Museum 36(1): 37-86 [keys, illustrations, maps].

## PLAGIOTHECIACEAE

(R. Ochrya & B.J. O'Shea, June 2003)

The family is here interpreted as monotypic, although in the past various classifications have included several other genera in it. They have been presented by Buck and Ireland (1985).

***Plagiothecium* Bruch, Schimp. & W.Gümbel**

# Guide to Bryophytes of sub-Saharan Africa

Six species are recorded for Africa, two of them endemic to Africa. The genus is distributed mainly in temperate regions, and confined to the higher altitudes in the tropics.

**Plants** small to medium-sized, slender to rather robust, in loose to dense, flat mats, glossy, green to yellowish-green. **Stems** creeping to ascending, mostly freely, irregularly branched, occasionally nearly simple; in cross-section with a small but distinct central strand; pseudoparaphyllia and paraphyllia none; rhizoids reddish-brown, smooth, branched, intercalary below the leaf insertion. Leaves weakly to strongly complanate, very rarely julaceous, mostly asymmetric, ovate, oblong-ovate to ovate-lanceolate, flat to concave, acute to narrowly acuminate, narrowly or broadly short- to long-decurrent; margins plane throughout to variously reflexed or recurved, entire or sparsely serrulate at the apex; costae short, forked, with unequal branches, usually reaching 1/3–1/2 way up the leaf, sometimes absent; laminal cells smooth, linear-flexuose to oblong-rhomboidal above, shorter and broader and often lax at base, thin- to firm-walled; alar cells often differentiated, consisting of few, quadrate to oblong cells forming decurrencies; nematogen cells sometimes present at the apex. **Propagula** occasionally present, cylindrical, smooth. **Autoicous or dioicous**. **Perichaetia** lateral; perichaetial leaves somewhat enlarged, sheathing, with spreading tips. **Seta** smooth, elongate, twisted above, becoming reddish with age. **Capsule** suberect and symmetric to strongly curved, or inclined to horizontal and asymmetric, obloid-cylindrical from a short neck, smooth or longitudinally wrinkled-plicate when dry and empty; exothecial cells isodiametric, thick-walled; annulus in 2-3-seriate, deciduous. **Operculum** conic to rostrate, oblique. **Peristome** double; exostome teeth 16, cross-striate below, distally papillose, occasionally papillose throughout, bordered, trabeculate on back; endostome composed of 16 keeled and perforated segments arising from high basal membrane, cilia 1-3, nodose, rarely rudimentary or none. **Calyptra** cucullate, smooth, naked. **Spores** mostly spherical, smooth or lightly papillose.

*Habitat.* On soil, humus, tree roots and trunks, logs, rotten stumps and rocks, mostly in dry and shaded situations; from mid-montane forest to alpine zone, 2200–4250 m.

*Discussion.* *Plagiothecium* is recognized by the generally complanate-foliate habit, the commonly asymmetric, ovate to ovate-lanceolate, gradually acuminate or acute leaves with short and inflated alar cells and thin-walled cells extending down the stem in triangular or oval decurrencies, entire or slightly serrulate margins at the apex, the smooth and strongly chlorophyllose, linear to oblong-hexagonal cells, sometimes with a group of nematogen cells in the apex and short and double costae. An unpublished revision of the genus in Africa has been completed by the first author and some individual species have recently been treated in separate accounts.

*Study guide.* Species of *Plagiothecium* can be successfully determined in sterile condition because leaves are sufficient for identification. However, they must be carefully removed from the stem in order to preserve the base intact for examination of decurrencies.

*Literature.* **Buck, W.R. 1993.** Taxonomic results of the BRYOTROP expedition to Zaire and Rwanda. 24. Leskeaceae, Brachytheciaceae, Stereophyllaceae, Plagiotheciaceae, Entodontaceae, Sematophyllaceae p.pte, Hypnaceae (except Hypnum). *Tropical Bryology* 8: 199-217. [description of *P. nitidifolium*]. **Buck, W. R & Ireland, R.R. 1985.** A reclassification of the Plagiotheciaceae. *Nova Hedwigia* 41: 89-125. **Ochyra, R. 1993.** Taxonomic results of the BRYOTROP expedition to Zaire and Rwanda. 20. Grimmiaceae, Funariaceae, Bartramiaceae (Philonotis), Amblystegiaceae, Plagiotheciaceae. *Tropical Bryology* 8: 181-187. [description of *P. nitens* (= *membranosulum*) & *P. mildbraedii* (= *nitidifolium*)]. **Ochyra, R. & Buck, W.R. 2002.** A re-appraisal of the type material of *Plagiothecium drepanophyllum*. *Bryologist* 105: 641-644. [illustration of *P. standleyi*]. **Ochyra, R., Kempa, R. & Buck, W.R. 2000.** *Plagiothecium lucidum* (Hook.f. & Wils.) Paris in tropical Africa. *Tropical Bryology* 18: 147-152. [illustration of *P. lucidum*].

## POLYTRICHACEAE

# Guide to Bryophytes of sub-Saharan Africa

(F. Müller, August 2000)

**Plants** small to very large and robust. **Stems** erect, solitary or with a few branches, arising from rhizoidal or persistent protonemal mats or from subterranean rhizomes; well-developed internal conducting systems present (hydroids for water conduction, leptoids for assimilate conduction). **Leaves** lower down the stem scale-like, upper leaves oblong- to lingulate-lanceolate or differentiated with a narrow to broad lanceolate limb from a clasping sheathing base that is broadly oblong to obovate-oblong, leaves mostly of rather opaque appearance and a stiff texture; whole or part of the upper surface of the limb covered by longitudinal, ribbon-like, photosynthetic lamellae, in continuous or discontinuous rows over the costa, few to several cells high, terminal lamella cells variously shaped, rounded, truncate, U-shaped or pyriform, smooth or papillose; margins plane, erect, incurved or folded, sometimes limbate, often serrate to spinose, teeth single or double; costa single, usually strong, narrow to nearly the width of the limb, percurrent to somewhat long excurrent, often with teeth on abaxial side; sheathing base cells mostly elongate-rectangular to linear; limb cells isodiametric, thick-walled. **Dioicous**, rarely autoicous. **Perigonia** often conspicuous and in the form of apical, flower-like rosettes. **Perichaetia** terminal; leaves differentiated. **Seta** elongate, stout and wiry. **Capsule** large, suberect to inclined, urn obtusely or sharply angled or cylindrical; apophysis indistinct or distinct; stomata present or absent. **Operculum** usually long rostrate, oblique. **Peristome** single, of 32 or 64 short and rigid teeth, joined terminally onto a membranous epiphragm covering the mouth of the capsule like the head of a drum. **Calyptra** cucullate, usually densely hairy, less commonly smooth to slightly scabrous distally. **Spores** variously ornamented.

*Discussion.* The Polytrichaceae contain about 18 genera and some 160 or more species with a worldwide distribution (Hyvönen et al., 1998); in sub-Saharan Africa there are 5 genera and about 20 to 30 species. The family is distinguished by the usual presence of longitudinal lamellae on the upper leaf surface, the formation of an epiphragm from the columella, and the multicellular peristome appearing single and commonly with 32 or 64 teeth. Plant size is remarkably variable. Our species can range from 0.5 to 30 cm or more in height, mostly growing on soil or humus, rarely on rock. Many members of this family are some of the earliest colonizers of disturbed sites such as landslides, exposed banks and road and trail cuts.

The genus concept in the family is based mainly on sporophytic characters. The determination of sterile plants to genus level can be therefore sometimes difficult, but fertile material is quite easily identified. The number and form of the lamellae on the leaf surface are useful in identification, which requires in most cases a cross-section of the leaf to examine the lamellae.

*Literature.* **De Sloover, J.L. 1986.** Note de bryologie africaine XIII. Polytrichaceae. Bulletin du Jardin Botanique National de Belgique 56: 241-300 [keys to species, illustrations, distribution maps of selected species]. **Hyvönen, J., Hedderson, T.A., Smith Merrill, G.L., Gibbings, J.G. & Koskinen, S. 1998.** On the phylogeny of the Polytrichales. Bryologist 101(4): 489-504 [discussion of phylogeny of family based on morphological and molecular data]. **Smith, G.L. 1971.** A conspectus of the genera of Polytrichaceae. Memoirs of the New York Botanical Garden 21: 1-83 [keys to genera, limited illustrations, no generic descriptions].

1. Upper leaf surface without lamellae; leaf margin thickened, mostly bistratose; seta tuberculate-papillose	<b>Pogonatum</b>
1. Upper leaf surface with lamellae; leaf margin thickened or not; seta smooth	<b>2</b>
2. Leaves with border of long, narrow, incrassate cells; margins double-toothed; nerve narrow; lamellae 4-6, straight; leaves undulate, strongly crisped when dry; capsule with long rostrate operculum and cucullate, smooth calyptra	<b>Atrichum</b>

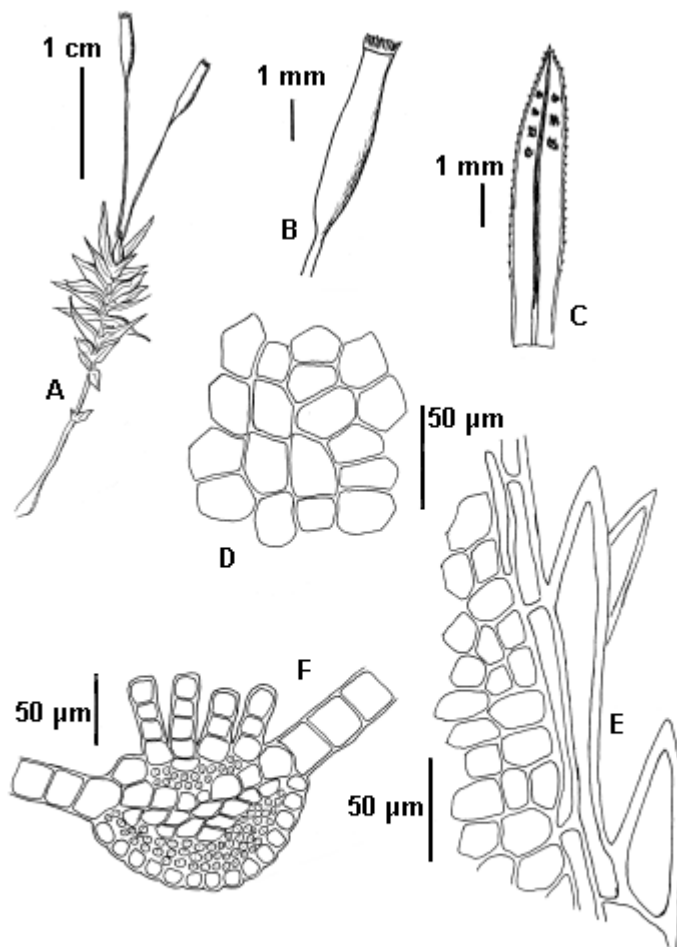
# Guide to Bryophytes of sub-Saharan Africa

2. Leaves unbordered or indistinctly so; margins with single teeth or entire; nerve wide, especially in the upper leaf part; lamellae few and sinuose or more than 10 and straight; leaves not undulate; calyptra mostly mitrate and hairy	<b>3</b>
3. Leaf margins entire and folded in over the lamellae in upper surface of limb, nerve excurrent in hyaline or brownish arista or terminal cells of lamellae U-shaped	<b><i>Polytrichum</i></b>
3. Margins plane or incurved, upper surface usually observable, nerve not excurrent into an arista; terminal cells of lamellae variously shaped, rounded, truncate or pear-shaped	<b>4</b>
4. Lamellae fewer than 10, restricted to upper costa surface, sinuose; leaves without or with indistinct sheathing base; calyptra sparsely hairy or smooth	<b><i>Oligotrichum</i></b>
4. Lamellae distinctly more than 10, extending over costa and lamina surface, + straight; calyptra with a dense mat of hairs which partly or wholly envelops the capsule	<b>5</b>
5. Leaves not or only slightly differentiated between sheath and limb, sheath ovate, slightly broader than limb width; capsules cylindric or with inconspicuous longitudinal ridges, peristome teeth 32, capsule without stomata and differentiated apophysis	<b><i>Pogonatum</i></b>
5. Leaves strongly differentiated between sheath and limb, sheath obovate to oblong-obovate; capsules 4- to 6-angled, peristome teeth 64, capsule with stomata and differentiated apophysis	<b>6</b>
6. Terminal lamellae cells conic; capsule obtusely angled; exothelial cells smooth; peristome teeth not keeled at back; epiphragm fringed with tooth-like processes opposite the peristome teeth and adhering to their inner face, the undersurface of the epiphragm with a curtain-like annulus; inner surface of the peristome smooth	<b><i>Polytrichastrum</i></b>
6. Terminal lamellae cells retuse to bilobed; capsule sharply angled; exothelial cells mammillose; peristome teeth vertically keeled at back; epiphragm with entire margin, its undersurface with sac-like processes alternating with the peristome teeth; inner surface of the peristome with vertical partitions and spur-like appendages	<b><i>Polytrichum</i></b>

## ***Atrichum* P.Beauv.**

One species in the area, *A. androgynum* (Müll.Hal.) A.Jaeger, which also occurs in central and southern America, and Australasia; about 20 species worldwide of mainly temperate regions, particularly the Northern Hemisphere.

# Guide to Bryophytes of sub-Saharan Africa



***Atrichum androgynum* (Müll.Hal.) A.Jaeger** (Réunion, hb. F. Müller R 660)

A: plant; B: capsule; C: leaf; D: mid-leaf cells; E: leaf margin; F: section of upper part of leaf.

A,B: del. T. Lautenschläger

**Plants** medium sized, forming loose tufts, dark green to blackish-green or -brown. **Stems** erect, simple to branched, radiculose, up to 8 cm tall; central strand well-developed; rhizoids reddish-brown or pale white. **Leaves** erect spreading when wet, translucent, strongly crisped when dry, narrowly- to oblong-lanceolate, 5-10 mm long, often weakly to strongly undulate, usually toothed on back of lamina and costa, apex acute to short acuminate, base little differentiated, weakly sheathing; margins plane, limbate, double-toothed; costa narrow, percurrent, in cross-section with stereid bands above and below guide cells; laminal cells oblong-short rectangular to subquadrate, thick-walled, unistratose; basal cells rectangular, thick-walled; margins cells elongate, forming 1-3-stratose border; lamellae few (4-6), confined to upper surface of costa, 2-6 cells high, terminal cell rounded. **Autoicous**. **Perichaetia** terminal; leaves differentiated. **Seta** elongate, smooth. **Capsule** suberect to inclined, very long and narrow, urn cylindrical, asymmetric, slightly to somewhat strongly curved; exothecial cells rectangular, thick-walled. **Operculum** conic long-rostrate, oblique. **Peristome** teeth 32. **Calyptra** cucullate, glabrous, roughened at apex. **Spores** papillose.

**Habitat.** On acidic soil, in partly or fully shaded sites, frequent along stream banks, tracks, on roadsides, in heaths and on forest floors; in Africa the species shows a montane distribution, and grows at elevations from near sea level (in southern Africa) to

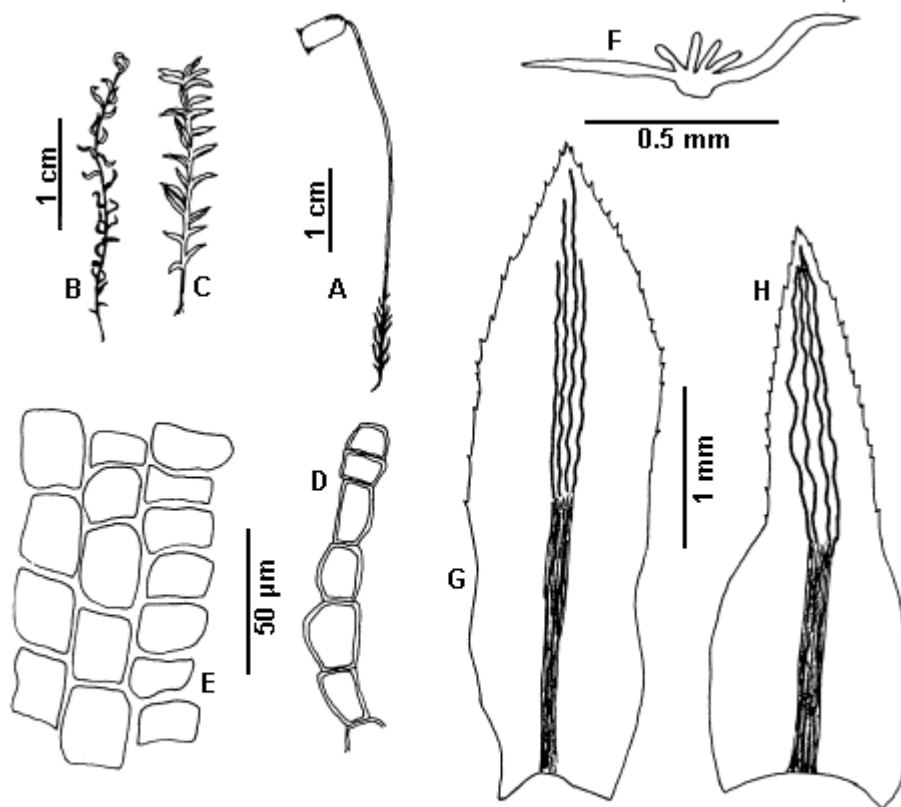
2100 m.

**Discussion.** The genus is characterized by the undulate leaves (in dry condition crispate and contorted), not or weakly differentiated at the leaf base, narrow costa, 4-6 rows of lamellae, doubly toothed and bordered margins, and 32 peristome teeth.

**Literature.** De Sloover, J.L. 1986 (see family ref.) [illustration]. Nyholm, E. 1971. Studies in the genus *Atrichum* P. Beauv. Lindbergia 1: 1-33.

***Oligotrichum* Lam. & DC.**

# Guide to Bryophytes of sub-Saharan Africa



## *Oligotrichum cavallii* (G.Negri) G.L.Sm.

(Uganda: Ruwenzori, herb. BM 662540)

A: fertile plant; B: sterile plant in dry condition; C: sterile plant in wet condition; D: section of a lamella; E: mid-leaf cells; F: section of upper part of leaf; G: leaf; H: leaf of fertile stem

Three species in Africa; about 25 species worldwide. Two of the African species are restricted to the southernmost part of Africa (South Africa, Lesotho). The third taxon, *O. cavallii* (Negri) G.L.Sm., is known from the East African mountains (Kenya, Rwanda, Tanzania, Uganda, DR Congo).

**Plants** small, forming low tufts, dark green to reddish-brown. **Stems** erect, to 1 cm tall. **Leaves** somewhat crispate when dry, erect when wet, upper leaves obovate-lanceolate, 4-5 mm long, to 2 mm wide, lower leaves oblong or obovate-oblong, apex acute, base weakly sheathing stems; margins plane to distally incurved at apex, denticulate in distal half; costa rather strong, percurrent; median cells isodiametric, rather collenchymatous; basal cells short to rather long rectangular-rounded, somewhat lax; upper marginal cells firm, thick-walled; lower 1/3-1/2 of

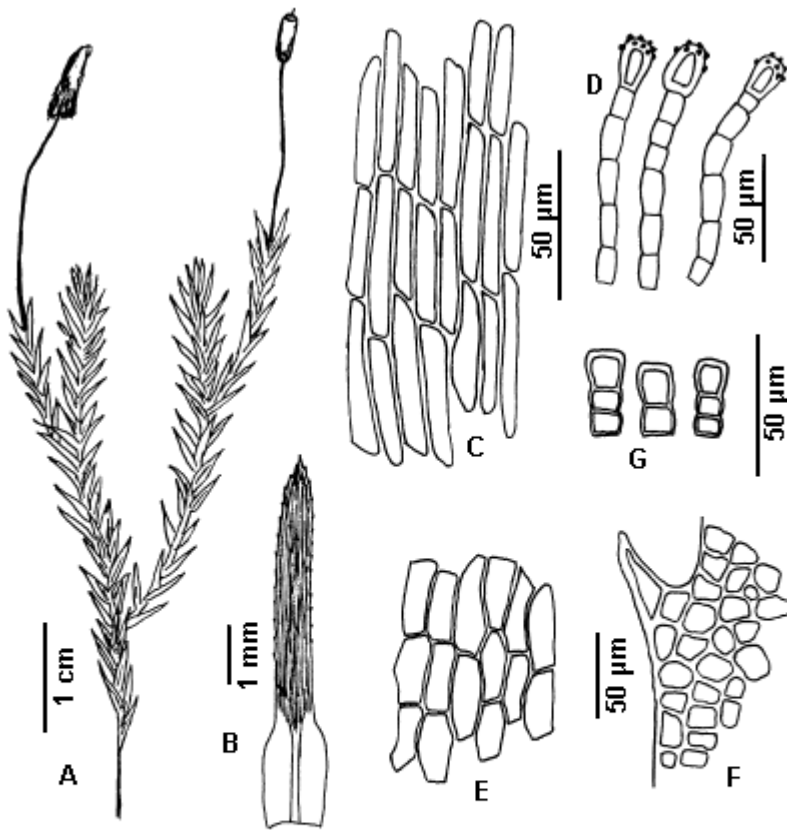
leaf with cells short to long rectangular, thick-walled; lamellae in 6-7 rows, 3-6 cells high, sinuose, terminal cell rounded. **Diocious**. **Perichaetia** terminal; leaves strongly enveloping seta, longer than stem leaves. **Seta** elongate, to 40 mm long, slender, smooth. **Capsule** suberect, ovoid-cylindrical, to 4 mm long, indistinctly 6-8 angled, apophysis lacking; stomata present at base, superficial. **Operculum** conic-long rostrate, oblique. **Peristome** teeth 32. **Calyptra** cucullate, sparsely hairy or smooth, slightly roughed at apex.

**Habitat.** On acid, mineral soils, in exposed sites usually associated with other tufted bryophytes; e.g. along trails, on slopes, humid rocks. Montane to alpine, 1200-4200 m.

**Discussion.** The genus is characterized by the presence of few (< 10) sinuose lamellae, the additional production of lamellae on the dorsal leaf surface, ovoid-cylindrical, only an indistinctly angled capsule with stomata and without an apophysis, peristome teeth 32, sparsely hairy or smooth calyptra.

**Literature.** De Sloover, J.L. 1979. Note de bryologie africaine X. *Blindia*, *Pilopogon*, *Bryoerythrophyllum*, *Orthodontium*, *Orthostichidium*, *Oligotrichum*. Bulletin du Jardin Botanique National Belgique 49: 393-408 [illustrations of *O. cavallii*]. De Sloover, J.L. 1986 (see family ref.) [key to all three species].

## Sharan Africa



### *Pogonatum urnigerum* (Hedw.) P.Beauv.

(D.R. Congo: herb. F. Müller Z591, Z592)

A: plant; B: leaf; C: leaf cells of sheathing base; D: transverse section of lamellae.

### *Pogonatum convolutum* (Hedw.) P.Beauv.

(Réunion: herb. F. Müller R260)

E: basal cells; F: leaf margin towards apex; G: transverse section of lamellae.  
A: drawn by T. Lautenschläger

Ten species in Africa; about 52 species distributed worldwide, generally associated with temperate and montane regions. The largest and most diverse genus in the Polytrichaceae.

**Plants** small (a few mm) to large (up to 20 cms), solitary or forming tufts, dark green to reddish-brown or blackish, protonema often persistent. **Stems** mostly erect, simple or with few branches, occasionally distally curved. **Leaves** rather crowded, contorted or crispate when dry, mostly weakly differentiated between sheath and limb, base slightly expanded and slightly sheathing, ovate to short oblong, limb oblong- to lingulate-lanceolate; margins plane, dentate to somewhat sharply serrate; costa weak to mostly strong, percurrent or excurrent, often toothed on the abaxial side towards the apex; median cells isodiametric, thick-walled; lamellae usually well developed, at least in the

upper part of the limb, usually covering most of the leaf surface but occasionally few and confined to the leaf midline (e.g. *P. proliferum* [Griff.] Mitt.) or absent (*P. marginatum* Mitt.), (1-)2-6 cells high, terminal cells rounded, rarely truncate or pear-shaped, smooth or rarely papillose. **Diocious**. **Perichaetia** terminal. **Seta** elongate, stout and smooth (rarely tuberculate-papillose). **Capsule** suberect to inclined, urn short to long cylindrical, terete, not angular, ± symmetrical, without apophysis or stomata. **Operculum** conic-mammillate. **Peristome** teeth 32. **Calyptra** densely hairy. **Spores** variously ornamented.

**Habitat.** On soil or soil covered rocks, cliffs and tree trunks, frequent on exposed landslides, road cuts, roadside and trail banks, heaths and on forest floor in rainforest; calcifuge pioneer plants; from near sea level to 4200 m.

**Discussion.** The genus is rather variable and necessarily defined by a combination of characters. Three characters considered by Hyvönen (1989) to be uniquely derived (synapomorphies) defining *Pogonatum* as a monophyletic group included: exothelial cells roughened-papillose, absence of stomata, and strongly pigmented 32 compound peristome teeth. Sterile specimens may be difficult to place in the genus. The worldwide treatment by Hyvönen (1989) and the regional treatment of De Sloover (1986) are very useful for sub-Saharan Africa.

For the differentiation of *Pogonatum urnigerum* (Hedw.) P.Beauv. from *Polytrichastrum alpinum* (Hedw.) G.L.Sm. see under the latter genus. *Pogonatum marginatum* Mitt., which is recorded from one specimen from Mauritius, is sometimes placed in the separate genera *Pseudoracelopus* or *Plagioracelopus*. We follow Touw (1986) and Hyvönen (1989), who incorporated this taxon in *Pogonatum*; among the African taxa of the genus it is unique in having no lamellae on the ventral surface of the nerve.

**Literature.** De Sloover, J.L. 1986 (see family ref.) [keys, illustrations]. Hyvönen, J. 1989. A synopsis of the genus *Pogonatum* (Polytrichaceae, Musci). Acta Botanica Fennica 138: 1-87 [keys, illustrations, distribution maps]. Touw, A. 1986. A revision of *Pogonatum* sect. *Racelopus*, sect. nov., including *Racelopus* Dozy & Molk.,

# Guide to Bryophytes of sub-Saharan Africa

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*Pseudoracelopus* Broth. and *Racelopodopsis* Thér. Journal of the Hattori Botanical Laboratory 60: 1-33 [keys, illustrations].

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## ***Polytrichastrum* G.L.Sm.**

One species in Africa, *P. formosum* (Hedw.) G.L.Sm.; a genus of about 10 or more species of cool temperate regions. The records of *P. alpinum* (Hedw.) G.L.Sm. for the area are based on misidentifications of *Pogonatum urnigerum* (De Sloover, 1986).

**Plants** medium sized to rather large, forming loose tufts or patches, dull to dark green. **Stems** 4-20 cm tall, erect to erect-spreading, somewhat stiff; central strand well developed. **Leaves** when dry erect-flexuose, appressed to spreading above base, when wet erecto-patent, spreading to recurved, strongly differentiated between sheathing base and limb, base ovate to ovate-oblong, 1.6-3 mm long, to 2.6 mm wide, limb narrowly lanceolate, 2.6-12 mm long, apex acuminate; margins plane or erect, base entire, limb sharply toothed; costa percurrent; limb cells mostly quadrate, thick-walled; cells between junction of limb and base oblate-oval to elongate, very thick-walled; sheathing base cells long rectangular, somewhat tapering or rounded, thin-walled; lamellae covering costa and lamina, in cross-section 5-9 cells high, apical cells conic, smooth. **Dioicous**. **Capsule** indistinctly 4-angled, erect to inclined, globose to rectangular, apophysis distinct, stomata present at base. **Operculum rostrate**, oblique. **Peristome** single, teeth 64, attached to epiphragm, marginal teeth on epiphragm. **Calyptra** cucullate, pilose. **Seta** flexuose.

**Habitat.** On acidic soil and soil covered rocks in heaths, woods and moorland; montane, at elevations of 500 to 2000 m.

**Discussion.** The genus is similar to *Polytrichum*, sharing the differentiated limb and base, with lamellae extending over both the costa and lamina, the peristome teeth attached to an epiphragm, and the densely hairy calyptra. It differs from that genus mainly by sporophytic characters (see key to genera). The differentiation of sterile material of *P. alpinum* and *Pogonatum urnigerum* is sometimes difficult. African material of the latter has been misidentified as *P. alpinum*. *Polytrichastrum alpinum* is usually distinct from *Pogonatum urnigerum* by its duller green colour (vs. glaucous green colour), longer, less wide leaf blades, longer lamellae (6-9 cells vs. 5-6 cells), apical cells of the lamellae elongated (vs. rounded or elliptical), papillae of the apical cells of the lamellae elongated (vs. round papillae), distal walls of apical cells of the lamellae highly incrassate (vs. distal walls of apical cells not or only slightly incrassate).

**Literature.** De Sloover, J.L. 1986 (see family ref.) [key, illustration].

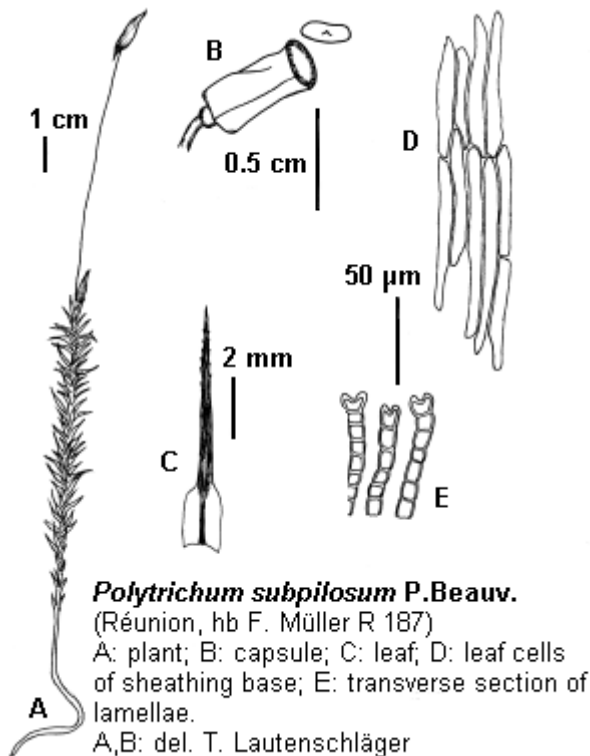
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## ***Polytrichum* Hedw.**

About 9 species in Africa, probably half or fewer are valid; a widespread genus of some 50 species.



# Guide to Bryophytes of sub-Saharan Africa



**Plants** variable in size, mostly medium sized to large and robust, gregarious or forming compact tufts, dark to glaucous green, seldom reddish-brown. **Stems** erect, rigid, simple, reddish-brown; shoots arising from underground rhizome-like stem; central strand well developed. **Leaves** erect-appressed to -spreading when dry, erect- to wide-spreading when wet, leaf differentiated between sheathing base and limb, base ovate-oblong and sheathing, limb oblong-, ligulate- or linear-lanceolate, apex broadly acute to acuminate; margins of limb erect to broadly folded and forming a flap covering adaxial surface of limb, base entire, limb entire with apices toothed or limb sharply serrate; costa  $\pm$  narrow in leaf base, expanding in limb to 2/3-4/5 of width, percurrent to excurrent, often toothed distally on back, in cross-section stereids above and guide cells below; cells at transition between limb and base oblong-oblatt, compressed and thick-walled, base cells long rectangular, thin-walled; ventral leaf surface usually covered nearly completely by lamellae, lamellae straight, 5-8 cells high, terminal cell rounded, pear- or U-shaped, smooth. **Dioicous**. **Perigonia** terminal, usually conspicuous and flowerlike or cupulate; leaves strongly differentiated, short and broadly oval to ovate. **Perichaetia** terminal; leaves similar to stem leaves. **Seta** elongate, erect or weakly flexuose, rather stout. **Capsule** suberect to horizontal, urn somewhat longer than wide,

strongly 4-angled; neck short and compressed, constricted below urn base; apophysis and stomata present at base of capsule. **Operculum** rostrate from a plano-convex base. **Peristome** single, teeth 64, teeth attached to a thick oval epiphragm, teeth alternating with short segments or lobes beneath epiphragm. **Calyptra** cucullate, densely hairy, covering capsule. **Spores** appearing smooth.

**Habitat.** On soil and soil covered rocks, e.g. along trails and roads, in moorlands, heaths, peat banks, on forest floor, rocks, walls etc.; mostly calcifuge; montane to afroalpine, at elevations of 400-4950 m.

**Discussion.** The genus is characterized by the differentiated limb and base, lamellae extending over the costa and lamina, U- or pear-shaped terminal cells of lamellae, strongly 4-angled capsules, strongly constricted hypophysis below neck, 64 peristome teeth attached to an epiphragm, lower margin of epiphragm divided into lobes alternating with peristome teeth, and densely hairy calyptra. Of the four commoner species in Africa, *Polytrichum subpilosum* P. Beauv. is endemic to Africa, but the other three (*P. commune* L. ex Hedw., *P. juniperinum* Willd. ex Hedw. and *P. piliferum* Schreb. ex Hedw.) are found almost worldwide.

**Literature.** De Sloover, J.L. 1986 (see family ref.) [key to the 4 commoner species].

## PTERIGYNANDRACEAE

(B.J. O'Shea, May 2000)

The Pterigynandraceae contain about five genera and 20-25 species; primarily of the Northern Hemisphere. The definition and circumscription of the family, a member of the Hypnales, is outlined by Buck and Crum (1990). Only

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

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one genus is known from sub-Saharan Africa (*Trachyphyllum*), but *Pterigynandrum filiforme* Hedw. is known from northern Africa; it is distinguished by slender, julaceous branches, elliptic to oblong-ovate leaves (to 1 mm long), apices acute, short and forked costa, and the cells strongly projecting at both ends.

## *Trachyphyllum* A.Gepp in Hiern

A pantropical genus of seven species, four of which occur in Africa (O'Shea 1999).

**Plants** small, forming rather dense mats, brownish green to yellow. **Stems** creeping, 1-pinnately branched, branches short, suberect and curved; in cross-section outer 2-3 rows of cells small, thick-walled, inner cells larger, thin-walled, central strand weak; rhizoids clustered beneath stems, appearing smooth. **Leaves** of stem julaceous to erect, broadly ovate-lanceolate, to 1.2 mm long, apex acuminate to apiculate; margins plane or slightly reflexed at base, appearing denticulate at mid region; costae short and forked, joined at base; apical cells long linear, smooth or nearly so; median cells linear (shorter than apical cells), rather strongly papillose by projecting cell angles; basal cells adjoining costa oblong-rectangular, porose; alar region well differentiated, cells numerous, extending to, or just beyond broadest portion of leaf, oblate short rectangular to subquadrate; marginal cells at mid-leaf shorter and broader; branch leaves usually smaller, narrowly ovate-lanceolate, apex slenderly long acuminate. **Dioicous**. **Perichaetia** lateral; leaves abruptly long acuminate from an oblong base, costae single or double, margins strongly serrate, teeth sometimes multicellular. **Seta** elongate, smooth, twisted. **Capsule** exserted, inclined, urn short-cylindrical, asymmetric, constricted below mouth when dry; exothecial cells quadrate to rectangular, not collenchymatous; stomata at urn base, superficial; annulus absent. **Operculum** short rostrate. **Peristome** double, exostome teeth 16, densely cross-striate below, distally papillose, median zig-zag line present, trabeculate on back; endostome nearly equal exostome length, basal membrane rather high, segments 16, keeled and perforate, finely papillose, cilia well-developed, 1-3. **Calyptra** cucullate, smooth and naked. **Spores** spherical, finely papillose.

*Habitat.* Tree trunks and bases, rocks, broken ground and soil; in open woodland, at elevations from 500-1800 m.

*Discussion.* The genus is recognized by the broadly ovate-lanceolate leaves, acuminate to apiculate apex, short and forked double costa, upper long, smooth, linear apical cells, projecting papillae at distal angle of median cells, and well differentiated alar cells that extend up the margin of the leaf. Not often seen with sporophytes.

The gametophytes of *Trachyphyllum* can be mistaken for *Erythrodontium* (Entodontaceae), but are readily separated by the strong projecting papillae at the distal cell angles of *Trachyphyllum*, and smooth laminal cells of *Erythrodontium*. *Trachyphyllum* was only recently reported in the Americas (Buck & Griffin, 1984).

*Literature.* **Buck, W.R. 1979.** A revision of the moss genus *Trachyphyllum* Gepp (Thuidiaceae). *Brittonia* 31: 379-394 [keys, illustrations]. **Buck, W. R. & Crum, H. 1990.** An evaluation of familial limits among the genera traditionally aligned with the Thuidiaceae and Leskeaceae. *Contributions to the University of Michigan Herbarium* 17: 55-69. **Buck, W.R. & Griffin III, D. 1984.** *Trachyphyllum*, a moss genus new to South America with notes on African-South American bryogeography. *Journal of Natural History* 18: 63-69. **O'Shea, B.J. 1999.** British Bryological Society Expedition to Mulanje Mountain. Malawi. 11. Pterigynandraceae M.Fleisch. and Rigodiaceae H.A.Crum (Bryopsida) in Africa. [key to African species, distribution map]

## RACOPILACEAE

(B.J. O'Shea, May 2000)

# Guide to Bryophytes of sub-Saharan Africa

The Racopilaceae contain two genera (one in Africa) and about 25 species with a pantropical distribution. The family is placed in the Leucodontales.

## ***Racopilum* P.Beauv.**

28 species and three varieties of this genus have been reported from Africa, although there may be only one or two good species involved.

**Plants** medium sized, forming loose to somewhat dense mats, mostly dark green. **Stems** creeping and spreading, irregularly to regularly pinnately branched, often densely tomentose; in cross-section outer 2-3 rows of cells small, thick-walled, inner cells larger, thin-walled, central strand present; rhizoids rusty-red, smooth or appearing lightly papillose. Leaves dimorphic, dorsal (upper) leaves small and symmetric, narrowly triangular, 1.5-2.0 mm long, apex narrowly acuminate; margins distally serrate; costa single, long excurrent; lateral leaves ovate- to oblong-lanceolate, 2-3 mm long, asymmetric, apex acute to broadly acuminate; margins plane, serrate distally, rather coarsely so; costa single, short excurrent; median cells irregularly isodiametric, hexagonal or rhomboidal, thick-walled, smooth to weakly papillose. **Monoicous or dioicous.** **Perichaetia** lateral, leaves ovate-long acuminate. **Seta** elongate, 10-30 mm long, smooth. **Capsule** often curved, urn cylindrical, 2.5-4.0 mm long, smooth to furrowed, neck short; exothecial cells oblong-rectangular, thick-walled; stomata at urn base, superficial. **Operculum** short or long rostrate. **Peristome** double, exostome striate below, papillose distally, endostome basal membrane short to high, cilia 2-4, nodose. **Calyptra** cucullate, sparsely hairy. **Spores** spherical, lightly papillose.

**Habitat.** On trunks and branches of trees and shrubs, logs, soil and rock; moist to wet forests from low to high elevations, near sea level to around 3000 m.

**Discussion.** *Racopilum* is characterised by the creeping habit, with dimorphic leaves, the upper leaves triangular and symmetric, the lateral leaves ovate to broadly oblong-lanceolate and asymmetric, distally serrate, elimbate margins, single and excurrent costa, firm-walled and smooth laminal cells, and cylindrical, slightly curved capsules. In the field, the complanate stem and the dimorphic leaves with excurrent costae are the most obvious characters.

Investigations by de Vries et al. (e.g. 1989), based in part on electrophoretic data, suggest that there is a great deal of genetic variation with *Racopilum*, but at the same time it may be possible only to recognise a few species because of morphological overlap (van Zanten, pers. com.).

**Literature.** De Vries, A., Bramer, J.P.J., van Zanten, B.O., Hoffman, A. & Bijlsma, A. 1989. Allozyme variation in populations of four *Racopilum* species, including the polyploid *R. tomentosum*. *Lindbergia* 15: 47-59.

## REGMATODONTACEAE

(B.J. O'Shea, May 2000)

A monogeneric family placed in the Hypnales.

## ***Regmatodon* Brid.**

A single species in Africa, *R. orthostegius* Mont. (Mexico and Central America to Bolivia & Southeast Brazil, palaeotropics); a genus of two species with a pantropical distribution.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** small to medium sized, forming loose to dense mats, dark green to brownish. **Stems** creeping, distal stems and branches ascending to erect, irregularly subpinnately branched, branches several, radiculose beneath; in cross-section outer 2-3 rows of cells  $\pm$  thick-walled, inner cells larger, thin-walled, central strand weak. **Leaves** concave, erect when dry, erect-spreading when wet, ovate-short lanceolate, 0.5-1.2 mm long, to 0.5 mm wide, somewhat asymmetric, apex short acuminate; margins entire, partially reflexed; costa single, ca. 1/2-2/3 lamina length, strong, occasionally weakly forked; laminal cells smooth and  $\pm$  thick-walled, median cells rhomboidal to oblong,  $\pm$  obliquely arranged; marginal and basal cells subquadrate to short rectangular. **Autoicous. Perichaetia** lateral; leaves elongate, ovate-lanceolate, to 2.2 mm long, acuminate, cells oblong, some porose. **Seta** elongate, 5.5-12 mm long, rather stout, smooth or roughened. **Capsule** erect to inclined, urn oblong-cylindrical, 2-3 mm long, somewhat asymmetric, smooth; neck short; exothecial cells mostly irregularly rectangular, longitudinal walls thick; stomata few at urn base, superficial; annulus undifferentiated. **Operculum** conic. **Peristome** double, set below mouth, exostome teeth 16, tips obtuse, cross-striate with a zig-zag line, trabeculate on back, ca. 1/2 or less endostome length; endostome basal membrane low, segments 16, broadly keeled, perforate below, punctate. **Calyptra** cucullate, smooth and naked. **Spores** spherical, granulose.

*Habitat.* Epiphytic on trunks and branches of trees (often on fallen branches), or occasionally on logs and rocks; semi-dry montane forests, sometimes more open areas; 1000-2500 m.

*Discussion.* The genus is characterized by ascending to erect distal stems and branches, somewhat asymmetric, ovate-short lanceolate leaves, short acuminate apex, entire margins, a strong to occasionally weakly forked costa ca. 2/3 lamina length, smooth and thick-walled laminal cells, rhomboidal to oblong, somewhat obliquely arranged median cells, and subquadrate to short rectangular marginal and basal cells. Under a x20 hand-lens or a dissection microscope, the dry leaves look like an upturned boat, with a wide, flat border. The peristome aids most in distinguishing this taxon, as the pale endostome is exerted way beyond the exostome. The genus may be confused with the Leskeaceae, but differs by the peristomial differences previously discussed.

*Literature.* **Eakin, D. A. 1998.** A taxonomic revision of the moss genera *Regmatodon*. *Nova Hedwigia* 67: 139-152. **Eakin, D.A. & Allen, B. 1999.** A nomenclatural note on *Regmatodon*. *Nova Hedwigia* 69: 311-312. **O'Shea, B.J. 1997.** British Bryological Society Expedition to Mulanje Mountain. Malawi. 9. Regmatodontaceae, Rhachithecaceae, Rhacocarpaceae and Rhizogoniaceae (Bryopsida). *Journal of Bryology* 19: 805-813.

## RHABDOWEISIACEAE

(J.-P. Frahm, May 2000)

**Plants** very small to medium sized, forming short tufts. **Stems** short, simple or few branched by innovations, with a central strand. **Leaves** mostly progressively larger distally, lanceolate to narrowly lanceolate or subulate from an oblong or oblong-ovate base; margins plane or recurved, entire or distal tips serrulate; costa single, subpercurrent to short excurrent; laminal cells smooth. **Asexual structures** absent. **Autoicous. Sporophytes** terminal; perichaetial leaves often larger and longer than stem leaves. **Seta** short to elongate, erect or curved to flexuose, smooth. **Capsule** immersed to exerted, urn obloid to pyriform with a neck distinctly elongate, occasionally as long as or much longer than the urn; stomata numerous in neck region, superficial; annulus often well developed. **Operculum** absent or present and rostrate. Peristome absent or single with 16 teeth. **Calyptra** cucullate or mitrate. **Spores** variously ornamented.

# Guide to Bryophytes of sub-Saharan Africa

*Discussion.* The Rhabdoweisiaceae, although introduced by Limpricht in 1890, were usually included as a subfamily in the Dicranaceae. Recent molecular-systematic studies (Stech 1999) support the maintenance of Limpricht's concept. Limpricht included *Cynodontium*, *Dichodontium*, *Oreas*, *Oreoweisia*, *Rhabdoweisia* and *Amphidium* in this family, of which all genera except for *Dichodontium* and *Oreas* occur in tropical Africa.

*Literature.* **Stech, M. 1999.** A reclassification of Dicranaceae (Bryopsida) based on non-coding cpDNA sequence data. *Journal of the Hattori Botanical Laboratory* 86: 137-160.

1. Upper laminal cells smooth or mamilllose; capsules with peristome	2
1. Upper laminal cells papillose; capsule without peristome	<i>Amphidium</i>
2. Upper laminal cells smooth	<i>Rhabdoweisia</i>
2. Upper laminal cells mamilllose	3
3. Leaves oblong-linear, apex obtuse	<i>Oreoweisia</i>
3. Leaves linear-lanceolate; apex acuminate	<i>Cynodontium</i>

## ***Amphidium* Schimp.**

A genus of 11 species worldwide, of which 4 occur in the mountains of tropical Africa. Three species are known only from a small range, of which *A. aloysii-sabaudiae* G.Negri and *A. le-testui* Thér. are African endemics with very few collections and *A. lapponicum* (Hedw.) Schimp. is a mainly holarctic species which occurs also in southern Africa. Only *A. tortuosum* (Hornsch.) H.Rob. is more widespread.

**Plants** in small to tall, often large tufts, yellowish to olive green, rusty brown below. **Stems** erect, simple or rarely branched, moderately radiculose. **Leaves** crispate when dry, erect-spreading when wet, narrow-lanceolate, apex acute, concave; margins plane, smooth; costa percurrent; upper laminal cells irregularly subquadrate, polygonal or rounded, densely papillose on both surfaces, moderately incrassate, chlorophyllose, basal laminal cells lax, thin-walled, hyaline, elongate rectangular; alar cells not differentiated. **Autoicous.** **Perichaetia** terminal, perichaetial leaves longer, sheathing. **Seta** short, a few mm long, straight, twisted when dry. **Capsule** usually immersed in the perichaetial leaves or only shortly exerted, erect, pear shaped, with 8 distinct, darker coloured longitudinal ribs, widened at mouth when emptied. **Operculum** from flat convex base obliquely rostrate. **Calyptra** cucullate, smooth, entire at base. **Peristome** lacking. **Spores** verrucose, 20-25 µm.

*Habitat.* On rocks and in fissures of rocks in high montane to alpine regions, 2400–4800 m.

*Discussion.* Until recently, the systematic position of this genus was controversial, as the genus lacks peristome teeth and it could not be decided whether it was a haplolepidous or diplolepidous genus. According to gametophytic characters, it was either included in the Orthotrichaceae or Dicranaceae. Recent molecular systematic studies (Goffinet & Vitt, 1998; Stech, 1999) revealed that *Amphidium* is not a diplolepidous moss and does not fit into the Orthotrichaceae. It is now placed into the Rhabdoweisiaceae because of morphological and anatomical similarities with the other genera of this family. The two southern African species are well illustrated by Van Rooy (1991).

# Guide to Bryophytes of sub-Saharan Africa

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*Literature.* **Goffinet, B. & Vitt, D.H. 1998.** Revised generic classification of the Orthotrichaceae based on molecular phylogeny and comparative morphology. In Bates, J.W., Ashton, N.W. & Duckett, J.G. (eds.) *Bryology for the twenty-first century*: 143-159. Leeds: Maney Publishing and the British Bryological Society. **Stech, M. 1999.** A molecular systematic contribution to the position of *Amphidium* Schimp. (Rhabdoweisiaceae, Bryopsida). *Nova Hedwigia* 68: 291-300. **Van Rooy, J. 1991.** The genus *Amphidium* Schimp. in southern Africa. *Lindbergia* 17: 59-63.

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## ***Cynodontium* Schimp.**

A genus of about 10 species primarily distributed in the Northern Hemisphere. Only *C. tanganyikae* P.de la Varde has been recorded from tropical Africa.

**Plants** in small tufts, green to yellowish green. **Stems** to 3 cm tall, simple or rarely branched, whitish radiculose below. **Leaves** crispate when dry, erect-spreading when wet, linear-lanceolate, 4-5 mm long, apex acute, concave; margins partially recurved in the lower part of the leaf, weakly dentate in the upper part; costa subpercurrent, 1/4-1/5 width of leaf base; upper laminal cells irregularly subquadrate, mamilllose, basal laminal cells lax, translucent, shortly rectangular, narrower at margins; alar cells not differentiated. **Autoicous.** **Perichaetia** terminal, perichaetial leaves ecostate, truncate, smooth. **Seta** 3-7 mm long, straight to curved or cygneous (when wet), smooth. **Capsule** erect to suberect, urn obovoid-cylindrical, 2.4 mm long, strongly furrowed when dry; annulus absent. **Operculum** conic-long rostrate, erect or oblique. **Calyptra** cucullate, smooth, entire at base. **Peristome** teeth golden, to 1/2-2/3 divided, vertically striate. **Spores** verrucose, 20--25 µm.

*Habitat.* Below a *Philippia*-shrub, only known from the type locality at Kilimanjaro Mtn., 4000 m.

*Discussion.* Potier de la Varde (1955) compares the only African species with *C. fallax*, from which it can be distinguished by a longer seta, ecostate perichaetial leaves and deeply furrowed capsule.

*Literature.* **Potier de la Varde, R. 1955.** Mousses récoltées par M. le Dr. Olov Hedberg en Afrique centrale, au cours de la mission suédoise de 1948. *Arkiv för Botanik* 2,3: 124-204.

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## ***Oreoweisia* (Bruch, Schimp. & W.Gümbel) De Not.**

A genus of 15 species worldwide, which are characteristic for tropical mountains, especially the Andes. Only *O. erosa* (Müll.Hal.) Kindb. occurs in Central and Southern Africa, which is also widespread in the Andes from Mexico to Bolivia (Griffin, 1989).

**Plants** in loose tufts, green to yellow green. **Stems** erect, to 1 cm tall, radiculose below; in cross-section with central strand. **Leaves** crispate when dry, loosely erect-patent when moist, ligulate, ca. 1.5-2 mm long, apex obtuse, rarely acute to rounded acute; margins recurved, erose-serrate in the upper part; costa strong, ending just

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

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below apex, ca. 1/5 width of leaf base, prominent on back; upper laminal cells short irregular, highly mammillose on both sides, basal laminal cells short rectangular, smooth, hyaline; alar cells lacking. **Autoicous**. **Perichaetia** appearing lateral, **Perigonia** terminal, leaves with clasping base. **Seta** 5-6 mm long, erect. **Capsule** erect, urn short cylindrical, 1.5 mm long; annulus persistent. **Operculum** conical, erect or somewhat oblique. **Peristome** teeth irregularly perforated, smooth. **Calyptra** cucullate, smooth, base mostly entire. **Spores** coarsely papillose, 20-22 µm.

*Habitat.* Terricolous.

*Discussion.* The genus resembles *Rhabdoweisia* with which it is placed in the same subfamily. The latter differs, however, by the 8-ribbed capsule and absence of a stem central strand.

*Literature.* **De Sloover, J.L. 1975.** Note de bryologie africaine. II. *Oreoweisia*, *Eriopus*, *Cyclodictyon*, *Hookeriopsis*, *Lepidopilidium*, *Lepidopilum*. Bulletin du Jardin Botanique National de Belgique 45: 103-124. [description, illustration]. **Griffin, D. 1989.** *Oreoweisia erosa* (C. Muell.) Kindb., an African-neotropical disjunct. Cryptogamie. Bryologie, Lichénologie 10: 297-300. [description]. **Magill, R.E. 1981.** - see general ref. [description, illustration].

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## ***Rhabdoweisia* Bruch, Schimp. & W.Gümbel**

Nine species worldwide, mainly in the northern hemisphere. Four species occur in Africa south of the Sahara, of which *R. crispata* (Dicks.) Lindb. and *R. fugax* Bruch, Schimp. & W.Gümbel are mainly holarctic species with disjunct occurrence in Southern Africa; *R. africana* Dixon & Naveau and *R. lineata* P.W.Richards & Argent are endemics in tropical Africa. All taxa except *R. crispata* are discussed briefly and partly illustrated by De Sloover (1973).

**Plants** small, in short dense or loose short tufts, green. **Stems** erect, to ca. 10 mm, little branched; central strand absent. **Leaves** crispate when dry, erect patent when moist, linear-lanceolate to oblong-lanceolate, 2-3 mm long, apex acuminate to obtuse; margins plane, entire to irregular denticulate or serrate at leaf tips; costa ending shortly below apex, filling 1/5 of leaf base; upper laminal cells quadrate-rounded, smooth; basal laminal cells elongate, lax and translucent; alar cells not differentiated. **Autoicous**. **Perichaetia** terminal, leaves similar to stem leaves. **Seta** short to elongate, 2.5-5.0 mm long. **Capsule** erect, urn ovoid to short cylindrical, to 1 mm long, distinctly ribbed when dry; annulus absent or weakly differentiated and persistent. **Operculum** short rostrate, oblique. **Peristome** reduced, teeth smooth or striate, undivided. **Calyptra** cucullate, smooth at base. **Spores** lightly to rather coarsely papillose.

*Habitat.* On rock and in rock crevices in montane regions.

*Discussion.* This genus differs from *Cynodontium* and *Oreoweisia* in its reduced peristome and capsules with 8 ribs; *Amphidium* is distinguished by its lack of a peristome.

*Literature.* **De Sloover, J.L. 1973.** Note de bryologie africaine. I. *Brachyodontium*, *Atractylocarpus*, *Amphidium*, *Rhabdoweisia*, *Tayloria*, *Rhacocarpus*, *Trachypodopsis*. Bulletin du Jardin Botanique National de Belgique 43: 333-348.

# Guide to Bryophytes of sub-Saharan Africa

## RHACITHECIACEAE

(B.J. O'Shea, April 2000)

**Plants** small, solitary or more commonly forming short tufts. **Stems** erect, simple or few branched by innovations; radiculose below. Leaves crispate or curled when dry, erect-spreading when wet, mostly oblong to oblong-lanceolate or spatulate, acute to obtuse-rounded, apiculate or not; margins plane to erect or slightly incurved, entire or crenulate; costa single, 2/3 lamina length to short excurrent; median cells mostly subquadrate, occasionally rhomboid to short oblong-rectangular or hexagonal, smooth or pluripapillose; basal cells quadrate to more commonly oblong-rectangular, smooth, lax or not. **Autoicous. Perichaetia** terminal; leaves differentiated or not. **Seta** single, short to somewhat elongate, erect or curved, smooth. **Capsule** immersed to shortly exserted, urn short cylindrical, ovoid or subglobose, strongly 8-ribbed or not; stomata at base of urn, superficial; annulus often enlarged, persisting or deciduous. **Operculum** plano-mammillate to conic-apiculate or rostrate and often oblique. **Peristome** absent or if present then single, teeth 8 or 8 pairs, smooth or vertically ornamented. **Calyptra** cucullate to possibly mitrate, smooth or distally roughened, naked. **Spores** spherical to ellipsoid, granulate to finely papillose.

*Discussion.* The Rhachithecaceae contain seven genera and 15 species distributed, in addition to Africa, in the tropical and subtropical areas of America and Asia; in Africa there are five genera and six species. The family, allied to the Orthotrichales, was reviewed recently by Goffinet (1998a), who provided a key for all species in the family, and interpreted the scattered and highly disjunct distribution of the family as indicating an ancient origin. A brief overview of the family in Africa appeared in O'Shea (1997). Characteristics of the family include the small plant stature, leaves oblong(-lanceolate) to broadly or narrowly spatulate, upper laminal cells mostly subquadrate, setae short, capsules immersed to short exserted and when present, peristome single with 8 teeth and urn strongly 8-ribbed. The family was established by Robinson (1964).

*Literature.* **Goffinet, B. 1998a.** The Rhachithecaceae: Revised Circumscription and Ordinal Affinities. *Bryologist* 100: 425-439. **O'Shea, B.J. 1997.** British Bryological Society Expedition to Mulanje Mountain, Malawi. 9. Regmatodontaceae, Rhachithecaceae, Rhacocarpaceae and Rhizogoniaceae (Bryopsida). *Journal of Bryology* 19: 805-813. **Robinson, H. 1964.** New taxa and new records of bryophytes from Mexico and Central America. *Bryologist* 67: 446-458.

1. Upper laminal cells pluripapillose	2
1. Upper laminal cells smooth	3
2. Leaves narrowly oblong-lanceolate, margins entire; peristome present, teeth 8; operculum conic-apiculate	<b><i>Hypnodontopsis</i></b>
2. Leaves spatulate, margins crenulate; peristome absent; operculum long rostrate	<b><i>Tisserantiella</i></b>
3. Leaves erect-appressed when dry; costa subpercurrent to short excurrent; seta very short, inconspicuous; capsule subglobose; peristome absent	<b><i>Jonesiobryum</i></b>
3. Leaves curled-contorted or erect-spreading when dry; costa less than 9/10 lamina length; seta up to 2 times the urn length; capsule cylindrical and 8-ribbed when dry; peristome	4



# Guide to Bryophytes of sub-Saharan Africa

present, teeth 8-paired	
4. Stem with central strand, costa abaxial cells in 2 layers, calyptrae papillose, operculum conic and short rostrate	<b><i>Rhachithecium</i></b>
4. Stem without central strand, costa abaxial cells to 5 layers, calyptrae smooth, operculum flat	<b><i>Rhachithecopsis</i></b>

## ***Hypnodontopsis* Z.Iwats. & Nog.**

A single species occurs in Africa, *H. mexicana* (Thér.) H.Rob. from Uganda, which is also known from Mexico; the two other member of the genus are found in Japan and Burma (Myanmar). Akiyama & Tanaka (2002) suggest that the current distribution of the genus may be the remnants of what was once a wide distribution.

**Plants** small. **Stems** to 3 mm tall, few branched; weakly radiculose. **Leaves** crispate when dry, erect-spreading to spreading when wet, narrowly oblong-lanceolate, to 1.4 mm long, apex bluntly acute to obtuse-rounded; margins erect, entire; costa subpercurrent; lamina unistratose; upper cells irregularly quadrate-rounded, thick-walled, pluripapillose, papillae several over cell lumen; basal cells of the lower 1/4-1/3 differentiated, extending upward along margin a short distance, oblong-rectangular, smooth. **Perichaetial** leaves sheathing at base, to 1.5 mm long, otherwise similar to stem leaves. **Seta** curved or twisted when dry, curved when wet, ca. 1 mm long. **Capsule** slightly exserted, urn subcylindrical and strongly 8-ribbed when dry, ellipsoid when wet, ca. 0.6 mm long; exothecial cells differentiated between rib and inter-rib bands; stomata at urn base, superficial; annulus broad, deciduous. **Operculum** low conic, obliquely apiculate. **Peristome** single, teeth 8, coarse vertical markings below. **Calyptra** cucullate, smooth. **Spores** spherical, finely roughened.

**Habitat.** Epiphytic, on bark of trees; montane forests, at 2300 m elevation.

**Discussion.** The genus is characterised by narrowly oblong-lanceolate leaves, erect, entire margins, pluripapillose laminal cells, strongly 8-ribbed capsules, 8 peristome teeth coarsely vertical marked below, and obliquely apiculate low conic operculum. Our species is only known from a recent collection from Uganda (Hodgetts & Goffinet, 1998), a remarkable disjunction from the only other known collection in Mexico.

**Literature.** **Akiyama, H. & Tanaka, A. 2002.** *Hypnodontopsis spathulata* H.Akiyama & A.Tanaka (Rhachithecaceae; Musci), a new species from Myanmar (Burma). *Bryological Research* 8: 131-136. [key to all 3 species] **Hodgetts, N.G. & Goffinet, B. 1998.** *Hypnodontopsis mexicana* (Thér.) H. Rob., a genus and species new to Africa. *Journal of Bryology* 20: 251-252. **Iwatsuki, Z. 1957.** The genus *Hypnodon* and its allies. *Bryologist* 60: 299-310.

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## ***Jonesiobryum* B.H.Allen & Pursell**

A single species, *J. sphaerocarpum* Bizot ex B.H.Allen & Pursell, is known from Nigeria and more recently from Central African Republic (Goffinet, 1998b); two additional species are recorded from Brazil.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** solitary or forming small tufts, yellowish-green. **Stems** to ca. 1 mm tall; in cross-section cells of nearly equal size, rather thin-walled, central strand weak; radiculose at base, rhizoids smooth. **Leaves** crowded, erect-appressed when dry, erect-spreading when wet, progressively larger above, oblong to obovate or orbicular, to ca. 1 mm long, apex bluntly acute to obtuse-rounded, margins erect to somewhat incurved, entire; costa strong below, subpercurrent to short excurrent; upper laminal cells irregularly subquadrate to rhomboid, smooth, thin-walled, rather lax; basal cells slightly differentiated, quadrate. **Perichaetial** leaves larger, obovate, to 1.3 mm long, apex bluntly acute and slightly reflexed, costa prominent on back. **Seta** very short, hardly observable. **Capsule** immersed, urn subglobose to broadly ovoid, to ca. 0.6 mm long; exothecial cells elongate, thin-walled; stomata at urn base, superficial or appearing slightly immersed; annulus well developed, persistent, ca. 3 outer layers of small isodiametric cells, inner row of much elongate narrowly oblong cells (to 55 µm long). **Operculum** plano-mammillate, ca. 0.2 mm long. **Peristome** absent. **Calyptra** not observed, possibly mitrate. **Spores** spherical, somewhat spaced coarsely papillose (granulate).

*Habitat.* Epiphytic, on trees, originally found on boles of *Uapaca*; in savanna woodlands, at elevations probably below 500 m.

*Discussion* The genus is characterised by oblong to obovate or orbicular leaves erect-appressed when dry, costa subpercurrent to short excurrent, smooth, little differentiated distal and proximal laminal cells, very short inconspicuous seta, subglobose capsule, large annulus, and absence of a peristome. *Jonesiobryum* has previously been placed in the Funariaceae: reasons for placement in the Rhachithecaceae are explored in depth by Allen and Pursell (1991). *Jonesia* is an invalid name. The genus is named in honour of Eustace Wilkinson Jones (1909-1992), long time student of African bryophytes, particularly hepatics.

*Literature.* Allen, B. & Pursell, R.A. 1991. A reconsideration of the systematic position of *Jonesiobryum*. *Bryologist* 94: 438-442. Bizot, M., Pierrot, R.B. & Pócs, T. 1974. Trois genres nouveaux de Muscinées. *Revue Bryologique & Lichénologique* 40: 25-31. Goffinet, B. 1997b. *Jonesiobryum sphaerocarpum* Allen and Pursell (Musci: Rhachithecaceae) new to the Central African Republic. *Journal of Bryology* 20: 242-243.

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## ***Rhachithecopsis* P.de la Varde**

This monotypic genus is known only from *R. tisserantii* P.de la Varde (Potier de la Varde, 1926), from about five collections in Central African Republic.

**Plants** solitary or in tufts, green. **Stems** to 3 mm tall, branched; cells with wide lumens and thick walls, epidermal cells not differentiated, no central strand. **Leaves** spreading when moist, erect to spreading when dry, lingulate-spathulate, acute, to 1.4 mm long, 0.5 mm wide, margins plane, entire; costa strong, to 3/4 or 9/10 of lamina length, in transverse section with large, thin-walled, hyaline laminal cells, covering up to 5 abaxial layers of substereids; basal cells differentiated in lower third or half of the leaf, hyaline, subquadrate to mostly long rectangular, about twice as long as wide, moderately thick-walled, smooth; upper cells green, short, subquadrate to isodiametric, hexagonal, rather thin-walled, flat, smooth. **Gemmae** not seen. **Perichaetial leaves** weakly differentiated, erect-spreading, lingulate to lanceolate, with incurved margins near apex, apiculate, with costa filling most of the apiculus, to 1.7 mm long. **Seta** 1.5 mm long, erect and kinked upward when dry, twisted to right, curved downward when moist or capsule young. **Capsule** 0.8 mm long, eight-ribbed, broadly cup-shaped, exothecial cells 2:1, those forming ribs, yellowish, with very thick longitudinal anticlinal walls, stomata superficial, few, restricted to neck. **Operculum** slightly convex, lacking rostrum or mammilla. **Peristome** single, with 8 pairs of fused teeth; teeth

# Guide to Bryophytes of sub-Saharan Africa

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incurved when moist, recurved when dry, smooth; annulus bistratose (two distinct layers), with both concentric layers uniseriate, caducous to persistent. **Calyptra** smooth, cucullate. **Spores** papillose.

*Habitat.* On trees and old wood.

*Discussion.* The genus is distinguished from *Rhachithecium* by the absence of a central strand in the stem, more than 2 layers of abaxial cells in the costa, a smooth calyptra, a bistratose annulus, papillose spores and a flat (not conic) operculum.

*Literature.* **Potier de la Varde, R. 1926.** *Rhachitheciopsis* P. de la V., genre nouveau d'Orthotrichacées de l'Afrique tropical. Bulletin de la Société Botanique de France 73: 74-76.

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## ***Rhachithecium* Broth. ex Jolis**

There is one widespread species in Africa, *R. perpusillum* (Thwaites & Mitt.) Broth. which is also widespread in Asia and the Neotropics, and a second *R. welwitschii* (Duby) R.H.Zander (doubtfully distinct from *R. perpusillum*) known only from one collection in Angola, which is said to have a double (rather than single) annulus. *Rhachitheciopsis tisserantii* P.de la Varde was considered by Robinson (1964 - see family ref.) to belong to this genus, but it was returned to *Rhachitheciopsis* by Goffinet (1998a - see family ref.). O'Shea (1997 - see family ref.) provides a key to species.

**Plants** solitary or forming short tufts, green or yellowish green. **Stems** short, to ca. 1 mm tall, with central strand; radiculose below. **Leaves** contorted and curled, lower leaves shorter and somewhat lingulate, upper leaves oblong-spathulate, to 2 mm long, apex obtuse-rounded or apiculate; margins plane, entire; costa strong below, to 2/3-4/5 lamina length, abaxial cells in 2 layers; lamina unistratose, laminal cells smooth, upper cells quadrate- to rectangular-rounded or irregularly hexagonal; basal 1/4 with cells laxly rectangular. **Gemmae** occasional, in upper leaf axils, obloid, multicellular. **Perichaetial leaves** strongly differentiated, erect-sheathing, narrowly oblong-lanceolate, to 2 mm or more long. **Seta** to 2.5 mm long, erect when dry, curved distally when wet, twisted. **Capsule** slightly exserted, urn cylindrical, to 1.2 mm long, strongly 8-ribbed when dry, ovoid to ellipsoid when wet, mouth flared when deoperculate; exothelial cells thin-walled; stomata at urn base, superficial; annulus unistratose, deciduous. **Operculum** conic or shortly rostrate, slightly oblique. **Peristome** single, set below mouth, reflexed when dry, inflexed when wet, teeth fused into 8 pairs, distally divided, smooth. **Calyptra** cucullate, papillose. **Spores** ellipsoid, finely punctate, appearing smooth.

*Habitat.* Epiphytic on bark of trees, apparently not an uncommon coloniser charred trees following fires, occasionally on rocks (see Jones, 1985 and O'Shea, 1997 - see family ref.); open savannas to moist woodland forests.

*Discussion.* The genus is characterised by the upper, oblong-spathulate leaves, curled-contorted when dry; costa 2/3-4/5 leaf length, smooth upper laminal cells, usually curved when wet, short seta ca. two times the urn length, cylindrical capsule, 8-ribbed when dry; smooth, distally divided into 8 paired peristome teeth.

*Literature.* **Jones, E.W. 1985.** *Rhachithecium perpusillum* (Thwait. & Mitt.) Broth. in Africa. Cryptogamie, Bryologique & Lichénologique 6: 47-50.

# Guide to Bryophytes of sub-Saharan Africa

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## ***Tisserantiella* P.de la Varde**

A single species in Africa, *T. pulchella* (Thér. & Hilp.) R.H.Zander (syn. *T. spathulata* P.de la Varde) is known from Cameroon. A second species occurs in Brazil and Bolivia.

**Plants** forming short tufts, olive to yellowish green. **Stems** to 1-2 mm tall; weakly radiculose below. **Leaves** crowded, strongly crispate, contorted-incurved when dry, erect-spreading when wet, spathulate, to 1 mm long, somewhat channelled above, apex broadly obtuse-rounded; margins plane to cross-section stereoids below guide cells; lamina unistratose, strongly differentiated with upper cells subquadrate, pluripapillose, papillae several over cell lumen, rather thick-walled; basal 1/4-1/3 with cells oblong-rectangular, smooth, lax. **Perichaetial leaves** somewhat differentiated, larger, to 1.85 mm long, apex often notched. **Seta** to ca. 2.3 mm long, slender. **Capsule** erect, urn ovoid to ovoid cylindrical, to 0.6 mm long; remaining features not observed (immature capsules). **Operculum** long rostrate, erect to somewhat oblique. **Peristome** stated to be absent. **Calyptra** not observed. **Spores** not observed.

*Habitat.* Epiphytic, on tree bark, apparently from semi-dry vegetation.

*Discussion.* The genus is distinguished by the spathulate leaves, crenulate margins, strongly differentiated upper, thick-walled, pluripapillose, isodiametric and lower lax, thin-walled smooth laminal cells, absence of a peristome, and long rostrate operculum. Zander (1993) excluded *Tisserantiella* in the treatment of the Pottiaceae, suggesting the Rhachithecaceae, and this was confirmed by Goffinet (1998a - see family ref.).

*Literature.* **Zander, R.H. 1993.** Genera of the Pottiaceae: Mosses of Harsh Environments. Bulletin of the Buffalo Society of Natural Sciences, 32: 1-378.

## RHACOCARPACEAE

(B.J. O'Shea, May 2000)

A monotypic family, placed in the Leucodontales.

## ***Rhacocarpus* Lindb.**

One or two species in Africa; a tropical/Southern Hemisphere genus containing seven species (Frahm 1995).

**Plants** mostly medium sized, forming large loose to dense mats, pale olive green to yellowish-brown or pale golden, often with reddish tinge. **Stems** spreading to subascending, occasionally pendent, irregularly to regularly pinnately branched, stem and branches tips attenuate; in cross-section outer rows very small and thick-walled,

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

inner cells larger, thick-walled, central strand absent; pseudoparaphyllia absent. **Leaves** distant to crowded, ovate to oblong, often panduriform, apiculate to long piliferous (usually reddish), to 3 mm long, concave, base slightly decurrent; margins serrulate distally, usually appearing bordered, piliferous tip smooth to weakly toothed; costa none; laminal cells strongly porose, median cells linear-oblong, appearing finely pluripapillose, papillae numerous over lumen and walls; marginal cells linear, usually forming a distinct often rusty red border; alar region differentiated, cells short to rather long rectangular, often dark rusty red or occasionally hyaline. **Dioicous**. **Perichaetia** appearing lateral, on short terminal branches; leaves sheathing seta, oblong-lanceolate. **Seta** elongate, to 28 mm long, smooth below, roughened below capsule, usually twisted distally. **Capsule** erect to suberect, urn broadly ovoid-short cylindrical, to 2 mm long, strongly to weakly ribbed when deoperculate; exothecial cells subquadrate-rounded to short oblong, cells below urn mouth oblate, smaller and walls thicker. **Operculum** long rostrate, oblique. **Peristome** absent. **Calyptra** cucullate, naked and smooth. **Spores** trilete, appearing finely papillose.

*Habitat.* Typically on rocks (particularly with seepage or by streams), soil and humus, rarely on tree branches; open montane to alpine, ca. 150-3500 m.

*Discussion.* The distinguishing features of this handsome genus are as follows: well-branched, rigid stems with cuspidate apices, with a glossy gold-red-bronzed appearance, particularly when dry; under the hand lens, the leaves are thick and opaque with distinct abruptly-narrowed apices usually with reddish hairpoints; under the microscope the leaves are oblong to panduriform, ecostate, with a distinct to indistinct border of smooth, linear cells and laminal cells that are finely pluripapillose over and between the lumen, with enlarged alar cells. The most widespread and often abundant African species (also found in America, Australia and some sub-Antarctic islands) is *Rhacocarpus purpurascens* (Brid.) Paris, which as presently understood is highly polymorphic with regards to gametophytic features. Further studies are needed, specifically to determine morphological limits and the possible influence of environmental factors. Two species were accepted for Africa by Frahm (1996), which can be distinguished as follows: *R. purpurascens* has a hairpoint, and the border is the full length of the leaf; *R. rehmannianus* var. *rehmannianus* (Müll.Hal.) Wijk & Margad. is apiculate with a border for only 1/2 to 2/3 of the leaf. The former is widespread in East and southern Africa, Réunion and Madagascar, whereas the latter occurs only in Cape Province, South Africa. However, Magill and van Rooy (1998) treat *R. rehmannianus* as a variant within the scope of the polymorphous *R. purpurascens*. Buck (1995) has suggested that *Rhacocarpus* is acrocarpous, i.e., the sporophyte is produced terminally. Furthermore, the genus is argued to be better positioned in the Dicranales, close to the family Dicnemonaceae.

*Literature.* **Buck, W. R. 1995.** The systematic position of the moss genus *Rhacocarpus*. *Fragmenta Floristica et Geobotanica* 40: 127-131. **Frahm, J.-P. 1996.** Revision der Gattung *Rhacocarpus* Lindb. (Musci). *Cryptogamie: Bryologie, Lichénologie* 17: 39-65 [keys, illustrations]. **O'Shea, B.J. 1997.** British Bryological Society Expedition to Mulanje Mountain. Malawi. 9. Regmatodontaceae, Rhachithecaceae, Rhacocarpaceae and Rhizogoniaceae (Bryopsida). *Journal of Bryology* 19: 805-813.

## RHIZOGONIACEAE

(B.J. O'Shea, May 2000)

Plants small to rather large, forming loose to dense tufts. Stems mostly erect, few branched, radiculose, often densely tomentose; central strand well developed. Leaves spirally arranged or appearing two-ranked, distant to rather crowded, ovate to narrowly or broadly oblong-lanceolate, or linear-lanceolate, apex acute to acuminate, base decurrent or not; margins plane or reflexed to recurved, crenulate, dentate or sharply serrate, teeth single and

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

margins unistratose or double and margins bistratose; costa single, strong, percurrent to short excurrent, entire or toothed on back distally; laminal cells mostly isodiametric and smooth, or bulging mammillose, walls firm and entire; alar region undifferentiated. Gemmae in leaf axils of distal stems and branches (absent in *Pyrrhobryum*), cylindrical, smooth to papillose. Autoicous or dioicous. Perigonia bud-like, usually below perichaetia. Perichaetia lateral at base or at mid stem, or terminal, leaves small and differentiated. Seta elongate, wiry, smooth. Capsule erect to horizontal, urn short to rather long cylindrical, symmetric to asymmetric, curved or straight. Operculum conic or short rostrate, oblique. Peristome double or absent, exostome teeth 16, cross-striate below, papillose above, or papillose throughout; endostome basal membrane moderately high, segments 16, keeled, cilia usually present. Calyptra cucullate, naked and smooth. Spores spherical, lightly papillose.

*Discussion.* The Rhizogoniaceae contain eight genera and some 40 species with a pantropical distribution, with two genera and three species in Africa. The family is placed in the Bryales. The distinguishing feature of the Rhizogoniaceae is that the sporophytes occur laterally near the base or midway along the erect stems (but terminal in *Leptotheca*). Manuel (1980) segregated *Pyrrhobryum* from *Rhizogonium*, a subdivision that appears well supported from several lines of evidence (cf. Inoue & Iwatsuki, 1976). Koponen (1988) has presented a classification in which *Leptotheca* and *Pyrrhobryum* are placed in an amended Mniaceae. Certainly the traditional concept of the Mniaceae, the Rhizogoniaceae and related families needs critical reassessment, although the cladistic analyses presented by Koponen only weakly support the new classification.

*Literature.* Inoue, S. & Z. Iwatsuki. 1976. A cytotaxonomic study of the genus *Rhizogonium* Brid. (Musci). Journal of the Hattori Botanical Laboratory 41: 389-403. Koponen, T. 1988. The phylogeny and classification of Mniaceae and Rhizogoniaceae (Musci). Journal of the Hattori Botanical Laboratory 64: 37-46. Manuel, M. G. 1980. Miscellanea bryologica II. Classification of *Rhizogonium* Brid., *Penzigiella hookeri* Gangulee, and some *nomina nuda*. Cryptogamie, Bryologie. Lichénologie 1: 67-72. O'Shea, B.J. 1997. British Bryological Society Expedition to Mulanje Mountain. Malawi. 9. Regmatodontaceae, Rhachithecaceae, Rhacocarpaceae and Rhizogoniaceae (Bryopsida). Journal of Bryology 19: 805-813 [keys].

1. Leaves lanceolate, doubly-serrate, margins bistratose; exostome cross-striate	<i>Pyrrhobryum</i>
1. Leaves ovate-lanceolate, singly-serrate, margins unistratose; exostome papillose	<i>Leptotheca</i>

## *Leptotheca* Schwägr.

A genus of three species, of which only one occurs in Africa, *L. gaudichaudii* Schwägr., which is found in the South African Cape area, but also elsewhere in the circum-Antarctic region from Chile through to New Zealand.

**Plants** rather small to medium sized, forming tufts, light to dark green. **Stems** erect, to 3 cm tall, often densely tomentose below; in cross-section 5-sided, outer 2-3 rows of cells small, thick-walled, on corners rows to 5, inner cells larger, thick-walled, central strand well differentiated; rhizoids rusty-red, distinctly papillose. **Leaves** erect when dry, linear-lanceolate, 2-2.3 mm long, apex acuminate, base slightly decurrent; margins plane above, recurved below, serrate in distal 1/2, teeth single, sharply toothed to spinose distally; costa strong, short excurrent, toothed on back; laminal cells smooth, thick-walled; median cells isodiametric or oval to irregularly rectangular-rounded; basal cells similar, but those associated with propagula cells long rectangular-rounded. **Gemmae** infrequently present on terminal stems in leaf axils, often in a dense cluster (like a bottle-brush), each long-cylindrical, golden-red, lightly papillose. **Dioicous.** **Perichaetia** terminal; leaves lanceolate-acuminate, costa short to rather long excurrent, not serrate, upper cells similar, lower and basal cells short rectangular, lax, golden red. **Sporophyte** unknown in Africa.

# Guide to Bryophytes of sub-Saharan Africa

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*Habitat.* In the Cape it is restricted to rock recesses and crevices in the mountain fynbos (Magill 1987), but elsewhere it is a common rainforest epiphyte, also growing on logs and rocks, in moist or wet premontane to high montane forests, 1000-3100 m.

*Discussion.* This genus is distinguished by (when present) the bottle-brush appearance of clustered, papillose, cylindrical gemmae on distal portion of stems; additional features include the often very tomentose lower stems, the spirally arranged leaves, and the single toothed serration of the leaf margin.

*Literature.* **Churchill, S.P. & Buck, W.R. 1982.** A taxonomic investigation of *Leptotheca* (Rhizogoniaceae). *Brittonia* 34: 1-11 [keys, illustrations, maps]. **Magill, R.E. 1987.** - see general refs. [description, illustration].

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## ***Pyrrhobryum* Mitt.**

Probably only two species in Africa, *Pyrrhobryum spiniforme* (Hedw.) Mitt. (pantropical), and *P. vallis-gratiae* (endemic to the South African Cape) (O'Shea 1997); a pantropical genus of 15 about species.

**Plants** medium sized to somewhat large, forming loose to dense tufts, dark green. **Stems** erect or curved; in cross-section outer 2-3 rows of cells small, thick-walled, inner cells larger, moderately thick-walled, central strand distinct; rhizoids often forming a dense tomentum below. **Leaves** linear-lanceolate to broadly lanceolate, 4-8 mm long, apex acuminate, base decurrent or not; margins plane, bistratose and doubly-serrate to near base; costa strong, percurrent to excurrent, toothed on back, in cross-section stereids above and below guide cells; laminal cells uniform throughout except at base, isodiametric, rounded to 4-6 sided, thick-walled, smooth; juxtacostal basal cells often weakly differentiated, enlarged, short to rather long rectangular, lax or not. **Gemmae** absent. **Synicous.** **Perichaetia** lateral, confined to base or lower part of stem; leaves oblong-lanceolate, marginal teeth single or double, upper cells elongate, oblong-rectangular, lower cells larger, lax, golden. **Seta** elongate, 2-6 cm long, smooth. **Capsule** inclined to horizontal, urn cylindrical, 1.5-3 mm long, usually curved, becoming striate and flared at the mouth when deoperculate; exothecial cells quadrate- to rectangular-rounded, moderately thick-walled, somewhat weakly collenchymatous at base; stomata at urn base, superficial. **Operculum** conic-rostrate, oblique. **Peristome** double, exostome teeth lanceolate, appearing cross-striate (actually finely striate-papillose), distally papillose; endostome basal membrane rather high, segments keeled and perforate, cilia 2-3. **Calyptra** cucullate, smooth. **Spores** spherical, lightly papillose.

*Habitat.* On tree trunks, logs and soil or humus, leaf litter covered banks, silty rocks in streams; wet lowland to high montane forests, from near sea level to 2550 m.

*Discussion.* The genus is characterized by the elongate stems, distal and spirally arranged broadly to narrowly lanceolate or linear-lanceolate leaves, doubly toothed, bistratose leaf margins, costa distally toothed at the back, mostly isodiametric laminal cells uniform to near base, and sporophytes positioned somewhat midway on stem or near the base. The local species were previously placed in the genus *Rhizogonium*. The two species may be differentiated by the following: *P. vallis-gratiae* - stem branching above, seta arising above base from short lateral branch, leaves < 2mm long, ovate-lanceolate, appressed when dry; and *P. spiniforme* - stem not branched or branched below, seta arising from base, leaves 4-8 mm long, linear-lanceolate, crisped when dry.

*Literature.* **Magill, R.E. 1987.** - see general refs. [key, descriptions, illustrations].

# Guide to Bryophytes of sub-Saharan Africa

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## RIGODIACEAE

(B.J. O'Shea, May 2000)

The Rigodiaceae as presently defined is a monotypic family, previously placed in the Lembophyllaceae. The family is placed in the Hypnales.

### ***Rigodium* Kunze in Schwägr.**

A genus of six species and one variety, but only a single species in Africa, *R. toxarion* (Schwägr.) A.Jaeger (west, central and east tropical Africa, as far south as Zambia). The genus has a tropical to austral-temperate distribution.

**Plants** medium sized to somewhat large, forming loose tufts, dark green to blackish-green. **Primary stems** creeping. **Secondary stems** weakly to strongly stipitate, stems above stipe suberect to arching and subdendroid, to about 3.5 cm tall, but sometimes much longer, usually rather stiff, several-pinnately branched, branches slender to filiform, usually becoming flagellate; in cross-section stem surface ridged or fluted, outer 3-4 rows of cells small, thick-walled, inner cells large, thin-walled, central strand well developed; pseudoparaphyllia and paraphyllia absent. **Leaves** differentiated; stipe leaves wide-spreading, broadly ovate and abruptly long acuminate, to 1.4 mm long, 1 mm wide, base somewhat decurrent, usually ecostate, or costa short and single or forked; stem leaves wide-spreading to squarrose, 1-1.5 mm long, to 0.8 mm wide, similar to stipe leaves but apex gradually narrowed and acute; costate, costa single, ending in or just below acumen; branch leaves short ovate-lanceolate, 0.25-0.55 mm long; costa ending below or into acumen; margins usually serrulate throughout; laminal cells smooth and thick-walled, subquadrate- to oblong-rounded, smaller along margin; alar region not well differentiated, cells oblong-rectangular or subquadrate. **Dioicous**. **Perichaetia** lateral; leaves differentiated, elongate, oblong-subulate. **Seta** elongate, 10-25 mm long or more, smooth. Capsule inclined to horizontal, urn ovoid-cylindrical, 1.5 mm long, constricted below mouth when dry; exothecial cells thick-walled; annulus present, in 2 rows, deciduous. **Operculum** conic-long rostrate. **Peristome** double, exostome teeth 16, cross-striate below, distally papillose; endostome basal membrane high, segments 16, keeled and perforate, finely papillose, cilia 1-3. **Calyptra** cucullate, naked and smooth. **Spores** spherical, finely papillose.

**Habitat.** Epiphytic on tree trunks and branches, also on logs, shaded rocks and soil, often by streams; montane forests, 900-3500 m.

**Discussion.** The genus was recently revised thoroughly (Zomlefer, 1993), and is distinguished by the subdendroid habit, stipitate with secondary stems often exhibiting long delicate, flagellate branches, differentiated stipe, stem and branch leaves, finely serrulate margins, and oval to oblong-oval laminal cells. Although sporophytes are sometimes present, it is likely that the common mode of reproduction in *Rigodium* is asexual by propagula in the form of distal flagellate branches and deciduous leaves.

**Literature.** **Crum, H. 1981.** Taxonomic and nomenclatural notes on middle American mosses. *The Bryologist* 84: 390-393. **O'Shea, B.J. 1999.** British Bryological Society Expedition to Mulanje Mountain. Malawi. 11. Pterigynandraceae M.Fleisch. and Rigodiaceae H.A.Crum (Bryopsida) in Africa. [key to African species, distribution map]. **Zomlefer, W. B. 1993.** A revision of *Rigodium* (Musci: Rigodiaceae). *The Bryologist* 96: 1-72 [keys, illustrations, map].



# Guide to Bryophytes of sub-Saharan Africa

## SPLACHNACEAE

(B.J. O'Shea, April 2000)

**Plants** somewhat small to medium sized, gregarious or forming loose to dense tufts, often lustrous green or reddish-brown. **Stems** erect, few to several branched by innovations, radiculose below, occasionally tomentose; central strand present. **Leaves** distant to crowded, often comose distally, rather lax, occasionally crispate when dry, ovate-lanceolate, oblong or obovate to spatulate, apex apiculate, acuminate, acute or obtuse, base occasionally decurrent; margins entire or bluntly to sharply serrate or ciliate, limbate or elimbate; costa single, subpercurrent to long excurrent; laminal cells rather large, smooth, median cells rhomboidal, hexagonal or irregularly rectangular; lower and basal cells laxly oblong or rectangular; alar region undifferentiated. **Propagula** apparently absent. **Autoicous or dioicous**. **Perigonia** on lateral short branches; paraphyses clavate. **Perichaetia** terminal, leaves little differentiated. **Seta** somewhat short to more commonly elongate, rather stout, smooth to scabrous. **Capsule** erect, urn mostly short or long cylindrical; hypophysis lacking or when present inflated and elongate or obovoid, sometimes as long or longer than urn; annulus appearing absent. **Operculum** conic or convex-apiculate. **Peristome** single, teeth 16 and united in 8 pairs or initially 4 pairs at base and distally divided, erect or reflexed, mostly variously papillose. **Calyptra** mitrate and lobed at base, naked to roughened-papillose or ciliate. **Spores** spherical, smooth or variously papillose.

*Discussion.* The Splachnaceae contain seven genera and about 60 species, widely distributed in boreal and temperate regions, and in the tropics confined to the highlands; in Africa four genera and 12 species. The Splachnaceae are the only family of mosses known to exhibit entomophily, usually involving those plants found growing on dung or carrion. The studies summarised by Koponen (1990) have shown that various species in several genera produce volatile compounds, emitting an odour from the stomata that attracts flies and assists in the dispersal of spores (not unlike that of many members of the family Araceae). Most of the studies involve taxa from the Northern Hemisphere, and it is not clear whether tropical Splachnaceae are also entomophilous, and only *Tetraplodon* of the African genera has been noted as growing on dung (but see also *Splachnum* treatment below).

*Literature.* **Koponen, A. 1977.** *Tayloria* subgen. *Pseudotetraplodon*. subgen. nov., and new combinations in *Brachymitrium*, *Moseniella* and *Tayloria* (Splachnaceae, Musci). *Annales Botanici Fennici* 14: 193-196. **Koponen, A. 1982.** On the structure and function of the peristome in Splachnaceae. *Journal of the Hattori Botanical Laboratory* 53: 73-98. **Koponen, A. 1983.** Studies on the generic concept in the classification of the moss family Splachnaceae. Academic Dissertation, University of Helsinki. **Koponen, A. 1990.** Entomophily in the Splachnaceae. *Botanical Journal of the Linnean Society* 104: 115-127. **Koponen, A., Koponen, T., Pyysalo, H., Himberg, K. & Mansikkamäki, P. 1990.** Composition of volatile compounds in Splachnaceae. Pages 449-460. In: H. D. Zinsmeister & R. Mues, *Bryophytes: Their Chemistry and Chemical Taxonomy*. Oxford: Clarendon Press. **Koponen, T. & Weber, W.A. 1972.** A revision of African Tayloriae (Splachnaceae), including *Bryomnium*. *Annales Botanici Fennici* 9: 126-134.

1. Leaf margins ciliate or distinctly bordered; peristome teeth 16, united in pairs at the apex	<b><i>Brachymitrium</i></b>
1. Leaf margins not or weakly bordered or ciliate; peristome teeth in pairs of 8 or initially 4 and divided distally, erect or reflexed, or absent	<b>2</b>

# Guide to Bryophytes of sub-Saharan Africa

2. Leaf apices bluntly acute or obtuse to acuminate	<i>Tayloria</i>
2. Leaf apices narrowly acuminate	3
3. Leaf margins weakly bordered; hypophysis noticeably inflated, often greatly so; peristome of 8 pairs of fused teeth	<i>Splachnum</i>
3. Leaf margins not differentiated; hypophysis slightly expanded; peristome fused initially in 4 pairs distally divided	<i>Tetraplodon</i>

## ***Brachymitrium* Taylor**

Four species in Africa (Gulf of Guinea islands, Cameroon, Tanzania and Madagascar), with six species in the genus.

**Plants** medium sized to rather large, forming loose tufts, glossy or somewhat lustrous green, yellowish-green or golden. **Stems** erect, few branched, densely tomentose; in cross-section angular (5-sided), hyalodermis present, central strand present; rhizoids reddish-brown, smooth or papillose. **Leaves** crispate or contorted when dry, erect-spreading when wet, obovate to spatulate, 4-6 mm long, apex broadly acute or obtuse and apiculate, base short to long decurrent; margins plane, bluntly serrate or ciliate, limbate or not; costa subpercurrent to ending well below apex; laminal cells smooth, median cells short hexagonal to rhomboidal; lower and basal cells long rectangular; marginal cells forming a weak border with a single row of cells or distinct golden coloured border of 4-6 rows, cells fusiform to rhomboidal. **Autoicous**. **Seta** elongate, 2-20 mm long, smooth, twisted or not. **Capsule** erect, urn cylindrical, 1.5-4.5 mm long, mouth somewhat flared when deoperculate, hypophysis absent; neck short; exothecial cells thick-walled; stomata at base of urn, superficial. **Operculum** short rostrate. **Peristome** single, teeth 16, united at apex, reticulate or reticulate-striate, occasionally with few perforations along median line. **Calyptra** mitrate, ciliate or scabrous. **Spores** reticulate.

**Habitat.** Information on the genus is limited, but it has been found on rocks and stones, epiphytic on tree trunks and on decaying logs, in montane forests, 950-2890 m.

**Discussion.** The genus is characterized by ciliate or distinctly bordered leaf margins, apices of peristome teeth united in pairs, and a ciliate or scabrous mitrate calyptra. Koponen & Weber (1972) provides a key for *B. jamesonii* and *B. moritzianum* (= *B. thomeanum*), with *B. immersum* described in Goffinet (1999) and *B. pocsii* in Koponen (1975). Mt. Cameroon is the prime African locality for this genus, with 3 of the 4 species.

**Literature.** **Goffinet, B. 1999.** *Brachymitrium immersum* (Splachnaceae, Musci) a new species from Cameroon. *Bryologist* 102: 108-111. **Koponen, A. 1975.** *Tayloria pocsii*, spec. nova (Musci, Splachnaceae) from Mt. Kilimanjairo, Tanzania. *Annales Botanici Fennici* 12: 22-24 [= *Brachymitrium pocsii* (A.Kop.) A.Kop.]. **Koponen, T. & Weber, W.A. 1972.** - see family ref.

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***Splachnum* L. ex Hedw.**

# Guide to Bryophytes of sub-Saharan Africa

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One species in Africa, *Splachnum adolphi-friederici* Broth. known from D.R. Congo and Uganda; a genus of nine species associated with cool, moist temperate regions.

**Plants** forming dense tufts, glossy pellucid green. **Stems** to ca. 4 cm or more tall, few branched, tomentose below; central strand present. **Leaves** smaller below, distally crowded and larger,  $\pm$  crispate or contorted when dry, erect-spreading when wet, elliptical-lanceolate or oblanceolate, 3.0-5.5 mm long, to 2 mm wide, distally folded, apex narrowing into an apiculus; margins plane, entire to sharply serrate distally; costa short excurrent; median cells large, hexagonal to hexagonal-fusiform; lower and basal cells long rectangular; alar region undifferentiated; marginal cells oblong-rectangular. **Autoicous**. **Perigonia** on short branches; leaves with an oval base and distal wide-spreading, lanceolate limb. **Perichaetia** terminal; leaves similar. **Seta** elongate, 5-40 mm long, slender, flexuose or not, pale whitish-green to pink or dark bright red, smooth, twisted when dry. **Capsule** erect, short to long exserted, differentiated between a short urn and inflated neck (hypophysis), urn cylindrical, 0.6-1.5 mm long, brown; exothecial cells strongly collenchymatous, oblate-rectangular or subquadrate; hypophysis pyriform or only slightly inflated, 1.5-6.0 mm long, to 4 mm wide, pale pink or red; stomata on distal hypophysis, superficial; columella often shortly exserted when dry. **Operculum** convex- or conic-apiculate. **Peristome** teeth fused in 8 pairs, papillose, reflexed when dry. **Calyptra** mitrate-campanulate, ca. 1.2 mm long. **Spores** spherical or oval, smooth or lightly papillose.

*Habitat.* On dung or soil probably previously associated with dung; mid to high open montane areas, 3000-3900 m.

*Discussion.* The genus is readily recognized by the inflated hypophysis, combined with apiculate, elliptical-lanceolate or oblanceolate leaves, often weakly bordered margins, and peristome teeth fused into 8 pairs. *Splachnum adolphi-friederici* Broth. appears to have been collected only four times (Porley in Eggers et al. 2001), most recently in the Virunga mountains (Uganda), and three times in the Rwenzori mountains. Porley (op. cit.) notes that one of the BM specimens suggests a similarity to the boreal *S. ampullaceum*, although on the specimens seen, the African collections appears to have apiculate leaves (rather than long-acuminate as in *S. ampullaceum*), and the plants are significantly taller. The Uganda specimen was collected from a decaying log, but might have been growing on animal dung.

*Literature.* Eggers, J., Stevenson, C.R., Porley, R.D. & Stech, M. 2001. New bryophyte taxon records for tropical countries IV. *Tropical Bryology* 20: 97-100.

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## **Tayloria** Hook.

Six species in Africa; about 38 species worldwide, rather widely distributed but concentrated in the highland tropics and subtemperate regions.

**Plants** small to medium sized, forming tufts, glossy green to reddish-brown. **Stems** erect, simple or few branched, usually tomentose below; in cross-section epidermis small, inner cells large and thin-walled, central strand present; rhizoids smooth to papillose. **Leaves** mostly crispate or contorted when dry, erect-spreading when wet, ovate-short lanceolate, elliptical to obovate or spatulate, apex broadly acuminate, acute or obtuse; margins plane to reflexed below, entire, bluntly serrate or crenulate distally, elimbate; costa  $3/4$  -  $4/5$  lamina length or subpercurrent; upper and median cells large and smooth, hexagonal to rhomboidal; basal cells rectangular, rather lax. **Autoicous**. **Perichaetia** terminal, leaves similar to stem leaves. **Seta** rather short to elongate, twisted or not, smooth or scabrous. **Capsule** emergent to long exserted, erect, dark red to reddish-black, urn short cylindrical; exothecial

# Guide to Bryophytes of sub-Saharan Africa

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cells oblate, thick-walled; hypophysis short (usually equal to or shorter than urn), cells elongate, thin-walled, stomata in distal half, superficial. **Operculum** not observed. **Peristome** single, teeth 8 or 16, papillose, reflexed when dry. **Calyptra** not observed. **Spores** spherical, appearing smooth to lightly papillose.

*Habitat.* Usually epiphytic (including forest trees, bamboo, Ericaceae and Dendrosenecio), but also on soil and humus, occasionally on dung; open montane forests and afro-montane areas, 500-3700 m.

*Discussion.* The genus is characterized by the obovate, spatulate to elliptical or broadly short lanceolate leaves, eilimbate, entire to toothed margins, smooth to occasionally papillose seta, cylindrical capsule, rather narrow and short hypophysis, and papillose, 8 or 16 toothed peristome. Koponen & Weber (1972) provides a key, with additional information on *T. orthodonta* in De Sloover (1973).

*Literature.* **Boecker, M. 2001.** Taxonomic results of the BRYOTROP expedition to Zaire and Rwanda 33. Splachnaceae, *Tayloria*. Tropical Bryology 20: 71-72. **De Sloover, J.L. 1973.** Note de bryologie africaine. 1. *Brachydontium*, *Atractylocarpus*, *Amphidium*, *Rhabdoweisia*, *Tayloria*, *Rhacocarpus*, *Trachypodopsis*. Bulletin du Jardin Botanique National de Belgique 43: 338-348. **Koponen, T. & Weber, W.A. 1972.** - see family ref.

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## ***Tetraplodon* Bruch, Schimp. & W.Gümbel**

A single species in Africa, *T. mnioides* (Hedw.) Bruch, Schimp. & W.Gümbel, known from Kenya, Tanzania, Uganda and D.R. Congo (Zaire); about five species in the genus, primarily of the Northern Hemisphere, but also in mountains throughout the tropics.

**Plants** medium sized, forming dense compact tufts, pale green to yellowish-green. **Stems** erect, to 3 cm or more tall, few branched, densely tomentose; central strand well developed. **Leaves** crowded, erect to erect-spreading, oblong- to obovate-lanceolate, 4.0-5.5 mm long, to 1.8 mm wide, deeply concave, apex narrowly acuminate, ending in a long hyaline subula; margins entire; costa ending in subula; laminal cells smooth, median cells oblong, rectangular- to hexagonal-rounded; basal cells long rectangular, lax. **Autoicous. Perichaetia** terminal, leaves ± larger than stem leaves. **Seta** elongate, to 30 mm long or more, stout, smooth. **Capsule** erect, urn short cylindrical, to 1.5 mm long, hypophysis narrowly elliptical, ca. 2 times longer than urn. **Operculum** conic. **Peristome** single, teeth fused into 4 pairs at base, and distally becoming 2-paired, reflexed when dry, outer surface papillose, inner surface smooth. **Calyptra** mitrate, smooth and naked. **Spores** spherical, smooth.

*Habitat.* On rocks, burnt ground, fallen trees and on carnivore dung, usually containing the remains of small mammals. Subalpine ericaceous heath and alpine semi-desert, 3000-4250 m.

*Discussion.* The genus is distinguished by the densely compact tufted plants, oblong-lanceolate to oblanceolate leaves, percurrent costa ending in a subula, and 8 peristome teeth, papillose on the outer surface, smooth on the inner.

## SPLACHNOBRYACEAE

# Guide to Bryophytes of sub-Saharan Africa

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(T. Arts, April 2000)

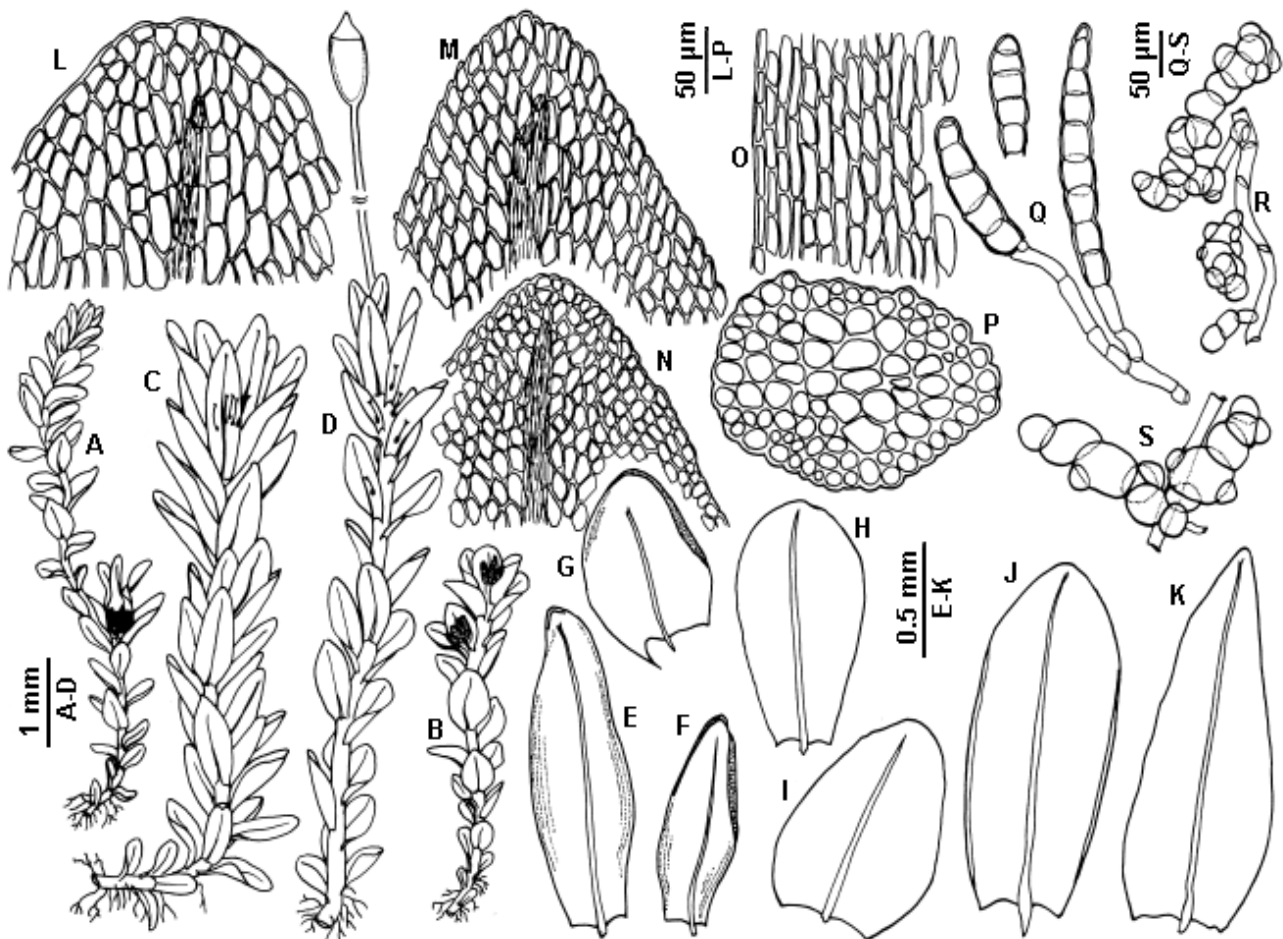
A monotypic family exhibiting features associated with the Pottiaceae and the Splachnaceae.

## ***Splachnobryum*** Müll.Hal.

A rather common and widespread genus, worldwide with ca. 26 species in tropical and subtropical regions, mostly from southeast Asia. A revision would probably reduce significantly the number of species, as demonstrated by Breen and Pursell (1959) and Arts (1996). Three species are accepted from Africa (Arts, 1996).

**Plants** small and soft, in loose to rather dense tufts, pale to dark green. **Stems** erect, mostly simple, or sometimes sparsely branched with subfloral innovations, 5-25 mm high; cells in cross section rather large and thin-walled, the epidermal cells with slightly thickened walls, central strand sometimes present, sometimes disintegrating in older stem parts; axillary hairs clavate 2-3 celled, with inflated apical cell, or linear 3-4(-5) celled, basal cell(s) short, yellowish, distal cell(s) much longer, hyaline. **Leaves** patent to widespread, oblong to obovate-spathulate or elliptical, plane to strongly concave; apex obtuse or rounded; costa single, often ending a few cells below apex and more or less bisected at the tip, rarely short or irregular forked; leaf margins plane to recurved, mostly crenulate at apex, sometimes entire; median cells of leaves large, oblong, rhomboidal to hexagonal, smooth and rather firm to thin-walled, apical cells smaller more or less quadrate, basal cells larger, rectangular. **Asexual reproduction** by green gemmae on axillary rhizoids stalks and by hyaline to yellowish rhizoidal tubers. **Dioicous**. Male plants often smaller than female plants, perigonia terminal, becoming lateral by innovations, bud-shaped, paraphyses lacking. **Perichaetia** lacking, archegonia naked, more or less clustered at stem apex and becoming solitary in leaf axils by elongation of stem apex. **Seta** single, 3--10 mm long, smooth. **Capsule** erect, symmetric, short-cylindrical, 0.9--1.4 mm long; exothecial cells irregularly quadrate to rectangular, firm but thin-walled; stomata few at urn base, superficial; annulus persistent, consisting of several rows of thick-walled isodiametric to horizontally elongated cells. **Operculum** conic-apiculate or rostrate. **Peristome** single, with 16 endostome teeth, papillose, arising below the capsule mouth. **Calyptra** elongate, narrowly conic-cylindric, cucullate, 1.2--1.4 mm long, smooth. **Spores** spherical, yellowish, 12-25 µm in diameter, indistinctly papillose.

# Guide to Bryophytes of sub-Saharan Africa



***Splachnobryum gracile* Besch.** (A, C, E-G, L) and ***Splachnobryum obtusum* (Brid.) Müll.Hal** (B, D, H-K, M-S)  
 A-B: male plants; C-D: female plants; E-K: leaves; L-N: cells of leaf apex; O: marginal and mid-leaf cells;  
 P: cross-section of stem; Q: axillary gemmae; R-S: rhizoidal gemmae.

**Habitat:** In exposed as well as shaded habitats, growing on base-rich and calcareous soils and rocks in permanently or periodically wet places, sometimes aquatic.

**Discussion.** The genus is characterized by soft, small, erect plants, with blunt or rounded apex; margins plane to more or less recurved, entire to crenulate at apex; costa ending below apex; median cells rhomboidal to hexagonal, smooth and rather large thin to firm-walled, quadrate distal marginal cells; erect and short cylindrical capsule with a single peristome consisting of a papillose endostome. The axillary naked archegonia, lack of paraphyses, unique peristome characters and peculiar axillary hairs are helpful to define the genus. Sterile plants may be difficult to distinguish from some *Bryum* species with rounded leaf apex such as *B. cyathiphyllum* and *B. ellipsifolium*. Of the species occurring in Africa, *Splachnobryum aquaticum* is distinguished by the nerve ending far below the apex, whereas in the other two species the nerve ends 2-5 cells below the apex. *S. gracile* is characterised by distinctly concave leaves with very large leaf cells, 20--35  $\mu\text{m}$  wide, and long, linear 4-5 celled axillary hairs, whereas in *S. obtusum* (as with *S. aquaticum*) the axillary hairs are short, clavate, 2-3 celled, with a distinctly inflated apical cell.

**Literature:** Arts, T. 1996. The genus *Splachnobryum* in Africa, with new combinations in *Bryum* and *Gymnostomiella*. *Journal of Bryology* 19: 65-77 [keys, illustrations]. Breen, R.S. and Pursell, R.A. 1959. The genus *Splachnobryum* in the United States, Mexico, Central America and the Caribbean. *Revue Bryologique et Lichénologique*. 38: 280-289. Koponen, A. 1981. Splachnobryaceae, a new moss family. *Annales Botanici Fennici* 18: 123-132.

# Guide to Bryophytes of sub-Saharan Africa

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## SYMPHYODONTACEAE

(S. He, February 2001)

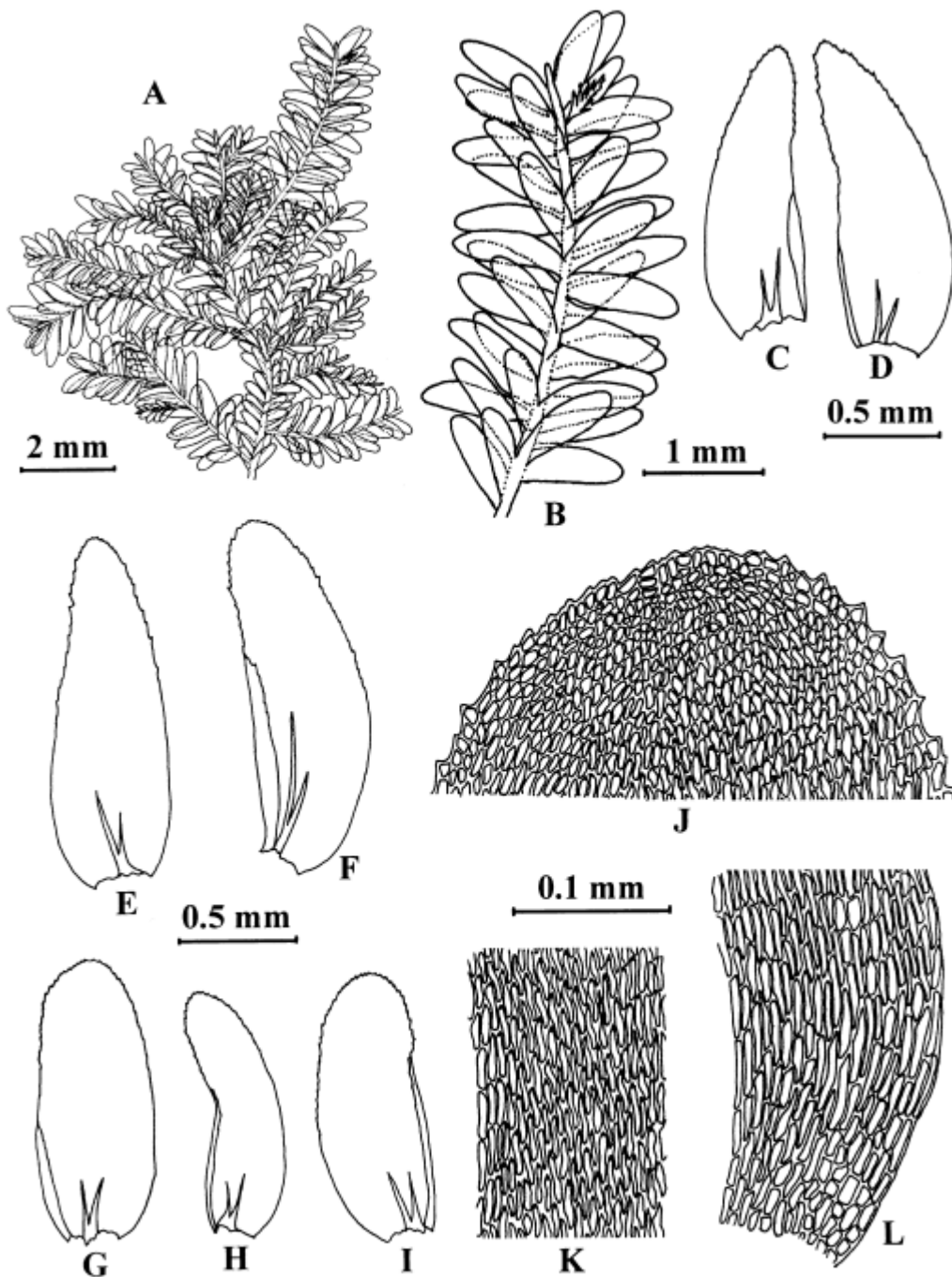
The Symphyodontaceae consist of a single genus, *Symphyodon* Mont., placed in the Leucodontales, suborder Neckerineae.

### ***Symphyodon* Mont.**

A genus of pleurocarpous, mostly epiphytic mosses, comprised of 15 species chiefly distributed in the tropical and the subtropical regions of the world with the majority of the taxa centered in southern and southeastern Asia. The genus is characterised by having echinate capsules, distally roughened or papillose setae, and prorate leaf cells. One species, *Symphyodon pygmaeus* (Broth.) S.He & Snider, is found in Africa (Ethiopia, Malawi, Mozambique, Madagascar, and Réunion), and is known elsewhere from India, Nepal, Thailand, China and Hawaii.

**Plants** medium-sized, in yellowish green to golden green, glossy mats. **Stems** to 5(-8) cm long, bipinnately to tripinnately branched, subcomplanate, central strand absent. **Leaves** similar in shape; stem leaves smaller than branch leaves, 1.0-1.2 x 0.4-0.5 mm, spreading, complanate, oblong-lanceolate to oblong-ovate to lingulate; branch leaves 1.2-1.8 x 0.4-0.6 mm; all leaves with apices rounded to truncate, margins coarsely serrate in the upper 2/3, serration formed by a row of enlarged cells (occasionally weakly serrulate at the apex), subentire to serrulate at the base; costae unequal, extending up to 1/2 total leaf length; apical leaf cells distinctly shorter than the adjacent cells; median cells linear, 35-55 x 3-4 µm, weakly to moderately prorate; alar cells differentiated, subquadrate to shortly rectangular, of 3-5 rows extending 3-4 cells up the margins. **Dioicous**. **Perichaetial leaves** sheathing at the base, abruptly narrowed to a long acumen, serrate at the apex, cells thick-walled, porose, costae double, indistinct. **Seta** 1.0-1.3 cm long, clearly roughened distally, smooth proximally. **Capsule** erect, oblong-ovoid, symmetric, 1.9-2.2 x 1.0-1.2 mm, moderately to densely echinate, spines to 60 µm long; exothecial cells rectangular, walls moderately thickened, 60-80 x 22-27 µm; annulus differentiated by a row of enlarged cells and 2-3 rows of smaller cells. **Operculum** rostrate, ca. 0.65 mm long. **Peristome** double, exostome teeth 0.28-0.31 mm long, papillose throughout, weakly papillose to cross-striate at the base; endostome segments reduced, 0.18-0.20 mm long, narrowly perforate, papillose, basal membrane very low, ca. 20 µm high. **Calyptra** not observed. **Spores** ca. 17 µm in diameter, finely papillose.

# Guide to Bryophytes of sub-Saharan Africa



***Symphyodon pygmaeus* (Broth.) He & Snider**

Malawi: C.R. Stevenson MR 139 (Hb B.J. O'Shea)

A: habit; B: branch; C, D: stem leaves; E-I: branch leaves; J: apical leaf cells; L: basal leaf cells.

*Habitat.* Epiphytic, on tree trunks and branches, and on soil.

*Discussion.* *Symphyodon pygmaeus* is characterised by its truncate leaf apices, strap-shaped leaves and abortive branch tips. Collections of *Symphyodon pygmaeus* are commonly sterile; some of the sterile plants of this species have previously been misplaced in *Glossadelphus* and *Homalia*. Sporophytes have not so far been recorded in Africa, but when sporophytes are present, plants are conspicuous by their suberect to erect, echinate capsules and

Updated month yyyy



# Guide to Bryophytes of sub-Saharan Africa

papillose setae. The African plants (ca. 3 cm long) are smaller than those from Asia. A revision of the genus is presented by He and Snider (2000).

*Literature.* He, S. & Snider, J. A. 2000. A taxonomic revision of *Symphiodon* (Musci: Symphyodontaceae). *Bryologist* 103: 52-81.

## THUIDIACEAE

(P. Martin, January 2003)

**Plants** small to large and rather robust, forming loose to somewhat dense mats or wefts, dull light to dark green, yellowish-green to brown, or golden. **Stems** 1-3 pinnately branched, often rather densely tomentose; central strand present (except in *Hylocomiopsis*); paraphyllia scattered or dense, simple to branched, smooth to papillose. **Leaves** usually weakly to strongly dimorphic. **Stem leaves** appressed to erect-spreading, ovate or cordate (triangular) -lanceolate or subulate, apex short to long acuminate; margins plane distally, recurved or reflexed below, entire to serrulate- or crenulate-papillose; costa single, usually strong and projecting on back, percurrent to excurrent; median cells oval to isodiametric, uni- or pluripapillose on back or both surfaces, papillae low or long and often curved. **Branch leaves** broadly to somewhat narrowly ovate or ovate-short lanceolate, apex acute to obtuse, costa often ending below apex. **Asexual structures** apparently absent. **Autoicous or dioicous.** **Perigonia** lateral, leaves ovate to short ovate-lanceolate. **Perichaetia** lateral, leaves usually differentiated, long ovate-lanceolate to lanceolate, margins ciliate or not. **Seta** elongate, smooth to papillose or hispid. **Capsule** sub-erect to pendulous, urn cylindrical, usually curved. **Operculum** short to long rostrate, oblique. **Peristome** double, exostome teeth 16, cross-striate below, distally papillose; endostome lightly papillose, basal membrane low to high, segments 16, keeled, endostome cilia in groups of 1-3. **Calyptra** cucullate, naked and smooth (hispid in *Pelekium velatum* Mitt.). **Spores** spherical, smooth to more commonly papillose.

*Discussion.* The Thuidiaceae contain sixteen genera, as defined here (Touw 2001a), and 150 or more species widely distributed in temperate and tropical regions; in sub-Saharan Africa seven genera and 22 species. There is an extensive literature discussing the delimitation of this family, and its relationship with other pleurocarpous families, some of which is listed below; the current scope of the family is as recognised by Touw (2001a). Any reference that is of value for identification is mentioned under the individual genera; Touw (1976) will be the most useful, but doesn't cover all the genera now included in the family.

*Study guide:* Attention must be given to branching patterns, i.e., 1-, 2-, 3-pinnately branched. Paraphyllia need to be observed, both on stems with some of the leaves removed and separated from the stem in order to examine the surface ornamentation. Stem and branch leaves are required with particular attention paid to papillae, which, together with paraphyllia allow many of the sub-Saharan African species to be identified without sporophytes. In a few cases, seta ornamentation and the inclination of the capsule are required.

*Literature.* Buck, W.R. & Crum, H. 1990. An evaluation of familial limits among the genera traditionally aligned with the Thuidiaceae and Leskeaceae. *Contributions to the University of Michigan Herbarium* 17: 55-69. Fang, Y. M., Koponen, T., 2001. A review of *Thuidium*, *Haplocladium* and *Claopodium* (Musci, Thuidiaceae) in China. *Bryobrothera* 6:1-82. Hedenäs, L. 1997. An evaluation of phylogenetic relationships among the Thuidiaceae, the Amblystegiaceae and the temperate members of the Hypnaceae. *Lindbergia* 22: 101-133. O'Brien, T.J. and Horton, D. 2000. *Bryochenea* (Musci: Thuidiaceae) is *Cyrto-hypnum* (Thuidiaceae), but *B. sachaliensis* is *Echinophyllum* (Thuidiaceae), a new genus from the Pacific rim. *Bryologist* 103: 509-517. Spence, J. R. 1997. A gametophytic evaluation of the Leskeaceae and related families. *Journal of the Hattori Botanical Laboratory* 82: 261-270. Touw, A. 1976. A taxonomic revision of *Thuidium*, *Pelekium*, and *Raiiella* (Musci: Thuidiaceae) in Africa south of the Sahara. *Lindbergia* 3: 135-195. Touw, A. 1993. Notes on tropical Asian Thuidiaceae, with two new

Updated month yyyy

# Guide to Bryophytes of sub-Saharan Africa

Malesian species of *Thuidium* s.l. Journal of the Hattori Botanical Laboratory 74: 193-204. **Touw, A. 2001a.** A review of the Thuidiaceae (Musci) and a realignment of taxa traditionally accommodated in *Thuidium* sensu amplo (*Thuidium* Schimp., *Thuidiopsis* (Broth.) M. Fleisch and *Pelekium* Mitt.), including *Aequatoriella* gen. nov. and *Indothuidium* gen. nov. Journal of the Hattori Botanical Laboratory 90: 167-209. **Touw, A., 2001b.** A taxonomic review of the Thuidiaceae (Musci) of tropical Asia, the western Pacific rim and Hawaii. Journal of the Hattori Botanical Laboratory 91:1-136. **Touw, A. & Falter-Van den Haak, L. 1989.** A revision of the Australasian Thuidiaceae (Musci), with notes on species from adjacent regions. Journal of the Hattori Botanical Laboratory 67: 1-57. **Watanabe, R. 1972.** A revision of the family Thuidiaceae in Japan and adjacent areas. Journal of the Hattori Botanical Laboratory 36: 171-320.

1. Plants monoicous, small	2
1. Plants dioicous, medium to large	5
2. Plants with stem leaf mid-leaf cells >25?m and stem without a central strand	<i>Hylocomiopsis</i>
2. Plants with stem leaf mid-leaf cells <25?m and stem with a central strand	3
3. Stem leaves with prorated mid-leaf cells	<i>Haplocladium</i>
3. Stem leaf cells not prorated	4
4. Paraphyllia 1-3 seriate at insertion	<i>Pelekium</i>
4. Paraphyllia pluriseriate at insertion	<i>Raiiella</i>
5. Plants with stem leaf mid-leaf cells >25?m and stem without a central strand	<i>Hylocomiopsis</i>
5. Plants with stem leaf mid-leaf cells <25?m and stem with a central strand	6
6. Plants forming ascending stiff mats, 1-pinnate	<i>Abietinella</i>
6. Plants forming intricate prostrate wefts usually 2-3 pinnate	7
7. Paraphyllia simple, calyptra with hairs	<i>Thuidiopsis</i>
7. Paraphyllia branched and simple, calyptra without hairs	<i>Thuidium</i>

## ***Abietinella* Müll.Hal.**

One species in sub-Saharan Africa, *A. abietina* Hedw., reported only from Lesotho and Natal.

**Plants** medium to large forming stiff yellow green to brownish mats. **Stems** erect-ascending, unipinnately branched. Branches short and varying in length, central strand present; paraphyllia abundant on stems and branches, simple or branched, often lanceolate, papillose. Leaves of stem and branch differentiated. **Stem leaves**

# Guide to Bryophytes of sub-Saharan Africa

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ovate to triangular, plicate, 1.1-1.8 mm long, apex acuminate, margin plane to broadly recurved; costa strong, ending below apex, cells rhombic, thick walled and strongly unipapillose dorsally, less so ventrally, sometimes curved. **Branch leaves** oval 0.6-0.7 mm long, cells rhombic, terminal cell with 2 or more papillae; costa ending below the apex. **Dioicous**. **Perichaetial leaves** up to 4 mm, serrate in upper leaf, longly lanceolate, apex drawn out, plicate with smooth cells. **Seta** 25 mm, red. **Capsule** 2-3mm, cylindrical, curved and inclined, annulus of large cells. **Operculum** conic to short rostrate. **Peristome** endostome with nodulose cilia and high basal membrane; cilia 2-3. **Calyptra** naked. **Spores** smooth to finely roughened 9-16?m

*Habitat.* Xerotolerant, found in open exposed areas.

*Discussion.* Although intermediates occur, *Abietinella* is distinct in the fronds forming turfs as opposed to the more common wefts in the Thuidiaceae. Differs from *Thuidium* in having once-pinnate ramification, more weakly ornamented paraphyllia, leaf cells ornamented on both faces and differentiated alar cells. These characters prevent a merging of *Abietinella* and *Thuidiopsis*.

*Literature.* **Touw, A. 2001a.** - see general refs.

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## ***Haplocladium* (Müll.Hal.) Müll.Hal.**

Two species for sub-Saharan Africa, *H. angustifolium* Hampe & Müll.Hal., known from eastern and Southern Africa, and *H. jacquemontii* Müll.Hal. recorded only from Ethiopia.

**Plants** small to medium forming loose mats green to yellow-brown. **Stems** creeping, 1-pinnate, central strand present; paraphyllia dense on stems, sparse on branches, unbranched and not papillose. **Leaves** on stem and branch differentiated. **Stem leaves** cordate to ovate with long drawn out apex 0.5–0.8 mm long, nerve excurrent, margin serrulate in upper leaf; cells oval to rectangular, prorulose on upper side. **Branch leaves** smaller than stem leaves, 0.3-0.5 mm long, lanceolate, margin serrulate above; costa ending in apex, cells oval to rectangular, prorulose on upper adaxial side. **Autoicous**. **Perichaetial leaves** lanceolate, 1-1.5 mm long, costa ending in apex, margin plane and serrulate. **Seta** 1.2-1.8 cm, smooth, red. **Capsule** 1.5-2 mm long, inclined asymmetric, annulus in 2-3 rows. **Operculum** high. **Peristome** endostome high, segments keeled, perforate in groups of 1-2; exostome teeth yellow to yellow-brown papillose distally. **Calyptra** cucullate and smooth. **Spores** spherical, slightly roughened.

*Habitat.* Grows in the bottom layer of forests as well as more open situations, on rocks, soil, logs or tree bases.

*Discussion.* *Haplocladium* has previously been placed in the Leskeaceae due to its smooth paraphyllia and terminal leaf cells. In both phenetic analysis of gametophyte morphology and cladistic analysis it has been shown to be close to the Thuidiaceae (Hedenäs 1997; Spence 1997). The most frequently found species, *H. angustifolium*, is found for instance in Mexico and India and is described in the bryophyte floras of those countries, as well as in Fang & Koponen (2001).

*Literature.* **Fang, Y. M., Koponen, T., 2001.** - see family refs. **Hedenäs, L. 1997** - see family refs. **Spence, J. R. 1997.** - see family refs.

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# Guide to Bryophytes of sub-Saharan Africa

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## ***Hylocomiopsis* Cardot**

One species in sub-Saharan Africa: *H. cylindricarpa* Thér., recorded from Cameroon and more widely in eastern Africa.

**Plants** medium sized forming intricate wefts, green to yellow, brown or blackish below. **Stems** creeping or occasionally erect and covered with brown tomentum, irregularly pinnate, sometimes bi-pinnate; central strand absent; branches often julaceous and pointed at apex; stem paraphyllia multibranching and numerous, shorter on branches. **Leaves** of stem and branches similar, branch leaves having shorter acumens. **Stem leaves** large, ovoid with long acumen, 1.4-2 mm, deeply plicate to undulate; margin plane or recurved; entire or sinuose, occasionally denticulate above; costa reaching base of acumen; cells variously shaped, elongated, especially in upper part of leaf; basal cells longer and porose, smooth or papillose. **Branch leaves** smaller, oval-triangular to oval round, straight or curved, 0.75-1.2 x 0.5-0.75 mm, plicate, margin plane or recurved in middle part; cells papillose with one large central papilla. **Autoicous**. **Perichaetial leaves** 7-8 mm long, costa, entire, plicate, cells 100 x 5-6 µm. **Seta** 2.3-3.5 mm. **Capsule** usually erect, rarely inclined 3-4 x 1.5 mm, brown or red-brown; annulus in 1-3 rows. **Operculum** conical. **Peristome** with exostome striate, pale yellow and papillose; endostome membrane high to low, cilia absent. **Calyptra** naked and smooth. **Spores** papillose and verruculose, green, large to 40-50 µm and multicellular in the closed capsule

*Habitat.* Montane forests, 2250-2500 m, mostly on bark.

*Discussion.* Has unusually large spores, becoming multicellular in closed capsules. *Hylocomiopsis* has a homogenous central stand, unique in the Thuidiaceae. Previously included in the Leskeaceae due to its specialised sporophyte, and in the Hylocomiaceae because of axillary hairs, paraphyllia, leaf cell ornamentation and ramification. More recent weight of opinion had accommodated *Hylocomiopsis* in the Thuidiaceae since the specialised sporophytes are similar to other epiphytic Thuidiaceae.

*Literature.* **De Sloover, J.L. 1976.** Note de bryologie Africaine VI. – *Hylocomiopsis*. *Bulletin du Jardin Botanique National de Belgique* 46: 379-385.

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## ***Pelekium* Mitt.**

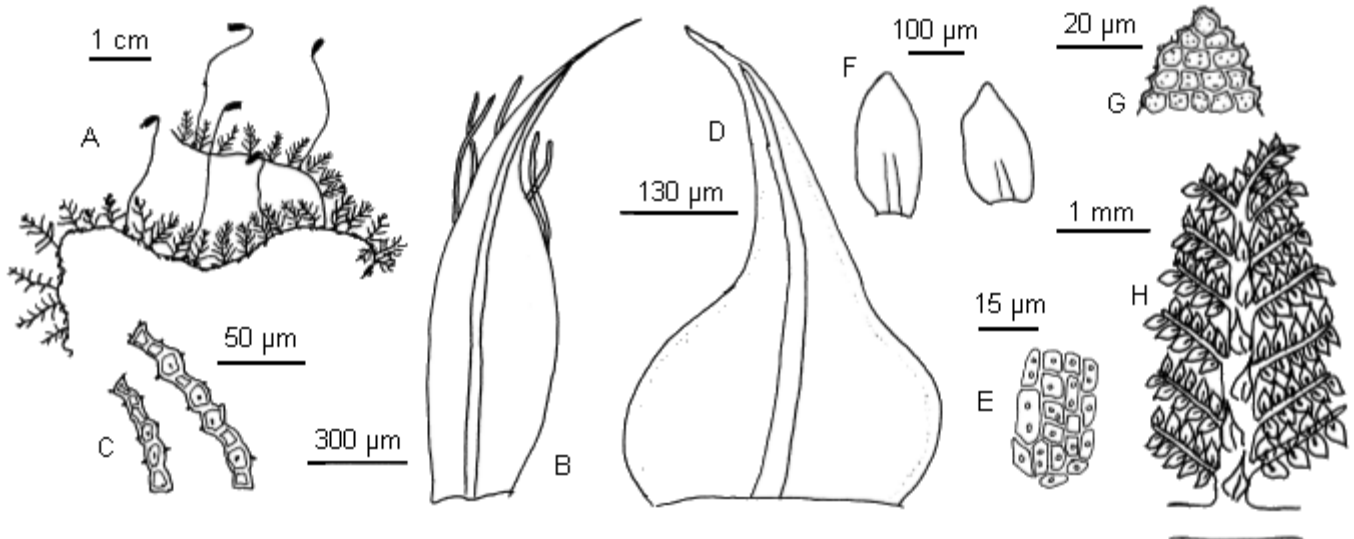
Eleven species for sub-Saharan Africa.

**Plants** small to medium forming intricate, often delicate mats. **Stems** prostrate to arching, pinnate to bi-pinnate rarely weakly tri-pinnate, central strand present; paraphyllia mostly simple and unbranched with weak to strong intermediate cells, apical cell mostly rounded or truncate, occasionally acute; paraphyllia absent or sparse on ultimate branches. **Stem leaves and branch leaves** usually differentiated in shape. **Stem leaves** usually triangular, occasionally ovate, 0.25-1mm, apex shortly acuminate, often incurved when dry; margin weakly to strongly recurved; costa strong, ending below apex; mid-leaf cells isodiametric to slightly longer than wide, quadrate to irregular, mamilllose and uni- to pluri-papillose on both leaf faces. **Branch leaves** smaller than stem leaves, usually ovate 0.3-0.9mm long, mid-leaf cells usually isodiametric, mamilllose and uni- to pluri- papillose on both leaf faces; leaf margin plane or recurved in lower leaf; costa single, ceasing below apex. **Autoicous**.

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# Guide to Bryophytes of sub-Saharan Africa

**Perichaetial leaves** lanceolate with elongate apex; costa single, leaf margin notched to longly ciliate. **Seta** (4-)10-20(-27) mm, smooth, occasionally papillose or hispid. **Capsule** 0.6-2 mm long, ovoid to elliptical, inclined to pendulous, reddish brown to orange. **Operculum** conic to long rostrate, 0.5-1mm. **Peristome** exostome with mostly high ventral lamellae, apically papillose; endostome basal membrane low to high, cilia in groups of 1-3. **Calyptra** 1.4-3.2 mm, cucullate and smooth though hispid and campanulate in *P. velatum* Mitt. **Spores** 8-20 (30)  $\mu\text{m}$ , spherical to sub-spherical, smooth to finely papillose.



## *Pelekium gratum* (P.Beauv.) Touw

Nigeria: (BM)

A: habit; B: perichaetial leaf; C: paraphyllia; D: stem leaf; E: stem leaf mid-leaf cells; F: branch leaves; G: branch leaf apical cells; H: branch of main stem.

**Habitat.** Tree trunks, logs and rocks in rain forest, 300-2500 m.

**Discussion.** In recent years the separation within *Thuidium* of the small monoicous from the large dioicous species has stimulated much discussion and nomenclatural changes. After the transfer of several species out of the genus (Touw 2001a) a sensible group remains which sees the merging of *Pelekium* (*sensu lato*) and *Cyrto-hypnum* to form *Pelekium* (Touw 2001a). *Pelekium* is distinguished from *Thuidium* and *Thuidiopsis* by its small size and autoicous breeding system.

**Literature.** Touw, A. 1976. - see family refs. Touw, A. 2001a. - see family refs.

## *Raiiella* Reimers

One species, *R. subfilamentosa* (Besch.) Wijk & Margad., recorded from Kenya, Tanzania, Malawi, Zimbabwe, South Africa and Madagascar.

**Plants** small, forming coarse thin to dense mats, dull olive green, yellowish, or golden to reddish-brown. **Stems** creeping and spreading, pinnately branched; central strand weak; rhizoids often produced on terminal branch tips;

# Guide to Bryophytes of sub-Saharan Africa

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paraphyllia abundant on stems, few to absent on branches, simple or weakly branched, papillose with oblate cells. **Leaves** erect when dry, spreading when wet, stem and branch leaves dimorphic. **Stem leaves** short to long lanceolate from an ovate base, 0.4-0.8(-0.9) mm long to 0.6 mm wide, plicate, apex usually abruptly long acuminate, base weakly decurrent; margins reflexed, crenulate; costa strong, percurrent to short excurrent; laminal cells similar throughout, oval to quadrate-rounded, strongly bulging, uni- or pluripapillose. **Branch leaves** ovate, to 0.65 mm long, apex acute to bluntly short acuminate. **Autoicous. Perichaetial leaves** glossy pale yellow, setaceous from an ovate base, to 3.5 mm long. **Seta** (5-)8-15 mm or more long, slightly twisted, smooth. **Capsule** inclined, urn ovoid-short cylindrical, (0.4-)0.9-1.5 mm long; annulus present. **Operculum** rostrate, oblique. **Peristome** with exostome teeth finely cross-striate below, distally papillose; endostome basal membrane high, cilia 1-2. **Calyptra** cucullate, naked and smooth. **Spores** spherical, lightly papillose.

*Habitat.* In montane forests on tree bases, rocks and occasionally terrestrial, 1200-1800m.

*Discussion.* Previously included in *Thuidium* and *Haplocladium*. Distinct from *Pelekium* by bulging leaf cells on both sides of leaf and larger paraphyllia which have oblate cells.

*Literature.* **Touw, A. 1976.** - see family refs. **Touw, A. 2001a.** - see family refs.

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## ***Thuidiopsis* (Broth.) M.Fleisch.**

One species for sub-Saharan Africa, *T. sparsa* Hook.f. & Wilson, reported for the Comoros islands.

**Plants** medium sized, pale to yellow-green. **Stems** spreading or ascending, mostly bi-pinnate; central strand present; paraphyllia unbranched and numerous on stem and lower part of branches, papillose. **Leaves** of stem and branch differentiated. **Stem leaves** triangular to cordate, 1-1.5 mm long, apically contracted to form acute acumen; leaf margin recurved below, plane above, usually entire; costa strong, ceasing below apex; median leaf cells mostly isodiametric, abaxially unipapillose to mostly pluripapillose, adaxially mamillose and mostly smooth. **Branch leaves** ovate to ovate-oblong, to 0.3 mm long, median cells pluripapillose to smooth; costa reaching 3/4 way up leaf. **Dioicous. Perichaetial leaves** to 2 mm, acuminate apex, margin mostly ciliate; costa usually weak, sometimes strong and excurrent, cells smooth. **Capsule** to 2.5 mm long, inclined to sub-pendulous. **Peristome** with yellowish to orange-brown exostome with high ventral lamellae; endostome yellowish, brownish or orange, well developed, basal membrane high, cilia in groups of 2-4. **Operculum** to 2 mm conical to rostrate. **Calyptra** cucullate, smooth and fringed at base. Spores 8-16  $\mu\text{m}$ , smooth or minutely papillose.

*Habitat.* Distributed in a variety of habitats from open forest communities, on boulders, base of trees or dead wood.

*Discussion.* Differs from *Thuidium* by having simple paraphyllia and leaf cells ornamented on both leaf faces. Has characteristic long paraphysal hairs fringing base of calyptra and strongly incurved stem leaves.

*Literature.* **Touw, A. 2001a.** - see family refs.

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# Guide to Bryophytes of sub-Saharan Africa

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## ***Thuidium* Bruch, Schimp. & W.Gümbel**

Five species in sub-Saharan Africa, mainly in eastern and southern Africa and the Indian Ocean islands; only one recorded also for west Africa (*T. involvens* ssp. *thomeanum*).

**Plants** medium to large forming loose to dense coarse mats, pale yellow-green to brownish green. **Stems** and branches spreading to loosely spreading, 1-3 pinnately branched; central strand present and sometimes well developed; paraphyllia mostly large and branched; weakly to strongly papillose and varying from numerous along stem and branches to few or scattered along stems and often absent on branches. **Leaves** of stems and branches differentiated, sometimes strongly dimorphic. **Stem leaves** broadly ovate/cordate or triangular, short to long lanceolate, 0.4-1.7 mm long; bi-plicate and sometimes short decurrent, apex broadly to narrowly short to long acuminate, occasionally ending in a long hyaline capillary hair point; margins often strongly incurved or recurved to reflexed at base, partially inflexed or erect above, serrate or serrulate in distal 2/3; costa strong ending below acumen or long excurrent; median cells oval-rhombic to +/- elongate or subhexagonal to subquadrate-rounded; uni-papillose or pluri-papillose, papillae projecting on dorsal lamina or both sides, somewhat erect to curved; basal cells +/- elongate. **Branch leaves** smaller, ovate-short lanceolate, up to 0.75 mm long, margins plane to erect, entire, costa mostly ending below the acumen. **Dioicous. Perichaetial leaves** elongate, ovate-triangular, lanceolate to oblong-lanceolate; apex short or more commonly gradually to abruptly long acuminate; costa single, margins entire to ciliate. **Seta** 7-40 mm long, papillose or smooth, reddish orange to brown. **Capsule** 0.6-3 mm, inclined to pendant, urn cylindrical or short to +/- long ovoid or ovoid cylindrical; annulus in 2-3 rows; peristome with exostome teeth cross-striate, papillose distally; endostome basal membrane high, segments keeled, cilia 1-3(-4). **Operculum** conic to conic- short to long rostrate, oblique. **Calyptra** cucullate, naked and smooth. **Spores** spherical, smooth to lightly papillose or papillose.

*Habitat.* Although found also in grassland and scrub, predominantly in mountain forest between 450-2000 m. Overall range from sea level to 3500 m. Mostly on tree trunks and decaying wood, but also found on soil, rocks, low branches and litter.

*Discussion.* This genus is now restricted to the large dioicous species. *Thuidium* has distinct bi- or tri-pinnate fronds and large paraphyllia. The genus presents difficulties in differentiation of the species which have slight, but consistent, differences.

*Literature.* Fang, Y. M., Koponen, T., 2001. - see family refs. Touw, A. 1976. - see family refs. Touw, A. 2001a. - see general refs.

## WARDIACEAE

(R.E. Magill, June 2003)

A monotypic family restricted to the mountains of the southwestern cape of South Africa.

### ***Wardia* Harv. & Hook.**

One species, *Wardia hygrometrica* Harv. & Hook.

# Guide to Bryophytes of sub-Saharan Africa

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**Plants** forming small or large, loose mats, dark green to yellowish green or blackish, aquatic, floating or in splash zones on rock. **Stems** elongated 15-80 mm, branching irregular above stipe, in cross-section round, central strand absent. **Leaves** spreading to erect-appressed, concave, elliptical to broadly oblong, 1.2-2.2 mm long, apex acute to narrowly acuminate, margins plane and entire. **Costa** extremely variable, absent, present only in the leaf base, discontinuous and present only at the apex and base, or strong throughout; in cross-section cells not differentiated, thick walled, 3-6 rows thick; upper leaf cells linear-fusiform, 55-90  $\mu\text{m}$  long, smooth, walls generally thickened, basal cells linear to long-rectangular, 50-125  $\mu\text{m}$  long, smooth, thickened; alar cells strongly differentiated and in distinct groups, enlarged and inflated, hyaline, thin walled. **Dioicous**. **Perichaetial leaves** broadly ovate, acute, sheathing below. **Seta** 4-6 mm long, yellow-brown or blackish, smooth, thick. **Capsule** exserted, erect, short cylindrical or ovoid, 1.0-2.2 mm long, smooth, exothecial cells irregular, rounded to quadrate or hexagonal, incrassate, stomata absent. **Peristome** rudimentary, yellow to orange, teeth short, truncate, erect, 40-50  $\mu\text{m}$  high, smooth with irregular prostome development. **Operculum** curved-rostrate, attached to columella, persistent, 1.0-1.3 mm long. **Calyptra** small, cucullate. **Spores** round, 25-31  $\mu\text{m}$ , granulate, brown.

*Habit.* Growing attached to rock submerged or in splash-zones in mountain streams. Endemic to South Africa, most specimens have been collected on Table Mountain. Its range has recently been expanded but is still restricted to the mountains of the southwestern cape.

*Discussion.* The genus shows a great deal of variability in gametophytic characters. This is true in plant length and firmness, stipe development, and development of leaf costa. For example, the costae on the same plants can be absent or present, present only in the base as a bistratose region near the leaf insertion, discontinuous with distinct, unconnected parts in the leaf base and apex, or strong and extending from base to near apex.

The plants are similar to *Fontinalis* in habit and habitat. They differ in alar cell development and several sporophyte characteristics. The sporophyte is adapted for the aquatic habitat with short, stout setae and not stomata. The operculum remains attached to the columella after the capsule is open, perhaps working in spore discharge but certainly resulting in the short, truncated peristome teeth. The alar cells of *Wardia* are enlarged and coloured. Despite their thickened walls, the alar cells are frequently lost, probably through erosion, and this important character can be missed.

*Literature.* **Magill, R. E. 1998.** Flora of Southern Africa. Part 1 Mosses. Fascicle 3: 538-540.