

POLYTRICHACEAE

(F. Müller)

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 cylindric; 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. A 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 *Pogonatum* p.p.
1. Upper leaf surface with lamellae; leaf margin thickened or not; seta smooth 2

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 *Atrichum*
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 3
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 *Polytrichum p.p.*
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 4
4. Lamellae fewer than 10, restricted to upper costa surface, sinuose; leaves without or with indistinct sheathing base; calyptra sparsely hairy or smooth *Oligotrichum*
4. Lamellae distinctly more than 10, extending over costa and lamina surface, \pm straight; calyptra with a dense mat of hairs which partly or wholly envelops the capsule 5
5. Leaves not or only slightly differentiated between sheath and limb, sheath ovate, slightly broader than limb width; capsules cylindrical or with inconspicuous longitudinal ridges, peristome teeth 32, capsule without stomata and differentiated apophysis *Pogonatum*
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 6
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 *Polytrichastrum*
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 *Polytrichum p.p.*

Atrichum P.Beauv. (Fig. XX)

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.

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 1-3stratose 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; exothelial 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. (Fig. XX)

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. **Dioicous.** **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. **Opercula** 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 indistinctly angled capsules with stomata and without an apophysis, peristome teeth 32, sparsely hairy or smooth calyptas.

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].

Pogonatum P.Beauv. (Fig. XX)

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. **Dioicous**. **Perichaetia** terminal. **Seta** elongate, stout and smooth (rarely tuberculate-papillose). **Capsule** suberect to inclined, urn short to long cylindrical, terete, not angular, \pm 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 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: exothecial 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. *P. 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., *Pseudoracelopus* Broth. and *Racelopodopsis* Thér. Journal of the Hattori Botanical Laboratory 60: 1-33 [keys, illustrations].

Polytrichastrum G.L.Sm. (Fig. XX)

One species in Africa, *P. formosum* (Hedw.) G.L.Sm.; the records of *P. alpinum* (Hedw.) G.L.Sm. for the area are based on misidentifications of *Pogonatum urnigerum* (De Sloover, 1986); a genus of about 10 or more species of cool temperate regions.

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*. *P. 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].

Polytrichum Hedw. (Fig. XX)

About 9 species in Africa, probably half or fewer are valid; a widespread genus of some 50 species.

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-oblate, 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, *P. subpilosum* P.Beauv. is endemic to Africa, but the other three (*P. commune* L. ex Hedw., *P. juniperinum* Willd. ex Hedw. & *P. piliferum* Schreb. ex Hedw.) are found almost worldwide.

LITERATURE. **De Sloover, J.L. 1986** (see family ref.) [key to the 4 commoner species].