

rows; transverse section ovate to semicircular, adaxial epidermis absent, adaxial stereid band present or absent, guide cells 2–4 in 1 layer, hydroid strand absent, abaxial stereid band present, crescentic to circular in sectional shape, abaxial epidermis weakly differentiated; proximal cells weakly differentiated in a very small group medially, occasionally across insertion, rectangular, little wider than distal cells, 2–4:1, proximal cells thick-walled, somewhat porose; distal medial cells rounded rhombic to quadrate, ca. 9–11 μm wide, 1:1, 1-stratose; papillae spiculate, mostly simple to 2-fid, 1 per lumen, cell walls thickened, weakly trigonous, weakly convex to distinctly bulging on both sides. **Specialized asexual reproduction** not seen. [**Sexual condition** dioicous. **Perichaetia** terminal and lateral, interior leaves strongly sheathing, ovate, rounded or shortly acuminate to apiculate. **Seta** elongate. **Capsule** stegocarpous, theca elliptic, annulus of ca. 3 rows of smaller, vesiculate cells; operculum conic; peristome teeth 16, variously cleft (usually to base) or perforate, subulate, transparent, straight. **Calyptra** cucullate. **Spores** ca. 10–13 μm .] **KOH laminal color reaction** orange to yellowish orange.

Species 9 (1 in the flora): w North America, s South America, s Africa, Pacific Islands (New Zealand), Australia.

Triquetrella is distinctive in the stems rounded-triangular in section though this character is varies to rounded-pentagonal in the one species in the flora area. Although not fruiting in that area (and rarely so elsewhere in the world), the genus is unique in having both acrocarpous and pleurocarpous perichaetia on the same plant (R. H. Zander 1993). Unlike the similar *Leptodontium*, *Triquetrella* may occasionally show a small central strand (except, again, in the flora area).

SELECTED REFERENCES Stark, L. R. 1980. *Triquetrella* in North America. Bryologist 83: 363–364. Zander, R. H. 1980. Acid-base color reactions: The status of *Triquetrella ferruginea*, *Barbula inaequalifolia* and *B. calcarea*. Bryologist 83: 228–233.

1. ***Triquetrella californica*** (Lesquereux) Grout, Moss Fl. N. Amer. 3: 201. 1934 [E F]



Anomodon californicus Lesquereux, Mem. Calif. Acad. Sci. 1: 30. 1868

Stems to 2.5 cm, rounded-triangular to rounded-pentagonal in cross section. **Leaves** ovate, very short-acuminate, 1.3–1.7 mm, spreading when moist, margins entire, decurrent, papillae short-columnar; costa adaxial stereid

band absent or weak, guides cells usually 2. **Sporophytes** not seen.

Roadsides, hillsides, rocky slopes, fields, chaparral; low to moderate elevations (50–500 m); Calif., Oreg.

Triquetrella californica is distinctive in its distal leaf margins sharply crenulate by projecting papillae (but not by projecting cell walls as in *Didymodon nigrescens*), and distal medial laminal papillae tall, branching from the base, and centered over each lumen. The leaves are decurrent on the margins, and arranged in 3 distinct rows on the stem—either straight or weakly spiraling in either direction. This rare species is easily confused with *Didymodon ferrugineus*, which has a rounded-pentagonal stem cross section, leaves in 3–5 rows, leaf margins weakly recurved, leaf cells smaller, and abaxial surface of the costa less papillose. Perigoniate plants have not been found in the flora area.

24. **PLAUBELIA** Bridel, Bryol. Univ. 1: 522. 1826 • [Probably for Julius August Plaubel, fl. 1828–1834, mycologist and homeopathist of Gotha, Thuringia]

Patricia M. Eckel

Hyophilopsis H. A. Crum; *Neohyophila* H. A. Crum; *Tortula* sect. *Plaubelia* (Bridel) Mitten

Plants small, turf-forming or loosely cespitose, green distally, sometimes brown proximally. **Stems** often branching, to 4 mm, hyalodermis absent, sclerodermis weak, central strand strong; rhizoids

sparse; axillary hairs of up to 5 cells, the basal 1–2 yellow. **Cauline leaves** smaller proximally, distally much larger, rosulate, crowded, incurved to spreading, often tubulose and incurved-contorted when dry, widespreading when moist, spatulate to oblong-ligulate; base little different in shape; margins incurved, involute or sometimes plane, entire or distantly denticulate above; apex rounded-acute to broadly rounded-obtuse, usually apiculate; costa short-excurrent, percurrent or ending up to 4 cells before the apex, adaxial surface of bulging cells, adaxial epidermis of bulging or mammillose cells, abaxial epidermis weakly differentiated, 1–2 stereid bands, guide cells 2–4 in 1 layer, hydroid strand often present; basal cells not differentiated or distinct in a small medial group or across the base, quadrate to short-rectangular, hyaline to yellowish; distal laminal cells rounded-hexagonal, walls evenly thickened, adaxially bulging-mammillose, abaxially nearly plane; distal laminal papillae often absent, or solid, small, simple, 1–2 per lumen abaxially or occasionally on both sides. **Specialized asexual reproduction** absent [gemmae present in leaf axils]. **Sexual condition** dioicous. **Perichaetia** terminal, leaves ovate-lanceolate to ligulate, shorter than stem leaves. **Seta** 1–8 mm. **Capsule** red to yellow-brown, ellipsoidal, operculum rostrate, peristome of 16 red, spiculate, long-linear teeth, not twisted, basal membrane absent. **Calyptra** cucullate. **Spores** lightly papillose, 8–10 μm . **Laminal KOH color reaction** in proximal leaves often orange-brown, in distal leaves yellow.

Species 3 (1 in the flora): sw, se United States, Mexico, West Indies, Central America, South America (Brazil, Venezuela), Asia (Burma), s Africa.

As discussed by R. H. Zander (1993), the circumscription of the genus *Hyophila* is unsatisfactory, being both artificial (e.g., absence of peristome) and polyphyletic. The genus *Plaubelia* is separated from *Hyophila* mainly by the presence of a peristome. The two genera are related by the adaxially bulging, abaxially flat laminal cells, spatulate-oblong leaves, poorly differentiated basal cells, similar clavate gemmae (in exotic species) and other characters. The single abaxial stereid band of *Plaubelia sprengelii* was once an important basis for the genus, but with the inclusion of var. *stomatodonta* with its second stereid band into the variation of the species (Zander 1983), the generic distinction becomes more problematic.

SELECTED REFERENCES Crum, H. A. 1965. *Hyophilopsis*, a new genus of Pottiaceae. *Bryologist* 68: 68–71. Crum, H. A. 1965. *Hyophilopsis*—a nomenclatural correction. *Bryologist* 68: 470. Delgadillo M., C. and R. H. Zander. 1984. The mosses of the Tehuacán Valley, Mexico, and notes on their distribution. *Bryologist* 87: 319–322. Saito, K. 1973. Taxonomic position of the genus *Neohyophila* Crum. *Misc. Bryol. Lichenol.* 6: 80–81. Zander, R. H. 1983. A reevaluation of *Neohyophila* Crum (Pottiaceae). *Bryologist* 86: 134–139.

1. *Plaubelia sprengelii* (Schwägrichen) R. H. Zander, *Bull. Buffalo Soc. Nat. Sci.* 32: 176. 1993 [F]



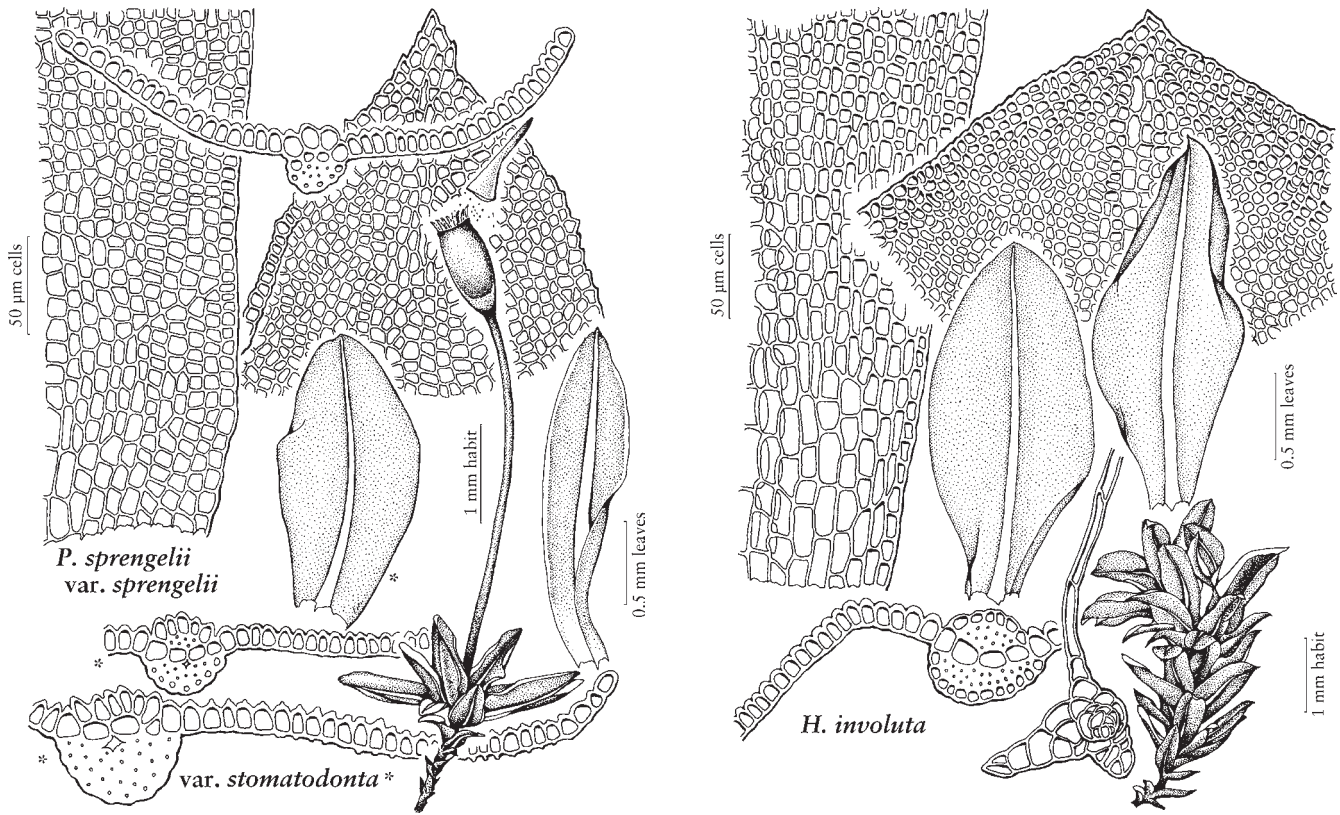
Barbula sprengelii Schwägrichen, Sp. Musc. Frond. Suppl. 2(1,1): 64, plate 119. 1823; *Desmatodon garberi* Lesquereux & James; *Neohyophila sprengelii* (Schwägrichen) H. A. Crum

Plants loosely cespitose. **Stems** 1–4(–6) mm, not radiculose. **Cauline leaves**, spatulate, 1.3–1.5(–2) mm, margins entire, apex broadly acute to rounded-obtuse; costal adaxial stereid band variously developed or absent, basal cells not differentiated or occasionally as a small median group of short oblong-rectangular cells to 15 μm wide, 2–3:1, hyaline to yellow across the insertion, distal cells, 7–9 μm wide, 1:1. **Specialized asexual reproduction**

absent. **Seta** 2–4.5 mm, yellow to red-brown. **Capsule** erect and symmetric, 0.8–1.7 mm, red brown, annulus of strongly vesiculose cells, revolute; operculum 0.6–0.9 mm; peristome well developed, irregularly 2-fid or perforate, densely spiculate, 120–180 μm . **Calyptra** 1.5–2 mm. **Spores** yellow, weakly papillose.

Varieties 2 (2 in the flora): North America, Mexico, West Indies, Central America, South America.

In *Plaubelia sprengelii*, hydroid strands in the costal section are frequent in Mexican populations (R. H. Zander 1994) as well as those in Florida. In Florida the range of the species overlaps that of the very similar but more wide-ranging *Hyophila involuta* (Hooker) Jaeger & Sauerbeck. Sterile plants may be identified by costal characteristics: the stereid bands of *Plaubelia* are both usually present, as is the case with *Hyophila*. The bulging adaxial epidermal costal cells are similar to the laminal



PLAUBELIA • HYOPHILA

cells: rounded, frequently green and isodiametric in surface view, collectively appearing as a cap or sheath of cells over the costa. Those of *Hyophila* in surface view are somewhat larger, more squarely short-rectangular (2:1) and appear flatter and yellower than the laminal cells, and appear to lie in a groove or channel. The shape of the dorsal stereid band of *Plaubelia* is semicircular, but flattened-lunate in *Hyophila*. No hydroid strand occurs in *Hyophila involuta* and that species often develops clavate, corniculate, stalked axillary propagula. The rosulate habit of *Plaubelia* is usually distinct from the elongate, densely foliate specimens of *Hyophila involuta*, although infertile stems of the former may be elongate and more sparsely foliate.

- 1. Leaves strongly incurved, narrowly ligulate to spathulate; adaxial distal laminal cells mammillose but smooth on both surfaces; leaf apex apiculate; costa percurrent to shortly excurrent
 1a. *Plaubelia sprengelii* var. *sprengelii*
- 1. Leaves weakly incurved, broadly spathulate; adaxial distal laminal cells mammillose but papillose abaxially or on both surfaces; leaf apex apiculate or apiculus lacking; costa percurrent or ending below the leaf apex
 1b. *Plaubelia sprengelii* var. *stomatodonta*

1a. *Plaubelia sprengelii* (Schwägrichen) R. H. Zander
 var. *sprengelii* [F]



Leaves apiculate; costa percurrent to excurrent; adaxial distal laminal cells mammillose, smooth on both surfaces.

Capsules mature winter (late Dec, Feb) to spring. Shaded or exposed moist limestone, quarries, brick mortar, stream banks; low elevations; Fla.; Mexico; West Indies; Central America; South America (Brazil, Venezuela).

The citation for Georgia by H. A. Crum and L. E. Anderson (1981) may have been based on a specimen here redetermined as *Hyophila involuta* (Anderson & Crum 13658, CANM, DUKE).

- 1b. *Plaubelia sprengelii* var. *stomatodonta* (Cardot)
R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 176. 1993

F



Hyophila stomatodonta Cardot,
Rev. Bryol. 36: 76. 1909;
Desmatodon stomatodontus
(Cardot) R. S. Williams; *Hyophila*
sprengelii var. *stomatodonta*
(Cardot) R. H. Zander; *Neohyophila*
stomatodonta (Cardot) H. A. Crum

Leaves with apiculus sometimes
lacking; costa percurrent or ending
short of the leaf apex; adaxial distal laminal cells
mammillose, also papillose on one or both surfaces.

Capsules mature winter–spring. Thin crusts on limestone rock; low elevations; Fla.; Mexico; West Indies (Cuba, Jamaica); Central America (Guatemala, Honduras); South America (Brazil).

The extensive variation of *Plaubelia sprengelii* var. *stomatodonta* was described by R. H. Zander (1983); specimens of intermediate morphology can be found both from Mexico and those that derive from the flora region. All specimens of this variety seen from Florida regularly had two stereid bands and a hydroid strand in the costa, characters displayed even in minute specimens.

25. HYOPHILA Bridel, Bryol. Univ. 1: 760. 1827, name conserved • [Greek *hyo*, rain, and *philia*, fondness, alluding to wet habitats]

Patricia M. Eckel

Rottleria Bridel, Bryol. Univ. 1: 105. 1826, not Willdenow 1797

Plants turf-forming, sometimes loosely cespitose, dull, green distally, red to reddish brown or dark green proximally. **Stem** erect, rarely branched, to 1 cm, hyalodermis absent or weakly present and thin-walled, sclerodermis usually present, central cylinder of thick-walled cells, central strand usually strong; radiculose; axillary hairs 6–10 cells long, hyaline. **Leaves** tubulose-twisted, incurved, sometimes contorted when dry, spreading when moist, commonly spatulate or ligulate, ovate, oblong-elliptic, usually constricted at the base; distal lamina broadly channeled, occasionally concave, shallowly grooved along the costa; base not different in shape; margins plane to broadly incurved, sometimes narrowly recurved in proximal $\frac{2}{3}$, entire or denticulate to dentate in distal $\frac{1}{4}$ or at the apex; apex broadly acute to rounded, rarely cucullate or emarginate; costa subpercurrent or percurrent, ending in an apiculus or mucro, adaxial surface cells quadrate to short-rectangular, adaxial and abaxial epidermis present, stereid bands 2, guide cells 4(–6) in one layer; hydroid strand sometimes present; basal cells differentiated across the leaf to only in the median basal region, usually only in a small area near the insertion; distal cells rounded-quadrate to hexagonal, small, walls evenly thickened, bulging equally on both sides or bulging adaxially and plane abaxially, papillae absent or simple. **Specialized asexual reproduction** by axillary gemmae, these clavate, stellate or dentate-elliptic in the leaf axils on densely-branched stalks. **Sexual condition** dioicous or monoicous; perigonia terminal on perigoniate plants or as lateral buds on perichaetiate plants; perichaetia terminal, perichaetial leaves similar to or smaller than cauline leaves. **Seta** elongate. **Capsule** long-ovoid to cylindrical, operculum conic to long-conic or rostrate, peristome teeth absent. **Calyptra** cucullate. **Spores** 7–10 μm , papillose.

Species 85 (1 in the flora): worldwide in temperate and tropical areas.

SELECTED REFERENCES Andrews, S. and P. L. Redfearn Jr. 1965. Observations on the germination of the gemmae of *Hyophila tortula* (Schwaegr.) Hampe. Bryologist 68: 345–347. Britton, E. G. 1904. *Hyophila*—A new genus to the United States. Bryologist 7: 69–71. Sharp, A. J. 1955. Factors in the distribution of *Hyophila tortula* and an extension of its known range to include Michigan. Mitt. Thüring. Bot. Ges. 1: 222–224.

1. *Hyophila involuta* (Hooker) A. Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1871/1872: 354. 1873 [F]



Gymnostomum involutum Hooker, Musci Exot. 2: plate 154. 1819;
Hyophila tortula (Schwägrichen) Hampe

Plants in loose or dense, dark green to red-brown or blackish tufts, dull or occasionally with a metallic sheen. **Stem** densely foliate, 5–10(–20) mm, central strand strong. **Leaves** concave when moist, to 1.5–2 (–2.5) mm, oblong-spatulate to obovate, occasionally with multicellular teeth in distal 1/4, rounded to rounded obtuse at the apex, sometimes apiculate; costa stout, prominent abaxially, smooth on the abaxial surface to occasionally roughened at the apex, hydroids absent; laminal cells near insertion short-rectangular, 2–4:1, firm-walled, pale and brownish or hyaline, cells 8–10(–12) µm wide, in longitudinal and oblique rows, thin to thick-walled, bulging-mammillose on the adaxial surface, plane on the abaxial. **Sexual condition** dioicous. **Seta** 6–7 mm, reddish to yellow-brown with age. **Capsule** erect, 1.5–3 mm, narrowly cylindrical from an indistinct neck, annulus well differentiated, red-brown, of vesiculose cells, persistent or deciduous; [operculum erect, conic-rostrate, 0.6–0.8 mm].

Loosely consolidated sedimentary rocks, soft

limestone, rocky riverbanks, streamsides and bluffs in shaded woods; low to moderate elevations (0–1100 m); Ont.; Ala., Ariz., Ark., Conn., Fla., Ga., Ind., Kans., Ky., Md., Mich., Mo., N.J., N.Y., N.C., Ohio, Okla., Pa., Tenn., Tex., Vt., Va., W.Va., Wis.; Mexico; West Indies; Central America; South America; Europe; s Asia; s Africa; Pacific Islands; Australia.

Cells covering the adaxial costal surface in the related genus *Plaubelia* are rounded and similar to the laminal cells, being small and generally isodiametric; those of *Hyophila* are rather different from the laminal cells, being somewhat larger and quadrate to short-rectangular. The adaxial costal cells of *Plaubelia* are more saliently mammillose than those of *Hyophila*, but this is not always easy to establish. In the flora the range of *Plaubelia* is restricted to Florida, whereas that of *Hyophila involuta* extends from Florida north to Ontario. For distinction of *Hyophila* from *Dichodontium pellucidum*, see discussion of the latter species. *Hyophila involuta* apparently rarely fruits in the flora area (one old sporophyte was seen from Ohio; one fruiting specimen from New Jersey was noted by A. J. Grout 1928–1940).

29e. POTTIACEAE Schimper subfam. POTTIOIDEAE Brotherus in H. G. A. Engler et al., Nat. Pflanzenfam. ed. 2, 10: 282. 1924

Plants green to tan. **Stem** central strand usually present, sclerodermis and hyalodermis commonly absent. **Leaves** usually ovate or broadly ligulate to spatulate, apex usually rounded or broadly acute, margins recurved basally, distal laminal cells if 2-stratose stacked directly over one another, walls smooth or papillose, KOH yellow or red, occasionally orange, occasionally yellow distally and red basally; costa with or without a differentiated abaxial epidermis; gemmae largely absent.

Genera 21 (15 in the flora): worldwide.

26. TORTULA Hedwig, Sp. Musc. Frond., 122. 1801, name conserved • [Latin *torta*, twist, and *-ula*, diminutive, alluding to peristome teeth]

Richard H. Zander

Patricia M. Eckel

Desmatodon Bridel; *Phascum* Hedwig; *Pottia* (Reichenbach) Fürnrohr; *Protobryum* J. Guerra & M. J. Cano

Plants forming cushions, green, occasionally blackish green distally, yellow-brown to dark brown proximally. **Stems** usually to 2 cm, occasionally branching; rounded-pentagonal in transverse section, hyalodermis generally absent; sclerodermis absent, central strand present; rhizoids often dense; axillary hairs ca. 5–8 cells in length, basal 1–3 cells thicker-walled. **Leaves** appressed-incurved to lax when dry, weakly to widely spreading when moist; obovate to spatulate, ovate to elliptical, occasionally ligulate, adaxial surface nearly flat to concave, broadly channeled, occasionally grooved along costa, 1–4(–6) mm; base scarcely differentiated to elliptical; margins recurved proximally or rarely plane, entire or occasionally serrulate near apex, margins occasionally with 1–4 cell rows often less papillose and smaller, walls thicker; apex broadly acute to rounded, lamina inserted laterally or to 45° on costa; costa short- to long-excurrent as an awn, occasionally percurrent or subpercurrent, adaxial outgrowths rarely present as an elliptical pad of cells bulging from adaxial costal surface, adaxial cells quadrate, papillose or smooth, in 3–4(–5) rows adaxially, abaxial cells short-rectangular to elliptic, papillose or smooth; transverse section of costa circular to semicircular, adaxial epidermis present, adaxial stereid band absent [occasionally small], guide cells 2(–3) [absent], in 1(–2) layers, hydroid strand present, often large, abaxial stereid band present, rounded, elliptical, or semicircular in sectional shape, abaxial epidermis present, occasionally present only laterally, rare absent; basal cells reaching across leaf or rising higher medially, rectangular, 18–25 µm, 2–5:1, walls thin, hyaline; distal laminal cells rounded-quadrate to hexagonal, occasionally rhomboidal, distal laminal cells ca. 15–19 µm wide, 1:1–2, papillae mostly hollow, simple or 2-fid, 4–6 per lumen, occasionally on conic salients, cell walls thin, seldom evenly thickened, superficially convex. **Specialized asexual reproduction** by brood bodies on rhizoids [gemmae on leaves]. **Sexual condition** dioicous or monoicous (commonly autoicous or synoicous); perichaetia terminal, inner leaves little different or somewhat larger than the cauline. **Seta** yellowish brown or brown, very short to 2.5 cm, twisted counterclockwise or not twisted. **Capsule** usually stegocarpic, occasionally cleistocarpic, yellowish brown or dark brown, spheric, ovate, elliptic or cylindric, occasionally inclined, 0.5–3(–7) mm, exothecial cells rectangular, 25–30 µm, ca. 2–3:1, walls thin or evenly thickened; annulus of 1–2 rows of vesiculose cells, persistent [very rarely revoluble], cells twisted counterclockwise; peristome of 32 filaments or 16 long or shortly triangular teeth, cleft to near base, or absent, straight or twisted counterclockwise, articulations usually many, teeth absent, rudimentary, or up to 2000 µm, spiculose, basal membrane absent, low, or up to 1000 µm, spiculose; operculum long-conic, occasionally shortly rostrate, occasionally not differentiated, 0.5–2.5 mm. **Calyptra** cucullate, 2.5–6 mm, smooth. **Spores** 13–30(–50) µm, papillose, rarely densely spiculose, light brown. **Laminal color reaction to KOH** yellow, occasionally red medially or rarely throughout, or negative or orange.

Species ca. 163 (26 in the flora): worldwide.

The transfer of the type species of the former genera *Desmatodon*, *Phascum*, and *Pottia* to *Tortula*, and the redistribution of many of the species of these four into new and resurrected

genera by R. H. Zander (1989, 1993) was based largely on characteristics of the gametophyte. The rationale was that reduction easily explains the inclusion of cleistocarpic, eperistomate, and peristomate capsules in one genus, while lumping of very different, complex gametophytic traits into one genus is less easily supported. Species of the flora area previously in *Tortula* having, among other characters, leaves red in 2% KOH solution, have been transferred to *Hennediella*, *Microbryum*, or *Syntrichia*. The reasons proposed by J. Guerra and M. J. Cano (2000) for erection of the genus *Protobryum* for *Tortula protobryoides* are not compelling. This species has the gametophyte of closely related species in *Tortula*. The sporophyte is not unique (see discussion below) and has an intermediate and possibly hybrid nature (nondehiscing annulate and peristomate).

The stem leaves of this genus are usually characterized as being lax, with lax and more delicate cell walls than species of *Syntrichia*. *Tortula* species are delicate in appearance, characteristically light green, with smooth awns, with a gradual transition in form from medial to basal laminal cells, the papillae are generally low and sometimes apparently absent, and the costa has a rounded or semicircular abaxial stereid band section. Species of *Syntrichia* are more coarse in habit, a dark green to red-orange laminal color in nature, with smooth or serrulate awns, with usually an abrupt fenestration of the basal laminal cells, the papillae are usually evident and strongly differentiated, and the abaxial stereid band is lunate in section. *Tortula* is remarkably homogeneous with respect to the gametophyte. The sporophytes are notable, however, in the apparent reduction series of capsule and peristome development, ranging from complete cleistocarpy, incomplete stegocarpy, the peristomes being absent, many variously absent, rudimentary to well developed. Of the well-developed peristome structures, included are peristomes with low to high basal membranes, the variation more likely due to different degrees of retraction of the capsule mouth than to teeth fusion, peristome teeth that are short and erect, to longer and oblique or inclined to fully elongate and spirally twisted. These transformations are reminiscent of the genus *Weissia*. *Syntrichia*, on the other hand, has little evidence of sporophyte reduction. Following M. J. Cano and M. T. Gallego (2003), *T. bolanderi* is included here, as well as the closely related *T. amplexa*, in spite of the reddish cast of the leaves in nature.

SELECTED REFERENCE Steere, W. C. 1939c. *Tortula*. In: A. J. Grout, ed. 1928–1940. Moss Flora of North America, North of Mexico. 3 vols. in 12 parts. Newfane, Vt. and New York. Vol. 1, pp. 228–246.

1. Sporophytes immersed, capsules cleistocarpic 7. *Tortula acaulon*
1. Sporophytes exserted, capsules stegocarpic.
 2. Leaves strongly bordered at the leaf base, near the apex, or throughout with thicker-walled cells, these smaller and quadrate to rhomboid, or narrower, short- to long rectangular; capsule horizontal to curved, cernuous or pendent, or erect and nearly straight.
 3. Leaves strongly mucronate to short-awned; distal laminal cells strongly papillose or smooth; capsules erect and nearly straight.
 4. Leaves strongly papillose, border strong 20. *Tortula subulata*
 4. Leaves smooth or nearly so, border weak or often absent . . . 21. *Tortula mucronifolia* (in part)
 3. Leaves muticous, apiculate or short-mucronate; distal laminal cells indistinctly papillose or smooth; capsules variously nearly straight or bilaterally symmetrical.
 5. Leaf border of narrower, elongate cells with thickened walls; capsule horizontal to curved, cernuous or pendent, occasionally apparently absent.
 6. Leaf cells strongly papillose; capsule inclined to pendent, narrowly elliptical, peristome somewhat twisted 22. *Tortula laureri*
 6. Laminal cells smooth or lightly papillose; capsule inclined to horizontal, short-cylindric, curved or cernuous, peristome not twisted or apparently absent 23. *Tortula cernua*
 5. Leaf border of somewhat smaller cells, quadrate to short-rectangular; capsule erect.

7. Distal laminal cells smooth; plants yellowish green in nature.
8. Leaves short- to long-ovate, apex broadly acute; costa ending in an apiculus or short, sharp mucro; capsule urn 1.3–1.5 mm 1. *Tortula cuneifolia* (in part)
8. Leaves ovate to elliptic, apex commonly short-acuminate as a broad apiculus, this often constricted; costa excurrent as a blunt mucro or percurrent or ending before the apex; capsule urn 2.7–3.3 mm 2. *Tortula deciduidentata*
7. Distal laminal cells weakly to strongly papillose; plants reddish green in nature.
9. Perichaetial leaves sheathing; distal laminal cells weakly papillose 25. *Tortula amplexa*
9. Perichaetial leaves not sheathing; distal laminal cells strongly papillose 26. *Tortula bolanderi*
- [2. Shifted to left margin.—Ed.]
2. Leaves not bordered or with a border but the marginal cells only weakly or gradually thicker than the medial; capsule erect and nearly straight, never cernuous.
10. Leaves muticous, apiculate or short-mucronate.
11. Distal laminal cells 11–22 μm wide; spores 11–24 μm .
12. Medial laminal cells smooth; seta short, 0.4–0.5 cm 1. *Tortula cuneifolia* (in part)
12. Medial laminal cells papillose; seta longer.
13. Distal costa narrow, 2–3 cells across adaxial surface; spores 20–23 μm ; capsule urn 1.5–2(–2.8) mm, peristome teeth usually not twisted 15. *Tortula hoppeana* (in part)
13. Distal costa wider, 3–4(–5) cells across adaxial surface; spores 11–15 μm ; capsule urn 3–4 mm, peristome strongly twisted more than 1 turn 19. *Tortula inermis*
11. Distal laminal cells 8–15 μm wide; spores 8–18 μm .
14. Dioicous, leaf margins plane, spores 8–10 μm 11. *Tortula porteri*
14. Autoicous, leaf margins revolute or usually so, spores 15–18 μm .
15. Costa broad but lacking an adaxial pad of swollen cells, leaf apex usually obtuse or rounded, apiculate but never mucronate 12. *Tortula obtusifolia*
15. Costa with a swollen adaxial pad of swollen cells on the distal surface, apex usually broadly acute to rounded, apiculate or mucronate 24. *Tortula atrovirens*
10. Leaves, at least the distal, awned.
16. Leaf cells smooth or nearly so.
17. Peristome absent or rudimentary.
18. Distal and median cell width 16–22 μm , ca. 2:1; seta 0.8–1.6 cm; leaf margins plane 6. *Tortula nevadensis*
18. Distal and medial cell width 18–24 μm , 1:1; seta usually 0.2–0.4 cm; leaf margins plane or recurved .
19. Leaf margins usually plane, cells smooth; capsule urn urceolate or obovate, 0.6–1 mm 13. *Tortula truncata*
19. Leaf margins usually recurved, cells indistinctly papillose; capsule short-cylindric, urn 1–1.5 mm 14. *Tortula modica*
17. Peristome present and well developed.
20. Peristome teeth divided to near base, straight; capsule systylius 18. *Tortula systylia*
20. Peristome teeth long and twisted from a high basal membrane, capsule with operculum not strongly attached to the columella.
21. Leaf margins plane, not bordered or weakly bordered proximally with thicker-walled cells; costa excurrent as a long awn 5. *Tortula californica*
21. Leaf margins recurved at least at base, weakly bordered by long-rectangular cells proximally; costa excurrent as an apiculus or short awn 21. *Tortula mucronifolia* (in part)
16. Leaf cells papillose (at least the adaxial costal surface).

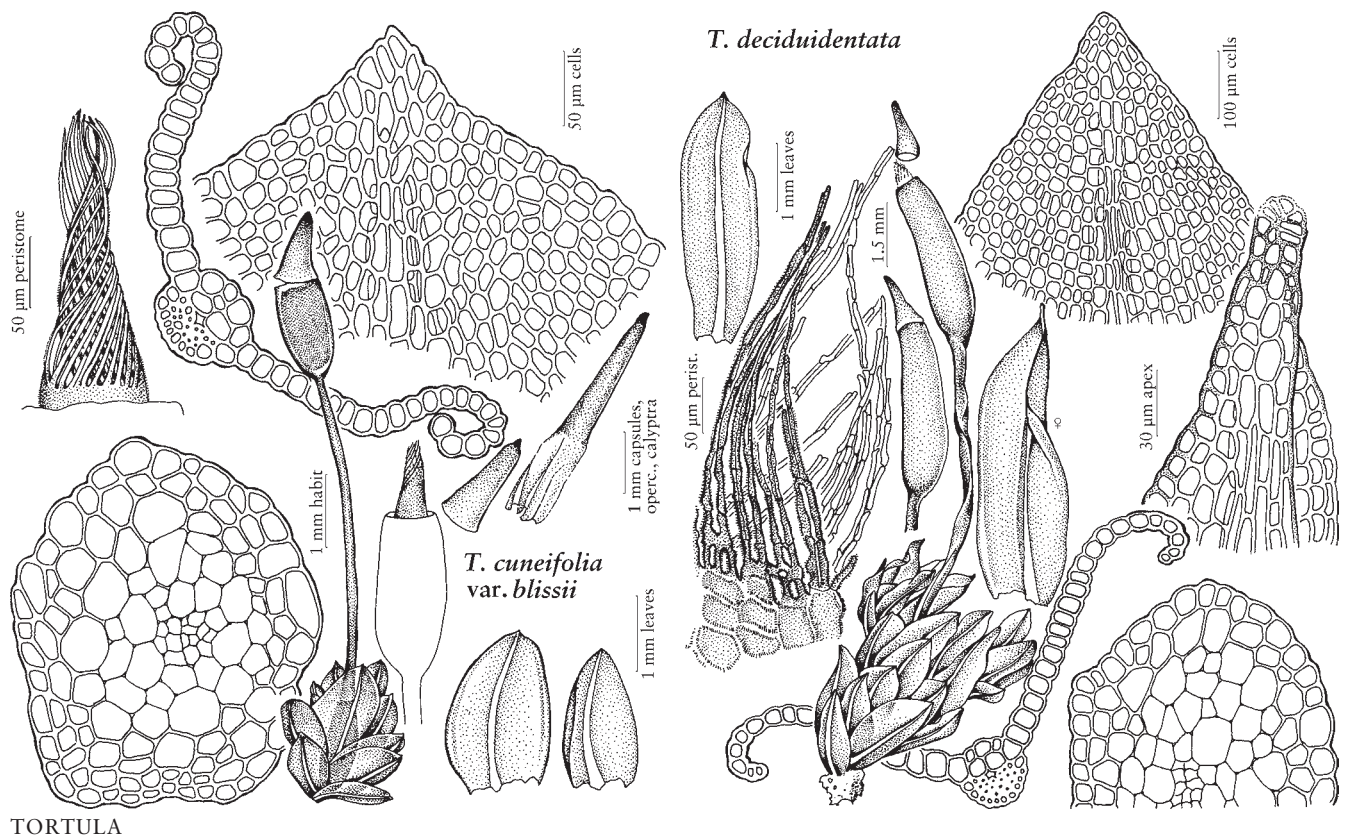
[22. Shifted to left margin.—Ed.]

22. Peristome rudimentary or well developed, attached to the inside of the indehiscent operculum 4. *Tortula protobryoides*
22. Peristome absent to well developed; operculum readily dehiscing.
23. Most leaves ovate-lanceolate or ovate, tapering distally 16. *Tortula leucostoma*
23. Most leaves obovate, oblong or elliptic, usually not tapering to the apex.
24. Peristome rudimentary or of 16 subulate, entire teeth, basal membrane low or absent 3. *Tortula lanceola*
24. Peristome present, of 16 lanceolate teeth each split distally into 2 branches, or of 32 filaments.
25. Distal laminal cells 15–20 μm wide, spores 13–23 μm , spheric to elliptic, papillose.
26. Cells of distal laminal margins not less papillose than medial; basal membrane low, spores 20–23(–25) μm ; subarctic and montane 15. *Tortula hoppeana* (in part)
26. Cells of distal laminal margins less papillose than medial; peristome basal membrane relatively high; spores 13–18 μm ; southwest United States 17. *Tortula guepinii*
25. Distal laminal cells 8–13 μm wide, spores 6–12 μm , spheric, finely papillose or essentially smooth.
27. Peristome teeth erect or slightly inclined, irregular, perforated or \pm divided into 2 cohering divisions 10. *Tortula plinthobia*
27. Peristome teeth twisted, very long, filamentous.
28. Peristome basal membrane 150–200 μm ; spores ca. 10–13 μm ; leaf border absent 8. *Tortula brevipes*
28. Peristome basal membrane to 50 μm ; spores 8–12 μm ; leaf border present or absent 9. *Tortula muralis*

Alternative key emphasizing sporophyte traits.

1. Capsule cleistocarpic, operculum if present not falling.
2. Capsule with indehiscent operculum, peristome commonly visible internally 4. *Tortula protobryoides*
2. Capsule lacking operculum 7. *Tortula acaulon*
1. Capsule stegocarpic, operculum falling.
3. Peristome absent or rudimentary.
4. Capsule curved or ovoid and bilaterally symmetric 23. *Tortula cernua* (in part)
4. Capsule straight or weakly curved.
5. Spores 9–11 μm 12. *Tortula obtusifolia* (in part)
5. Spores greater than 15 μm .
6. Spores 15–18 μm .
7. Seta ca. 0.4(–0.9) cm 3. *Tortula lanceola* (in part)
7. Seta 0.6–1.2 cm 24. *Tortula atrovirens* (in part)
6. Spores 23–35 μm .
8. Capsule urceolate, seta 0.25–0.4(–0.6) cm 13. *Tortula truncata*
8. Capsule cylindrical, seta greater than 0.4 cm.
9. Seta 1–1.4 cm 6. *Tortula nevadensis*
9. Seta 0.4–0.6 cm 14. *Tortula modica*
3. Peristome present, of 16 or 32 teeth.
10. Peristome of 16 straight teeth 3. *Tortula lanceola* (in part)
10. Peristome of 32 teeth or 16 each variously split into 2 or more branches.
11. Peristome of 16 teeth each variously split into 2 or more branches; spores variously 9–35 μm .
12. Spores small, 9–18 μm .
13. Leaf apex apiculate 12. *Tortula obtusifolia* (in part)
13. Leaf apex awned.

14. Spores 8–10 μm ; distal laminal cells 10–13 μm wide 10. *Tortula plinthobia*
 14. Spores 13–18 μm ; distal laminal cells 16–19 μm wide 17. *Tortula guepinii*
12. Spores larger, (18–)20–30(–35) μm .
 15. Capsule nodding.
 16. Capsule nearly straight 22. *Tortula laureri*
 16. Capsule usually ovoid and bilaterally symmetric 23. *Tortula cernua* (in part)
15. Capsule erect.
 17. Leaves mucronate or occasionally short-awned 15. *Tortula hoppeana*
 17. Leaves awned.
 18. Capsule with free operculum 16. *Tortula leucostoma*
 18. Capsule systylius 18. *Tortula systylia*
- [11. Shifted to left margin.—Ed.]
11. Peristome of 32 teeth, each tooth filamentous and not clearly doubled branches of 16 teeth, spores small, usually 11–18 μm .
 19. Urn usually 2.5–6 mm.
 20. Distal laminal cells smooth.
 21. Leaves awned 5. *Tortula californica*
 21. Leaves apiculate or mucronate (occasionally long-mucronate or short-awned).
 22. Leaves muticous or ending in a truncate or constricted mucro (in perichaetial leaves); costa subpercurrent or percurrent 2. *Tortula deciduidentata*
 22. Leaves mucronate to short-awned; costa excurrent 21. *Tortula mucronifolia*
20. Distal laminal cells papillose.
 23. Apex awned.
 24. Peristome basal membrane 150–200 μm ; spores ca. 10–13 μm 8. *Tortula brevipes*
 24. Peristome basal membrane to 50 μm ; spores 8–12 μm 9. *Tortula muralis*
23. Apex apiculate or mucronate.
 25. Leaves not bordered 19. *Tortula inermis*
 25. Leaves bordered by 3–5 rows of thicker-walled, less papillose cells 20. *Tortula subulata*
19. Urn usually 1.3–2.5 mm.
 26. Distal laminal cells smooth 1. *Tortula cuneifolia*
 26. Distal laminal cells papillose.
 27. Adaxial costal cells forming a bulging pad 24. *Tortula atrovirens* (in part)
 27. Adaxial costal cells not especially bulging.
 28. Distal marginal cells elongate; leaves plane 11. *Tortula porteri*
 28. Distal marginal cells quadrate; leaves recurved proximally.
 29. Autoicous; leaf margins strongly recurved to revolute; plants yellowish green 12. *Tortula obtusifolia* (in part)
 29. Dioicous; leaf margins weakly recurved proximally; plants reddish green.
 30. Perichaetial leaves sheathing; distal laminal cells weakly papillose 25. *Tortula amplexa*
 30. Perichaetial leaves not sheathing; distal laminal cells strongly papillose 26. *Tortula bolanderi*



1. *Tortula cuneifolia* (Dickson) Turner, Muscol. Hibern. Spic., 51. 1804 [F]

Bryum cuneifolium Dickson, Fasc. Pl. Crypt. Brit. 4: [29]. 1801

Varieties 2 (1 in the flora): Nunavut; Europe; sw, c Asia; n Africa; Atlantic Islands (Macaronesia).

1a. *Tortula cuneifolia* var. *blissii* R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 223, plate 85, figs. 21–25. 1993 [E] [F]



Leaves short- to long-ovate, apex broadly acute, apiculate, margins plane, weakly bordered throughout or near apex with 2–4 rows of smaller, thicker-walled cells, occasionally short-rectangular; costa ending in an apiculus, lacking an adaxial pad of cells, distally narrow, (2–)4 cells across

adaxial surface; distal laminal cells inflated hexagonal to short-rectangular, width 15–20 µm, 1(–2):1, smooth. **Sexual condition** paroicous or autoicous. **Sporophytes** exerted. **Seta** length 0.4–0.5 cm. **Capsule** stegocarpic,

not systylious, cylindrical, erect and nearly straight, urn 1.3–1.5 mm; peristome ca. 800 µm, teeth of 32 filaments twisted about 1/2 turn, basal membrane ca. 100 µm; operculum ca. 1.1 mm. **Spores** 12–15 µm, spheric, finely papillose.

Capsule maturity date unknown (the typical variety has capsules mature in spring). Apparently on soil; low elevations (0 m); Nunavut.

Variety *blissii* is known only from the type collection, Nunavut, Cornwallis Island, Resolute Bay area. It differs from the typical variety by blackish gametophyte, short-elliptic (not broadly obovate) leaves that are apiculate (never grading to short-awned), costa slightly wider, seta shorter and thicker, operculum larger. The leaves of var. *blissii* are identical to those of muticous-leaved forms of the typical variety, but show a very strong color reaction to KOH: bright yellow upper lamina and deep brick-red basal cells, colors which are pale in European specimens. The short, thick seta is apparently unique to this arctic variety; European specimens have setae 0.7–1.5 mm in length and ca. 0.15 mm in width. As in European specimens, the capsule is variably macro- and microstomous, and the operculum is broadly to narrowly

conic. The type specimen was incorrectly reported (D. H. Vitt and R. H. Zander 1978) as representing a second known station for *Tortula deciduidentata* (as *Crumia deciduidentata*), which has a similar short, thick seta and smooth, weakly bordered leaves that are bright yellow in KOH except for brick-red basal cells, but which differs in the operculum pushed off by the elongating columella; capsule and spores larger; and leaves revolute proximally, with much-enlarged basal cells and costa narrower, sometimes excurrent and sharply truncate.

2. *Tortula deciduidentata* (Sharp & Z. Iwatsuki) R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 223. 1993

[E] [F]



Crumia deciduidentata Sharp & Z. Iwatsuki, J. Hattori Bot. Lab. 32: 95, figs. 1, 2. 1969

Leaves ovate to elliptic, occasionally lingulate, apex broadly acute, bluntly acute and mucicous or ending in a truncate or constricted mucro (in perichaetial leaves), margins

revolute in proximal $1/2-2/3$ of leaf, weakly bordered in distal $2/3$ of leaf with 2–6 rows of thicker-walled, smaller cells; costa subpercurrent or percurrent, occasionally excurrent, lacking an adaxial pad of cells, distally narrow, 2(–3) cells across adaxial surface; distal laminal cells hexagonal to short-rectangular, width 13–18(–25) μm , 1(–2):1, smooth. **Sexual condition** paroicous or autoicous. **Sporophytes** exerted. **Seta** 0.6–1 cm. **Capsule** stegocarpic, systylius and pushing the operculum off, cylindrical, erect and nearly straight, urn 2.7–3.3 mm; peristome remaining in the operculum, delicate, teeth fragmentary, of somewhat twisted filaments, basal membrane low, hyaline; operculum ca. 1 mm. **Spores** 15–18 μm , spheric, finely papillose.

Capsules mature Jul. Moist crevices, bayside bluff, hill in wet area; low elevations (0 m); Alaska.

Tortula deciduidentata is known only from the type locality at Moller Bay and from Segum Island, Aleutians (Bank 966, NY, as *Gymnostomum calcareum*). The perichaetial leaves have an excurrent costa with a truncate apex that appears apically discolored, but no deciduous parts were seen. This rare species is similar to 1a. *Tortula cuneifolia* var. *blissii*, and is further discussed there.

3. *Tortula lanceola* R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 223. 1993 [F]



Encalypta lanceolata Hedwig, Sp. Musc. Frond., 63. 1801, not *Tortula lanceolata* (Hedwig) P. Beauvois 1805; *Pottia lanceolata* (Hedwig) Müller Hal.

Leaves obovate, elliptic or less commonly ovate, apex broadly acute to occasionally rounded, awned or long-mucronate, margins strongly and broadly recurved in proximal $4/5$ of leaf,

not bordered; costa long-excurrent, with an elongate adaxial pad of bulging, rounded cells with 3–4 simple papillae, distally narrow, 2–4 cells across adaxial surface; distal laminal cells subquadrate, 12–16 μm wide, 1:1, smooth or less commonly papillose with 1(–2) scattered simple papillae. **Sexual condition** autoicous. **Sporophytes** exerted. **Seta** ca. 0.4(–0.9) cm. **Capsule** stegocarpic, not systylius, elliptic or cylindrical, or erect and nearly straight, urn ca. 0.8–1.2 mm; peristome 100–150 μm , teeth 16, ligulate straight, or short, rudimentary, basal membrane lacking or very low; operculum 0.5 mm. **Spores** 15–18 μm , spheric, finely papillose.

Capsules mature spring. Soil or walls, often in calcareous regions; low to moderate elevations; Ariz., Idaho, S.C., Tex; Europe; Asia; n Africa.

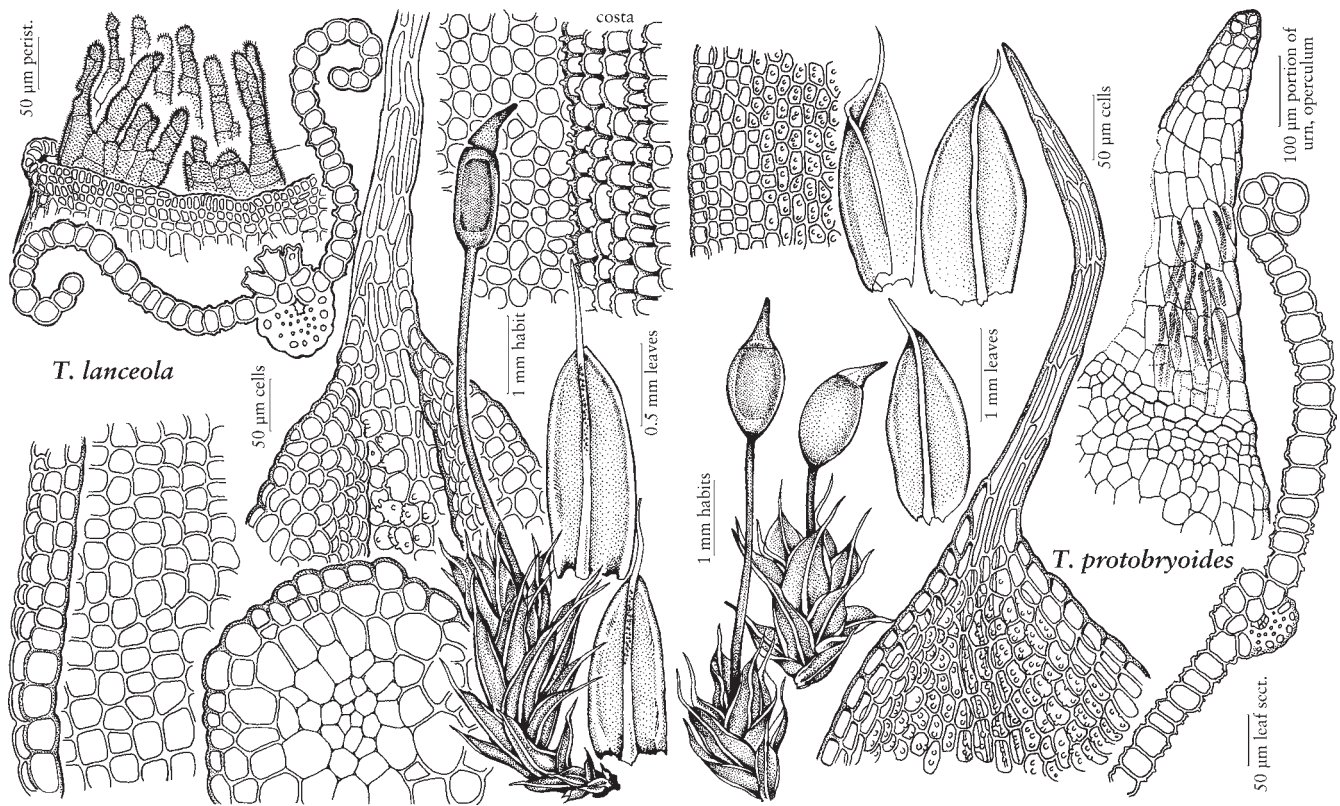
The tiny but often fruiting *Tortula lanceola* is uncommon in the flora area. The bulging, rounded cells of the adaxial costal pad have the distinctive appearance of cows' udders, and viewed laterally have the appearance of longitudinal ridges. H. A. Crum and L. E. Anderson (1981) pointed out that the antheridia are borne naked in axillary clusters, but occasionally bracts, albeit rudimentary, are present. *Tortula acaulon* has much the same gametophyte, but the sporophyte is reduced and cleistocarpic. *Tortula atrovirens* and *Crossidium aberrans* have a somewhat similar leaf section but the former lacks an awn, and the latter has a short awn, and the adaxial costal pad is of low 1–2-celled filaments.

4. *Tortula protobryoides* R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 226. 1993 [F]



Phascum bryoides Dickson, Fasc. Pl. Crypt. Brit. 4: 3, plate 10, fig. 3. 1801, not *Tortula bryoides* Hooker 1828; *Pottia bryoides* (Dickson) Mitten; *Protobryum bryoides* (Dickson) J. Guerra & M. J. Cano

Leaves ovate to oblong-lanceolate, apex broadly acute to rounded, mucronate to short-awned, margins revolute in mid $2/3-3/4$ of leaf, weakly bordered from apex to near base with (2–)4 rows of weakly thicker-



TORTULA

walled and less-papillose or smooth cells; costa excurrent, lacking an adaxial pad of cells though convex adaxially, distally narrow, 3–4 cells across adaxial surface; distal laminal cells subquadrate to hexagonal, occasionally somewhat elongated longitudinally, width 13–18 μm wide, 1(–2):1, papillose with 4(–6) simple papillae per lumen. **Sexual condition** autoicous. **Sporophytes** exerted. **Seta** length 0.2–0.4 cm. **Capsule** stegocarpic, not systylius, broadly cylindrical, erect and nearly straight, urn ca. 1.4–1.5 mm; peristome remaining adherent to the inside of the operculum, teeth rudimentary to linear, to 300 μm , of several filaments variously anastomosing and weakly twisted, basal membrane length to 50 μm ; operculum ca. 0.7–0.8 mm, not falling. **Spores** ca. 20–25 μm , spheric, densely low-papillose.

Capsules mature winter–spring. Soil; low elevations; B.C., Sask.; Ariz., Calif., Colo., Minn.; Mexico (Baja California); Europe; sw Asia.

In *Tortula protobryoides*, only by dissecting the capsule can the peristome be revealed, as it is attached to the inside of the operculum. The capsule has an annulus but the operculum does not fall. The peristome adherent to the operculum is scarcely unique in the Pottiaceae. A peristomate capsule with operculum differentiated but not falling is matched in at least some specimens of *Microbryum starckeanum* var. *fosbergii*. In *T. cernua*, the peristome is attached and the operculum falls, taking

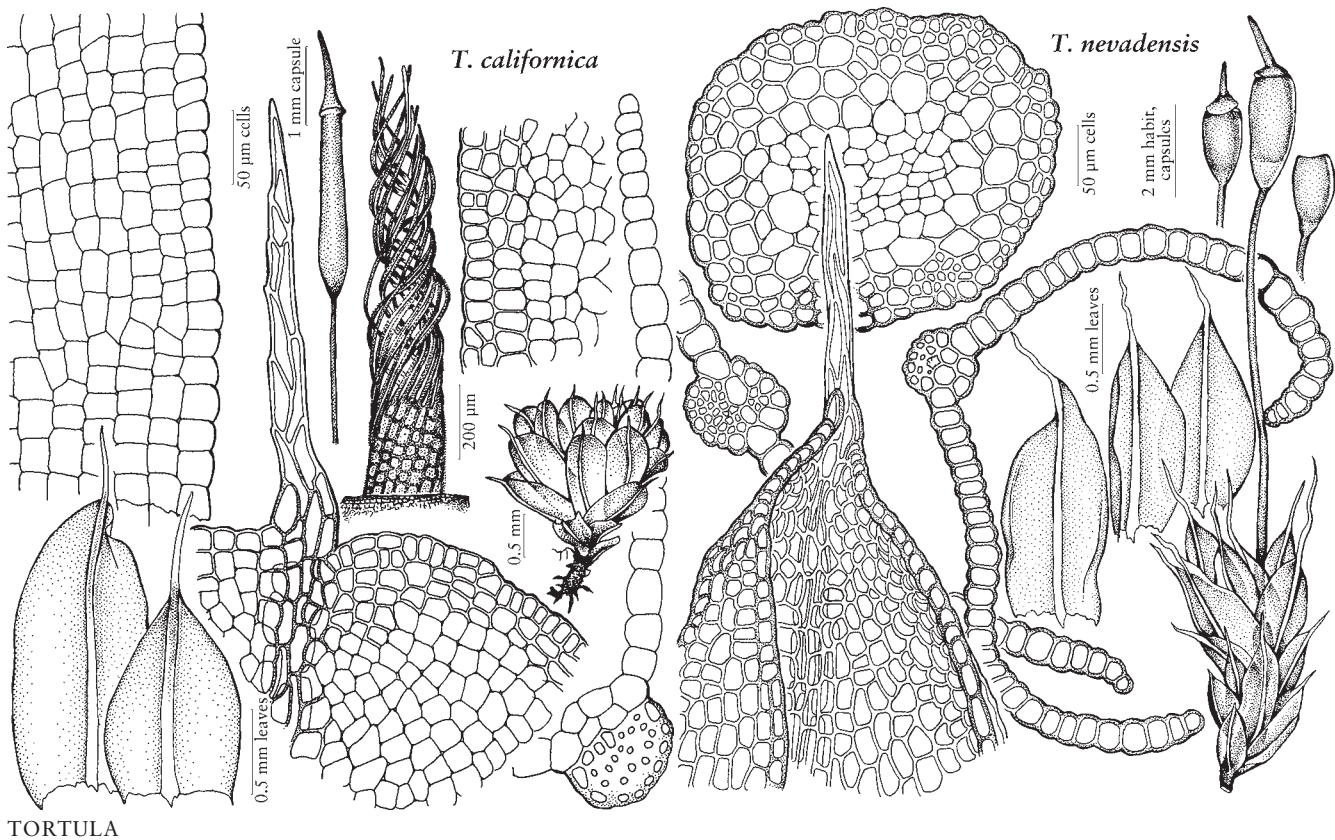
the peristome with it. The gametophyte of *T. protobryoides* is similar to that of *T. acaulon* and *T. lanceola* but the papillae are more dense. The perigonia are borne at the ends of short, basal branches.

5. *Tortula californica* E. B. Bartram, Bryologist 48: 92, figs. h–n. 1945 [F]



Leaves broadly obovate, occasionally elliptic, apex broadly acute, rounded or occasionally emarginate, awned, margins plane or occasionally weakly recurved proximally, often weakly bordered distally with slightly smaller and slightly more thick-walled cells; costa long-excurrent, lacking an

adaxial pad of cells, strong but distally narrow, mostly 2–4 cells across adaxial surface; distal laminal cells inflated hexagonal, occasionally irregularly quadrate, width 18–25 μm , 1:1 or occasionally longitudinally elongate, smooth. **Sexual condition** autoicous. **Sporophytes** exerted. **Seta** 0.9–1.1 cm. **Capsule** stegocarpic, not systylius, cylindrical, erect and nearly straight, urn 2–2.7 mm; peristome 1000–1400 μm , teeth of 32 filaments, twisted once, basal membrane ca. 200 μm ; operculum 1.1–1.5 mm. **Spores** 11–14 μm , spheric, essentially smooth.



Capsules mature spring. Arid soil, rock; low elevations (0–50 m); Calif.; Mexico (Baja California).

Tortula californica has now been reported from several counties in southern California (D. H. Norris and J. R. Shevock 2004), and is characterized by obovate leaves with smooth awns, plane margins, and smooth laminal cells.

6. *Tortula nevadensis* (Cardot & Thériot) R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 226. 1993 [E] [F]



Pottia nevadensis Cardot & Thériot, Bot. Gaz. 37: 365, plate 18, fig. 1. 1904

Leaves ovate to obovate or elliptical, apex acute, short-awned, sometimes long, margins plane or rarely weakly recurved medially, not bordered; costa long-excurrent, lacking an adaxial pad

of cells, distally narrow, 2–3 cells across adaxial surface; distal laminal cells subquadrate or occasionally hexagonal, 16–22 µm wide, 1(–2):1, smooth. **Sexual condition** autoicous. **Sporophytes** exerted. **Seta** 1–1.4 cm. **Capsule** stegocarpic, not systylius (but columella falls with operculum), obovate to cylindric, erect and nearly straight, urn 0.8–1.6 mm; peristome absent;

operculum 0.6–1 mm. **Spores** 23–30 µm, spheric, granulose-papillose papillose.

Capsules mature spring–summer. Soil, occasional saline soil, clay; moderate to high elevations (500–3900 m); Alta., B.C., Ont., Que., Sask.; Colo., Nev., Oreg., Utah, Wash.

In *Tortula nevadensis*, the often long-cylindric capsule with operculum rostrate from a flattened base is much like that of *Hennediella heimii* but is not technically systylius because the operculum usually falls without being lifted by the columella; the columella is cut near the base and remains attached to the operculum. The leaves are reddish only in the extreme basal portion in 2 percent KOH solution. The costa seen in section has two (sub)steroid bands in the more robust leaves, but the large, smooth laminal cells and broad leaf shape preclude confusion with taxa in genera characteristically having two steroid bands (but only one band if plant environmentally depauperate). What appears to be a ventral steroid band may be secondary thickening of an internal epidermal layer. The distal leaves may be weakly denticulate near the apex by projecting cell ends. This uncommon species is a western North American one that is disjunctive to Ontario and Quebec.

7. *Tortula acaulon* (Withering) R. H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 378. 1994



Phascum acaulon Withering, Syst. Arr. Brit. Pl. ed. 4., 3: 768. 1801 (as *acaule*); *Microbryum floerkeanum* var. *henrici* Renaud & Cardot; *Phascum cuspidatum* Hedwig; *P. cuspidatum* var. *americanum* Renaud & Cardot; *P. cuspidatum* var. *henrici* (Renaud & Cardot) Wijk & Margadant; *P. cuspidatum*

var. *piliferum* (Hedwig) Hooker & Taylor; *P. cuspidatum* var. *schreberianum* (Dickson) Bridel; *Tortula acaulon* var. *pilifera* (Hedwig) R. H. Zander; *T. acaulon* var. *schreberiana* (Dickson) R. H. Zander; *T. atherodes* R. H. Zander; *T. atherodes* var. *pilifera* (Hedwig) R. H. Zander; *T. atherodes* var. *schreberiana* (Dickson) R. H. Zander

Leaves ovate to oblong-lanceolate, apex acute, mucronate to short-awned, occasionally comparatively long-awned, margins recurved proximally to nearly plane, not or weakly bordered distally with slightly thicker-walled cells; costa excurrent, lacking an adaxial pad of cells, distally narrow, 2(–3) cells across adaxial surface; distal laminal cells distally quadrate-hexagonal, width 13–17 μm , 1:1, weakly simply papillose or smooth. **Sexual condition** autoicous. **Sporophytes** immersed. **Seta** very short. **Capsule** cleistocarpic, spheric to very short-ellipsoid, erect, mostly 0.9–1.3 mm; peristome absent; operculum not differentiated. **Spores** (25–)33–40 μm , spheric, densely papillose.

Capsules mature winter–spring. Soil, lawns, fields, banks; low to moderate elevations; Alta., B.C., N.S., Ont., Que., Sask.; Alaska, Ariz., Ark., Calif., Colo., Conn., Del., Fla., Idaho, Ill., Ind., Iowa, Kans., La., Md., Mich., Minn., Mo., Mont., Nebr., Nev., N.J., N.Mex., N.Y., N.C., Ohio, Okla., Oreg., Pa., S.Dak., Tenn., Tex., Utah., Va., Wash., W.Va., Wis.; Mexico; Europe; Asia; n Africa; Pacific Islands (New Zealand).

The varieties *pilifera* and *schreberiana* are not recognized here. The former name may be used for plants with long awns, and the latter for robust specimens ranging to 1 cm tall, but intergrades appear to be common.

8. *Tortula brevipes* (Lesquereux) Brotherus in H. G. A. Engler and K. Prantl, Nat. Pflanzenfam. 214[I,3]: 431. 1902



Barbula brevipes Lesquereux, Mem. Calif. Acad. Sci. 1: 12. 1868; *B. macrotrichia* Cardot & Thériot

Leaves short-elliptic or long-obovate, sometimes ovate, apex very broadly acute to rounded, short- to long-awned, margins very broadly recurved or revolute to near apex, not bordered; costa usually long-excurrent, lacking an adaxial pad of cells, distally narrow, ca. 3–4 cells across the convex adaxial surface; distal laminal cells hexagonal, 10–15 μm wide, 1:1, densely papillose with 2-fid papillae. **Sexual condition** apparently dioicous but more probably rhizautoicous, occasionally autoicous. **Sporophytes** exerted. **Seta** length ca. 0.7–1.4(–2) cm. **Capsule** stegocarpic, not systylius, cylindric, erect and nearly straight, urn length ca. (1.7–)2.5–3.5 mm; peristome 800–1000 μm , teeth of 32 filaments twisted about one full turn, basal membrane 150–200 μm ; operculum 1–1.5 mm. **Spores** ca. 10–13 μm , spheric, finely papillose.

Calcareous soil; low to moderate elevations; Ariz., Calif., Colo., Idaho, Nev., Oreg., Utah, Wash.; Mexico (Baja California, Sonora).

Tortula brevipes is much like *T. muralis*, but differs in the soil substrate, absence of a leaf border (common in *T. muralis*), the apparently dioicous inflorescence, the commonly very long (to 5 mm) operculate capsule, and the well-developed basal membrane of the peristome. According to B. D. Mishler (1994), *T. brevipes* in Mexico intergrades with *T. muralis* in capsule length, height of the basal membrane, and development of a leaf border.

9. *Tortula muralis* Hedwig, Sp. Musc. Frond., 123. 1801



Leaves ovate or elliptic to obovate, apex broadly acute to rounded or emarginate, short- to long-awned, margins narrowly recurved or revolute to near apex, commonly bordered distally with 2–4 rows of thicker-walled, papillose to smooth cells; costa long-excurrent, lacking an adaxial pad of cells, distally narrow, 3–4(–6) cells across the convex adaxial surface; distal laminal cells hexagonal, 10–15 μm wide, 1:1, strongly papillose with 2(–4)-fid papillae. **Sexual condition** autoicous. **Sporophytes** exerted. **Seta** 0.6–1.5 cm. **Capsule** stegocarpic, not systylius, cylindric, erect and nearly straight, urn 1.5–2.7 mm; peristome 300 μm , teeth of 32 filaments twisted $\frac{1}{2}$ –2 times, basal membrane