

showing large adaxial hyalocysts, abaxial stereids absent, almost smooth at back. **Specialized asexual reproduction** frequently by deciduous stem tips. **Sporophytes** not known in North America.

Soil in tundra habitats; in alpine elevations, 2700–3400 m; Greenland; B.C., Nfld. and Labr. (Nfld.), Yukon; Alaska, Colo.; Europe; Asia (Bhutan, China, Japan, Nepal).

Records of *Campylopus schimperi* from Mexico and the Andes are doubtful. The taxonomic value of this species has often been doubted. It was frequently regarded as a variety of *C. subulatus*, which is similar in several respects. *Campylopus schimperi*, however, has more elongate, distal laminal cells (1:4 instead of 1:1.5–2) and abaxially nearly smooth costa (ribbed in *C. subulatus*). Furthermore, *C. schimperi* is a species of arctic-alpine habitats and *C. subulatus* is found at low elevations. These anatomical as well as ecological differences indicate that *C. schimperi* should be regarded as a separate species.

13. *Campylopus schmidii* (Müller Hal.) A. Jaeger, *Thätigk. St. Gallischen Ber. Naturwiss. Ges.* 1870–1871: 439. 1872



Dicranum schmidii Müller Hal., *Bot. Zeitung (Berlin)* 11: 37. 1853;
Campylopus aureus Bosch & Sande La Coste

Plants 2–5 cm, yellowish green, stiff, evenly foliate, the perichaetia in comal tufts. Leaves 5–6 mm, erect-patent when wet, appressed when dry, from oblong base gradually contracted to a long subula, ending in a straight, hyaline, serrate tip; alar cells hardly differentiated; basal laminal cells thin-walled, rectangular, hyaline; distal laminal cells chlorophyllose, oval to narrow or elongate oval, incrassate; costa filling $\frac{1}{2}$ – $\frac{2}{3}$ of leaf width, in transverse section showing adaxial hyalocysts as large as the median deuter cells, and abaxial groups of stereids, ribbed abaxially. **Specialized asexual reproduction** by deciduous buds produced in the distalmost part of the stem. **Sporophytes** not known from North America.

Soil in open pine, cedar and cypress forests; 80–200 m; Calif., Oreg.; Mexico; Asia (China, s India, Sri Lanka, Java, Sulawesi, Borneo, Taiwan); Africa (c Africa); Indian Ocean Islands (Madagascar); Pacific Islands (Hawaii); n Australia.

Campylopus schmidii does not fruit in North America, where apparently only female plants exist. The range of this species is mainly southeastern Asia. From there it extends south to Queensland, west to Madagascar and Central Africa, east to Hawaii, California, Oregon, and Mexico. In California it is known from two localities, in Oregon from one, and in Mexico from one, which suggests that the occurrence of *C. schmidii* may result from occasional long distance dispersal events across the Pacific Ocean; it may not be native in North America. The first collection was made in California in 1933. Plants of *C. schmidii* resemble *C. pilifer* but are distinguished by elongate-oval rather than oval distal laminal cells and costa smooth at the abaxial surface and not with lamellae 3–4 cells high as in *C. pilifer*. *Campylopus introflexus* has lamellae 2 cells high and a similar areolation as *C. pilifer* but is distinguished in the field by reflexed hairpoints. All three species are more or less vicariant sister species, *C. introflexus* in the subantarctic to subtropical parts of the southern hemisphere, *C. pilifer* in tropical India, Africa, and South America and from there extending to southeastern North America and southwestern Europe, and *C. schmidii* mainly in southeastern Asia.

14. *Campylopus sinensis* (Müller Hal.) J.-P. Frahm,
Ann. Bot. Fenn. 34: 202. 1997



Dicranum sinense Müller Hal.,
Nuovo Giorn. Bot. Ital., n. s. 4: 249.
1897; *Campylopus japonicus*
Brotherus; *Dicranodontium sinense*
(Müller Hal.) Paris

Plants to 3 cm, in dense tufts, blackish proximally, golden green distally. **Leaves** 5–10 mm, the distal ones longest, erect patent

when wet, appressed when dry, narrowly lanceolate, long-subulate, ending in a straight, fine, almost entire apex, piliferous at least in the distalmost leaves and plants from exposed habitats, rarely subhyaline; alar cells reddish brown, inflated; basal laminal cells thick-walled, rectangular, narrower at margins, thin-walled in perichaetial leaves; distal laminal cells shortly rectangular or oblique, 3–5:1; costa filling $\frac{1}{2}$ – $\frac{3}{4}$ of leaf width, excurrent, in transverse section showing abaxial groups of stereids and adaxial firm-walled hyalocysts, slightly abaxially ridged. **Specialized asexual reproduction** by deciduous stem tips or deciduous leaves. **Sporophytes** not known from the flora area.

Usually on soil and rocks; ca. 60 m; B.C.; Mexico; Asia (China, Japan, Korea, Vietnam); Pacific Islands (Tahiti); Australia (Queensland).

In North America north of Mexico *Campylopus sinensis* has been found only once, in a depauperate

condition in a blanket bog in the Queen Charlotte Islands. The species shows a distinct gradient from large to small plants in the tropical to the subtropical or temperate-oceanic parts of its range in East Asia, which seems to be matched also for the North American populations with regard to specimens from Mexico and from British Columbia. It is not evident whether the record from Queen Charlotte Islands is the result of a long distance dispersal or a relict from the Tertiary, as supposed from some other bryophyte species with amphipacific range or disjunct occurrence in East Asia and Mexico. It is also possible that *C. sinensis* was hitherto overlooked in North America and (as frequently in China) confused with the similar 3. *C. atrovirens* (for differences see discussion under the latter species).

15. *Campylopus subulatus* Schimper in G. L.
Rabenhorst and G. Winter, Bryotheca Eur. 9: no. 451.
1861 [F]



Plants 0.5–3 cm, in loose, slender tufts, yellowish green to green, not tomentose. **Leaves** 3–4 mm, erect-patent when wet, appressed when dry, lanceolate, narrowed into a short, straight subula; margins entire below, faintly serrate at apex; apex of leaf serrate at back; alar cells hardly differentiated,

only slightly larger than the basal laminal cells; basal laminal cells thin-walled, hyaline, rectangular; distal laminal cells short, subquadrate; costa filling $\frac{1}{2}$ – $\frac{2}{3}$ of leaf width, excurrent in a short concolorous apex, in transverse section showing adaxial hyalocysts that are $\frac{1}{3}$ as wide as the costa, without abaxial stereids, ribbed at back. **Specialized asexual reproduction** by deciduous stem tips. **Sporophytes** not known in North America [rare elsewhere].

Open soil in oak and Douglas fir forests, also open sand in dunes with *Pinus contorta*; 80–200 m; Calif., Oreg.; Europe; Asia.

Campylopus subulatus is known only from two localities in California and one in Oregon. Although all records of *C. subulatus* from North America were referred to *C. schimperi* by J.-P. Frahm and D. H. Vitt (1978), collections made later in California and Oregon proved to be the former species. *Campylopus schimperi* grows in compact tufts in alpine habitats and differs from *C. subulatus* by an abaxially smooth costa, and rectangular, not subquadrate distal laminal cells. *Campylopus subulatus* resembles *C. tallulensis*. The latter differs by distinct groups of abaxial stereids and adaxial hyalocysts, which are $\frac{1}{2}$ as wide as the thickness of the costa.

16. *Campylopus surinamensis* Müller Hal., *Linnaea* 21: 186. 1848



Campylopus donnellii (Austin) Lesquereux & James; *C. gracilicaulis* Mitten; *C. gracilicaulis* var. *donnellii* (Austin) Grout; *C. tallulensis* var. *subleucogaster* (Müller Hal.) Grout; *Dicranum donnellii* Austin

Plants 0.5–3 cm, in loose tufts, light green, young plants forming low rosettes, older plants taller,

with a stem arising from the rosette with densely appressed leaves, ending in a comal tuft that consists of perichaetia or produces brood leaves. **Leaves** 4–7 mm, narrow lanceolate, narrowed to a short (in stem leaves) or long (in rosette and comal leaves) serrate subula; alar cells sometimes well developed, forming reddish or hyaline auricles, sometimes not much differentiated; basal laminal cells of appressed stem leaves more or less thick-walled, of comal leaves thin-walled, narrower at margins, forming an indistinct small border; distal laminal cells short to long-rectangular or oblique, 2–5:1; costa filling half of the leaf width, excurrent in a serrate awn that is subhyaline in the comal leaves, in transverse section with adaxial hyalocysts and abaxial groups of stereids, abaxially ribbed. **Specialized asexual reproduction** by small hooked or boomerang-shaped leaves (similar to those of *C. fragilis*) in axils of comal leaves. **Sporophytes** not seen in North America.

Open, acidic, sandy soil in sandhills or open forests, white sands; 0–50 m; Ala., Fla., Ga., La., N.C.; West Indies (Cuba, Trinidad); Central America (Honduras); South America.

Campylopus surinamensis was named *C. gracilicaulis* in North America before the identity with the South American *C. surinamensis* was determined. As expressed in the description, the rosette leaves, appressed stem leaves and comal leaves have a different shape, have different, short or long, concolorous or subhyaline leaf tips and different basal laminal cells. This and the variability of the plant morphology have caused confusion. The almost hairpointed apices of the comal leaves have led to identification as *C. introflexus*, the production of brood leaves to identification as *C. fragilis*. The confusion increased when Bartram transferred *C. gracilicaulis* and *C. donnellii* to *C. flexuosus*, as he did with *C. subleucogaster*. The latter was regarded as a distinct species by Williams but placed as a variety of *C. tallulensis* by Grout. The type specimen of *C. donnellii* does not differ from those of *C. surinamensis* or *C. gracilicaulis*. However, this name has frequently been used for forms of *C. surinamensis* without comal tufts or consisting only of small rosettes

17. *Campylopus tallulensis* Sullivant & Lesquereux, *Musci Bor.-Amer.* ed. 2, 17. 1865



Plants to 5 cm, in tufts, yellowish green, rarely green. **Stems** slender, not or densely reddish tomentose, evenly foliate. **Leaves** about 5 mm, erect-spreading, lanceolate, narrowed to a straight, serrate tip; alar cells hardly differentiated, forming hyaline or reddish auricles; basal laminal cells

hyaline, thin-walled, rectangular, often forming a V-shaped area; distal laminal cells short-rectangular, incrassate; costa filling half of the leaf width, shortly excurrent in a concolorous tip, in transverse section showing large adaxial hyalocysts occupying 1/2 of the thickness of the leaf, and abaxial groups of stereids, abaxially ridged. **Specialized asexual reproduction** by deciduous leaves or stem tips. **Sporophytes** not known.

Acidic rocks (granite, sandstone), exposed boulders, rarely on soil in open woods; 100–600 m; Ala., Ariz., Ark., Del., Ga., Ill., La., Miss., N.C., Ohio, S.C., Tenn., Va., Wyo.; Mexico; Central America (Nicaragua); South America (Bolivia, Colombia, Peru, Venezuela)

The disjunction of *Campylopus tallulensis* from southeastern North America to Mexico, which is also met in other bryophytes and flowering plants, is considered to be a result of a former continuous range in the Tertiary. *Campylopus tallulensis* was included in *C. flexuosus* by American authors. There is a superficial similarity regarding the habit and the shape of the distal laminal cells. *Campylopus flexuosus* is, however, easily distinguished by thick-walled basal laminal cells and the presence of microphyllous brood branches. Plants of *C. tallulensis* from Mexico and eastern North America are robust and yellowish to golden green. In contrast, the specimens collected in Illinois, Mississippi (in part), and Arkansas are more slender and dark green, resembling *C. subulatus* in appearance. It is not known whether these differences in color depend on a different geological substrate or are the expression of different populations. Both species are anatomically very similar with thin-walled hyaline basal laminal cells, almost quadrate distal laminal cells, a costa excurrent in a sometimes subhyaline point and being roughened at the abaxial side like a rat's tail file and a channeled leaf apex. The only way to distinguish both species seems to be the transverse section of the costa, which shows very distinct groups of abaxial stereids in *C. tallulensis* but no abaxial stereids in *C. subulatus*. Furthermore, the adaxial hyalocysts of *C. tallulensis* are twice as wide as those of *C. subulatus* (J.-P. Frahm 1994). On the basis of this character, the only records of *C. subulatus* in North America from California belong to this species and are not extensions of the range of *C. tallulensis* from Mexico.

Excluded Species:

Campylopus zygodonticarpus (Müller Hal.) Paris

L. E. Anderson et al. (1990) in their most recent checklist of the mosses of North America listed this species, based on a specimen (Anderson 26656, DUKE) collected in Mississippi in 1992, consisting of *C. tallulensis*.

Campylopus subporodictyon (Brotherus) B. H. Allen & Ireland

Known in North America only from British Columbia, this species has recently been transferred to *Campylopus* from *Dicranoweisia*.

6. CYNODONTIUM Bruch & Schimper in W. P. Schimper, Coroll. Bryol. Eur., 12. 1856, name conserved • [Greek *kynos*, dog, *odon*, tooth, and *-ium*, diminutive, alluding to peristome]

Patricia M. Eckel

Cnestrum I. Hagen

Plants in loose to dense tufts, dull, dark or yellowish green sometimes brownish. **Stems** erect, (0.5–)1–2(–3) cm, simple or forked, slightly to densely radiculose basally, the rhizoids reddish near the stem, often hyaline distally, smooth or roughened, arising from the stems and the base of branches. **Leaves** crispate when dry, curled-contorted when wet, the limb erect-flexuose from an erect base, ovate- or oblong- or linear-lanceolate, ovate and concave basally, limb distally narrow, keeled to tubulose, gradually acuminate to a fine point; apex acute to obtuse, not deciduous; margins at the base erect and entire, recurved beyond the base or occasionally throughout, nearly entire or evenly to coarsely serrulate in the distal $\frac{1}{4}$ – $\frac{1}{3}$ or just at the apex; margins (1–)2(–3)-stratose, occasionally 2-stratose along costa or scattered; costa single, usually ending before the apex, proximally smooth or sometimes toothed on abaxial surface especially in apical third by projecting cell ends; 7.5–10 μm , adaxial epidermal layer absent, adaxial stereid band poorly developed, guide cells present in 1 row, abaxial stereid band strong, abaxial epidermal layer poorly differentiated from abaxial stereids or absent; basal cells elongate, rectangular, mostly to 5:1, alar cells not or little differentiated; medial and distal laminal cells short, rounded-quadrate to irregular, or short-rectangular, mostly 2:1, longer and broader along costa, occasionally oblate to triangular, smooth or sometimes spinose and bulging mammillose (strongly mammillose-papillose), nonpitted. **Specialized asexual reproduction** absent. **Sexual condition** autoicous or cladautoicous; perigonia sessile or stalked, perigonial bracts (2–)4–6 (–7) mm, ovate-lanceolate, concave, smooth, acute to rounded-obtuse, occasionally with recurved tips; perichaetial bracts similar to vegetative leaves or larger. **Seta** 2–15 mm, smooth, yellow, tending to reddish brown with age, occasionally curved-cygneous when wet, straight when dry [*C. gracilescens*]. **Capsule** erect or inclined, oblong, ovoid, cylindric, straight or often arcuate, occasionally zygomorphic, smooth or longitudinally broadly or narrowly striate when moist, becoming more deeply furrowed to sulcate when dry, with or without weakly differentiated to distinct struma; annulus variable, absent, rudimentary, small and adherent or large, 1–3 rows of deciduous, revoluble cells; operculum obliquely high-conic, rostrate to long-rostrate; peristome single, of 16 lanceolate teeth, more or less entire, irregularly perforate or divided about halfway to $\frac{2}{3}$ or nearly to the base into two divisions, distinctly vertically striate basally, red, with pale, papillose tips. **Calyptra** cucullate, smooth. **Spores** (10–)15–23(–25) μm , smooth, finely to distinctly papillose.

Species ca. 15 (9 in the flora): Northern Hemisphere, mainly temperate and arctic areas.

Cynodontium, like *Dicranodontium*, has a stem central strand with a central cylinder of enlarged cells, a sclerodermis of small, thick-walled cells in 1–2 rows, and lacks a hyalodermis.

It is a genus of damp or moist ledges and rock crevices of boulders and vertical cliffs and boulders, soil over rock, shaded, sheltered or occasionally exposed stations, tundra hummocks, near streams in forest and alpine areas. The present treatment is primarily based on the descriptions and discussions in various manuals. B. H. Allen (2005) gave an instructive synopsis of the genus.

The ubiquitous *Ceratodon purpureus* (Ditrichaceae) may resemble *Cynodontium* species, especially *C. jeneri*, when the leaves are tipped with irregular teeth, also in the strongly recurved laminal margins, which are unistratose and recurved on both sides nearly to the apex. The capsule is likewise fluted when dry. Distinguishing sporophytic characters of *Ceratodon purpureus* are the red-purple seta, the strumose dark-colored capsule, which is inclined horizontally at the juncture of seta and urn, and the short-conic operculum, not longly and obliquely rostrate as in *Cynodontium* species, which have yellow setae and capsules. The mammillose-papillose, hornlike papillae of some *Cynodontium* species should not be confused with those of genera in the large family Pottiaceae.

Cynodontium has long been included in *Oncophorus* in earlier manuals; that genus includes species with leaves abruptly narrowed from a flaring, broadly sheathing base to a wide-spreading subula, and capsules not regularly striate-furrowed when dry and old, but only weakly furrowed. *Cynodontium* was once commonly separated from the genus *Dichodontium* by the autoicous condition, but one of the two species of the latter (*D. olympicum*) also is autoicous. The capsules of *Cynodontium* are regularly striate and the leaves linear-lanceolate, whereas the capsules of *Dichodontium* are smooth to irregularly furrowed and the leaves are shorter and generally broadly lanceolate.

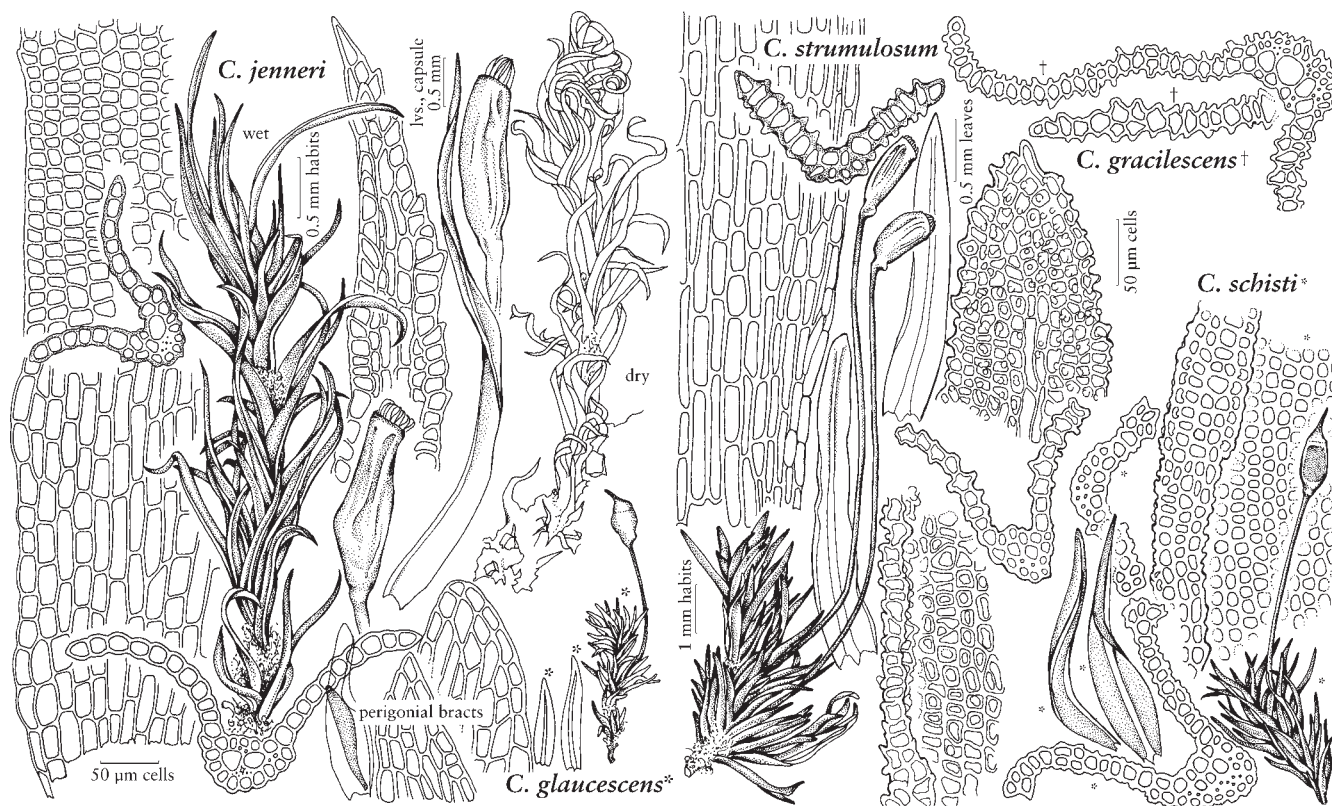
Leaves of *Cynodontium* often have both broadly rounded and broadly to narrowly acute apices on leaves from the same stem. This includes the perigonal buds where, even in the case of perigonia with only two bracts, one will be broad and the other narrow, introducing uncertainty in using perigonal leaf shape to distinguish species. Some sterile specimens identified as *Cynodontium* have been found to be *Dicranoweisia* instead, which has quadrate cell lumina in section without the distortions (mammillae) typical of *Cynodontium*. These specimens are also quite densely and regularly papillose in their narrowly tubulose apices. In section, the costa in the apices displays no differentiation into layers, and often grades into the lamina, which may be bistratose. Most strikingly, in *Dicranoweisia* the papillae are arranged in longitudinal lines over the lamina, which never occurs in *Cynodontium*. Sometimes descriptions in the literature contradict one another, and even themselves with internal conflicts between keys and descriptions. The genus in the flora area is badly in need of a morphologic and taxonomic revision.

Cynodontium has been divided into two genera based on the sessile (autoicous, *Cynodontium*) perigonia with mostly two leaves, or stalked (cladautoicous, *Cnestrum*) perigonium with mostly three or four leaves. Species previously placed in *Cnestrum* favor calcareous substrates while those of *Cynodontium* in the strict sense favor siliceous rocks or soil (E. Nyholm 1986+, fasc. 1). *Cnestrum* species accepted by Nyholm (*C. schisti*, *C. alpestre*, and *C. glaucescens*) are small or slender plants ca. 0.5–1.5 cm, whereas those placed with *Cynodontium* are medium-sized, 1–5 cm. The segregate genus *Cnestrum* includes species, here treated in *Cynodontium*, with a stalked perigonium (not sessile) and erect-spreading leaves (not long-flexuose) as per discussions by Nyholm (1953, 1986) and G. S. Mogensen and W. C. Steere (1979). *Cynodontium schisti* was long the sole species of this segregate, based on its undivided peristome teeth. The addition

of two additional species to *Cnestrum* (*C. alpestre* and *C. glaucescens*), with teeth divided to at least the middle, seemed to weaken the case for segregation. The synonymy of *Cnestrum* with *Cynodontium* seems to follow H. A. Crum and L. E. Anderson (1981), whose decision apparently was based on an incomplete understanding of *Cynodontium alpestre* as distinct from *C. tenellum*, and the absence of *C. glaucescens* from the area of their work. Although the three species in *Cnestrum* are of small stature, they intergrade with the taller species of *Cynodontium* through the medium sized *C. tenellum* and *C. strumulosum*. *Cynodontium glaucescens* has a strumose capsule, which allies it more with *Cynodontium* than with *Cnestrum*. Except for the stalked perigonial bud, which also occurs in the closely related genera *Trichostomum* and *Tortella*, *Cnestrum* might be said to represent part of a reduction series in the genus *Cynodontium*.

SELECTED REFERENCE Ireland, R. R. 1994c. *Cynodontium*. In: A. J. Sharp et al., eds. The moss flora of Mexico. Mem. New York Bot. Gard. 69: 153–155.

1. Leaf margins uniformly 2-stratose, occasionally multistratose.
 2. Lamina strongly papillose-mammillose on both sides; perigonium stalked 6. *Cynodontium schisti*
 2. Lamina mostly smooth or mammillose on one surface only (may have scattered low papillae, or somewhat papillose on the margins); perigonium sessile.
 3. Distal laminal cells 7–10 μm ; annulus of small, persistent cells; peristome teeth cleft to near the base; perigonial bracts obtuse; operculum entire at the base; distal laminal cells smooth or slightly mammillose with mammillae mainly on abaxial side 7. *Cynodontium tenellum*
 3. Distal laminal cells 10(–14) μm wide or more; annulus of large, deciduous cells; peristome teeth divided to about mid tooth; perigonial bracts more or less acute; operculum crenulate at base; distal laminal cells smooth or distinctly mammillose on adaxial side.
 4. Distal laminal cells smooth or only scattered cells slightly mammillose, sometimes papillose abaxially; capsules erect, symmetric, not strumose 8. *Cynodontium polycarpon*
 4. Distal laminal cells moderately papillose except at leaf margins; capsule curved, strumose 9. *Cynodontium strumiferum*
1. Leaf margins 1-stratose (sometimes with 2-stratose patches).
 5. Laminal cells mostly smooth, occasionally with scattered low papilla or with papillae on the leaf margins or at the apex.
 6. Distal laminal cells thin-walled, often lax, 12–14(–20) μm wide; perigonium sessile; laminal cells nearly smooth in apex; annulus large, of 2 rows of cells; capsule not strumose; leaf margins plane or in some leaves shortly recurved at mid leaf but never to the apex 1. *Cynodontium jenneri*
 6. Distal laminal cells incrassate, firm-walled, about 10 μm wide; perigonium short-stalked; laminal cells rather distinctly low-mammillose near the apex; annulus cells weakly developed; capsule with small but conspicuous struma; leaf margins recurved nearly to the apex 2. *Cynodontium glaucescens*
 5. Laminal cells distinctly papillose-mammillose.
 7. Distal laminal cells (6–)8–9 μm wide; capsule erect; perigonium stalked . . . 3. *Cynodontium alpestre*
 7. Distal laminal cells 8–12(–15) μm wide; capsule curved or erect; perigonium sessile.
 8. Lamina 1-stratose; seta straight wet or dry; capsule mostly curved, somewhat zygomorphic, strumose 4. *Cynodontium strumulosum*
 8. Lamina with 2-stratose patches; seta curved to cygneous when wet, erect when dry; capsule straight, symmetric, not strumose 5. *Cynodontium gracilescens*



CYNODONTIUM

1. *Cynodontium jenneri* (Schimper) Stirton, Ann. Scott. Nat. Hist. 15(58): 106. 1906 [F]



Didymodon jenneri Schimper, Trans. Bot. Soc. Edinburgh 9: 314, fig. 5. 1886; *Cynodontium polycarpum* var. *laxirete* (Schimper) Stirton

Stems to 5 cm. Leaves to 6 mm, narrowly lanceolate, long-acuminate to aciculose; leaf margins plane or some leaves shortly recurved at mid leaf, never

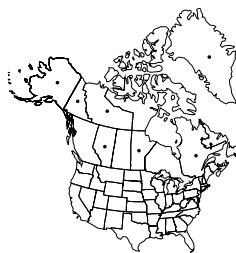
to the apex, 1-stratose with patches of 2-stratose cells on one or both margins; cells of lamina essentially smooth with scattered low papilla, nearly smooth in apical region, thin-walled, often lax, angular, distal cells 12–14(–20) µm wide. Perigonium sessile. Seta ca. 1 cm, straight wet or dry. Capsule symmetrical, erect, not strumose; annulus well developed, deciduous, of 2 rows of large, separating cells.

Capsules mature summer. Shady rock, soil over rock, occasionally rotting wood; low to moderate elevations; B.C., Nfld. and Labr. (Nfld.), Yukon; Alaska, Wash., Wyo.; Europe; Atlantic Islands (Faroes).

Cynodontium jenneri is a tall, luxuriant species with long, flexuose leaves of a dilute yellow color, and pellucid areolation due to the relative scarcity of cell ornamen-

tation (papillae) or distortion (mammillae). This is an oceanic species of western Europe, the Pacific Northwest, and the Avalon Peninsula of Newfoundland (H. A. Crum and L. E. Anderson 1981). See discussion under 8. *C. polycarpon*.

2. *Cynodontium glaucescens* (Lindberg & Arnell) Paris, Actes Soc. Linn. Bordeaux, sér. 5, 6: 306. 1894 [F]



Oncophorus glaucescens Lindberg & Arnell, Kongl. Svenska Vetensk. Acad. Handl., n. s. 23(10): 93. 1890

Stems ca. 0.5 cm. Leaves 1–1.2 mm, broadly lanceolate, mostly bluntly rounded at the tips to broadly acute; leaf margins broadly recurved often to near the apex, 1-stratose; laminal cells essentially smooth, somewhat mammillose-papillose on the margins with a single mammilla per cell, more strongly mammillose-papillose at the leaf apex, with thick walls, firm, rounded at the angles, distal cells around 10 µm wide. Perigonium short-stalked. Seta to 0.7 cm, straight wet or dry. Capsule symmetrical, erect, struma small but conspicuous; annulus weakly developed, adherent.

Capsules mature summer. Rock crevices, tundra hummocks, soil banks, both acid and calcareous

substrates; moderate to high elevations; Greenland; Alta., Man., N.W.T., Que., Yukon; Alaska; Asia (Siberia).

Cynodontium glaucescens is separated from *C. schisti* and *C. alpestre* by less strongly mammillose-papillose leaves, and laminal cell walls decidedly thicker. The species was reported for North America by W. C. Steere (1977, 1978) and C. D. Bird et al. (1977); a synopsis and complete list of specimens throughout its range was presented by G. S. Mogensen and Steere (1979).

SELECTED REFERENCE Mogensen, G. S. and W. C. Steere. 1979. The taxonomic position of *Cynodontium glaucescens* (Lindb. et Arn.) Kindb. (Dicranaceae, Musci). *Lindbergia* 5: 19–24.

3. *Cynodontium alpestre* (Wahlenberg) Milde, Bryol. Siles., 51. 1869



Dicranum alpestre Wahlenberg, Fl. Lapp., 339, fig. 21. 1812; *Cnestrum alpestre* (Wahlenberg) Nyholm

Stems to 1.5 cm. Leaves to 1.5 mm, broadly lanceolate, nearly all leaves with bluntly rounded apices; leaf margins recurved proximally, the cells mostly 1-

stratose; cells of distal lamina (6–)8–9 μm wide, with moderately developed or high mammillae and 1(–2) papillae per cell, walls rather thin, angular to somewhat rounded. Perigonium short-stalked. Seta ca. 0.6 cm, straight wet or dry. Capsule symmetrical, erect, not strumose; annulus weakly developed, adherent.

Capsules mature summer. Rock crevices, commonly on calcareous substrates; moderate to high elevations; Greenland; Alta., B.C., Man., N.W.T., Sask., Yukon; Alaska, Maine, Wis.; n Eurasia

The description of *Cynodontium alpestre* above follows authors who did not consider the species to be a variant of *C. tenellum*. Authors who do unite the two (as *C. alpestre*) conflate the characters, emphasizing those of *C. tenellum*. The present description and that of, for example, H. A. Crum and L. E. Anderson (1981) for *C. alpestre* would not be parallel and would be misleading. *Cynodontium tenellum* as *C. alpestre*, for example, would have strongly 2- to multistratose margins and sessile perigonial buds, and the cells would be smooth on the lamina; all these features are contradicted by the present description. The distribution in the flora area is poorly known for the United States because of confusion with *C. tenellum*, and here follows W. C. Steere (1978) and R. R. Ireland et al. (1987). See G. S. Mogensen (1980) for clarification of the taxonomic position of *Cynodontium alpestre*.

SELECTED REFERENCE Mogensen, G. S. 1980. *Cnestrum alpestre*, with notes on the nomenclature of *Dicranum alpestre* Wahlenb. *Lindbergia* 6: 118–120.

4. *Cynodontium strumulosum* Müller Hal. & Kindberg in J. Macoun, Cat. Canad. Pl., Musci., 6. 1892

[E] [F]



Oncophorus strumulosus (Müller Hal. & Kindberg) E. Britton

Stems (0.5–)1–1.5 cm. Leaves ca. 2 mm, oblong-lanceolate to nearly linear, apex acute to somewhat obtuse; recurved generally in the middle third on one or both sides; margins 1-stratose; laminal cells strongly papillose-mammillose,

distal and medial cells quadrate with rounded corners, 8–15 μm wide. Perigonium sessile. Seta (0.5–)0.8–1 cm, straight wet or dry. Capsule inclined, somewhat zygomorphic, strumose; annulus weakly developed.

Capsules mature summer. Soil over rock; high elevations; Alta., B.C.

The epithet *strumulosum* implies that the capsule is somewhat or sometimes strumose, but in the type specimen examined all the capsules were distinctly strumose. The illustration is drawn from the type specimen.

5. *Cynodontium gracilescens* (F. Weber & D. Mohr) Schimper, Coroll. Bryol. Eur., 12. 1856 [F]



Dicranum gracilescens F. Weber & D. Mohr, Bot. Taschenbuch, 184. 1807

Stems to 5 cm. Leaves to 3 mm, long ovate-lanceolate, gradually narrowed from a broadly ovate base, apex blunt or sometimes acute; margins somewhat recurved, 2-stratose only in the

distal portion of the leaf; laminal cells both mammillose and spinose (strongly mammillose-papillose) on both surfaces, distal leaf cells thin-walled, irregularly rounded quadrate, ca. 10 μm wide. Perigonium sessile. Seta ca. 1.5 cm, curved-cygneous when wet, nearly straight when dry. Capsule straight and erect, not strumose; annulus weakly developed, of small persistent cells.

Capsules mature summer. Moist, shaded ledges, rock crevices; moderate to high elevations; Greenland; N.W.T., Ont.; Colo.; Eurasia.

The bistratose distal leaf margins, the swan-necked (cygneous) curved seta when wet, as well as the distinctly striate-furrowed capsule are all characteristic of the autoicous *Cynodontium gracilescens*. The seta ranges from cygneous, with the capsule pendent, to arched or bowed, with the capsule more inclined to the horizontal. The seta curved when wet is reminiscent of the closely related but smooth-celled *Oreas martiana*, the seta of

which behaves in similar fashion, as do those of several species of *Seligeria* (Seligeriaceae), such as *S. campylopoda*. The costa of *C. gracilescens* is papillose abaxially nearly throughout. The dioicous *Dichodontium pellucidum* may be very similar in strongly horned-papillose distal laminal cells but this occurs only in variants with a short and broad leaf with a broadly rounded or broadly acute apex. In the long-linear leaved form of *D. pellucidum*, the papillae are low or the cells are nearly smooth; in either form the margins are unistratose. *Oreas* has strongly striated capsules that are nearly globose, and undivided peristome teeth. *Cynodontium fallax* Limpricht has not been reported for the flora area but may be expected. This Eurasian species has an erect seta when wet, leaf apices more narrowly pointed than those of *C. gracilescens*, and larger distal laminal cells (9–14 µm) that are nearly smooth on the abaxial surface. In *C. gracilescens* the leaf apices are more broadly pointed, while distal laminal cells are smaller (7–11 µm) and coarsely mammillose on both adaxial and abaxial surfaces. Specimens of the latter from North America also have bistratose patches on the lamina. H. A. Crum and L. E. Anderson (1981) considered this species to be absent from eastern North America.

6. *Cynodontium schisti* (F. Weber & D. Mohr) Lindberg, Öfvers. Kongl. Vetensk.-Akad. Förh. 21: 230. 1864 [F]



Grimmia schisti F. Weber & D. Mohr, Index Mus. Pl. Crypt., [2]. 1803; *Cnestrum schisti* (Wahlenberg) I. Hagen

Stems 0.4–0.8(–1) cm. **Leaves** 1.5–1.8(–2) mm, ovate-lanceolate to linear-lanceolate, acute, sharply pointed at the apex; margins flat or partially narrowly recurved, 2-

stratose; distal laminal cells strongly mammillose-papillose on both surfaces, thin-walled, rounded to quadrate to irregular, 8–9 µm wide. **Perigonium** stalked. **Seta** 0.2–0.3(–0.4) cm, straight, wet or dry. **Capsule** straight and erect, striate, not strumose; annulus weakly developed.

Capsules mature spring. Rock crevices, soil over rock; moderate elevations; Greenland; Alta., B.C., Nfld. and Labr. (Nfld.), Nunavut, Ont., Que., Sask., Yukon; Alaska, Colo., Maine, Mich., Mont., N.C., S.Dak., Wis., Wyo.; Eurasia.

Cynodontium schisti is distinctive in having undivided peristome teeth that may be perforated. *Cynodontium alpestre* and *C. glaucescens* are reported also with poorly divided teeth, commonly divided in the distal 1/4 or to near the middle, whereas all other species of the genus have teeth typically divided to the middle or reaching to nearly the base. If the division of the peristome is part of

a transformation series involving *Cynodontium* and the segregate *Cnestrum*, then *Cynodontium schisti* would represent the end-member, with peristome undivided. The operculum is only obliquely conical, rather than the long-rostrate operculum typical of *Cynodontium*. The cell lumen shape in leaf cross sections is more regularly quadrate rather than distorted-mammillose, and the cells generally have the low, rounded papillae of papillose mosses such as those of the Pottiaceae. The presence of similar quadrate (nonmammillose) lumina in section in *C. alpestre* and *C. glaucescens* should be looked for.

7. *Cynodontium tenellum* (Schimper) Limpricht in F. J. Cohn, Krypt.-Fl. Schlesien 1: 425. 1877



Cynodontium polycarpum var. *tenellum* Schimper, Syn. Musc. Eur. ed. 2, 63. 1876; *C. torquescens* Limpricht

Stems (0.5–)1–2(–3) cm. **Leaves** 2–3(–3.5) mm, linear-lanceolate, apex more or less acute; margin weakly recurved for a short portion of the leaf length or

sometimes almost plane, 2(–3)-stratose; laminal cells smooth or with scattered papillae distally, mainly on the abaxial side, distal cells about 7–10 µm. **Perigonium** sessile. **Seta** (0.5–)0.6–0.7(–1) cm, straight wet or dry. **Capsule** straight and erect, not strumose; annulus weakly developed.

Capsules mature summer. Rocks, tree boles, soil; moderate elevations; Greenland; Alta., B.C., Man., Nfld. and Labr., N.W.T., N.S., Nunavut, Ont., Que., Sask., Yukon; Alaska, Maine, Minn., Mont., S.Dak.; Eurasia; Atlantic Islands (Iceland).

The distribution of *Cynodontium tenellum* is fairly well understood for Canada but not for the United States because of confusion with 3. *C. alpestre* (see discussion thereunder). The present treatment follows W. C. Steere (1978) and R. R. Ireland et al. (1987). The problem in nomenclature of *C. tenellum* is still unresolved (G. S. Mogensen 1980; B. H. Allen 2005).

8. *Cynodontium polycarpon* (Hedwig) Schimper, Coroll. Bryol. Eur., 12. 1856



Fissidens polycarpus Hedwig, Sp. Musc. Frond., 159. 1801

Stems to 5 cm. **Leaves** to 5 mm, rather broadly lanceolate, long-acuminate; distal leaf margin broadly recurved, at least on one side, 2-stratose; cells of lamina smooth, scattered mammillose or distinctly mammillose distally,

mammillae well developed especially on the adaxial side, distal cells 10 µm wide or more. **Perigonium** sessile. **Seta**

ca. 0.8 cm, straight wet or dry. **Capsule** symmetrical, erect, not strumose; annulus of large, deciduous cells.

Capsules mature summer. Acid rock; moderate to high elevations; Greenland; B.C., Man., N.B., Nfld. and Labr., N.W.T., N.S., Nunavut, Ont., P.E.I., Que., Yukon; Alaska, Colo., Idaho, Mich., Minn., Mont., Wyo.; n Eurasia; Atlantic Islands (Iceland).

Specimens of *Cynodontium polycarpon* generally found in American herbaria upon re-examination will likely be *C. jenneri* instead. The latter was once considered to be a variety of *C. polycarpon*, accounting for many distributional records of *C. polycarpon* in North America; for example, in the most recent Canadian checklist (R. R. Ireland et al. 1987), of 10 provincial reports only that for the Northwest Territories could be verified by the authors, and the remaining Canadian distribution cited above must be viewed, then, with skepticism. E. Nyholm (1986+, fasc. 1) stated that both *C. polycarpon* and *C. strumiferum* have somewhat smaller, less regularly quadrate cells in the distal portion of the leaf and a broadly recurved margin on at least one side of the leaf as opposed to the case of *C. jenneri*, which has rather regularly quadrate, transparent cells. According to Nyholm, laminal cells of *C. polycarpon* are 10–12(–14) μm wide, whereas those of *C. jenneri* are larger: 12–14(–20) μm . H. A. Crum and L. E. Anderson (1981) considered this species doubtfully present in North

America. *Cynodontium polycarpon* subsp. *fallax* (Limpricht) Kindberg was excluded by Anderson et al. (1990).

9. ***Cynodontium strumiferum*** (Hedwig) Lindberg, Övers. Kongl. Vetensk.-Akad. Förh. 21: 230. 1864



Fissidens strumifer Hedwig, Sp. Musc. Frond., 160. 1801

Stems to 2.5 cm. **Leaves** 2–4(–5) mm, linear-lanceolate, tapering to a fine point; distal leaf margins broadly recurved in the proximal half; distal lamina cells more or less scattered mammillose-papillose but smooth at leaf

margins, distal and medial cells 10–14 μm . **Perigonium** sessile. **Seta** (0.6–)0.9–1.3 cm, straight wet or dry. **Capsule** curved, zygomorphic, strumose; annulus of large, deciduous cells.

Capsules mature summer. Shady, acid rock, soil over rock; moderate to high elevations; Greenland; Alta., B.C., Man., N.B., Nfld. and Labr., N.W.T., N.S., Nunavut, Ont., Que., Sask., Yukon; Alaska, Colo., Maine, Mich., Minn., Mont., N.H., N.Y., Wis.; Eurasia; Atlantic Islands (Iceland).

7. **DICHODONTIUM** Schimper, Coroll. Bryol. Eur., 12. 1856 • [Greek *dicha*, in two, and *odontos*, tooth, alluding to partially divided peristome teeth]

Patricia M. Eckel

Plants forming mats, cushions, or loosely caespitose, dull yellow or green to dark green. **Stems** 1–5(–8) cm, erect, simple or sparingly branched; sparsely tomentose or radiculose proximally. **Leaves** straight, not secund, more or less strongly and irregularly contorted or crisped with incurved apices when dry, the limb concave and erect-spreading to squarrose from an erect base when wet, narrowly to broadly oblong- or ovate-lanceolate or ligulate; apex acute to rounded-obtuse; margins involute-tubulose to plane or strongly recurved, rarely 2-stratose, distally irregularly and abruptly serrulate-dentate, with narrow, fragile decurrencies; apex acute to rounded-obtuse; costa narrow or broad, subpercurrent, sharply mammillose or densely covered with horned (columnar) papillae on both surfaces to nearly smooth, not rhizoidiferous, guide cells in 1 row, often individual cells in pairs, stereid bands 2 proximal to midleaf, adaxial band less developed, abaxial band strong, adaxial and abaxial epidermis distinct; all cells not pitted; medial laminal cells rounded-quadrate to short-rectangular, 1(–2):1, sharply to bluntly mammillose on both surfaces or merely convex near apex, or densely covered with horned (columnar) papillae on both surfaces, sometimes 2-stratose near costa, walls evenly thickened; alar cells not differentiated in size or color; basal cells rectangular, 3(–5):1. **Specialized asexual reproduction** occasional, by multicellular gemmae borne on branching stalks in leaf axils. **Sexual**

condition autoicous or dioicous; perigonal buds below the perichaetium and sessile or terminal on male plants, perigonal leaves ovate, concave, short-acuminate; perichaetial leaves similar to distal cauline leaves. **Seta** single, yellow at first, becoming red-brown, 4–20 mm, erect. **Capsule** erect to weakly inclined, exserted, oblong-ovate, straight, arcuate to zygomorphic, with or without struma, smooth or irregularly furrowed-rugose when dry; operculum obliquely long-rostrate, usually as long as urn; basal membrane low, projecting above the mouth; peristome teeth 16, divided to the middle into 2 divisions, dark red, vertically pitted-striolate basally, papillose distally; annulus none. **Calyptra** cucullate, somewhat roughened at apex, covering capsule to just below the mouth. **Spores** 12–18(–20) μm , smooth or minutely papillose.

Species 2 (2 in the flora): Northern Hemisphere, largely in temperate and subarctic areas.

Dichodontium had eight recognized taxa world-wide before J.-P. Frahm et al. (1998) reduced the number to three. The number declined to two when *D. brasiliense* Brotherus was synonymized with *Chrystoblastella chilensis* (Montagne) Reimers of the Ditrichaceae (R. Ochya 1999; P. Sollman 1999), reinforcing the possibility that the genus may be artificial. *Dichodontium flavescens* is here considered to be a synonym of *D. pellucidum* (see discussion below). The morphologically similar *Cynodontium* differs from *Dichodontium* by its autoicous sexual condition (*Dichodontium* may be autoicous or dioicous) with leaves narrowly lanceolate, apex acute, and keeled, not tubulose. The dry capsule of all species of *Cynodontium* is furrowed with regular striations but in *Dichodontium* the dry capsules are either smooth or irregularly furrowed-rugose. The distinctly tall, conical papillae in some species of *Cynodontium* seem to relate the two genera; the papillae separate both genera from the smooth-celled *Dicranella* and *Rhabdoweisia*. Species of *Dichodontium* are hygrophilic mosses on soil banks, soil over cliffs and in other rocky habitats.

The color of *Dichodontium* ranges from a dark, pellucid, emerald green in smaller plants, to a more general sordid yellowish to orange-green. The species have stems in section with distinct central strands, enlarged cells in the stem cortex and smaller thick-walled epidermal cells in 1–2 rows, and no hyalodermis. The rhizoids are smooth, the leaves slightly undulate. The leaf section is not well differentiated into distinct layers, especially distal to midleaf where the adaxial stereid band usually vanishes, while the abaxial one disappears farther towards the apex. Both epidermal layers together with the guide cells often form an undifferentiated cylinder distally. This condition may also be seen in *Cynodontium*.

A. J. E. Smith (2004) included *Dicranella palustris* in *Dichodontium*, based on molecular studies that indicate a close relationship with *Dichodontium pellucidum*, citing the work of M. Stech (1999). The two species have a superficial similarity morphologically: a generally short, oblong-lanceolate leaf (the limb of *Dicranella palustris* strongly squarrose from an erect base), nearly identical capsule and peristome, the leaf apex rounded-obtuse, a long leaf decurrency, stem central strand present, and heterogeneous costal anatomy in section, as in small leaves of *Dichodontium pellucidum*. However, in *Dicranella palustris* the leaf cells are elongate (7–12:1) to the leaf tip with short- to long-rectangular cells only on the leaf margins, the leaves are flaccid, and the cell walls lax, somewhat inflated in section, and smooth. Many other characters are also those associated with the genus *Dicranella*: dioicous sexuality, capsule shape and peristome divided to the middle, vertically pitted-striolate, and strongly squarrose leaves. Many species in *Dicranella* have rhizoidal gemmae, as has *Dicranella palustris*, rather than those located on the stem, as in *Dichodontium pellucidum*. Morphologically *Dicranella schreberiana* is difficult to distinguish from *Dicranella palustris* and further genetic analysis may relate that species with *Dichodontium pellucidum* as well. Placement of *Dicranella palustris* in the genus *Dicranella* is retained here pending further study.

SELECTED REFERENCES Frahm, J.-P. et al. 1998. Revision der Gattung *Dichodontium* (Musci, Dicranaceae). *Trop. Bryol.* 14: 109–118. Tan, B. C. and W. B. Schofield. 1980. On *Dichodontium pellucidum* and *D. olympicum*. *Canad. J. Bot.* 58: 2067–2072.

1. Autoicous; leaf margins mostly plane at base, margins prominently papillose near insertion; capsule strumose, irregularly furrowed when dry; marginal laminal cells strongly papillose by projecting distal cell ends to within 10 cells of the insertion, margins of leaf apex strongly papillose but without teeth; median leaf cells always with horned (sometimes branched) papillae on both surfaces; cells on adaxial surface of the costa quadrate or short-rectangular (1–2:1), papillose, scarcely different from adjacent laminal cells 1. *Dichodontium olympicum*
1. Dioicous; leaf margins weakly to strongly recurved in proximal half, margins generally smooth near the insertion; capsule not strumose, smooth when dry; marginal laminal cells weakly papillose by projecting distal cell ends or smooth in proximal half of the leaf, leaf apex variously both papillose and toothed; median leaf cells with horned papillae on both surfaces varying to nearly smooth; cells on adaxial surface of the costa elongate (3–6:1), often smooth, clearly different from adjacent laminal cells 2. *Dichodontium pellucidum*

1. ***Dichodontium olympicum*** Renaud & Cardot, Bot. Gaz. 17: 296. 1892 [E] [F]



Stems 0.4–0.8 cm. **Leaves** 1–2.2 mm, apex rounded-obtuse to obtusely acute, occasionally truncate; leaf margins mostly plane at base, rarely some leaves recurved, prominently papillose near insertion, margins of leaf apex strongly papillose but without teeth; laminal cells at

margins strongly papillose by projecting distal cell ends to within 6–10 cells of the insertion; median leaf cells with horned (sometimes branched) papillae on both surfaces; costal cells adaxially quadrate or short-rectangular (1–2:1), papillose, scarcely different from adjacent laminal cells. **Specialized asexual reproduction** unknown. **Sexual condition** autoicous, perigonium located just below the perichaetium. **Seta** 4–8 mm. **Capsule** 1–1.4 mm, strumose, irregularly furrowed when dry. **Spores** 10–15 μ m.

Capsules mature summer–fall (Jul–Oct). Wet soil or soil over rock, montane areas, especially associated with melting snow; moderate to high elevations (1000–2200 m); Alta., B.C.; Calif., Idaho, Mont., Wash.

Rarely, one or both leaf margins may be recurved to various extents in some of the larger leaves of *Dichodontium olympicum*. The costa near the leaf insertion is 50–62 μ m across, while that of *D. pellucidum* varies from 30 to 100 μ m. The leaves are strongly papillose-mammillose. The margins are evenly denticulate, whereas in *D. pellucidum* similar denticulations are interrupted at intervals by teeth with the outer edge curving toward the apex. The papillae salients tend to become more prominent on the leaf margins approaching the leaf insertion. There does not appear to be a hydroid strand in the costa in the proximal leaf section, which could help differentiate this species

from *D. pellucidum*, which often possesses this feature in robust (longer) stems and leaves.

Dichodontium olympicum is often cited as dioicous in past literature, while J.-P. Frahm et al. (1998) correctly noted its autoicous sexuality but did not include this useful character in their key to species. Since the sexuality of the genus is often said to in part differentiate *Dichodontium* from other genera, such as *Cynodontium*, which has autoicous species, one wonders how artificial *Dichodontium* and other closely related genera are, as several characters, such as strumiferous capsules and the striking “horned” papillae and variously undifferentiated costa anatomy, seem to vary independently of generic limits.

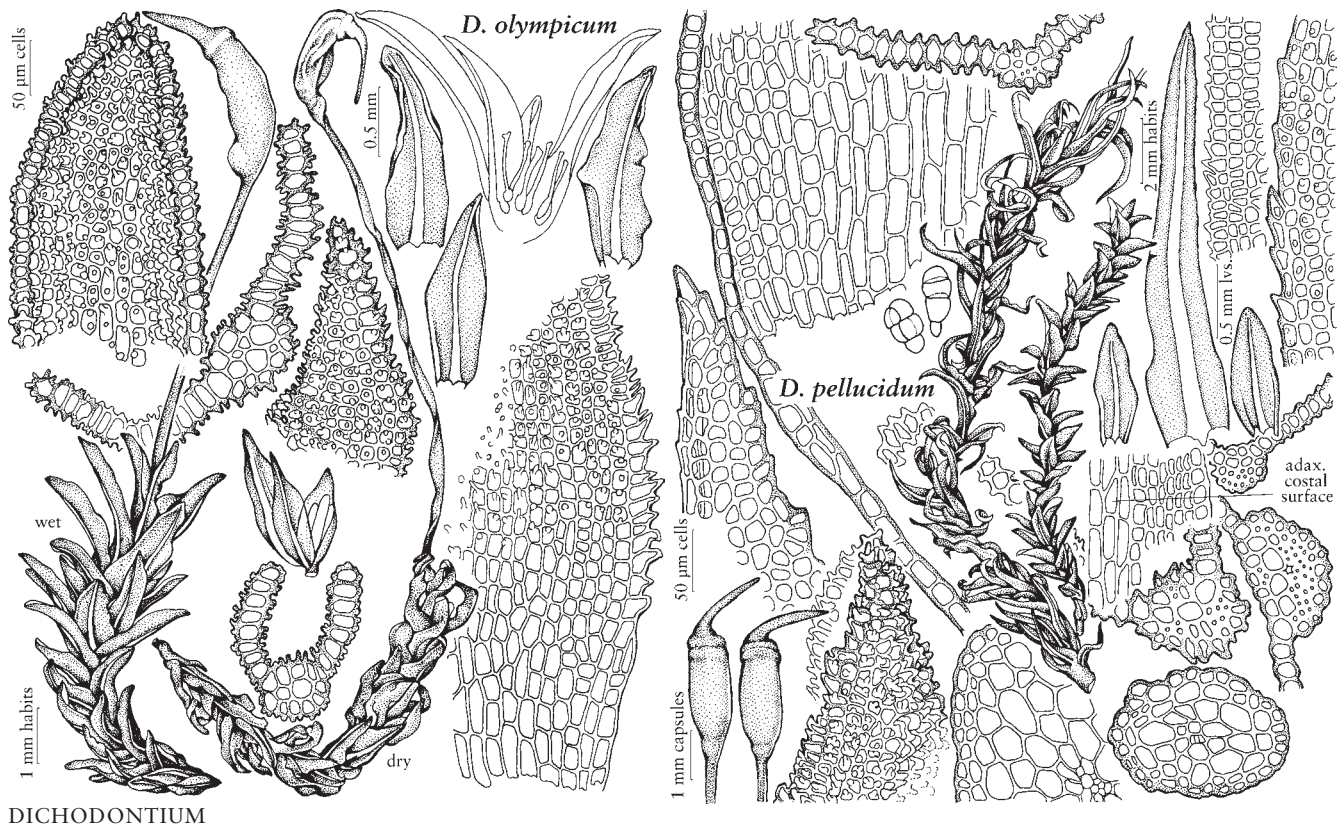
Dichodontium integrum Sakurai has been cited by Gao C. et al. (1999) for the flora of China, without observation of specimens, but indicating that the species, based on a translation of part of the protologue, “is similar to the North American *Dichodontium olympicum*.” The description given, however, lacks the essential distinctions of *D. olympicum*. Further inquiry is needed.

2. ***Dichodontium pellucidum*** (Hedwig) Schimper, Coroll. Bryol. Eur., 12. 1856 [F]



Dicranum pellucidum Hedwig, Sp. Musc. Frond., 142. 1801; *Bryum flavescens* Dickson ex Withering; *Dichodontium flavescens* (Dickson ex Withering) Lindberg; *D. pellucidum* var. *americanum* Lesquereux & James; *D. pellucidum* var. *fagimontanum* (Bridel) Schimper; *D. subflavescens* Kindberg

Stems 1.5–5.5(–8) cm. **Leaves** 1–4 mm, apex narrowly to broadly acute to rounded-obtuse; margins weakly to strongly recurved in proximal half or sometimes nearly to the apex, generally smooth near the insertion, margins



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of leaf apex strongly papillose but without teeth; marginal laminal cells weakly papillose by projecting distal cell ends or smooth in proximal half of the leaf; median leaf cells with horned papillae on both surfaces; costal cells adaxially elongate (3–6:1), often smooth, clearly different from adjacent laminal cells. **Specialized asexual reproduction** occasional, by multicellular ovoid to ellipsoidal gemmae borne on branched, rhizoid-like structures in the leaf axils. **Sexual condition** dioicous. **Seta** 9–20 mm. **Capsule** 1.2–1.6 mm, not strumose, smooth when dry. **Spores** 13–20(–25) µm.

Capsules mature late fall–early spring. Moist soil on banks, wet cliffs, near streams, calcareous or acid rock; low to high elevations (to 2300 m); Greenland; Alta., B.C., N.B., Nfld. and Labr., N.S., Nunavut, Ont., P.E.I., Que., Yukon; Alaska, Ariz., Calif., Colo., Idaho, Mich., Minn., Mont., N.J., N.C., Ohio, Oreg., Pa., Tenn., Utah, Wash., Wis.; Europe; Atlantic Islands (Iceland).

The leaf margins of *Dichodontium pellucidum* are strongly serrate-denticulate in the distal $2/3$ – $3/4$ of the leaf, varying to minutely serrulate to nearly entire in the proximal part. In *D. olympicum* there are no distant marginal teeth in addition to the even denticulations from apex almost to the leaf insertion. In *D. pellucidum*, such teeth are always present even though the denticulations may be nearly absent. A distinct hydroid strand is visible in leaf sections in the proximal half of the leaf in the

larger stems, disappearing in the distal half together with a general loss of anatomical differentiation.

The distinction of *Dichodontium flavescens* from *D. pellucidum* has been supported by J. Werner (2002), and accepted by D. H. Norris and J. R. Shevock (2004) for the California flora. Werner reviewed the literature regarding the separation of these two species and showed that there is no consensus of opinion, which ranges from no distinction (all *D. pellucidum*) to intergradation to separation. Analysis of the morphology of collections, including a few from the flora area, determined that the two taxa are inseparable morphologically. A similar, systematic review of the issue in the flora area, using additional characters, was made by B. C. Tan and W. B. Schofield (1980), who found no clear distinction between the two species, which is the view adopted here. Werner indicated that *D. flavescens* has a more elongate leaf (4:1) whereas that of *D. pellucidum* did not exceed 3:1, the capsules were longer in *D. flavescens* and erect (not inclined), the leaves were broadest at the base and less papillose with the costa wider proximally (to 100 µm in California specimens), whereas *D. pellucidum* was broadest above the base with much more coarsely papillose cells and with a much narrower costa (to 30 µm). The two variants are sympatric across the United States and they appear to have the same ecology and intergrade morphologically. Curiously, in the Japanese

moss flora (A. Noguchi and Z. Iwatsuki 1987+), there is a similar distinction between an elongate variant (*D. pellucidum* var. *pellucidum*) and a shorter-leaved, “endemic” one (var. *yezoense* Noguchi), also apparently sympatric. *Dichodontium nelsonii* Kindberg described from Missouri is, according to B. H. Allen (2005), *Bartramia pomiformis*.

The rather smooth leaves of large-stemmed *Dichodontium pellucidum* without their typical robust papillae and generally from the northwestern United States may resemble *Hyophila involuta*. In *H. involuta* the width of the leaf at the insertion is nearly 1/2 the width

of the leaf lamina at mid leaf. Its marginal teeth are located in the distal 1/4 of the leaf, not nearly to the insertion as in *D. pellucidum*. In *D. pellucidum* the leaf cells, in section, are convex and papillose, sometimes strongly so, on both sides of the leaf, whereas in *H. involuta* they only bulge on the adaxial side. *Hyophila involuta* has no papillae, and has clavate, stellate or dentate-elliptical “multi-horned” axillary gemmae, whereas the gemmae of *D. pellucidum* are simpler, cylindrical or globose with smooth walls and without projections.

8. DICRANELLA (Müller Hal.) Schimper, Coroll. Bryol. Eur., 13. 1856, name conserved

- [Genus *Dicranum* and Latin *-ella*, diminutive]

Howard A. Crum†

Aongstroemia sect. *Dicranella* Müller Hal., Syn. Musc. Frond. 1: 430. 1848; *Anisothecium* Mitten; *Dicranella* subg. *Anisothecium* (Mitten) Kindberg; *Dicranella* subg. *Microdus* (Bescherelle) Brotherus; *Microdus* Bescherelle

Plants in loose to dense tufts, green to yellowish green, sometimes reddish. **Stems** 0.5–5(–11) cm, erect, simple or forked, rhizoids at bases of branches or stems. **Leaves** short- to long-lanceolate, concave to keeled, rarely flat, erect-spreading or appressed to squarrose, straight or falcate-secund, occasionally curled or crispate when dry; apices acute to obtuse, tips not deciduous; margins plane to recurved, entire, serrulate or serrate distally, entire proximally; laminae 1-stratose or rarely 2-stratose on margins; costa single, subpercurrent to excurrent, smooth or papillose to serrulate on abaxial surface, guide cells various, two stereid bands above and below, sometimes slightly differentiated or absent, adaxial and abaxial epidermal layers of cells differentiated or undifferentiated; laminal cell walls weakly bulging, or bulges absent; leaf cells not pitted, smooth, walls sometimes irregular; distal and median laminal cells long, rectangular to linear, proximal cells rectangular to linear, alar cells not differentiated. **Specialized asexual reproduction** absent or tubers borne on rhizoids. **Sexual condition** dioicous; male plants as large as female plants; perigonal leaves ovate, concave, short-acuminate; perichaetial leaves weakly sheathing; sometimes reported to be autoicous. **Seta** solitary, smooth, elongate, erect or flexuose, twisted when dry, yellow or red, brown with age. **Capsule** erect or inclined, usually ovoid, oblong or cylindrical, sometimes subglobose, straight or arcuate, smooth, struma present or absent, plicate or furrowed when dry, often contracted below the mouth, sometimes obliquely so, annulus of 1–2 rows of deciduous or persistent cells; operculum long-rostrate to conic, often arcuate; peristome single, 16 teeth, split ca. 1/2 their length into 2 divisions, vertically pitted-striolate below, papillose above, red. **Calyptra** cucullate, smooth, covering ca. 1/2 of capsule, fugacious. **Spores** 10–25 µm, spheric, smooth to minutely papillose.

Species ca. 215 (11 in the flora): worldwide including Antarctica.

Plants of *Dicranella* resemble those of *Dicranum* but are smaller and have scarcely differentiated alar cells. As presented here, the genus includes the subgenera *Dicranella* and *Microdus*, which can be differentiated only on the basis of a few sporophytic characters and therefore are best regarded as subgenera: subg. *Microdus* has a yellowish seta, an annulus, and short, papillose peristome teeth that are entire or bluntly and shortly 2-fid; subg. *Dicranella* has a red or yellow seta, an annulus (in most cases), and vertically pitted-striolate peristome teeth rising from

a short basal membrane. The genus *Anisothecium*, differing from *Dicranella* only in having no annulus and longer peristome teeth rising from a somewhat higher membrane, is included here in subg. *Dicranella*. What are here considered to be trivial differences separating the subgenera *Dicranella* and *Microdus* are very likely attributable to evolutionary reduction. The synonymy has been taken largely from R. S. Williams (1913).

- 1. Capsule subglobose; peristome teeth less than 180 μm, shortly and irregularly 2-fid, papillose (subg. *Microdus*) 1. *Dicranella lindigiana*
- 1. Capsule elongate; peristome teeth 250–500 μm, 2-fid to the middle or proximally, vertically pitted-striolate at base (subg. *Dicranella*).
 - 2. Seta yellow.
 - 3. Capsule erect, smooth; perichaetial leaves not sheathing; leaves often blunt or rounded at a narrow apex 7. *Dicranella hilariana*
 - 3. Capsule suberect to nodding, furrowed; perichaetial leaves sheathing at base; leaves acute.
 - 4. Leaves serrulate at the apex and sometimes also at shoulders; distal cells long-rectangular (5–10:1); capsule nodding, curved, not oblique mouthed, strumose 8. *Dicranella cerviculata*
 - 4. Leaves serrulate in distal half; distal cells short-rectangular (2–4:1); capsule suberect, not curved, oblique at the mouth, not strumose 9. *Dicranella heteromalla*
 - 2. Seta red.
 - 5. Perichaetial leaves scarcely different from stem leaves; leaves wide-spreading to secund, not squarrose.
 - 6. Leaf margins plane, sinuate-dentate; capsule erect and symmetric 6. *Dicranella rufescens*
 - 6. Leaf margins recurved, at least in part, entire except at the apex; capsule inclined, asymmetric.
 - 7. Leaves not 2-stratose, erect or ± incurved distally, but scarcely subtubulose; distal cells 6–9:1 4. *Dicranella varia*
 - 7. Leaves 2-stratose and incurved distally, subtubulose; distal cells 1–2:1 5. *Dicranella pacifica*
 - 5. Perichaetial or both stem and perichaetial leaves with obovate, sheathing bases and spreading to squarrose limbs.
 - 8. Costa long-excurrent; leaf cells long-rectangular, 6–8:1; annulus present.
 - 9. Leaves erect to falcate-secund; capsule inclined or nodding 10. *Dicranella subulata*
 - 9. Leaves squarrose distally, spreading-flexuose proximally; capsule erect and symmetric 11. *Dicranella crispa*
 - 8. Costa short-excurrent; leaf cells often short and broad, some cells only 2–3:1; annulus absent.
 - 10. Leaves long-decurrent, oblong-lanceolate, obtuse to rounded at the apex, entire 2. *Dicranella palustris*
 - 10. Leaves not decurrent, narrowly lanceolate, acute or obtuse, entire to irregularly toothed at apex. 3. *Dicranella schreberiana*

1. *Dicranella lindigiana* (Hampe) Mitten, J. Linn. Soc., Bot. 12: 30. 1869



Seligeria lindigiana Hampe, Ann. Sci. Nat., Bot., sér. 5, 3: 353. 1865; *Dicranella sphaerocarpa* Cardot; *Microdus lindigianus* (Hampe) Beschereille; *M. sphaerocarpus* (Cardot) Brotherus

Plants yellowish to green, 2–6 mm. **Leaves** erect-appressed or loosely erect-flexuose when dry, erect-spreading when moist, 1–2 mm, lanceolate; margins entire

or minutely serrulate at the apex, recurved proximally; costa ending at or near the apex; cells thin-walled, rectangular, 5–7:1. **Sexual condition** dioicous. **Seta** yellow, 4–6 mm. **Capsule** 0.5–0.8 mm, erect, subglobose, smooth; annulus large, ± persistent; operculum curved, long-rostrate; peristome teeth 90–180 μm, papillose, entire or somewhat perforate along the middle. **Spores** 12–22 μm, finely papillose.

Capsules mature spring. Clay soil of roadside ditches; low elevations; Fla.; Mexico; West Indies (Puerto Rico); Central America (Costa Rica, Honduras); South America (Colombia).

spreading when moist, 1–2 mm, lanceolate; margins entire