



NEW ZEALAND  
MOSSSES

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AN ILLUSTRATED KEY

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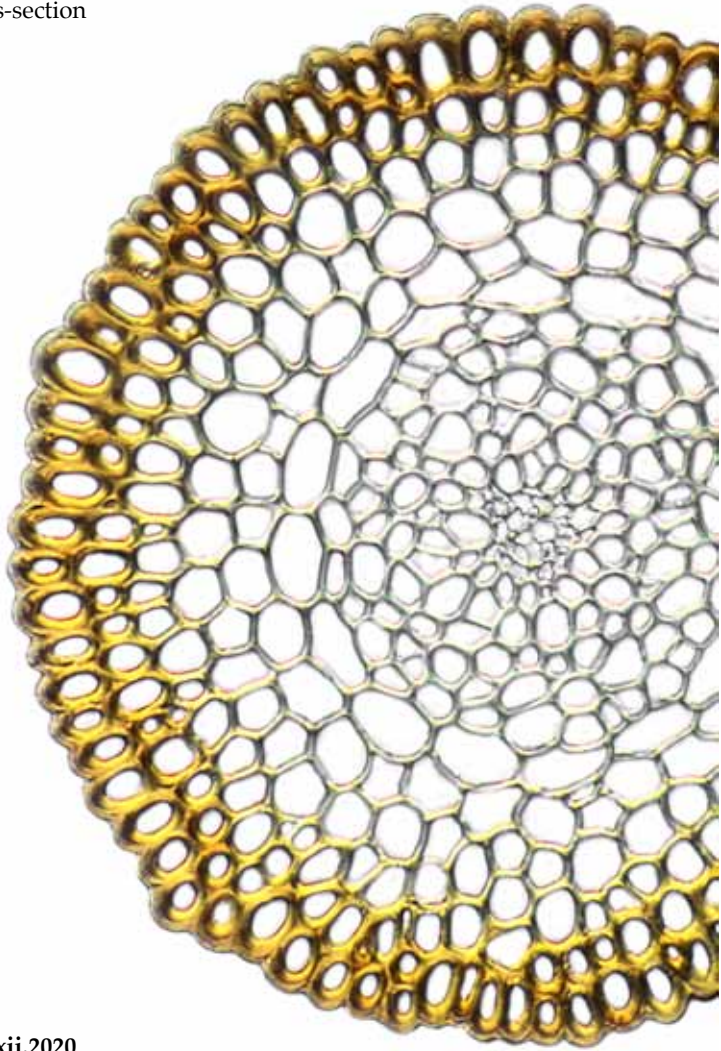
BILL & NANCY MALCOLM AND JIM SHEVOCK

Version xii.2020



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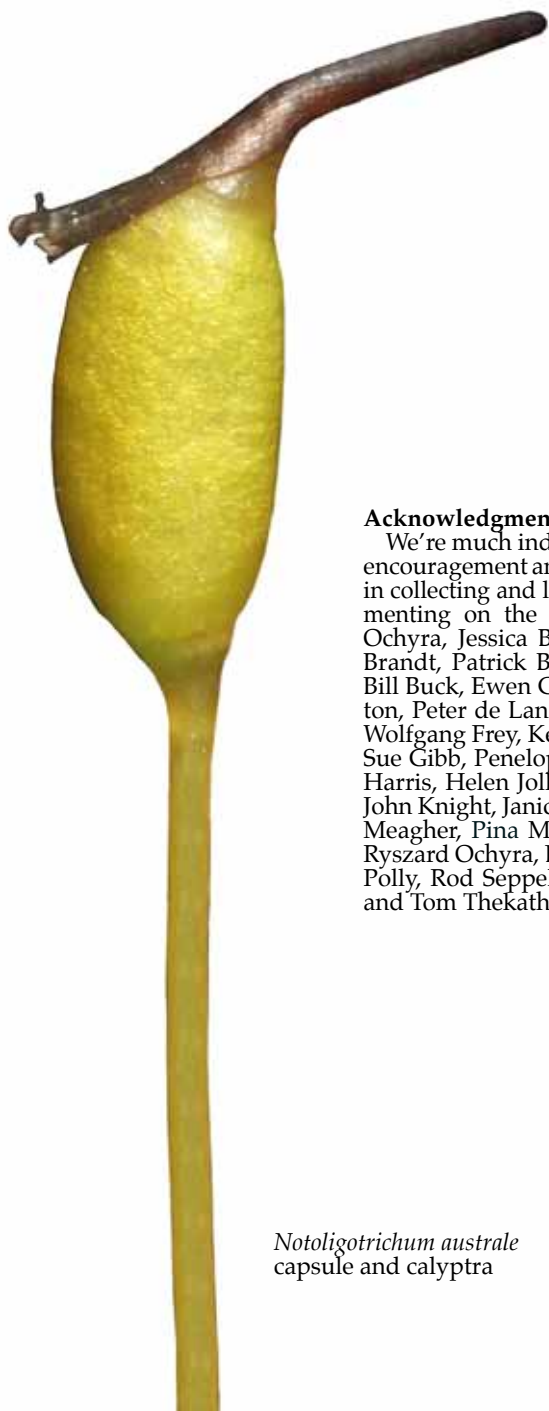
*Ptychomnion aciculare*  
stem cross-section



Version xii.2020

### Table of contents

Acknowledgments .....	4
Using the key .....	5
The key .....	8
Arrangement of the genera .....	35
The genera .....	38
Glossary of terms .....	1331
References and further reading .....	1340
Index of genera .....	1341
Index of epithets .....	1343
Index of binomials .....	1353



### **Acknowledgments**

We're much indebted to our colleagues for their encouragement and their help in finding literature, in collecting and lending specimens, and for commenting on the manuscript—Halina Bednarek-Ochyra, Jessica Beever, Peter Beveridge, Angela Brandt, Patrick Brownsey, Gretchen Brownstein, Bill Buck, Ewen Cameron, Lyn. Cave, Paddy Dalton, Peter de Lange, Alison and Kevin Downing, Wolfgang Frey, Kelly Frogley, Phil Garnock-Jones, Sue Gibb, Penelope Gillette, David Glenny, Anna Harris, Helen Jolley, Niels Klazenga, Allison and John Knight, Janice Lord, Sabrina Malcolm, David Meagher, Pina Milne, Maia Mistral, Dan Norris, Ryszard Ochyra, Leon Perrie, Vita Plasek, Barbara Polly, Rod Seppelt, Geoff Spearpoint, John Steel, and Tom Thekathyl.

*Notoligotrichum australe*  
capsule and calyptra

### Using the key

Keys are handy tools for identifying things. They've been used by botanists for more than three centuries, and by now they come in a variety of formats, each with its own advantages. This one is said to be dichotomous because it offers you a series of choices between two yes-no, either-or traits in the form of numbered *couplets*. Each couplet has two *leads* (both those leads are labelled with the same number, but the number of the second lead in this key is followed by a colon).

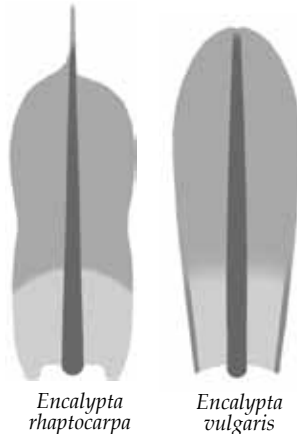
You work your way through the key by choosing the lead in each couplet that better describes the specimen you're trying to identify. With each choice you make, you steadily reject more and more of the genera that your specimen *might* belong to until you finally get down to just the one genus that it *must* belong to. If you get lost, you can retrace your original path through the key by using the backtracking numbers in parentheses at the beginning of each couplet. If you're not sure of the meaning of a term in the key, you can look it up in either the glossary that starts on page 1331 or our illustrated glossary *Mosses and Other Bryophytes* (second edition, 2006).

You can call up illustrations of the species in a genus by commanding your computer to search for the generic name elsewhere in this .pdf file. If a genus has more than one species in New Zealand, the plate is preceded by a page with a key to those species plus black-and-white diagrammatic outlines of their leaves. A species in the genus that's illustrated with a full-page colour plate is labelled with a red dot.

For example, if you've decided after working through the key that your specimen is most likely to be a species of *Encalypta*, searching for that name will call up on-screen a key to the two species of *Encalypta* that are found in New Zealand, plus black-and-white outlines of their leaves (*see below*).

### Key to New Zealand species of *Encalypta*

- 1 Some or all vegetative leaves distinctly long-awned..... ● *Encalypta rhamnifolia*  
 1: Vegetative leaves not long-awned..... ● *Encalypta vulgaris*



The pages following the key will have descriptions and illustrations of *Encalypta rhamnifolia* and *Encalypta vulgaris* (*see next page for the plate of E. vulgaris*).

**Encalypta vulgaris** Hedw.

**form:** tufted, erect, simple or branched, densely foliate, yellowish  
**habitat:** soil or calcareous rock

**leaf:** size: 2.5–3.0 × 1.0–1.2 mm

*shape:* oblong to subobovate, concave above

*tip:* rounded to obtuse or retuse

*base:* lower cells rectangular, hyaline, the transverse walls thickened

*costa:* failing below the apex to shortly excurrent

*border:* several rows of narrow cells in lower third of the margin

*margin:* entire but papillose, plane

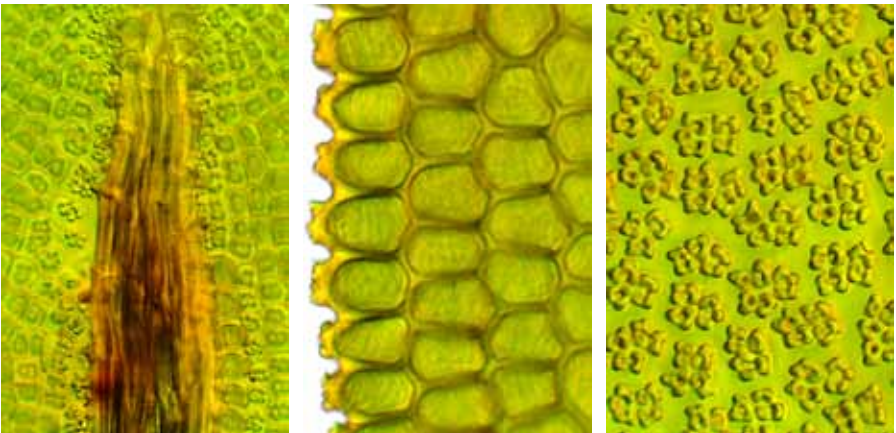
*cells:* 12–18 μm, isodiametric, firm-walled, densely papillose

**capsule:** 3–4 mm; narrowly cylindric, erect, ± striate; seta 10 mm, smooth;  
 calyptra large, resembling an old-fashioned candle-snuffer and entirely  
 covering the capsule; peristome none

**notes:** readily recognized by its large, campanulate calyptrae



fertile shoot (2) (dry), calyptra, leaf outline, and leaf apex showing costa terminus  
 1 mm, 1 mm, 0.5 mm, 0.5 mm, 50 μm

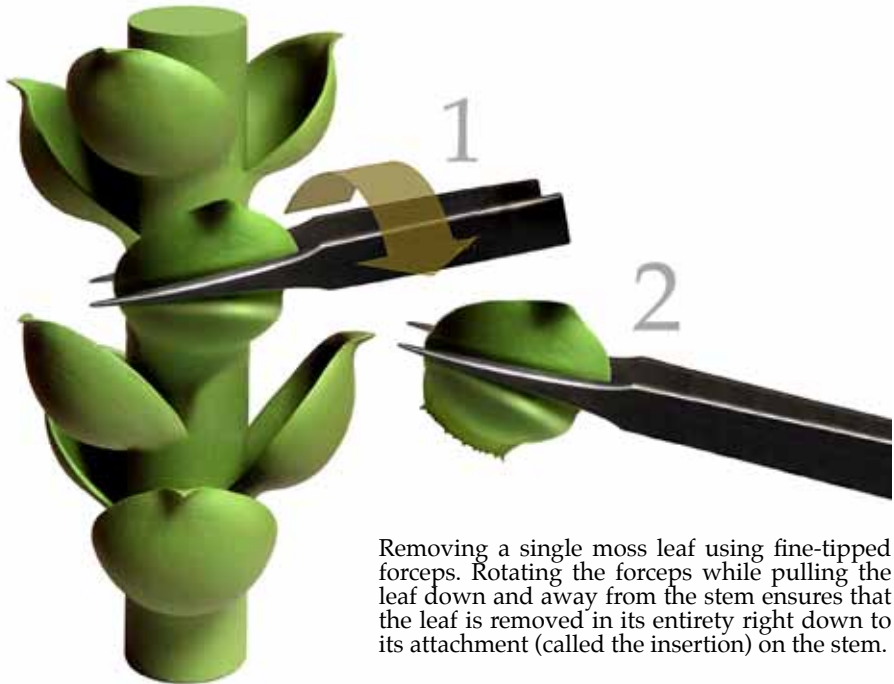


costa near apex, margin midleaf, and leaf papillae  
 50 μm, 10 μm, 10 μm

continued next page

### Getting a good look at your specimen

Because the key depends primarily on leaf traits, you'll have to pull one or more leaves off your specimen for viewing under a microscope. How to do that is illustrated below. Mosses typically have two or three kinds of leaves that differ in size and/or shape. One kind (called vegetative leaves) clothes much of the stem, and is usually by far the most abundant. A more specialized kind (called perichaetial leaves) surrounds the female sex organs, and in some mosses still another specialized kind (called perigonial leaves) surrounds the male sex organs. As well, branched mosses often have markedly different leaves on their main stems and branches, and a few mosses even have two or more kinds of leaf on their main stems, usually in separate rows. If the stem leaves come in two sizes, choose only the larger size. And, if your specimen has more than one kind of leaf, choose only ordinary stem leaves, with one exception—for the peat mosses (*Sphagnum*), you'll need *both* the stem leaves and branch leaves.



Removing a single moss leaf using fine-tipped forceps. Rotating the forceps while pulling the leaf down and away from the stem ensures that the leaf is removed in its entirety right down to its attachment (called the insertion) on the stem.

Because we all have a sharp memory for images, the more often you flip through the illustrations on the pages following the key, the better your chances will be of recognizing any new specimens that you've collected and want to identify. You might not remember the name that goes with the illustration, but by trolling through the pages you should be able to find it again quickly.

**KEY TO THE GENERA OF NEW ZEALAND MOSSES**

(family names end in **-aceae**; keys to the genera in families follow the main key)

1 Plants leafless, growing on bark or living leaves; capsules arising from a dense, persistent, orange-red protonemal mat .....	<b>Ephemeropsis</b>
1: Plants otherwise .....	2
2 Leaves slotted on the forward edge, clasping the stem and often dovetailing with the leaf above .....	<b>Fissidens</b>
2: Plants otherwise .....	3
3 (2:) Lamellae on the adaxial costa .....	4
3: Plants otherwise .....	5
4 (3:) Plants < 5 mm tall; leaf not sheathing, ending in a hyaline hair-point; guide cells plus one stereid band in costa xs.....	<b>Pterygoneurum</b>
4: Plants > 10 mm tall; leaf sheathing, not ending in a hyaline hair-point; guide cells plus two stereid bands in costa xs .....	<b>Polytrichaceae</b>
5 (3:) Walls of cells below midleaf distinctly wavy (sinuose) .....	<b>Grimmiaceae</b>
5: Plants otherwise .....	6
6 (5:) Plants frondose-dendroid <i>and</i> ventral leaves present <i>and</i> propagula absent .....	<b>Hypopterygiaceae</b>
6: Plants otherwise .....	7
7 (6:) Upper leaf cells oval and arranged diagonally <i>and</i> plants pleurocarpous <i>and</i> capsules immersed.....	<b>Cryphaeaceae</b>
7: Plants otherwise .....	8
8 (7:) Leaf with large empty cells (hyalocysts) on one or both surfaces.....	9
8: Leaf lacking hyalocysts .....	11
9 (8) Hyalocysts on the adaxial leaf surface .....	<b>Campylopus</b>
9: Hyalocysts on both leaf surfaces.....	10
10 (9:) Small green cells (chlorocysts) in a central layer surrounded by hyalocysts; leaf costate; peristome dicranoid .....	<b>Leucobryum</b>
10: Chlorocysts alternating with hyalocysts; leaf ecostate; peristome none.....	<b>Sphagnum</b>
11 (8:) Capsule opening by four valves; plants mostly on alpine rock.....	<b>Andreaea</b>
11: Plants otherwise .....	12
12 (11:) Midleaf cell shape linear or vermicular.....	13
12: Midleaf cell shape not linear or vermicular .....	83
13 (12) Costa none or short and double .....	14
13: Costa reaching to at least midleaf.....	43
14 (13) Alar cells absent or weak.....	15
14: Alar cells otherwise.....	26
15 (14) Shoots distichous (two-ranked).....	16
15: Shoots not distichous.....	20
16 (15) Leaf plane .....	17
16: Leaf conduplicate .....	18



17 (18) Leaf symmetric, plane, ovate, straight, entire .....	<b>Isopterygiopsis</b>
17: Leaf asymmetric, inflexed on one side below, oblong, ± falcate, serrulate toward the apex.....	<b>Pseudotaxiphyllum</b>
18 (16:) Leaf falcate, rounded or obtuse .....	<b>Orthorrhynchium</b>
18: Leaf straight or nearly so, not rounded or obtuse.....	19
19 (18:) Shoots complanate; leaf tip a reflexed mucro.....	<b>Catagonium</b>
19: Shoots not complanate; leaf tip acute, ± recurved.....	<b>Cryptogonium</b>
20 (19:) Shoots frondose; filamentous propagula on stem apex.....	<b>Trachyloma</b>
20: Shoots not frondose; propagula absent or otherwise .....	21
21 (20:) Shoots complanate; dorsal leaves present; apex rounded...	<b>Dichelodontium</b>
21: Shoots not complanate; dorsal leaves absent; apex not rounded .....	22
22 (21:) Leaves papery, translucent, rugose, and glossy .....	<b>Ptychomnion</b>
22: Leaves otherwise.....	23
23 (22:) Leaf hair-pointed; peristome endostome only and rudimentary.	<b>Lepyrodon</b>
23: Leaf not hair-pointed; peristome absent or double.....	24
24 (23:) Stem and branch leaves different; decurrent.....	<b>Ctenidium</b>
24: Stem and branch leaves similar, not decurrent.....	25
25 (24:) Plant on soil; leaves asymmetric, ± falcate, plane, entire; midleaf cells > 75 μm long, firm-walled .....	<b>Austrohondaella</b>
25: Plant on bark or rock; leaves symmetric, straight, recurved, serrulate above; midleaf cells < 60 μm long, thick-walled and porose .....	<b>Orthothecium</b>
26 (14:) Leaf apex rounded or obtuse .....	27
26: Leaf apex not rounded or obtuse.....	30
27 (26) Shoots frondose and complanate; leaves papery, translucent, and glossy .....	<b>Neckera</b>
27: Shoots and leaves otherwise.....	28
28 (27:) Shoots long-pendent, julaceous when dry; stem creeping; leaves rugose, not decurrent; alar cells quadrate and thick-walled .....	<b>Weymouthia</b>
28: Plants otherwise .....	29
29 (28:) Leaf ± orbicular, not sheathing; midleaf cell walls thick and porose.....	<b>Acrocladium</b>
29: Leaf ovate, sheathing; midleaf cell walls firm .....	<b>Calliergonella</b>
30 (26:) Long-pendent; capsule immersed to emergent, endostome rudimentary .....	<b>Alleniella</b>
30: Not long-pendent; capsule exerted or none; endostome otherwise .....	31
31 (30:) Leaves papery, translucent, and glossy; tip strongly reflexed ...	<b>Cladomnion</b>
31: Leaves otherwise .....	32
32 (31:) Shoots distichous (two-ranked); leaves oblong to linear; dorsal and ventral leaves present; filamentous propagules in leaf axils; capsule long-necked, strongly 8-ribbed when dry.....	<b>Hampeella</b>
32: Plants otherwise .....	33
33 (32:) Alar cells quadrate and thick-walled.....	34
33: Alar cells inflated and thin-walled .....	37

34 (33) Stem and branch leaves similar; margin $\pm$ recurved below .....	<b>Hypnum</b>
34: Stem and branch leaves different; margin plane .....	35
35 (34:) Shoots frondose; stem projections none; basal leaf cells thick-walled and porose; plant known from only Raoul Island .....	<b>Symphysodontella</b>
35: Plants otherwise .....	36
36 (35:) Shoots $\pm$ complanate; leaves secund; alar cells not auriculate..	<b>Isopterygium</b>
36: Shoots not complanate; leaves radial; alar cells $\pm$ auriculate....	<b>Campyliadelphus</b>
37 (33:) Plants frondose .....	<b>Wijkia</b>
37: Plants not frondose .....	38
38 (37:) Midleaf cells prorulose; capsule inclined to pendent.....	<b>Ectropothecium</b>
38: Plants otherwise .....	39
39 (38:) Stem and branch leaves different .....	<b>Drepanocladus</b>
39: Stem and branch leaves similar .....	40
40 (39:) Stem projections none; leaf tip $\pm$ apiculate; margin incurved; operculum conic; capsule mouth strangulate when dry .....	<b>Scorpidium</b>
40: Plants otherwise .....	41
41 (40:) Midleaf cell surface $\pm$ rugulose when dry; alar cells auriculate; capsule curved when dry; endostome of segments only .....	<b>Entodon</b>
41: Plants otherwise .....	42
42 (41:) Midleaf cell walls not porose; capsule inclined to horizontal; exothelial cells strongly trigonous.....	<b>Rhaphidorrhynchium</b>
42: Midleaf cell walls porose; capsule erect or nearly so; exothelial cells otherwise..	<b>Sematophyllum</b>
43 (13:) Costa long and double.....	44
43: Costa otherwise .....	47
44 (43) Plants dendroid.....	45
44: Plants not dendroid .....	46
45 (44) Plants single-tiered; leaves plane or conduplicate .....	<b>Camptochaete</b>
45: Plants two- or more tiered; leaves plicate .....	<b>Hylocomium</b>
46 (44:) Leaves papery, translucent, and glossy, > 2.5 mm long; stem and branch leaves different; ventral and dorsal leaves absent.....	<b>Rhytidadelphus</b>
46: Leaves not papery, < 2.5 mm long; stem and branch leaves similar; ventral and dorsal leaves present .....	<b>Plagiothecium</b>
47 (43:) Costa single and reaching to about midleaf .....	48
47: Costa otherwise .....	64
48 (47) Alar cells inflated and thin-walled.....	49
48: Alar cells otherwise.....	51
49 (48) Nematogons in upper leaf.....	<b>Warnstorfia</b>
49: Nematogons absent .....	50
50 (49:) Leaves falcate, often secund, the apex acuminate; stem and branch leaves different .....	<b>Drepanocladus</b>
50: Leaves straight, radial, the apex rounded; stem and branch leaves similar .....	<b>Straminogon</b>

51 (48:) Alar cells quadrate and thick-walled.....	52
51: Alar cells otherwise.....	59
52 (51) Leaf hair-pointed .....	<b>Lepyrodon</b>
52: Leaf otherwise .....	53
53 (52:) Leaf tip abruptly apiculate.....	<b>Pesudoscleropodium</b>
53: Leaf tip otherwise.....	54
54 (53:) Leaves asymmetric.....	55
54: Leaves symmetric or nearly so.....	56
55 (54) Ventral and dorsal leaves present; stem projections none; operculum conic; capsule ridged when dry .....	<b>Plagiothecium</b>
55: Ventral and dorsal leaves absent; stems tomentose; operculum rostrate; capsule not notably ridged when dry .....	<b>Rhynchostegium</b>
56 (54:) Leaf margins entire; alar cells auriculate; capsule mouth strangulate when dry .....	<b>Campyliadelphus</b>
56: Plants otherwise .....	57
57 (56:) Shoots julaceous when dry .....	<b>Brachythecium</b> and <b>Brachytheciastrum</b>
57: Shoots not julaceous when dry .....	58
58 (57:) Stems pseudoparaphylliate; costa ending with an abaxial spicule; midleaf cell surface smooth; capsule inclined to horizontal, curved.....	<b>Eurhynchium</b>
58: Stems tomentose; costa not spiculose; midleaf cell surface striolate or rugulose; capsule $\pm$ erect, straight.....	<b>Palamocladium</b>
59 (51:) Shoots complanate; leaves asymmetric, bordered; midleaf cells thin-walled; dorsal leaves present .....	<b>Epipterygium</b>
59: Shoots not complanate; leaves symmetric, not bordered; midleaf cells firm- walled; dorsal leaves absent.....	60
60 (59:) Plants long-pendent; midleaf cell surface unipapillose; capsule emergent....	<b>Meteoriopsis</b>
60: Plants not long-pendent; midleaf cell surface smooth; capsule exerted .....	61
61 (60:) Alar cells quadrate and thin-walled, in a distinct block that's higher toward the margin; stem tomentose; peristome single, exostome only .....	<b>Ischyrodon</b>
61: Alar cells absent or weak; stem projections none or pseudoparaphyllia; peristome double.....	62
62 (61:) Leaves sheathing and decurrent; costa often ending in an abaxial spicule....	<b>Platyhypnidium</b>
62: Leaves not sheathing or decurrent; costa not spiculose .....	63
63 (62:) Leaf margin serrulate; capsule erect, straight, long-necked, red-mouthed; operculum rostrate.....	<b>Eriodon</b>
63: Leaf margin entire; capsule inclined to horizontal, curved, short-necked, not red- mouthed; operculum conic.....	<b>Leptodictyum</b>
64 (47:) Costa single, subpercurrent to percurrent .....	65
64: Costa otherwise .....	78
65 (64) Plants dendroid.....	66
65: Plants not dendroid .....	67

66 (65) Plants on bark; shoots complanate; papillose filamentous brood bodies on upper stem among the leaves; alar cells distinct; capsule erect .....	<b>Braithwaitea</b>
66: Plants on soil, rotting wood, or acidic rock; shoots not complanate; alar cells weak or absent; capsule inclined to pendent.....	<b>Hypnodendron</b> and <b>Mniodendron</b>
67 (65): Leaves five-ranked (pentastichous) .....	<b>Conostomum</b>
67: Leaves not five-ranked .....	68
68 (67): Leaf apex rounded.....	<b>Ochiobryum</b>
68: Leaf apex not rounded .....	69
69 (68): Leaf bordered .....	70
69: Leaf not bordered .....	71
70 (69) Stems tomentose; alar cells absent or weak; hyalocysts on midleaf adaxial surface; costa xs guide cells plus one stereid band; capsule straight; peristome teeth lanceolate.....	<b>Campylopus</b>
70: Stems not tomentose; alar cells well-developed; hyalocysts absent; costa xs guide cells plus two stereid bands; capsule curved; peristome teeth forked, striate below .	<b>Dicranoloma</b>
71 (69): Leaves subulate.....	<b>Blindia</b>
71: Leaves not subulate .....	72
72 (71): Alar cells well-defined .....	73
72: Alar cells absent or weak .....	74
73 (72) Leaves falcate, often secund; midleaf cell surface smooth; alar cells inflated and thin-walled; capsule inclined to pendent; operculum conic.....	<b>Sanionia</b>
73: Leaves straight, not secund; midleaf cell surface striolate; alar cells quadrate and thick-walled; capsule erect; operculum rostrate.....	<b>Palamocladium</b>
74 (72): Plants whitish; leaves strongly keeled; capsule strangulate when dry; peristome single, exostome only, the teeth forked and papillose .....	<b>Saelania</b>
74: Plants otherwise .....	75
75 (74): Midleaf cells thin-walled.....	<b>Pohlia</b>
75: Midleaf cells firm-walled .....	76
76 (75): Plants about 20 mm tall; leaves < 2 mm long; peristome single, endostome segments only .....	<b>Schizymerium</b>
76: Plants < 10 mm tall; leaves > 3 mm long; peristome double .....	77
77 (76): Stems tomentose; midleaf cells > 80 $\mu\text{m}$ long; capsule cylindrical, short-necked, erect, straight; operculum rostrate .....	<b>Orthodontium</b>
77: Stems not tomentose; midleaf cells < 80 $\mu\text{m}$ long; capsule pyriform, long-necked, inclined to pendent, curved; operculum conic.....	<b>Leptobryum</b>
78 (64): Costa single, forked above .....	<b>Calliargon</b>
78: Costa not forked .....	79
79 (78): Plant aquatic; leaf bistratose, < 2 mm long; alar cells absent or weak; midleaf cells prurulose.....	<b>Hypnobartlettia</b>
79: Plants on soil, bark, or rock; leaf unistratose, > 3 mm long; alar cells distinct; midleaf cells smooth or nearly so .....	80

80 (79:)	Stems < 10 mm tall; leaves < 4 mm long, cells firm-walled; capsule inclined, curved, red-mouthed.....	<b>Kiaeria</b>
80:	Stems > 20 mm tall, leaves > 4 mm long, cells incrassate; capsule none or erect, straight, not red-mouthed.....	<b>81</b>
81 (80:)	Stem with sclerodermis, no projections; alar cells auriculate..	<b>Holodontium</b>
81:	Stem with central strand, tomentose; alar cells not in auricles .....	<b>82</b>
82 (81:)	Leaves keeled, sheathing; margin plane .....	<b>Holomitrium</b>
82:	Leaves not keeled, not sheathing; margin incurved .....	<b>Dicranum</b>
83 (12:)	Transverse walls of leaf angle cells thickened.....	<b>84</b>
83:	Transverse walls of leaf angle cells not thickened.....	<b>85</b>
84 (83)	Leaf with bistratose patches, costa excurrent, margin laxly denticulate above; base sheathing; midleaf cell surface smooth; capsule not ridged when dry; calyptra glabrous .....	<b>Cyrtopus</b>
84:	Leaf unistratose throughout, costa subpercurrent; margin entire; base sheathing; midleaf cell surface papillose; capsule ridged when dry; calyptra hairy .....	<b>Uloa</b>
85 (83:)	Midleaf cell lumina circular or oval.....	<b>86</b>
85:	Midleaf cell lumina otherwise.....	<b>106</b>
86 (85)	Dorsal leaves present .....	<b>87</b>
86:	Dorsal leaves absent .....	<b>88</b>
87 (86)	Leaf hair-pointed; margin serrate above; plants not frondose; leaves two-ranked (distichous): > 1 mm long; ventral leaves absent; plants not frondose.....	<b>Racopilum</b>
87:	Leaf rounded; margin entire; plants frondose; leaves radially arranged, < 1 mm long; ventral leaves present; plants frondose.....	<b>Leptodon</b>
88 (86:)	Shoots frondose; branch primordia on stem covered by foliose embryonic leaves.....	<b>Pendulothecium</b>
88:	Shoots not frondose; embryonic leaves absent.....	<b>89</b>
89 (88:)	Plants long-pendent; leaves papery, translucent, and glossy .....	<b>Lembophyllum</b>
89:	Plants not long-pendent; leaves not papery.....	<b>90</b>
90 (89:)	Leaf ± orbicular; midleaf cells thin-walled .....	<b>Plagiomnium</b>
90:	Leaf not orbicular; midleaf cells firm- or thick-walled .....	<b>91</b>
91 (90:)	Calyptra ciliate-fringed.....	<b>92</b>
91:	Calyptra not ciliate-fringed .....	<b>93</b>
92 (91)	Leaf margin bordered; endostome of segments only.....	<b>Crosbya</b>
92:	Leaf margin not bordered; endostome none or rudimentary.....	<b>Macromitrium</b>
93 (91:)	Shoots julaceous when dry .....	<b>94</b>
93:	Shoots not julaceous when dry .....	<b>95</b>
94 (93)	Midleaf cell surface papillose, walls thick; leaf margin plane; costa reaching to about midleaf; .....	<b>Haplohymenium</b>
94:	Midleaf cell surface smooth, walls firm; leaf margin recurved; costa failing just below the apex.....	<b>Pseudoleskea</b>
95 (93:)	Midleaf cell surface smooth .....	<b>96</b>
95:	Midleaf cell surface bulging or papillose .....	<b>100</b>

- 96 (95) Leaf margin bordered (intramarginal), incurved ..... **Tridontium**  
96: Leaf margin not bordered, plane or recurved ..... 97
- 97 (96:) Leaf oblong to lingulate; peristome none ..... **Hyophila**  
97: Leaf ovate to lanceolate; peristome single (exostome only) or double ..... 98
- 98 (97:) Leaf bistratose in patches; stem not tomentose; propagules absent; leaf margin plane ..... **Ptychomitrium**  
98: Leaf unistratose throughout; stem tomentose; propagules present; leaf margin recurved or undulate ..... 99
- 99 (98:) Leaf margin entire; leaf keeled; operculum rostrate; endostome of segments only; propagules short filaments ..... **Codonoblepharon**  
99: Leaf margin coarsely toothed near the apex; leaf plane; operculum conic; endostome of segments plus cilia; propagules long filaments ..... **Leptotheca**
- 100 (95:) Leaf margin bordered ..... 101  
100: Leaf margin not bordered ..... 102
- 101 (100) Border intramarginal; gemmae on adaxial costa surface; leaf strongly keeled, straight; margin undulate; costa excurrent as a cusp; alar cells absent or weak; exostome teeth filiform ..... **Calyptopogon**  
101: Border marginal; propagules absent; leaf plane, ± falcate; margin plane; costa failing below the apex; alar cells distinct; exostome teeth forked, striate below ..... **Sclerodontium**
- 102 (100:) Propagula on stem apex; alar cells distinct, pigmented; mature capsule curved; endostome of segments plus cilia ..... **Aulacomnium**  
102: Propagula absent; alar cells absent or weak; mature capsule straight; endostome segments only or rudimentary or none ..... 103
- 103 (102:) Leaf apex hair-pointed; peristome of endostome only ..... **Hymenodon**  
103: Leaf apex not hair-pointed; peristome double or of exostome only ..... 104
- 104 (103:) Shoots acrocarpous; midleaf cell surface smooth; filamentous propagula on adaxial costa surface; mature capsule mouth flaring ..... **Orthotrichum**  
104: Shoots pleurocarpous; midleaf cell surface bulging or pluripapillose; propagula absent; mature capsule mouth not flaring ..... 105
- 105 (104:) Midleaf cell surface mammillose; mature capsule mouth narrowed; calyptra hairy; exostome teeth rudimentary ..... **Macrocoma**  
105: Midleaf cell surface pluripapillose; mature capsule mouth not narrowed; calyptra glabrous; exostome teeth lanceolate ..... **Zygodon and Leratia**
- 106 (85:) Midleaf cells hexagonal or rhombic ..... 107  
106: Midleaf cells quadrate to rectangular ..... 205
- 107 (106) Costa none or short and double ..... 108  
107: Costa otherwise ..... 125
- 108 (107) Shoots and capsules arising from a persistent protonemal mat ..... 109  
108: Plants otherwise ..... 110
- 109 (108) Capsule exerted, inclined to horizontal, flattened vertically, stegocarpous, oval ..... **Buxbaumia**  
109: Capsule emergent, erect, not flattened, cleistocarpous, globose.. **Micromitrium**

- 110 (108:) Capsule cleistocarpous, discoid (flattened vertically), red at maturity; shoots julaceous when dry.....**Pleurophascum**  
 110: Plants otherwise ..... 111
- 111 (110:) Leaves papery, translucent, and glossy ..... 112  
 111: Leaves not papery ..... 114
- 112 (111) Plants growing on bark; shoots complanate; stem and branch leaves different; leaves asymmetric, oblong, rounded, decurrent on the trailing edge .....  
 .....**Neckeropsis**  
 112: Plants growing on soil, rotting wood, or rock; shoots not complanate; stem and branch leaves similar; leaves symmetric, orbicular to ovate or lanceolate, acuminate or hair-pointed, not decurrent..... 113
- 113 (112:) Shoots < 5 mm tall; leaves < 1 mm long, plane, acuminate; midleaf cells thin-walled .....**Gigaspermum**  
 113: Shoots > 10 mm tall; leaves > 4 mm long, undulate, hair-pointed; midleaf cell walls thick and porose .....**Pulchrinodus**
- 114 (111:) Leaf margin bordered..... 115  
 114: Leaf margin not bordered ..... 116
- 115 (114) Plants growing on bark; leaf plane or incurved, apex acute; cell walls thick and porose, surface smooth; capsule immersed to emergent, curved, not grooved when dry, the mouth oblique; peristome exostome only; teeth forked, striate below; spores > 50  $\mu\text{m}$  in diam. ....**Dicnemon**  
 115: Plants growing on rock or in water; leaf recurved, apex hair-pointed; cell walls thin, surface rugulose; capsule exerted, straight, grooved when dry, the mouth flaring when dry; peristome none; spores < 40  $\mu\text{m}$  in diam.....**Rhacocarpus**
- 116 (114:) Leaves conduplicate; capsule turbinate, wide-mouthed when empty; calyptra hairy.....**Orthorrhynchium**  
 116: Plants otherwise ..... 117
- 117 (116:) Ventral leaves present; shoots two-ranked (distichous).....**Erpodium**  
 117: Ventral leaves absent; shoots not distichous ..... 118
- 118 (117:) Peristome teeth four; thalloid protonemal flaps present .....**Tetrodontium**  
 118: Peristome teeth none or more than four; protonemal flaps absent..... 119
- 119 (118:) Leaf tips distinctly hyaline; capsules immersed, globose; operculum conic; peristome none.....**Hedwigia**  
 119: Leaf tips not hyaline; capsules exerted, oval or elliptic to cylindrical; operculum rostrate; peristome double..... 120
- 120 (119:) Midleaf cells thin-walled ..... 121  
 120: Midleaf cells firm- or thick-walled ..... 122
- 121 (120) Plants growing on soil or rotting wood; stem and branch leaves different; leaves asymmetric, margin plane; alar cells absent or weak; dorsal leaves present; shoots complanate, pseudoparaphylliate; endostome of segments plus cilia .....  
 .....**Vesicularia**  
 121: Plants growing on bark or rock; stem and branch leaves similar; leaves symmetric, margin recurved; alar cells distinct; dorsal leaves absent; shoots not complanate, tomentose; endostome of segments only .....**Sauloma**
- 122 (120) Leaf margin entire; midleaf cells > 60  $\mu\text{m}$  long.....**Campyliadelphus**  
 122: Leaf margin toothed; midleaf cells < 40  $\mu\text{m}$  long..... 123

- 123 (122:) Filamentous propagula in leaf axils; midleaf cell walls porose; capsule erect, ribbed when dry ..... **Glyphothecium**  
 123: Propagula absent; midleaf cell walls not porose; capsule inclined to pendent, not ribbed when dry ..... 124
- 124 (123:) Leaf widest above midleaf; midleaf cells thick-walled; mature capsule curved ..... **Fallaciella**  
 124: Leaf not widest above midleaf; midleaf cells firm-walled; mature capsule straight ..... **Pendulothecium**
- 125 (107:) Costa long and double ..... **Cyclodictyon**  
 125: Costa not long and double ..... 126
- 126 (125:) Costa single, forked above ..... 127  
 126: Costa not forked above ..... 129
- 127 (126) Plants < 10 mm tall, acrocarpous; leaves < 1 mm long, strongly decurrent on trailing edge; exostome teeth filiform ..... **Mittenia**  
 127: Plants > 10 mm tall, pleurocarpous; leaves > 2 mm long, not decurrent; exostome teeth lanceolate ..... 128
- 128 (127:) Shoots not distichous; leaf margin bordered, apex apiculate to acuminate; endostome of segments only ..... **Calypstrochaeta**  
 128: Shoots two-ranked (distichous); leaf margin not bordered, apex not apiculate or acuminate; endostome rudimentary ..... **Achrophyllum**
- 129 (126:) Costa single, reaching to about midleaf ..... 130  
 129: Costa otherwise ..... 147
- 130 (129) Plants long-pendent ..... 131  
 130: Plants not long-pendent ..... 132
- 131 (130) Leaves plane; midleaf cell surface unipapillose; capsule emergent .....  
 ..... **Meteoriopsis**  
 131: Leaves plicate; midleaf cell surface pluri- to multipapillose; capsule exerted ...  
 ..... **Papillaria**
- 132 (130:) Shoots frondose ..... 133  
 132: Shoots not frondose ..... 134
- 133 (130) Leaf margin plane, the apex rounded to mucronate; sclerodermis in stem cross-section ..... **Pendulothecium**  
 133: Leaf margin incurved, the apex acute to acuminate; central strand in stem cross-section ..... **Thamnobryum**
- 134 (132:) Brood bodies clustered at stem apex ..... 135  
 134: Brood bodies absent or not at stem apex ..... 136
- 135 (134) Plants growing on soil, rotting wood, or rock; shoots pseudoparaphylliate, complanate; leaves not five-ranked; midleaf cells thin-walled; dorsal and ventral leaves present; capsule not ribbed when dry ..... **Beeveria**  
 135: Plants growing on bark; shoots tomentose, not complanate; leaves five-ranked (pentastichous); midleaf cells firm-walled; dorsal and ventral leaves absent; capsule strongly 8-ribbed when dry ..... **Tetraphidopsis**
- 136 (134:) Stems < 3 mm tall; capsule cleistocarpous, emergent, globose .....  
 ..... **Physomitrella**  
 136: Plants otherwise ..... 137



137 (136:) Leaves papery, translucent, and glossy; ventral leaves present .....	<b>Distichophyllum</b>
137: Leaves not papery; ventral leaves absent .....	138
138 (137:) Shoots julaceous when dry; leaf margin recurved .....	<b>Bryum</b>
138: Plants otherwise .....	139
139 (138:) Alar cells quadrate and thin-walled; capsule mouth flaring when dry; peristome single, exostome only .....	<b>Fabronia</b>
139: Plants otherwise .....	140
140 (139:) Mature capsule mouth strongly oblique .....	<b>Funaria</b>
140: Capsule mouth not oblique .....	141
141 (140:) Plants growing on tree fern trunks or basic rock; dorsal leaves present; shoots two-ranked (distichous); midleaf cell length < 10 $\mu\text{m}$ .....	<b>Calomnion</b>
141: Plants growing on soil, bark, or acidic rock; dorsal leaves absent; shoots not distichous; midleaf cell length > 15 $\mu\text{m}$ .....	142
142 (141:) Leaf widest above midleaf; midleaf cells thin-walled; plants acrocarpous; capsule pyriform, long-necked .....	<b>Entosthodon</b>
142: Leaf widest below midleaf; midleaf cells firm- or thick-walled; plants pleurocarpous; capsule not pyriform, short-necked .....	143
143 (142:) Plants < 10 mm tall; branch leaves < 1 mm long; alar cells marginal .....	<b>Scorpiurium</b>
143: Plants > 10 mm tall; branch leaves > 1 mm long; alar cells not marginal .....	144
144 (143:) Leaf margin entire .....	145
144: Leaf margin serrulate or denticulate or coarsely toothed .....	146
145 (144) Stem and branch leaves different; stems pseudoparaphylliate; alar cells auriculate, quadrate and thick-walled; mature capsule strangulate when dry; operculum rostrate .....	<b>Campyliadelphus</b>
145: Stem and branch leaves similar; stem projections absent; alar cells absent or weak; mature capsule not strangulate; operculum conic .....	<b>Leptodictyum</b>
146 (144:) Stem and branch leaves different; leaves symmetric, plicate, decurrent; midleaf cells thick-walled, striolate; capsule erect, straight; endostome of segments only .....	<b>Palamocladium</b>
146: Stem and branch leaves similar; leaves asymmetric, plane, not decurrent; midleaf cells firm-walled, smooth; capsule inclined to pendent, curved; endostome of segments plus cilia .....	<b>Rhynchostegium</b>
147 (129:) Costa subpercurrent, percurrent, or excurrent .....	148
147: Costa otherwise .....	191
148 (147) Midleaf cell surface mammillose, unipapillose, or prorulose .....	149
148: Midleaf cell surface otherwise .....	154
149 (148) Plants growing on dung or bone; leaf widest above midleaf; capsule long- necked; operculum conic .....	<b>Tayloria</b>
149: Plants otherwise .....	150
150 (149:) Leaves three-ranked (tristichous), strongly keeled, decurrent; capsule erect; peristome single, exostome only .....	<b>Triquetrella</b>
150: Plants otherwise .....	151

151 (150:) Dorsal leaves present; leaves two-ranked (distichous); capsule strumose, curved when dry; calyptra hairy .....	<b>Racopilum</b>
151: Plants otherwise .....	152
152 (151:) Leaf margin entire; apex widely mucronate; basal cells thick and porose; basal lobes of calyptra abruptly flared; endostome of segments only ..	<b>Schlotheimia</b>
152: Plants otherwise .....	153
153 (152:) Plants growing on soil, rotting wood, or acidic rock; shoots dendroid, complanate; brood bodies none; stem and branch leaves different; leaves > 1.5 mm long; midleaf cells > 25 $\mu\text{m}$ long .....	<b>Hypnodendron</b>
153: Plants growing on coastal rock; shoots not dendroid; not complanate; brood bodies (surculi) in leaf axils; stem and branch leaves similar; leaves < 0.6 mm long; midleaf cells < 10 $\mu\text{m}$ long .....	<b>Lindbergia</b>
154 (148:) Midleaf cell surface pluri- or multipapillose .....	155
154: Midleaf cell surface otherwise .....	162
155 (154) Plants long-pendent, pleurocarpous; leaf plicate; peristome double; endostome of segments only .....	<b>Papillaria</b>
155: Plants not long-pendent, apocarpous; leaf not plicate; peristome none or single (exostome only); endostome none or rudimentary .....	156
156 (155:) Calyptra completely covering the capsule; capsule ribbed when dry .....	<b>Encalypta</b>
156: Calyptra only partly covering the capsule; capsule not ribbed when dry .....	157
157 (156:) Leaf base abruptly hyaline in a V-shape .....	<b>Tortella</b>
157: Leaf base otherwise .....	158
158 (157:) Leaf base abruptly hyaline in the shape of a lower-case letter <b>m</b> .....	159
158: Leaf base otherwise .....	160
159 (158) Leaves keeled, reacting red in 2% KOH .....	<b>Syntrichia</b>
159: Leaves plane, reacting yellow in 2% KOH .....	<b>Tortula</b>
160 (158:) Leaf apex rounded; leaf base not sheathing; midleaf cells thick-walled; exostome teeth lanceolate; spores > 50 $\mu\text{m}$ in diam. ....	<b>Orthotrichum</b>
160: Leaf apex not rounded; leaf base sheathing; midleaf cells thin- or firm-walled; exostome teeth filiform or absent; spores < 40 $\mu\text{m}$ in diam. ....	161
161 (160:) Leaves reacting yellow in 2% KOH; leaf margin not bordered, entire; costa cross-section guide cells plus two stereid bands; endostome rudimentary ...	<b>Barbula</b>
161: Leaves reacting red in 2% KOH; leaf margin bordered, toothed; costa cross-section guide cells plus one stereid band; endostome none .....	<b>Hennediella</b>
162 (154:) Midleaf cell surface smooth .....	163
162: Midleaf cell surface otherwise .....	232
163 (162) Leaf margin entire .....	164
163: Leaf margin toothed .....	181
164 (163) Midleaf cells thin-walled .....	165
164: Midleaf cells firm- or thick-walled .....	170
165 (164) Leaf widest above midleaf .....	166
165: Leaf widest below midleaf .....	167

- 166 (165) Plants growing on soil; hyalodermis in stem xs; leaf decurrent; capsule pyriform, cernuous to pendent, curved, sulcate when dry; peristome double, the exostome teeth fused at their tips into a lace-like disc ..... **Funaria**
- 166: Plants growing on dung or bone; central strand in stem xs; leaf not decurrent; capsule fusiform, erect, straight, not sulcate when dry; peristome single .... **Tayloria**
- 167 (165:) Leaf oblong or ligulate, apex rounded ..... **Plagiobryum**
- 167: Leaf ovate to lanceolate, the apex not rounded ..... **168**
- 168 (167:) Shoots < 3 mm tall; alar cells quadrate, thin-walled; capsule globose, cleistocarpous, erect; calyptra covering the entire capsule ..... **Goniomitrium**
- 168: Shoots > 3 mm tall; alar cells absent or weak; capsule not globose, stegocarpous, inclined to pendent; calyptra covering only part of the capsule ..... **169**
- 169 (168:) Shoots comose, not julaceous when dry ..... **Ptychostomum**
- 169: Shoots not comose, julaceous when dry ..... **Bryum**
- 170 (169:) Leaf base abruptly hyaline in the shape of a lower-case letter **m** ..... **171**
- 170: Leaf base otherwise ..... **172**
- 171 (170) Leaves keeled, reacting red in 2% KOH ..... **Syntrichia**
- 171: Leaves plane, reacting yellow in 2% KOH ..... **Tortula**
- 172 (170:) Leaf bistratose above, the apex rounded ..... **Orthotrichum**
- 172: Leaf unistratose throughout, the apex not rounded ..... **173**
- 173 (172:) Protonemal flaps present; peristome teeth four; calyptra covering the entire capsule ..... **Tetrodontium**
- 173: Protonemal flaps absent; peristome teeth none or more than four; calyptra covering only part of the capsule ..... **174**
- 174 (173:) Plants < 3 mm tall; capsule globose, cleistocarpous ..... **Acaulon**
- 174: Plants > 3 mm; capsule not globose, stegocarpous ..... **175**
- 175 (174:) Capsule immersed to emergent, mouth oblique; peristome exostome only, teeth forked, striate below; spores > 50  $\mu\text{m}$  in diam. .... **Dicnemon**
- 175: Plants otherwise ..... **176**
- 176 (175:) Stem and branch leaves different ..... **Amblystegium**
- 176: Stem and branch leaves similar ..... **177**
- 177 (176:) Capsule 8-ribbed when dry; basal lobes of calyptra abruptly flared ..... **Schlotheimia**
- 177: Plants otherwise ..... **178**
- 178 (177:) Plants growing on bark; shoots < 10 mm tall; leaf keeled ..... **Daltonia**
- 178: Plants growing on soil or rock; shoots > 10 mm tall; leaf plane ..... **179**
- 179 (178:) Alar cells quadrate and thick-walled; stem not tomentose ..... **Archidium**
- 179: Alar cells absent or weak; stem tomentose ..... **180**
- 180 (179:) Propagula in leaf axils or underground ..... **Gemmabryum**
- 180: Propagula usually absent ..... **Ptychostomum**
- 181 (106:) Thalloid protonemal flaps present; calyptra covering the entire capsule; exostome teeth four ..... **Tetrodontium**
- 181: Protonemal flaps absent; calyptra covering only part of the capsule; exostome teeth none or more than four ..... **182**

- 182 (181:) Leaf base abruptly hyaline in the shape of a lower-case letter **m**; exostome teeth filiform ..... **Syntrichia**  
 182: Plants otherwise ..... 183
- 183 (182:) Dorsal leaves present; calyptra hairy ..... **Racopilum**  
 183: Plants otherwise ..... 184
- 184 (183:) Shoots < 3 mm tall ..... **Bryobeckettia**  
 184: Shoot > 4 mm tall ..... 185
- 185 (184:) Capsule cleistocarpous ..... 186  
 185: Capsule stegocarpous ..... 187
- 186 (185) Leaf widest above midleaf, apex sharply apiculate, not clasping, midleaf cells < 30  $\mu\text{m}$  long; capsule elliptic ..... **Chenia**  
 186: Leaf widest below midleaf, apex acuminate, clasping, midleaf cells > 50  $\mu\text{m}$  long; capsule globose ..... **Pseudephemerum**
- 187 (185:) Leaf orbicular or nearly so ..... **Plagiomnium**  
 187: Leaf not orbicular ..... 188
- 188 (187:) Plants dendroid ..... 189  
 188: Plants not dendroid ..... 191
- 189 (188) Leaf apex obtuse; base decurrent; alar cells inflated and thin-walled, auriculate; endostome of segments only ..... **Climacium**  
 189: Leaf apex acute to acuminate; base not decurrent; alar cells absent or weak; endostome of segments plus cilia ..... 190
- 190 (189:) Stem projections absent; stem and branch leaves different; leaf margin plane; midleaf cells > 25  $\mu\text{m}$  long; capsule ribbed when dry ..... **Hypnodendron**  
 190: Stems tomentose and pseudoparaphylliate; stem and branch leaves similar; leaf margin incurved; midleaf cells < 20  $\mu\text{m}$  long; capsule not ribbed ..... **Thamnobryum**
- 191 (188:) Plants growing on dung or bone ..... **Tayloria**  
 191: Plants not growing on dung or bone ..... 192
- 192 (191:) Marginal teeth paired and made up of more than one cell... **Goniobryum**  
 192: Marginal teeth absent or otherwise ..... 193
- 193 (192:) Plants pleurocarpous ..... 194  
 193: Plants acrocarpous ..... 196
- 194 (191) Shoots complanate; capsule mouth reddish ..... **Rhizogonium**  
 194: Shoots not complanate; capsule mouth not reddish ..... 195
- 195 (194:) Stem and branch leaves different; leaf base decurrent; midleaf cells firm-walled, > 20  $\mu\text{m}$  long; alar cells inflated and thin-walled, auriculate; capsule curved when dry, long-necked, the mouth strangulate ..... **Cratoneuron**  
 195: Stem and branch leaves similar; leaf base not decurrent; midleaf cells thick-walled, < 12  $\mu\text{m}$  long; alar cells absent or weak; capsule not curved when dry, short-necked, the mouth not strangulate ..... **Echinodium**
- 196 (193:) Alar cells distinct; midleaf cells porose; peristome exostome only, the teeth forked and striate below ..... 197  
 196: Alar cells absent or weak; midleaf cells not porose; peristome none or double or endostome only ..... 198

197 (196) Reduced branchlets (surculi) on upper stem; leaf keeled, sheathing, the margin incurved; mature capsule not curved.....	<b>Dicranum</b>
197: Propagula absent; leaf not keeled, not sheathing, the margin plane; mature capsule curved.....	<b>Dicranoloma</b>
198 (196:) Propagula in leaf axils and/or on rhizoids.....	199
198: Propagula absent.....	200
199 (198) Gemmoid propagules in leaf axils or on rhizoids; leaves mostly widest below midleaf; capsule short-necked.....	<b>Gemmabryum</b>
199: Filamentous propagules in leaf axils and tubers on rhizoids; leaves mostly widest above midleaf; capsule long-necked .....	<b>Rosulabryum</b>
200 (198:) Leaves widest below midleaf .....	201
200: Leaves widest above midleaf .....	203
201 (200) Leaf strongly keeled; midleaf cell surface pluripapillose; capsule erect; peristome none .....	<b>Ardeuma</b>
201: Leaf not keeled; midleaf cell surface smooth; capsule inclined to pendent; peristome double or endostome only .....	202
202 (200:) Costa excurrent; midleaf cells > 80 $\mu$ m long; mature capsule straight, not wide-mouthed; peristome double .....	<b>Ptychostomum</b>
202: Costa failing below the apex; midleaf cells < 50 $\mu$ m long; mature capsule curved, wide-mouthed; peristome of endostome segments only.....	<b>Schizymerium</b>
203 (200:) Capsule immersed, straight, short-necked .....	<b>Physcomitrium</b>
203: Capsule exerted, curved, long-necked .....	204
204 (203:) Stems tomentose; capsule cernuous to pendent, the mouth oblique; exostome teeth fused at their tips into a lace-like disc .....	<b>Funaria</b>
204: Stems not tomentose; capsule erect, the mouth not oblique; exostome teeth not fused at their tips.....	<b>Entosthodon</b>
205 (106:) Midleaf cell surface striolate or rugulose.....	206
205: Midleaf cell surface otherwise.....	207
206 (179) Leaf tip hyaline; costa none; alar cells quadrate and thin-walled; capsule immersed, erect, not furrowed when dry; peristome none .....	<b>Hedwigia</b>
206: Leaf tip not hyaline; costa single, subpercurrent to excurrent; alar cells absent or weak; capsule exerted, inclined to horizontal, furrowed when dry; peristome double .....	<b>Plagiopus</b>
207 (205:) Midleaf cell surface smooth .....	208
207: Midleaf cell surface not smooth.....	232
208 (207) Primary stem fleshy and underground.....	<b>Aloina</b>
208: Primary stem none or not fleshy and underground .....	209
209 (208:) Capsule flattened vertically; endostome of segments only.....	<b>Buxbaumia</b>
209: Plants otherwise .....	210
210 (209:) Leaf base cancellinate; filamentous propagula on costa apex; leaf margin bordered (intramarginal); calyptra covering the entire capsule.....	<b>Calymperes</b>
210: Plants otherwise .....	211
211 (210:) Leaf papery, translucent, and glossy; alar cells marginal, inflated and thin-walled.....	<b>Breutelia</b>
211: Plants otherwise .....	212

212 (211:) Midleaf cells thin-walled .....	213
212: Midleaf cells firm- or thick-walled .....	215
213 (212) Shoots arising from persistent protonemal mat; capsule immersed.....	
.....	<b>Ephemerum</b>
213: Plants otherwise .....	214
214 (212:) Leaves five-ranked (pentastichous); leaf apex acuminate or hair-pointed; capsule stegocarpous, exerted .....	<b>Conostomum</b>
214: Leaves radially arranged; leaf apex acute; capsule cleistocarpous, emergent.....	
.....	<b>Eccremidium</b>
215 (145:) Midleaf cells firm-walled .....	216
215: Midleaf cells thick-walled .....	228
216 (215) Leaf margin bordered .....	<b>Pyrrhobryum</b>
216: Leaf margin not bordered .....	217
217 (216:) Capsule cleistocarpous .....	<b>Pleuridium</b>
217: Capsule stegocarpous.....	218
218 (217:) Margin toothed, the teeth paired and each made up of more than one cell; capsule immersed .....	<b>Cryptopodium</b>
218: Plants otherwise .....	219
219 (218:) Leaves two-ranked (distichous) .....	<b>Distichium</b>
219: Leaves not distichous .....	220
220 (219:) Leaves five-ranked (pentastichous); spores > 50 $\mu\text{m}$ in diam.....	
.....	<b>Conostomum</b>
220: Plants otherwise .....	221
221 (220:) Plants pleurocarpous; stem and branch leaves different... <b>Cratoneurospis</b>	
221: Plants apocarpous; stem and branch leaves similar .....	222
222 (221:) Leaf apex hair-pointed, margin incurved; filamentous propagula on adaxial costa surface .....	<b>Crossidium</b>
222: Plants otherwise .....	223
223 (222:) Peristome teeth filiform; propagula rhizoidal tubers.....	<b>Didymodon</b>
223: Peristome teeth not filiform; propagula none.....	224
224 (223:) Leaf apex rounded, base decurrent; peristome double.....	<b>Meesia</b>
224: Plants otherwise .....	225
225 (224:) Shoots < 10 mm tall .....	226
225: Shoots > 10 mm tall.....	227
226 (225) Plants growing on basic rock; leaf base sheathing; capsule straight, mouth flaring when dry .....	<b>Seligeria</b>
226: Plants growing on soil or rotting wood; leaf base not sheathing; capsule curved, not flaring when dry .....	<b>Trematodon</b>
227 (225:) Peristome teeth lanceolate; capsule mouth unchanged when dry.....	
.....	<b>Campylopodium</b>
227: Peristome teeth forked, striate below; capsule mouth flaring or oblique when dry .....	<b>Dicranella</b>

- 228 (215:) Leaf apex hair-pointed; peristome endostome only, rudimentary (low membrane) ..... **Leptostomum**  
 228: Leaf apex not hair-pointed; peristome exostome only ..... 229
- 229 (228:) Leaf strongly keeled ..... 230  
 229: Leaf not keeled ..... 231
- 230 (229) Leaf < 2 mm long, not sheathing, recurved; alar cells absent or weak; capsule 4–6-angled when dry; operculum conic; exostome teeth lanceolate ..... **Ceratodon**  
 230: Leaf > 3 mm long, sheathing, incurved,  $\pm$  undulate; alar cells quadrate and thick-walled, pigmented; capsule not angled when dry; operculum rostrate; exostome teeth forked, papillose throughout ..... **Holomitrium**
- 231 (229:) Alar cells quadrate and thick-walled; leaf base not sheathing; capsule straight when dry; exostome teeth lanceolate ..... **Dicranoweisia**  
 231: Alar cells absent or weak; leaf base sheathing; capsule curved when dry, exostome teeth forked, papillose throughout ..... **Ditrichum**
- 232 (207:) Midleaf cell surface mammillose, unipapillose, or prorulose ..... 233  
 232: Midleaf cell surface pluri- or multipapillose ..... 243
- 233 (232) Paraphyllia papillose ..... **Thuidium** and **Thuidiopsis**  
 233: Paraphyllia absent or not papillose ..... 234
- 234 (233:) Leaf base cancellinate, margin spinose/ciliate ..... **Syrrophodon**  
 234: Leaf base not cancellinate, margin not spinose/ciliate ..... 235
- 235 (234:) Leaves five-ranked (pentastichous) ..... **Conostomum**  
 235: Leaves not pentastichous ..... 236
- 236 (235:) Leaf apex hyaline; costa absent ..... **Hedwigia**  
 236: Leaf apex not hyaline; costa present ..... 237
- 237 (236:) Transverse walls of angle cells markedly thickened ..... **Ulota**  
 237: Transverse walls of angle cells not thickened ..... 238
- 238 (237:) Leaves papery, translucent, glossy, plicate; alar cells inflated, thin-walled, and marginal ..... **Breutelia**  
 238: Leaves not papery, not plicate; alar cells absent or weak ..... 239
- 239 (238:) Reduced branches (surculi) in upper leaf axils; endostome of segments plus cilia ..... **Philonotis**  
 239: Propagula absent or filamentous; endostome otherwise ..... 240
- 240 (239:) Leaf margin toothed, each tooth made up of more than one cell; costa prorulose on the back above; endostome of cilia only, 64 in 2's and 4's ..... **Timmia**  
 240: Leaf margin entire or toothed, each tooth part of only a single cell; costa not prorulose ..... 241
- 241 (240:) Shoots < 3 mm tall; not tomentose; leaf margin plane; midleaf cells firm-walled; exostome teeth forked, papillose throughout ..... **Trichodon**  
 241: Shoots > 3 mm tall; tomentose; leaf margin reflexed or undulate; midleaf cells thick-walled; exostome teeth absent or lanceolate ..... 242
- 242 (241:) Propagula absent; midleaf cells mostly > 15  $\mu$ m long; capsule inclined to horizontal, curved, the mouth oblique; operculum conic ..... **Bartremia**  
 242: Filamentous propagula on adaxial costa surface; midleaf cells < 15  $\mu$ m long; capsule erect, straight, the mouth flaring; operculum rostrate ..... **Orthotrichum**

243 (241:) Leaf apex hyaline; alar cells quadrate and thick-walled .....	<b>Hedwigia</b>
243: Plants otherwise .....	<b>244</b>
244 (243:) Paraphyllia papillose .....	<b>Thuidium and Thuidiopsis</b>
244: Paraphyllia absent or not papillose .....	<b>245</b>
245 (244:) Leaf subulate .....	<b>Tetracoscinodon</b>
245: Leaf not subulate .....	<b>246</b>
246 (245:) Leaf ovate to lanceolate or elliptic .....	<b>247</b>
246: Leaf oblong, lingulate, ligulate, or linear .....	<b>256</b>
247 (246) Costa none; stem pseudoparaphylliate; capsule globose .....	<b>Braunia</b>
247: Plants otherwise .....	<b>248</b>
248 (247:) Midleaf cells multipapillose .....	<b>Hennediella</b>
248: Midleaf cells prorulose or uni- or pluripapillose .....	<b>249</b>
249 (248:) Pinwheel-like in top view when dry .....	<b>Mesotus</b>
249: Plants otherwise .....	<b>250</b>
250 (249:) Lamina bistratose; capsule curved when dry .....	<b>Chrysoblastella</b>
250: Plants otherwise .....	<b>251</b>
251 (250:) Shoots < 3 mm tall; midleaf cells firm-walled; operculum conic .....	<b>Microbryum</b>
251: Shoots > 3 mm tall; midleaf cells thin- or thick-walled; operculum rostrate .	<b>252</b>
252 (251:) Filamentous brood-bodies on the upper stem .....	<b>Leptodontium</b>
252: Propagula absent or on the adaxial costa surface .....	<b>253</b>
253 (252:) Transverse walls of angle cells thickened .....	<b>Ulota</b>
253: Transverse walls of angle cells not thickened .....	<b>254</b>
254 (253:) Plants growing on soil or rotting wood; costa excurrent in an awn; exostome teeth filiform .....	<b>Pseudocrossidium</b>
254: Plants growing on bark or rock; costa; subpercurrent or percurrent; exostome teeth lanceolate .....	<b>255</b>
255 (254:) Calyptra mitrate or campanulate, ± plicate, often hairy; brood bodies laminal if present .....	<b>Orthotrichum</b>
255: Calyptra cucullate, not plicate, rarely hairy; brood bodies never laminal .....	<b>Zygodon</b>
256 (246:) Transverse walls of angle cells thickened; calyptra hairy; endostome of segments only .....	<b>Ulota</b>
256: Plants otherwise .....	<b>257</b>
257 (256:) Capsule curved when dry; exostome teeth forked, papillose throughout .	<b>Bryoerythrophyllum</b>
257: Capsule straight when dry; exostome none, rudimentary, or lanceolate .....	<b>258</b>
258 (257:) Leaf strongly keeled .....	<b>259</b>
258: Leaf plane .....	<b>260</b>
259 (258) Leaf margin recurved; capsule pyriform, 8-grooved, wide-mouthed when dry, short-necked; .....	<b>Amphidium</b>
259: Leaf margin plane; capsule cylindric, not grooved, not wide-mouthed when dry, long-necked .....	<b>Anoetangium</b>



- 260 (258:) Midleaf cells firm-walled ..... 261  
 260: Midleaf cells thick-walled ..... 262
- 261 (260) Plants growing on soil, rotting wood, or rock; stems tomentose; midleaf cells multipapillose ..... **Trichostomum**  
 261: Plants growing on bark or coastal rock; stems not tomentose; midleaf cells pluripapillose ..... **Willia**
- 262 (260:) Costa xs of guide cells plus one stereid band; capsule 8-ribbed when dry ..... **Zygodon**  
 262: Costa xs of guide cells plus two stereid bands; capsule not ribbed when dry .... 263
- 263 (262:) Plants growing on basic rock; stems tomentose; leaves < 1 mm long, the apex variably obtuse to acute ..... **Gymnostomum**  
 263: Plants growing on soil or rotting wood; stems not tomentose; leaves > 2 mm long, the apex aristate ..... **Weissia**

## KEY TO THE GENERA OF NZ POLYTRICHACEAE (9)

- 1 Plants dendroid ..... **Dendrologotrichum**  
 1: Plants not dendroid ..... 2
- 2 (1:) Plants > 250 mm tall; peristome a brush-like tuft of filiform papillose teeth.....  
 ..... **Dawsonia**  
 2: Plants < 150 mm tall; peristome not a brush-like tuft of filiform teeth ..... 3
- 3 (2:) Calyptra naked or nearly so..... 4  
 3: Calyptra densely hairy ..... 7
- 4 (3) Lamellae few or indistinct..... 5  
 4: Lamellae numerous ..... 6
- 5 (4) Leaves shortly dentate, bordered..... **Atrichum**  
 5: Leaves entire, not bordered ..... **Oligotrichum**
- 6 (4:) Distal leaf sheath deep orange; capsule 2-angled, convex or plane on one side  
 and concave on the other ..... **Polytrichadelphus**  
 6: Distal leaf sheath not coloured; capsule terete ..... **Notoligotrichum**
- 7 (3:) Capsule stomatose..... 8  
 7: Capsule not stomatose ..... **Pogonatum**
- 8 (7) Capsule apophysate, sharply angled; peristome teeth keeled on the back .....  
 ..... **Polytrichum**  
 8: Capsule not apophysate, bluntly angled; peristome teeth not keeled .....  
 ..... **Polytrichastrum**

**KEY TO THE GENERA OF NZ GRIMMIACEAE (4)**

- 1 Columella remaining attached to the operculum after capsule dehiscence.....**Schistidium**  
 .....**Schistidium**
- 1: Columella separating from the operculum at capsule dehiscence ..... **2**
- 2 (1:) Calyptra covering the capsule to the base, fringed ..... **Coscinodon**
- 2: Calyptra covering only part of the capsule, not fringed ..... **3**
- 3 (2:) Plants < 25 mm tall, usually in small, dense, hoary cushions.....**Grimmia**
- 3: Plants > 25 mm tall, usually in tufts or extensive turves ..... **Racomitrium**

KEY TO THE GENERA OF NZ HYPOPTERYGIACEAE (6)

- 1 Stems not differentiated into a stipe and rachis; capsules on the shoot's underside  
 ..... **Cyathophorum**
- 1: Stems differentiated into a stipe and rachis; capsules on the shoot's upperside... 2
- 2 (1:) Rudimentary branches present; stem leaves at least partly ciliate ..... 3
- 2: Rudimentary branches absent; stem leaves never ciliate ..... 4
- 3 (2) Stipe > 15 mm tall; stolon and stipe leaves 8-ranked; exostome present;  
 endostomial cilia present ..... **Canalohypopterygium**
- 3: Stipe < 15 mm tall; stolon and stipe leaves 3-ranked; exostome absent;  
 endostomial cilia absent ..... **Catharomnion**
- 4 (2:) Lamina cells collenchymatous; costa of lateral frond leaves percurrent.....  
 ..... **Lopidium**
- 4: Lamina cells not collenchymatous; costa of lateral frond leaves failing well below  
 the apex..... 5
- 5 (4:) Lateral and underleaves not bordered; apex of basal and middle stipe leaves  
 obtuse, rounded, truncate, or eroded..... **Dendrohypopterygium**
- 5: Lateral and underleaves bordered; apex of stipe leaves acute or acuminate.....  
 ..... **Hypopterygium**

KEY TO THE GENERA OF NZ CRYPHAEACEAE (3)

- 1 Plants terrestrial, on bark, never contaminated with silt ..... **Cryphaea**  
 1: Plants aquatic or occasionally inundated, on rock or bark, often silty ..... 2

- 2 (1:) Leaf base small-auriculate; alar cells subquadrate, brown; lamina cell corners lifted; perichaetial branches shorter than the sterile branches; annulus deciduous; exostome teeth 350–450  $\mu\text{m}$  long, erect when wet ..... **Dendrocryphaea**  
 2: Leaf not auriculate; alar cells not differentiated; lamina cell corners flattened; perichaetial branches as long as the sterile branches; annulus none; exostome teeth 150–200  $\mu\text{m}$  long, horizontal when wet ..... **Cyrtodon**

**KEY TO THE GENERA OF NZ MEESIACEAE (2)**  
*constructed from a DELTA database*

- 1** Plants > 10 mm tall; stems tomentose; leaf decurrent, the apex rounded or obtuse; margin reflexed in midleaf; cells rectangular, < 30  $\mu\text{m}$  long; capsule not flaring when dry; spores 45–54  $\mu\text{m}$  in diam. .... **Meesia**
- 1:** Plants < 10 mm tall; stem projections absent; leaf not decurrent, the apex acute; margin plane; cells linear, > 80  $\mu\text{m}$  long; capsule flaring when dry; spores 10–13  $\mu\text{m}$  in diam. .... **Leptobryum**

**KEY TO THE GENERA OF NZ HEDWIGIACEAE (2)**

*constructed from a DELTA database*

- 1** Leaf plicate, the margin plane; transverse walls of basal angle cells distinctly thickened; alar cells quadrate and thick-walled; capsule deeply grooved when dry. .... **Braunia**
- 1:** Leaf plane, the margin reflexed; basal angle cells undifferentiated; alar cells quadrate and thin-walled; capsule not deeply grooved when dry ..... **Hedwigia**

**KEY TO WEYMOUTHIA AND NEW ZEALAND METEORACEAE (2)**  
*constructed from DELTA database*

- 1 Lamina cells smooth ..... **Weymouthia**  
 1: Lamina cells papillose ..... 2 (Meteoraceae)
- 2 (1:) Leaves plane; midleaf cell surface unipapillose; capsule emergent.....  
 ..... **Meteoropsis**  
 2: Leaves plicate; midleaf cell surface pluri- to multipapillose; capsule exerted.....  
 ..... **Papillaria**



**KEY TO THE GENERA OF NEW ZEALAND CALYMPERACEAE (2)**  
*constructed from a DELTA database*

- 1** Costa excurrent, its apex bearing propagula; leaf apex acute to acuminate, margin toothed, border well-developed, intramarginal below; capsule emergent; peristome none; calyptra covering the entire capsule, persistent, clasping the seta below the capsule ..... **Calymperes**
- 1:** Costa percurrent, its adaxial surface bearing propagula; leaf apex rounded, margin spinose-ciliate, border weak, not intramarginal; capsule exerted; peristome single, exostome only; calyptra covering only part of the capsule, readily falling, not clasping the seta ..... **Syrhodon**



Two of New Zealand's most familiar mosses growing together. *Hypnum cupressiforme* (green) has been exploited for centuries as pillow stuffing, inspiring the common name of feather moss. *Polytrichum juniperinum*'s (red) hairy spore capsules (not shown) have inspired the common names of Goldilocks and hair-caps. 5 mm

**Arrangement of the genera** (following Goffinet, Buck & Shaw (2008) in Goffinet & Shaw, *Bryophyte Biology* (2nd ed.), Cambridge University Press, New York, pp. 100–126)

<b>Sphagnaceae</b>		<b>Erpodiaceae</b>	
<i>Sphagnum</i> .....	39–60	<i>Erpodium</i> .....	385
<b>Andreaeaceae</b>		<b>Rhabdoweisiaceae</b>	
<i>Andreaea</i> .....	61–84	<i>Amphidium</i> .....	386–390
<b>Polytrichaceae</b>		<i>Dicranoweisia</i> .....	391–395
<i>Atrichum</i> .....	85–89	<i>Holodontium</i> .....	396
<i>Dawsonia</i> .....	90	<i>Kiaeria</i> .....	397
<i>Dendrologotrichum</i> .....	91–94	<b>Dicranaceae</b>	
<i>Notoligotrichum</i> .....	95–104	<i>Campylopodium</i> .....	398–401
<i>Oligotrichum</i> .....	105–106	<i>Dicnemon</i> .....	402–408
<i>Pogonatum</i> .....	107–108	<i>Dicranella</i> .....	409–416
<i>Polytrichadelphus</i> .....	109–112	<i>Dicranoloma</i> .....	417–436
<i>Polytrichastrum</i> .....	113–122	<i>Dicranum</i> .....	437
<i>Polytrichum</i> .....	123–129	<i>Holomitrium</i> .....	438–442
<b>Tetraphidaceae</b>		<i>Mesotus</i> .....	443–445
<i>Tetradontium</i> .....	130	<i>Pseudephemerum</i> .....	446
<b>Buxbaumiaceae</b>		<i>Sclerodontium</i> .....	447–448
<i>Buxbaumia</i> .....	131–133	<b>Leucobryaceae</b>	
<b>Timmiaceae</b>		<i>Campylopus</i> .....	449–460
<i>Timmia</i> .....	134	<i>Leucobryum</i> .....	461–463
<b>Gigaspermaceae</b>		<b>Calymperaceae</b>	
<i>Gigaspermum</i> .....	135–138	<i>Calymperes</i> .....	464–469
<b>Encalyptaceae</b>		<i>Syrrophodon</i> .....	470
<i>Encalypta</i> .....	139–144	<b>Pottiaceae</b>	
<b>Funariaceae</b>		<i>Acaulon</i> .....	471–472
<i>Bryobckettia</i> .....	145	<i>Aloina</i> .....	473–478
<i>Entosthodon</i> .....	146–154	<i>Anoetangium</i> .....	479
<i>Funaria</i> .....	155–157	<i>Ardeuma</i> .....	480
<i>Goniomitrium</i> .....	158	<i>Barbula</i> .....	481–495
<i>Physcomitrella</i> .....	159	<i>Bryoerythrophyllum</i> .....	496–498
<i>Physcomitrium</i> .....	160–168	<i>Calyptopogon</i> .....	499–500
<b>Grimmiaceae</b>		<i>Chenia</i> .....	501–507
<i>Coscinodon</i> .....	196	<i>Crossidium</i> .....	508–512
<i>Grimmia</i> .....	197–216	<i>Didymodon</i> .....	513–531
<i>Racomitrium</i> .....	169–195	<i>Ephemerum</i> .....	532–534
<i>Schistidium</i> .....	217–222	<i>Gymnostomum</i> .....	535–537
<b>Ptychomitriaceae</b>		<i>Hennediella</i> .....	538–550
<i>Ptychomitrium</i> .....	223	<i>Hyophila</i> .....	551–555
<b>Seligeriaceae</b>		<i>Leptodontium</i> .....	556–557
<i>Blindia</i> .....	224–240	<i>Microbryum</i> .....	558–560
<i>Seligeria</i> .....	241–244	<i>Micromitrium</i> .....	561–562
<b>Archidiaceae</b>		<i>Pseudocrossidium</i> .....	563–569
<i>Archidium</i> .....	245–248	<i>Pterygoneurum</i> .....	570–571
<b>Fissidentaceae</b>		<i>Syntrichia</i> .....	572–600
<i>Fissidens</i> .....	249–340	<i>Tetracoscinodon</i> .....	601
<b>Ditrichaceae</b>		<i>Tortella</i> .....	602–613
<i>Ceratodon</i> .....	341–345	<i>Tortula</i> .....	614–631
<i>Chrysoblastella</i> .....	346–350	<i>Trichostomum</i> .....	632–640
<i>Distichium</i> .....	351–352	<i>Tridontium</i> .....	641–643
<i>Ditrichum</i> .....	353–368	<i>Triquetrella</i> .....	644–648
<i>Eccremidium</i> .....	369–371	<i>Weissia</i> .....	649–656
<i>Pleuridium</i> .....	372–378	<i>Willia</i> .....	657
<i>Saelania</i> .....	379	<b>Pleurophascaceae</b>	
<i>Trichodon</i> .....	380	<i>Pleurophascum</i> .....	658–659
<b>Bruchiaceae</b>		<b>Mitteniaceae</b>	
<i>Trematodon</i> .....	381–384	<i>Mittenia</i> .....	660

continued next page

<b>Splachnaceae</b>	
<i>Tayloria</i> .....	661–665
<b>Meesiaceae</b>	
<i>Leptobryum</i> .....	666
<i>Meesia</i> .....	667–669
<b>Pulchrinodaceae</b>	
<i>Pulchrinodus</i> .....	670–672
<b>Bryaceae</b>	
<i>Bryum</i> .....	673–684
<i>Gemmabryum</i> .....	685–712
<i>Plagiobryum</i> .....	713
<i>Ptychostomum</i> .....	714–719
<i>Rosulabryum</i> .....	720–739
<b>Mniaceae</b>	
<i>Epipterygium</i> .....	740
<i>Ochiobryum</i> .....	741–743
<i>Plagiomnium</i> .....	744–748
<i>Pohlia</i> .....	749–769
<i>Schizymenium</i> .....	770
<b>Leptostomataceae</b>	
<i>Leptostomum</i> .....	771–778
<b>Bartramiaceae</b>	
<i>Bartramia</i> .....	779–786
<i>Breutelia</i> .....	787–797
<i>Conostomum</i> .....	798–804
<i>Philonotis</i> .....	805–814
<i>Plagiopus</i> .....	815
<b>Orthotrichaceae</b>	
<i>Condonoblepharum</i> .....	816–821
<i>Leratia</i> .....	822
<i>Macrocoma</i> .....	823–826
<i>Macromitrium</i> .....	827–855
<i>Orthotrichum</i> .....	856–876
<i>Schlotheimia</i> .....	877–881
<i>Ulotia</i> .....	882–894
<i>Zygodon</i> .....	895–903
<b>Hedwigiaceae</b>	
<i>Braunia</i> .....	904–907
<i>Hedwigia</i> .....	904–908
<b>Rhacocarpaceae</b>	
<i>Rhacocarpus</i> .....	909–911
<b>Rhizogoniaceae</b>	
<i>Calomnion</i> .....	912–916
<i>Cryptopodium</i> .....	917–918
<i>Goniobryum</i> .....	919
<i>Pyrrohobryum</i> .....	920–928
<i>Rhizogonium</i> .....	929–934
<b>Aulacomniaceae</b>	
<i>Aulacomnium</i> .....	935–939
<b>Orthodontiaceae</b>	
<i>Hymenodon</i> .....	940–941
<i>Leptotheca</i> .....	942
<i>Orthodontium</i> .....	943
<b>Braithwaiteaceae</b>	
<i>Braithwaitea</i> .....	944
<b>Racopilaceae</b>	
<i>Racopilum</i> .....	945–953
<b>Hypnodendraceae</b>	
<i>Cyrtopus</i> .....	954

<i>Hypnodendron</i> .....	955–964
<i>Mniodendron</i> .....	965–972
<i>Sciadocladus</i> .....	973–980
<b>Ptychomniaceae</b>	
<i>Cladomnion</i> .....	981–983
<i>Dichelodontium</i> .....	984
<i>Glyphothecium</i> .....	985–987
<i>Hampeella</i> .....	988–992
<i>Ptychomnion</i> .....	993–1000
<i>Tetraphidopsis</i> .....	1001–1002
<b>Hypopterygiaceae</b>	
<i>Canalohypopterygium</i> .....	1003–1005
<i>Catharomnion</i> .....	1006–1009
<i>Cyathophorum</i> .....	1010–1013
<i>Dendrohypopterygium</i> .....	1014
<i>Hypopterygium</i> .....	1015–1027
<i>Lopidium</i> .....	1028–1029
<b>Saulomataceae</b>	
<i>Sauloma</i> .....	1030–1031
<b>Daltoniaceae</b>	
<i>Achrophyllum</i> .....	1032–1037
<i>Beeveria</i> .....	1038
<i>Calypstrochaeta</i> .....	1039–1050
<i>Crosbya</i> .....	1051–1055
<i>Daltonia</i> .....	1056
<i>Distichophyllum</i> .....	1057–1066
<i>Ephemeropsis</i> .....	1067
<b>Pilotrichaceae</b>	
<i>Cyclodictyon</i> .....	1068
<b>Trachylomataceae</b>	
<i>Trachyloma</i> .....	1069–1073
<b>Climaciaceae</b>	
<i>Climacium</i> .....	1074–1076
<b>Amblystegiaceae</b>	
<i>Amblystegium</i> .....	1077–1081
<i>Campyliadelphus</i> .....	1082–1085
<i>Cratoneuron</i> .....	1086
<i>Cratoneurospis</i> .....	1087–1089
<i>Drepanocladus</i> .....	1090–1093
<i>Hypnobartlettia</i> .....	1094–1095
<i>Leptodictyon</i> .....	1096–1097
<i>Sanionia</i> .....	1098
<i>Scorpidium</i> .....	1099
<b>Calliergonaceae</b>	
<i>Calliergon</i> .....	1100
<i>Straminergon</i> .....	1101
<i>Warnstorfia</i> .....	1102–1106
<b>Leskeaceae</b>	
<i>Lindbergia</i> .....	1107
<i>Pseudoleskea</i> .....	1108–1110
<b>Thuidiaceae</b>	
<i>Thuidiopsis</i> .....	1111–1116
<i>Thuidium</i> .....	1111, 1117–1122
<b>Brachytheciaceae</b>	
<i>Brachytheciastrum</i> .....	1123–1128
<i>Brachythecium</i> .....	1123–1138
<i>Eriodon</i> .....	1139
<i>Eurhynchium</i> .....	1140–1148
<i>Palamocladium</i> .....	1149

<i>Platyhypnidium</i> .....	1150
<i>Pseudoscleropodium</i> .....	1151–1154
<i>Rhynchostegium</i> .....	1155–1160
<i>Scleropodium</i> .....	1161
<i>Scorpiurium</i> .....	1162–1163
<b>Meteoriaceae</b>	
<i>Meteoriopsis</i> .....	1164–1165
<i>Papillaria</i> .....	1166–1177
<b>Fabroniaceae</b>	
<i>Fabronia</i> .....	1178–1180
<i>Ischyrodon</i> .....	1181–1183
<b>Hypnaceae</b>	
<i>Calliergonella</i> .....	1184–1186
<i>Ctenidium</i> .....	1187
<i>Ectropothecium</i> .....	1188
<i>Hypnum</i> .....	1189–1195
<i>Isopterygiopsis</i> .....	1196
<i>Orthothecium</i> .....	1197
<i>Pseudotaxiphyllum</i> .....	1198–1202
<i>Vesicularia</i> .....	1203–1205
<b>Catagoniaceae</b>	
<i>Catagonium</i> .....	1206–1207
<b>Hylocomiaceae</b>	
<i>Hylocomium</i> .....	1208–1209
<i>Rhytidiadelphus</i> .....	1208–1211
<b>Plagiotheciaceae</b>	
<i>Plagiothecium</i> .....	1212–1214
<b>Entodontaceae</b>	
<i>Entodon</i> .....	1215
<b>Pylaisiadelphaceae</b>	
<i>Austrohondaella</i> .....	1216–1218
<i>Isopterygium</i> .....	1219
<i>Wijkia</i> .....	1220–1224
<b>Sematophyllaceae</b>	
<i>Rhaphidorrhynchium</i> .....	1225–1226
<i>Sematophyllum</i> .....	1227–1240
<i>Warburgiella</i> .....	1241–1242
<b>Cryphaeaceae</b>	
<i>Cryphaea</i> .....	1243–1253
<i>Cyptodon</i> .....	1254–1255
<i>Dendrocryphaea</i> .....	1256–1257
<b>Pterobryaceae</b>	
<i>Cryptogonium</i> .....	1258–1259
<i>Symphysodontella</i> .....	1260
<b>Orthorrhynchiaceae</b>	
<i>Orthorrhynchium</i> .....	1261
<b>Lepyrodontaceae</b>	
<i>Lepyrodon</i> .....	1262–1266
<b>Neckeraceae</b>	
<i>Alleniella</i> .....	1267–1268
<i>Neckera</i> .....	1267–1270
<i>Neckeropsis</i> .....	1271–1272
<i>Pendulothecium</i> .....	1273–1280
<i>Thamnobryum</i> .....	1282–1285
<b>Echinodiaceae</b>	
<i>Echinodium</i> .....	1286–1292
<b>Leptodontaceae</b>	
<i>Leptodon</i> .....	1293–1294

**Lembophyllaceae**

<i>Acrocladium</i> .....	1295–1300
<i>Camptochaete</i> .....	1301–1312
<i>Fallaciella</i> .....	1314–1318
<i>Fifea</i> .....	1313
<i>Lembophyllum</i> .....	1319–1325
<i>Weymouthia</i> .....	1326–1329

**Anomodontaceae**

<i>Haplohymenium</i> .....	1330
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*Sphagnum* sp., vegetative shoot apex  
1 mm

**Key\* to the New Zealand species of *Sphagnum* (9)**

- 1 Branch leaves inrolled and cucullate at the apex .....2  
 1: Branch leaves not inrolled and cucullate at the apex.....4
- 2 (1) Pores of the abaxial branch leaf hyalocysts arranged over the entire cell surface ..... ● ***Sphagnum compactum***  
 2: Pores of the abaxial branch leaf hyalocysts arranged mostly at the cell angles or along the commissures (where the hyalocysts and chlorocysts adjoin) .....3
- 3 (1) Pores of the abaxial branch leaf hyalocysts numerous and conspicuous along the commissures and at the cell angles; branch leaves in cross-section plane on the adaxial surface, convex on the abaxial surface..... ● ***Sphagnum cristatum***  
 3: Pores of abaxial branch leaf hyalocysts few, most or all of them at the cell angles; branch leaves in cross-section convex on both leaf surfaces .....  
 ..... ***Sphagnum perichaetiale***
- 4 (1:) Stem leaves 0.6–1.4 mm long, pendent; pores on the adaxial surface of the branch leaves arranged in groups of three at the cell angles; cortical cells of branch stems uniform with a single pore at the upper end..... ● ***Sphagnum australe***  
 4: Stem leaves absent or longer than 1.5 mm, erect or erect-spreading; pores on the adaxial surface of the branch leaves not arranged in groups of three; cortical cells of branch stems of two kinds, either porose or eporose and enlarged and retort-shaped.....5
- 5 (3:) Branch leaves sheathing below and ± spreading above; walls of branch leaf chlorocysts often finely papillose in cross-section ..... ● ***Sphagnum squarrosom***  
 5: Branch leaves not sheathing below, not spreading above; walls of branch leaf chlorocysts smooth in cross-section .....6
- 6 (5:) Plants iridescent when dry; branch leaf chlorocysts in cross-section more exposed on their adaxial surface ..... ● ***Sphagnum subnitens***  
 6: Plants not iridescent when dry; branch leaf chlorocysts in cross-section equally exposed on their two surfaces or more exposed on their abaxial surface .....7
- 7 (6:) Branch leaf chlorocysts in cross-section equally exposed on their two surfaces; stem and branch leaves varying in size and shape, much smaller or larger than the branch leaves .....8  
 7: Branch leaf chlorocysts in cross-section more exposed on their abaxial surface; stem leaves smaller than the branch leaves ..... ● ***Sphagnum falcatum***
- 8 (7) Stems fascicled; stem leaves not resembling branch leaves.....  
 ..... ● ***Sphagnum novozelandicum***  
 8: Stems not fascicled; stem leaves resembling branch leaves.....  
 ..... ● ***Sphagnum simplex***

\* based on Fife, AJ (1996): A synopsis of New Zealand *Sphagna*, with a description of *S. simplex* sp. nov. *New Zealand Journal of Botany* 34, 311, plus Crum, HA; Anderson, LE (1981): *Mosses of Eastern North America*. Columbia University Press, New York. 22.

## pendent branch leaves



*Sphagnum  
cristatum*



*Sphagnum  
perichaetiale*



*Sphagnum  
australe*



*Sphagnum  
simplex*



*Sphagnum  
subnitens*



*Sphagnum  
compactum*



*Sphagnum  
squarrosum*



*Sphagnum  
novo-zelandicum*



*Sphagnum  
falcatulum*



**Sphagnum australe** Mitt.

**form:** robust, erect, sparingly branched, whitish; branches in fascicles of 4–5, 2 spreading and 2–3 pendent

**habitat:** soil, usually in boggy sites

**leaf:** size: stem: 1.4 mm; branch: 2.5–3.3 mm

**shape:** stem: lingulate; branch: ovate-lanceolate, concave

**tip:** stem: rounded; branch: acute to obtuse, ± eroded

**base:** not differentiated

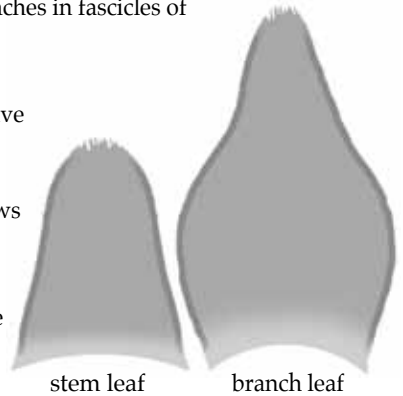
**costa:** none

**border:** stem: 1–2 rows of narrow cells; branch: 2–4 rows

**margin:** stem: entire; branch: inrolled to ± cucullate

**cells:** hyalocysts 100–150 × 24–30 μm, sigmoid, thin-walled, fibrillose, pored

**capsule:** 1 mm, globose, erect, dark, glossy, peristome none; pseudopodium 10–15 mm



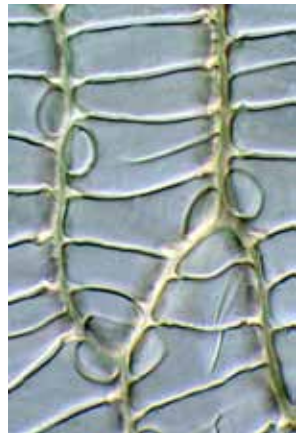
stem leaf

branch leaf



vegetative shoot (2), branch leaf outline, and branch leaf apex (eroded)

5 mm, 5 mm, 0.5 mm, 10 μm



margin midleaf, and pored cells midleaf (2)

50 μm, 10 μm, 10 μm

continued next page

**Sphagnum compactum** DC.

**form:** small, dense cushions of erect stems to 40 mm long, red-brown to purplish below; leaves  $\pm$  squarrose

**habitat:** on poorly drained peat, sand, or siliceous rock, to 1500 m elev.

**leaf:** stem leaves 0.3–0.8 mm, branch leaves  $1.4\text{--}3 \times 0.8\text{--}1.0$  mm

**shape:** stem leaves  $\pm$  triangular; stem leaves ovate

**tip:** stem leaves rounded; branch leaves  $\pm$  toothed, appearing  $\pm$  cucullate

**base:** not differentiated

**costa:** none

**border:** 2–5 rows of linear, thick-walled cells

**margin:** stem leaves entire, plane; branch leaves entire, involute above

**cells:** hyalocysts  $75 \times 30 \mu\text{m}$ , sigmoid, fibrillose, thin-walled, 8–15-ring-and-pseudopored abaxially, 3–5-pored adaxially

**capsule:** about 1 mm in diam., globose, erect, brown-black; spores 25–35  $\mu\text{m}$  in diam.



branch  
leaf



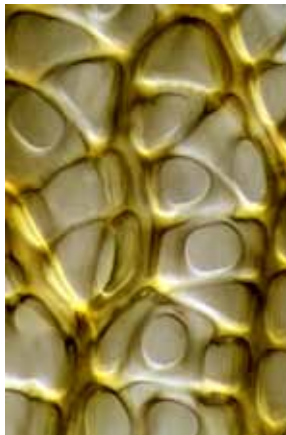
vegetative shoot, branch leaf outline, apex, and margin midleaf

1 mm,

1 mm,

0.5 mm,

50  $\mu\text{m}$



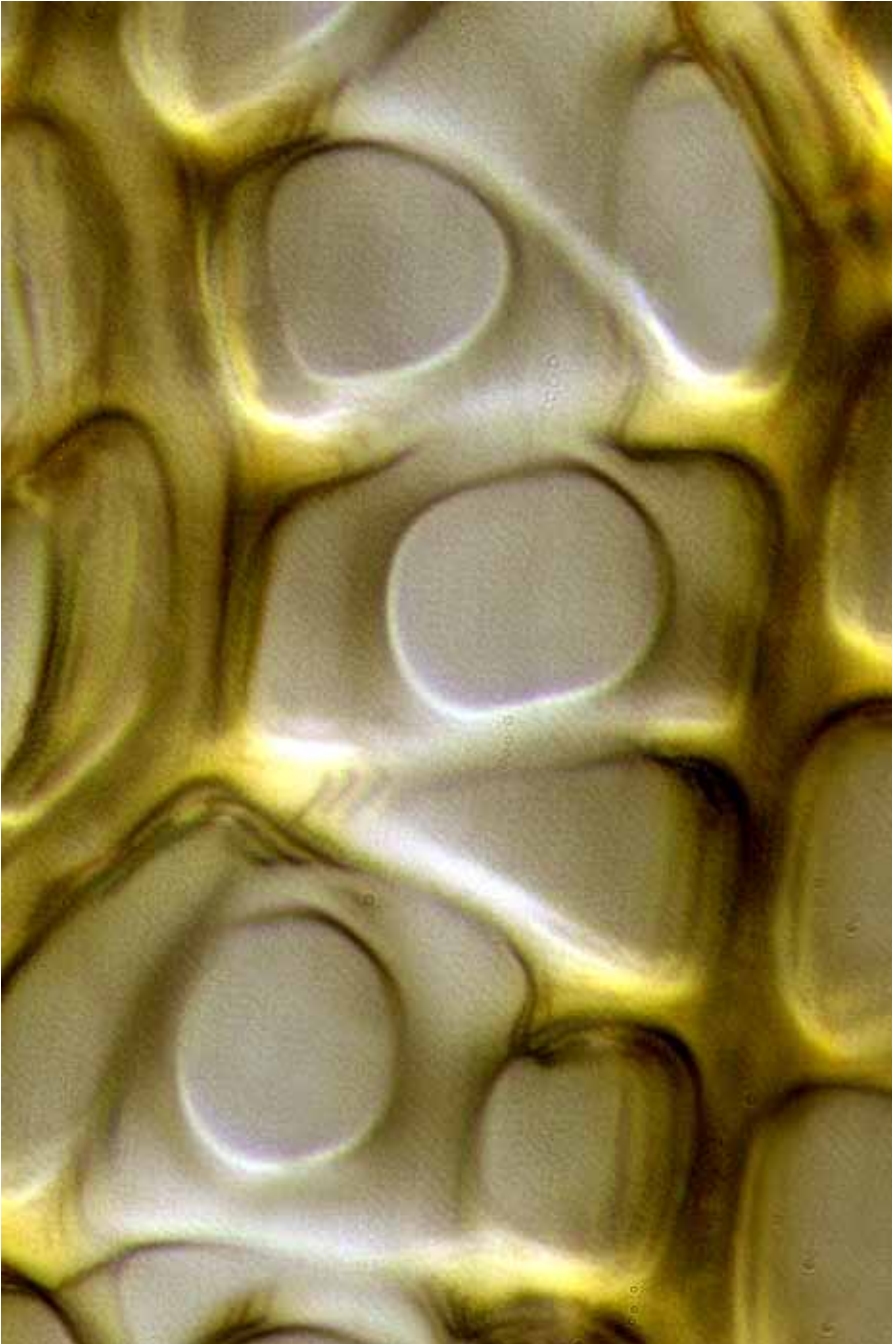
hyalocyst pores, pore detail, and leaf basal angle

50  $\mu\text{m}$ ,

50  $\mu\text{m}$ ,

50  $\mu\text{m}$

continued next page



*Sphagnum compactum* hyalocyst showing pores (detail)  
10  $\mu\text{m}$

**Sphagnum cristatum** Hampe

**form:** loose turfs or mounds of erect pale green to brownish stems;  
branches in 4–6 fascicles, 2–3 spreading and 2–3 pendent

**habitat:** moist to boggy sites, mostly subalpine

**leaf:** *size:* stem: 1 mm; branch: 1.6 mm

*shape:* stem: lingulate; branch: broadly ovate

*tip:* stem: rounded, eroded; branch: obtuse, cucullate, ± resorbed

*base:* not differentiated

*costa:* none

*border:* stem: none; branch: 1 row of narrowly elongate cells

*margin:* entire below, serrulate above, cucullate above,  
± incurved below

*cells:* hyalocysts 100–140 × 20–30 μm, sinuose, thin-walled,  
smooth, strongly fibrillose, pored

**capsule:** 1 mm, globose, erect, dark, glossy, no peristome;  
pseudopodium 10–15 mm

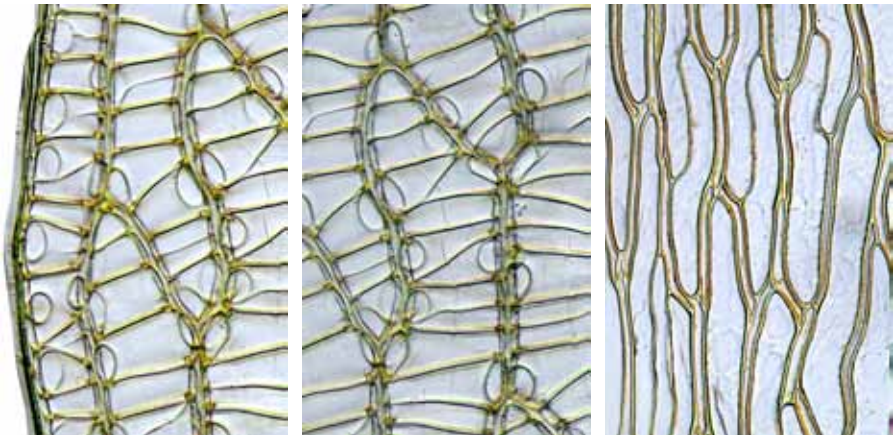


branch leaf



vegetative shoot, capitulum (top view), branch detail, and branch leaf outline

■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm



margin midleaf, branch leaf pores and fibrils, and stem leaf e fibrillose cells

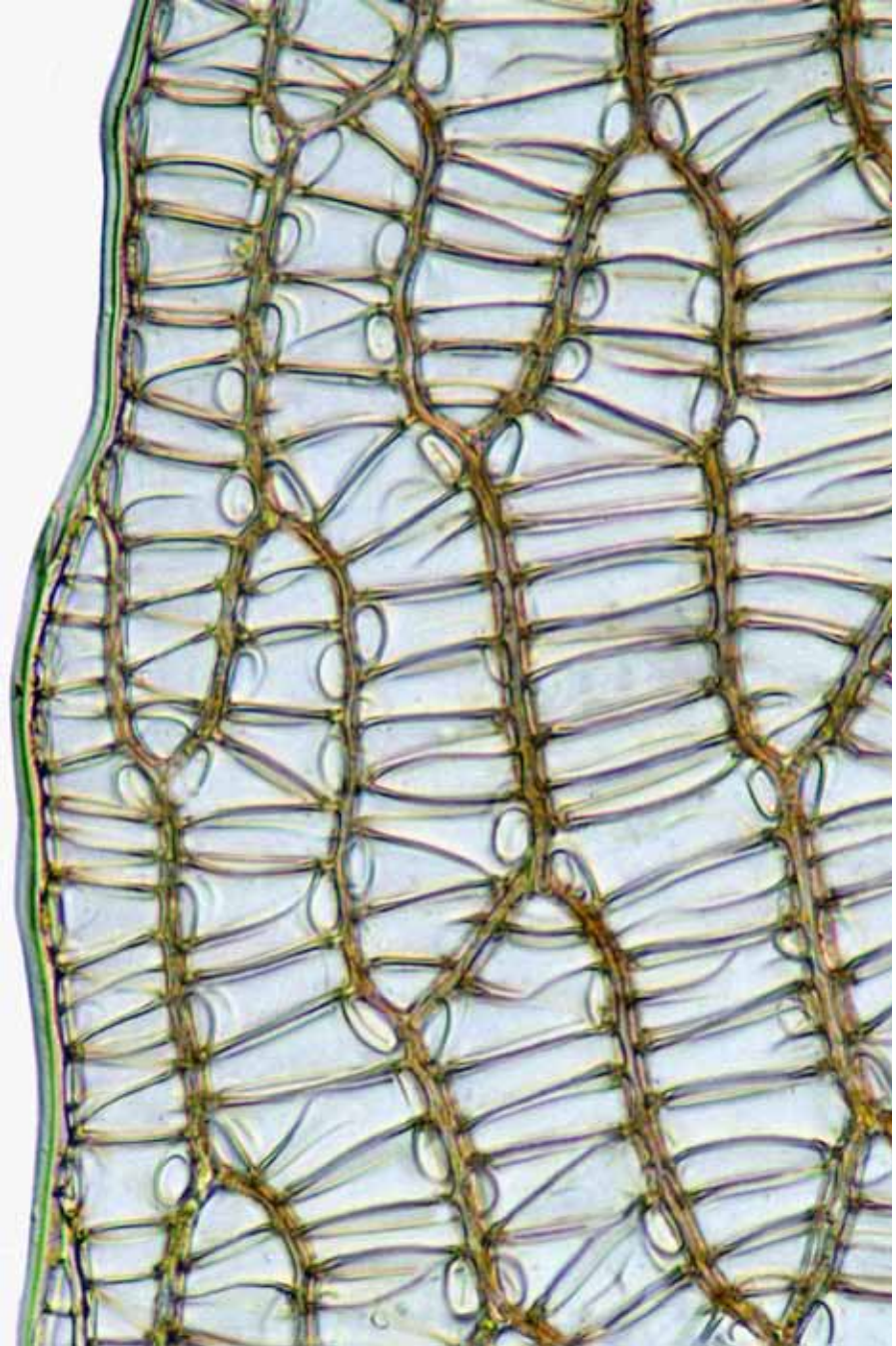
■ 50 μm, ■ 50 μm, ■ 50 μm

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*Sphagnum cristatum*, vegetative habit  
5 mm

continued next page



*Sphagnum cristatum* branch leaf  
50  $\mu$ m

continued next page

**Sphagnum falcatum** Besch.

**form:** robust, erect, branches in fascicles of 3–4, 1–2 spreading and 1–2 pendent  
**habitat:** soil, usually in well-drained sites

**leaf: size:** stem: 1.5 mm; branch: 2 mm

**shape:** stem: lingulate; branch: ovate-lanceolate

**tip:** stem: rounded, eroded; branch: acute

**base:** basal cells of stem leaves efibrillose

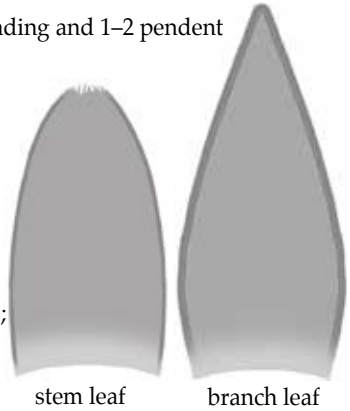
**costa:** none

**border:** stem: 3–4 rows of linear cells; branch: 3–6 rows

**margin:** stem: entire, plane; branch: entire, inrolled above

**cells:** hyalocysts  $120\text{--}160 \times 20\text{--}40 \mu\text{m}$ , sigmoid, fibrillose, thin-walled, pored

**capsule:** 1 mm; globose, erect, dark, glossy, no peristome; pseudopodium 10 mm



stem leaf

branch leaf



vegetative shoot (dry), stem and branch leaf outlines, and stem leaf apex (eroded)  
 10 mm, 0.1 mm, 0.1 mm, 50  $\mu\text{m}$



stem leaf margin, stem leaf cells (upper leaf), and stem leaf cells (lower leaf)  
 50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

**Sphagnum novo-zelandicum** Mitt.

**form:** cushions; branches in fascicles of 3–5, 2–3 spreading, 1–2 pendent  
**habitat:** wet habitats in forest, scrub, and roadside ditches, to subalpine

**leaf:** *size:* stem: 1.5–2.0 mm; branch: 1.8–2.3 mm

*shape:* stem: lingulate, adaxial pores few; branch: ovate to ovate-

lanceolate, abaxial pores 8–16 along commissures, adaxial pores sparse

*tip:* stem: rounded or obtuse, ± eroded; branch: 3–4-toothed by resorption

*base:* basal cells less fibrillose than the other lamina cells

*costa:* none

*border:* stem: 3–5 rows of narrow cells; branch: 1–3 rows of narrow cells

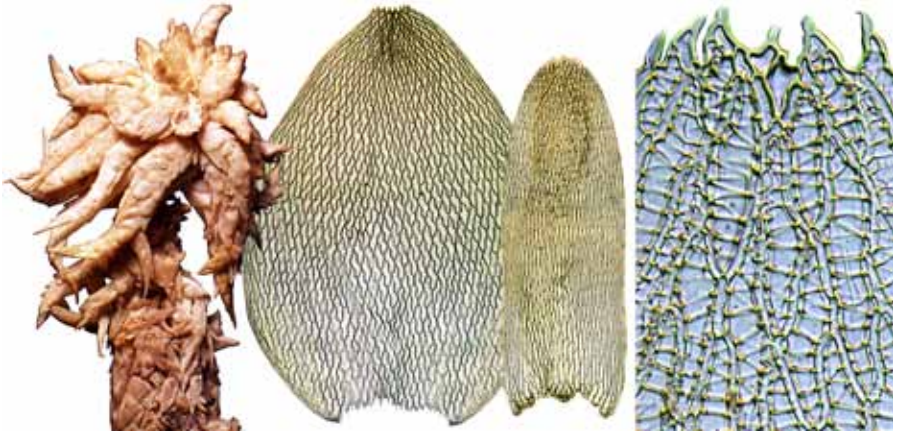
*margin:* entire, plane

*cells:* hyalocysts 150–200 × 30–50 μm, sigmoid, fibrillose, thin-walled, 8–16-ring-pored abaxially; chlorocysts exposed equally adaxially and abaxially

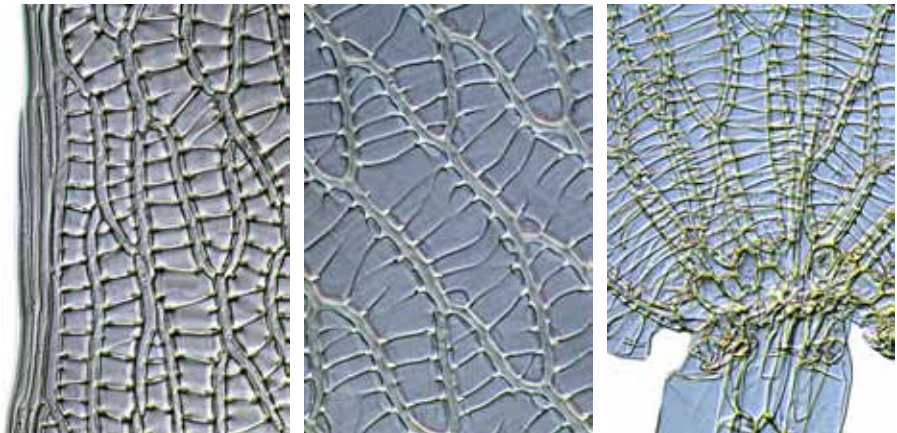
**capsule:** 1 mm, globose, erect, dark, glossy, no peristome; pseudopodium 10 mm long



branch leaf



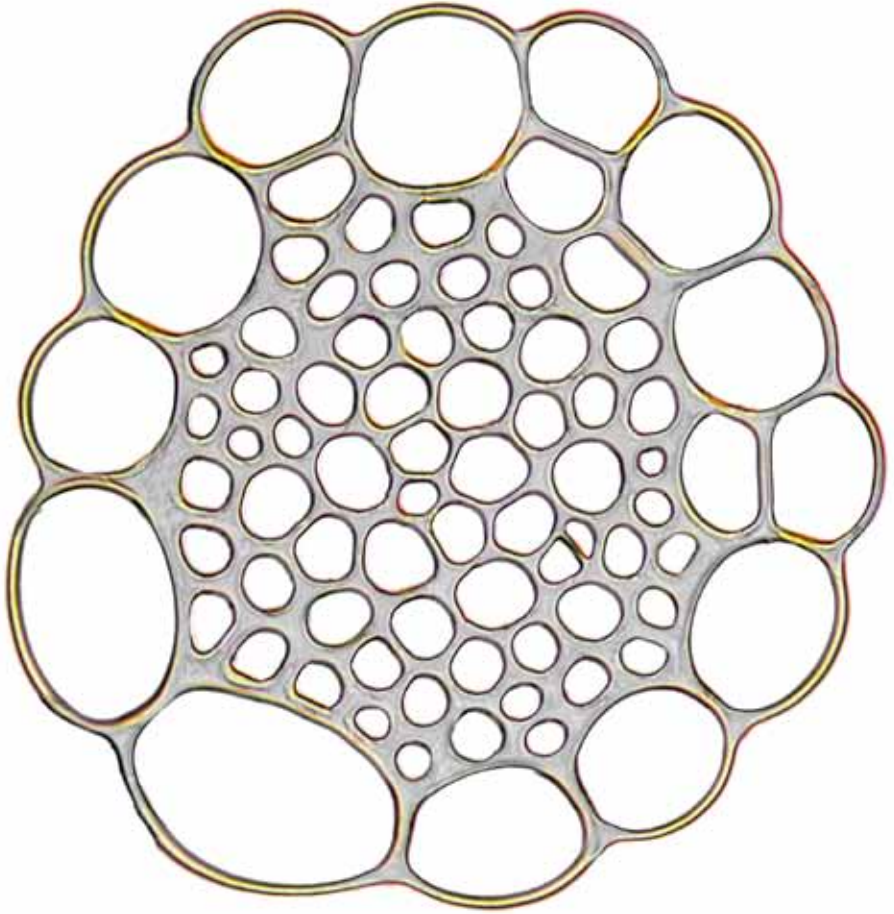
vegetative shoot (dry), branch and stem leaf outlines, and branch leaf apex  
 1 mm, 0.5 mm (2), 50 μm



branch leaf margin, branch leaf cells, and branch leaf base  
 50 μm, 50 μm, 50 μm

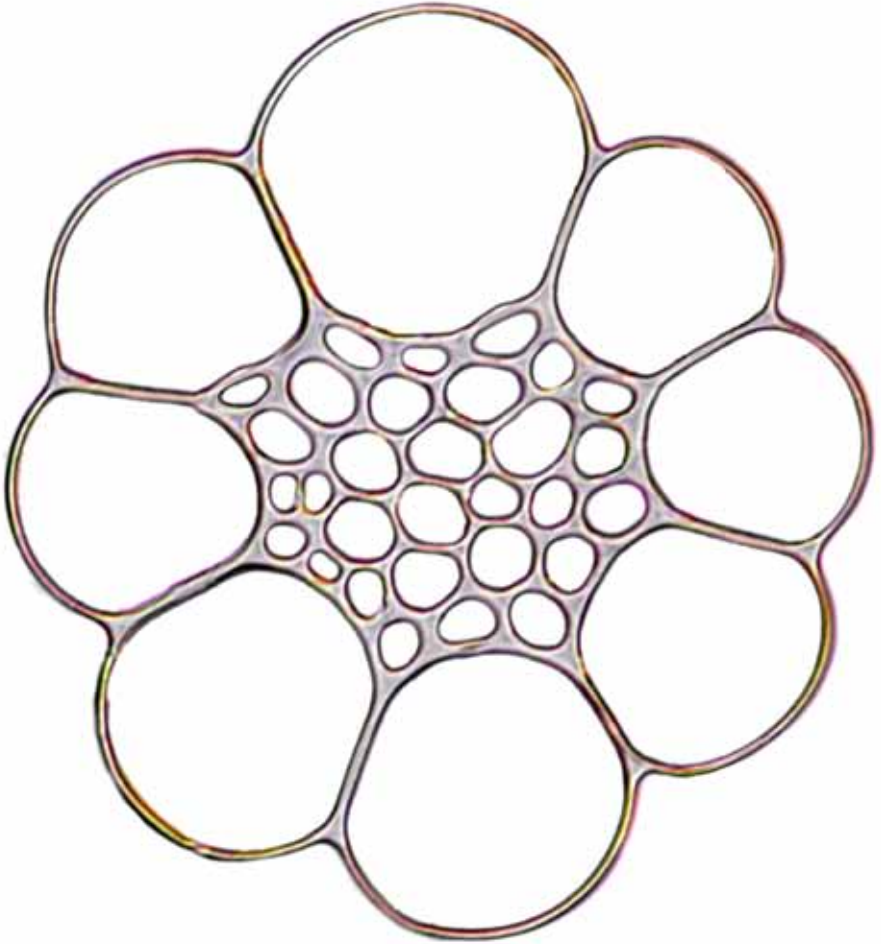
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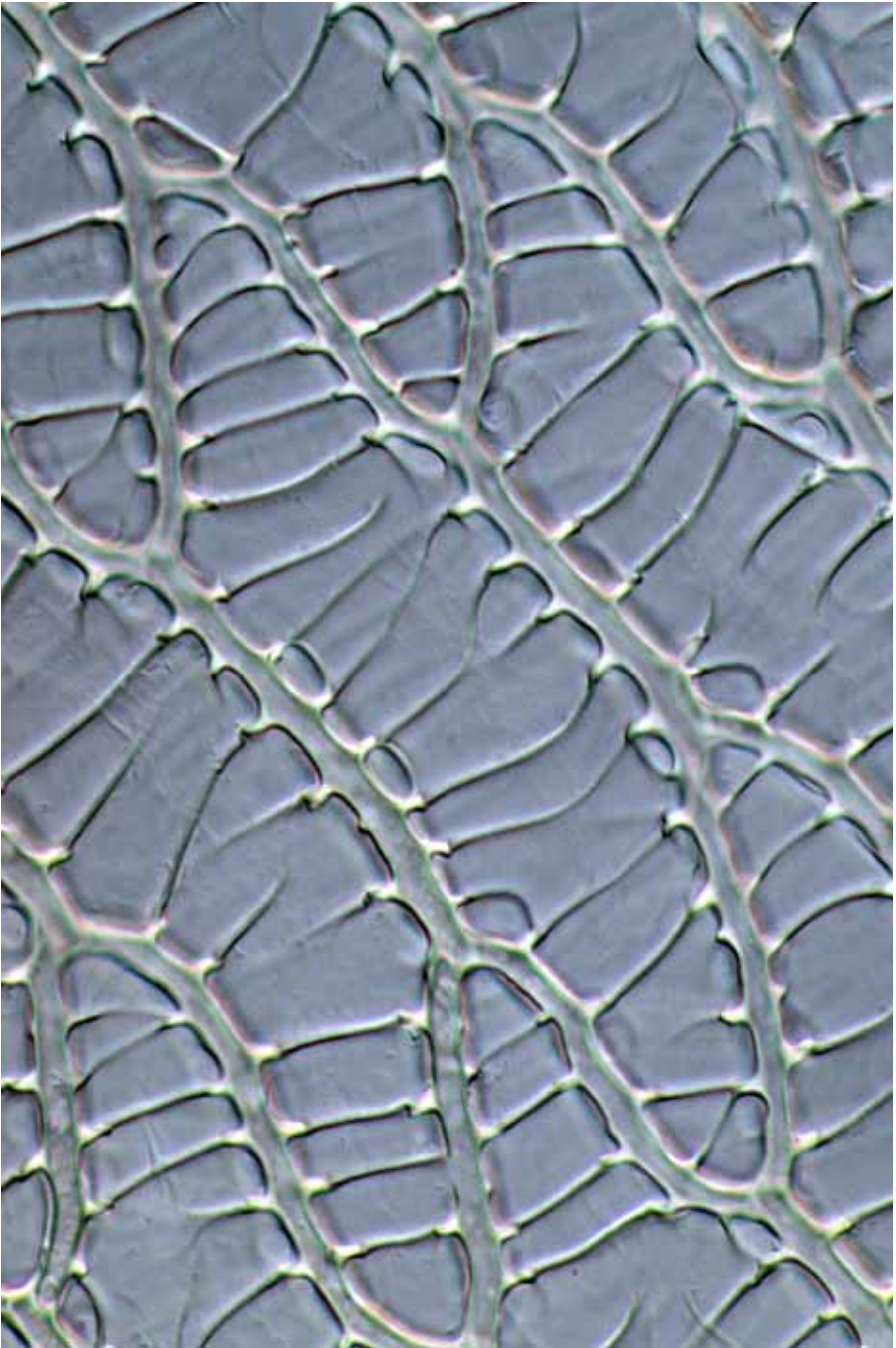
*Sphagnum novozelandicum* stem xs  
10  $\mu$ m

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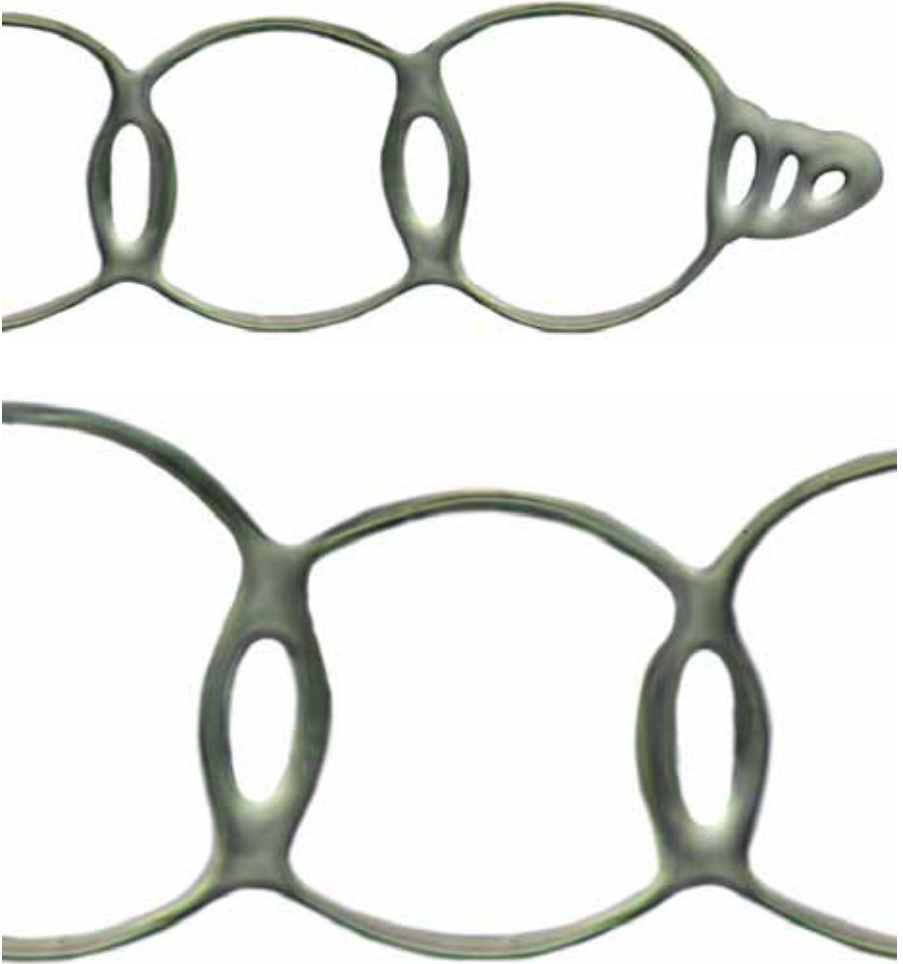
*Sphagnum novozelandicum* branch xs  
10  $\mu$ m

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*Sphagnum novozelandicum* branch leaf cells  
10  $\mu\text{m}$

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*Sphagnum novozelandicum* branch leaf cells showing margin and chlorocysts  
— 10  $\mu\text{m}$  (upper), — 10  $\mu\text{m}$  (lower)

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**Sphagnum simplex** Fife**form:** ± unbranched stems 10–100 mm long, leaves julaceous**habitat:** acidic soil of edges of subalpine and alpine bogs, to 1600 m elev.**leaf:** size: 3.4 × 1.2 mm*shape:* ovate, strongly concave*tip:* broadly rounded, ± toothed at the apex*base:* not differentiated*costa:* none*border:* 1–3 rows of narrowly linear cells*margin:* entire, concave*cells:* hyalocysts 90–150 × 15–36 μm, 10–16-pored (and pseudopored) abaxially, 0–1-pored adaxially**capsule:** sporophytes unknown**notes:** thought to be a New Zealand endemicbranch  
leaf

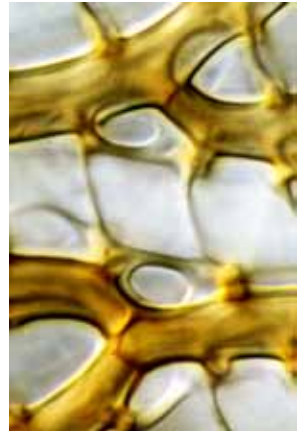
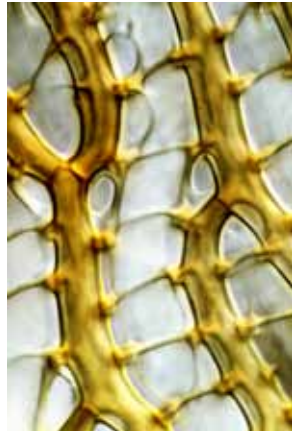
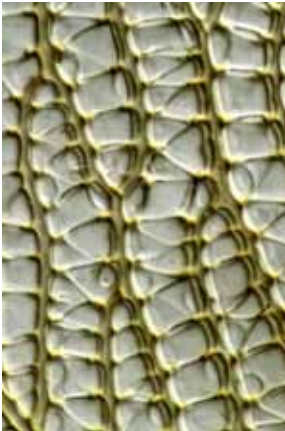
vegetative shoots (dry) (2), leaf outline, and margin midleaf

1 mm (2),

1 mm,

1 mm,

50 μm



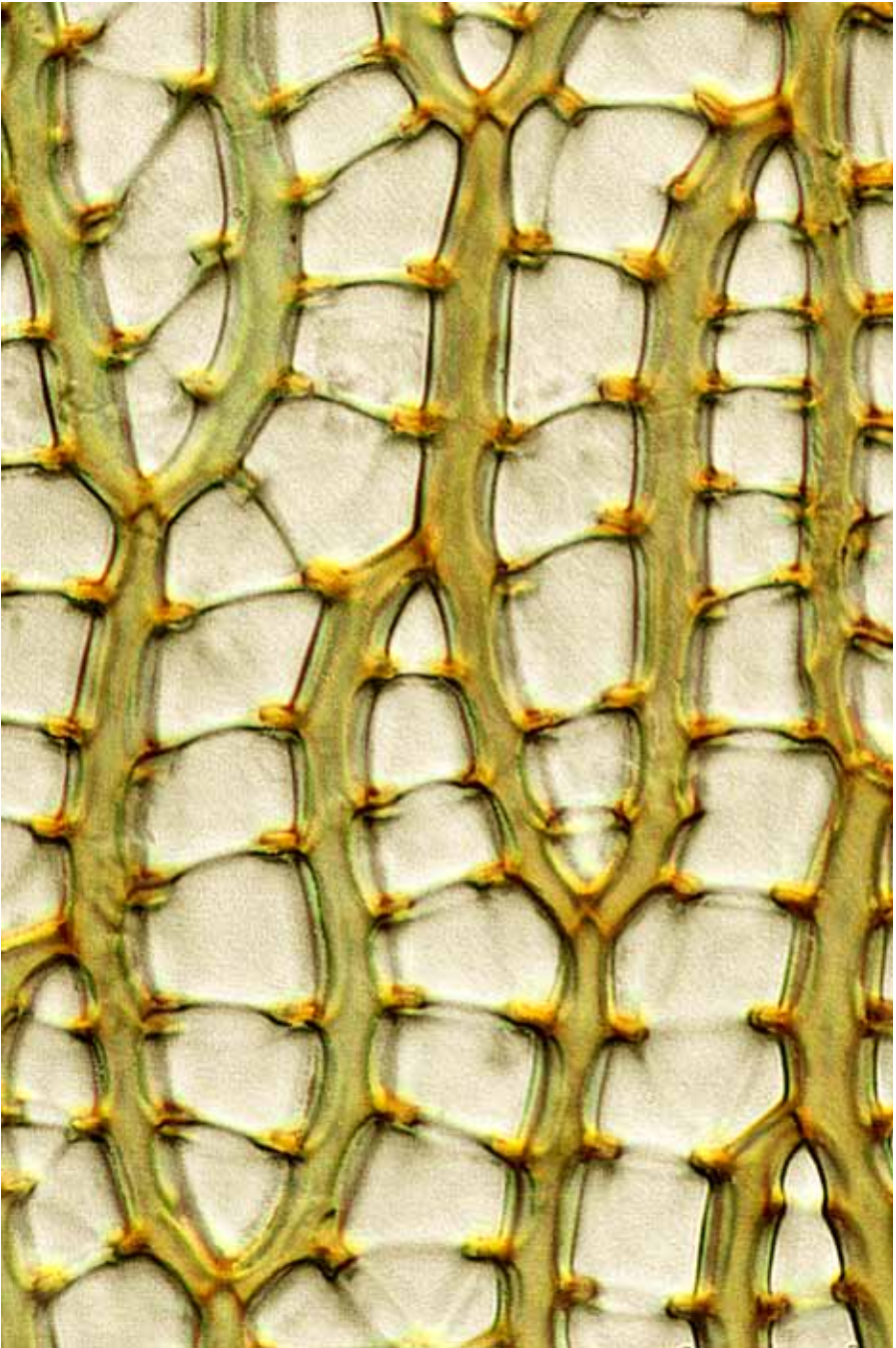
lamina cells, hyalocyst pores and detail

50 μm,

50 μm,

10 μm

continued next page



*Sphagnum simplex* lamina cells  
10  $\mu\text{m}$

**Sphagnum squarrosum** Crome in Hoppe

**form:** densely matted, erect, branched, with squarrose leaf-tips; branches in 4–5 fascicles, 2 spreading, 2–3 pendent

**habitat:** moist soil or humus in fens and meadows, often calciphilic

**leaf:** size: stem: 1.6–1.8 mm; branch: 2.0–3.5 mm, tips squarrose wet or dry

**shape:** stem: oblong-ligulate; branch: ovate-hastate narrowed from base

**tip:** stem: rounded; branch: acute to narrowly truncate, ± erose

**base:** undifferentiated

**costa:** none

**border:** stem: none; branch: 2–3 rows of linear cells

**margin:** entire, plane

**cells:** branch: chlorocysts trapezoidal, > abaxial exposure; hyalocysts not bulging; pores large, 1/3 hyalocyst width; 90–120(–150)  $\mu\text{m}$

**capsule:** 1 mm; globose, erect, dark, glossy, no peristome; spores 17–30  $\mu\text{m}$ , proximal surface papillose, distal surface bifurcate protuberances; pseudopodium 10 mm



branch leaf



vegetative shoots (dry) (2), stem and branch leaf outlines

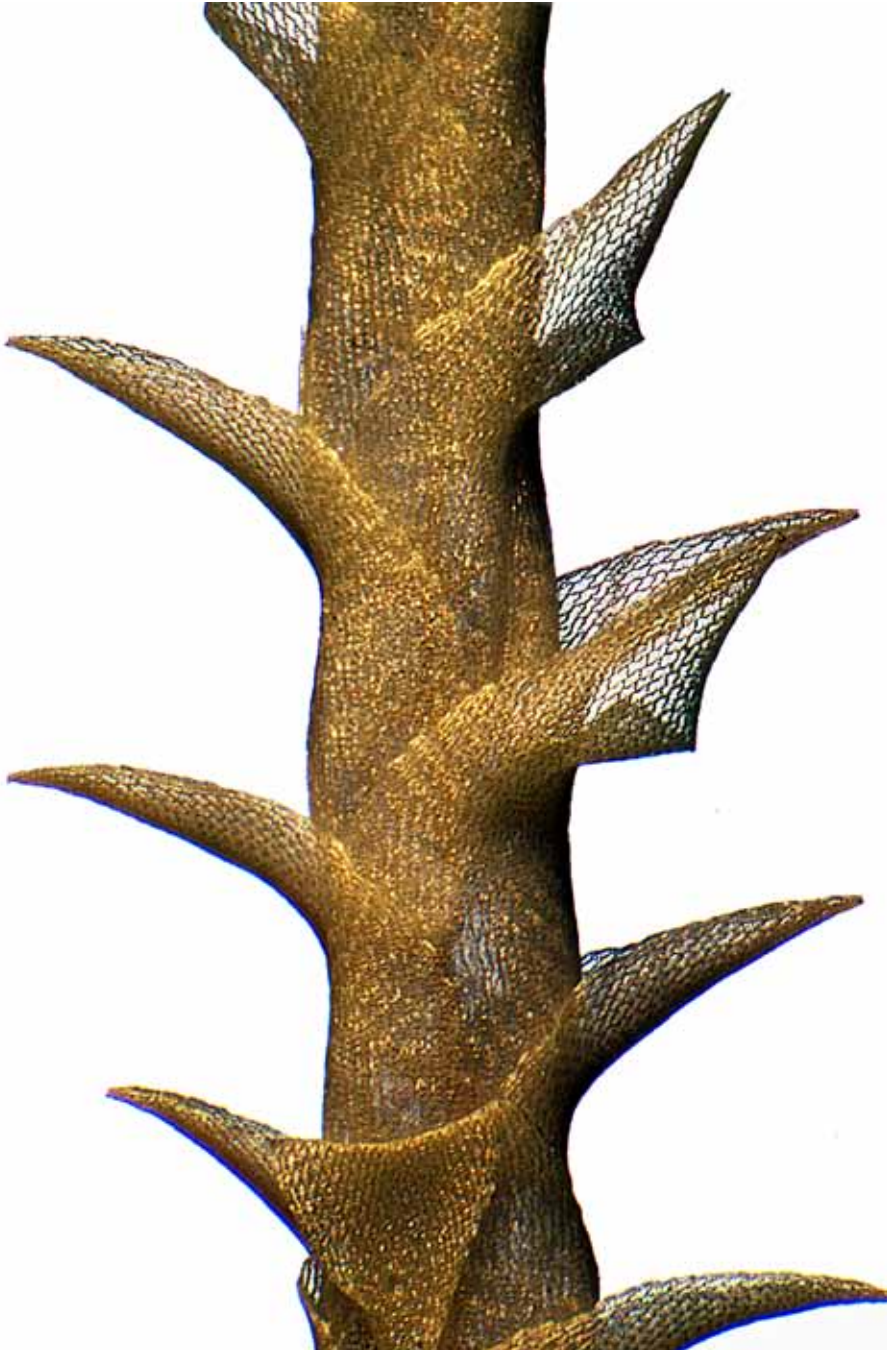
■ 5 mm, ■ 5 mm, ■ 0.1 mm, ■ 0.5 mm



branch leaf margin, branch leaf hyalocysts, and branch leaf cross-section (diagrammatic)

■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

continued next page



*Sphagnum squarrosum* branch leaves  
1 mm

continued next page





*Sphagnum squarrosum* branch leaf cells  
100  $\mu\text{m}$

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**Sphagnum subnitens** Russow & Warnst.

**form:** iridescent when dry; branches in fascicles of 3, 2 spreading, 1 pendent  
**habitat:** soil in boggy sites, Nelson and Westland (adventive)

**leaf:** *size:* stem: 1.5–1.7 mm; branch: 1.5 mm

*shape:* stem: triangular-lingulate; branch: ovate to ovate-lanceolate

*tip:* stem: acute to short-cuspidate; branch: truncate, toothed

*base:* basal cells  $240 \times 27 \mu\text{m}$ , fibrillose

*costa:* none

*border:* stem: 3–6 rows of narrow, porose cells; branch: 1–2 rows of narrow cells

*margin:* stem: entire, plane; branch: entire, inrolled above

*cells:* hyalocysts  $90\text{--}105 \times 18\text{--}24 \mu\text{m}$ , sigmoid, fibrillose, thin-walled, 3–5-ring-pored abaxially, convex and projecting abaxially; chlorocysts triangular, exposed adaxially broadly, abaxially narrowly

**capsule:** 1 mm; globose, erect, dark, glossy; pseudopodium 10 mm; no peristome



branch leaf

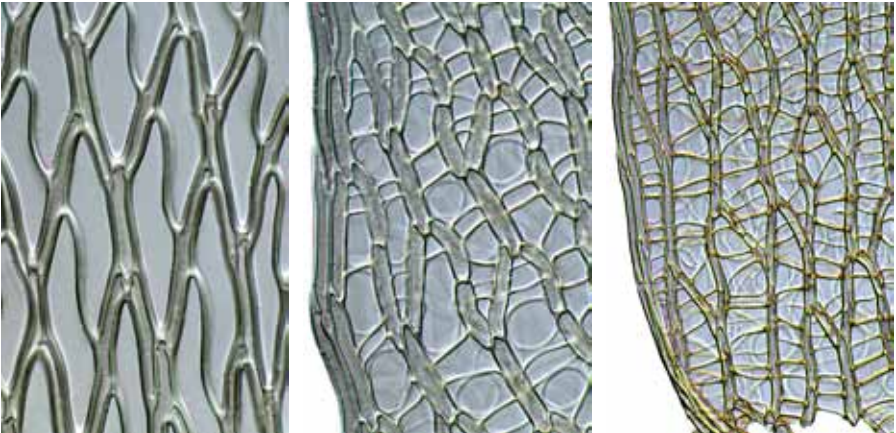


vegetative shoot (moist), stem and branch leaf outlines, and branch leaf apex

5 mm,

0.5 mm,

0.5 mm,

50  $\mu\text{m}$ 

stem leaf eifibrillose cells, branch leaf margin, and branch leaf basal angle

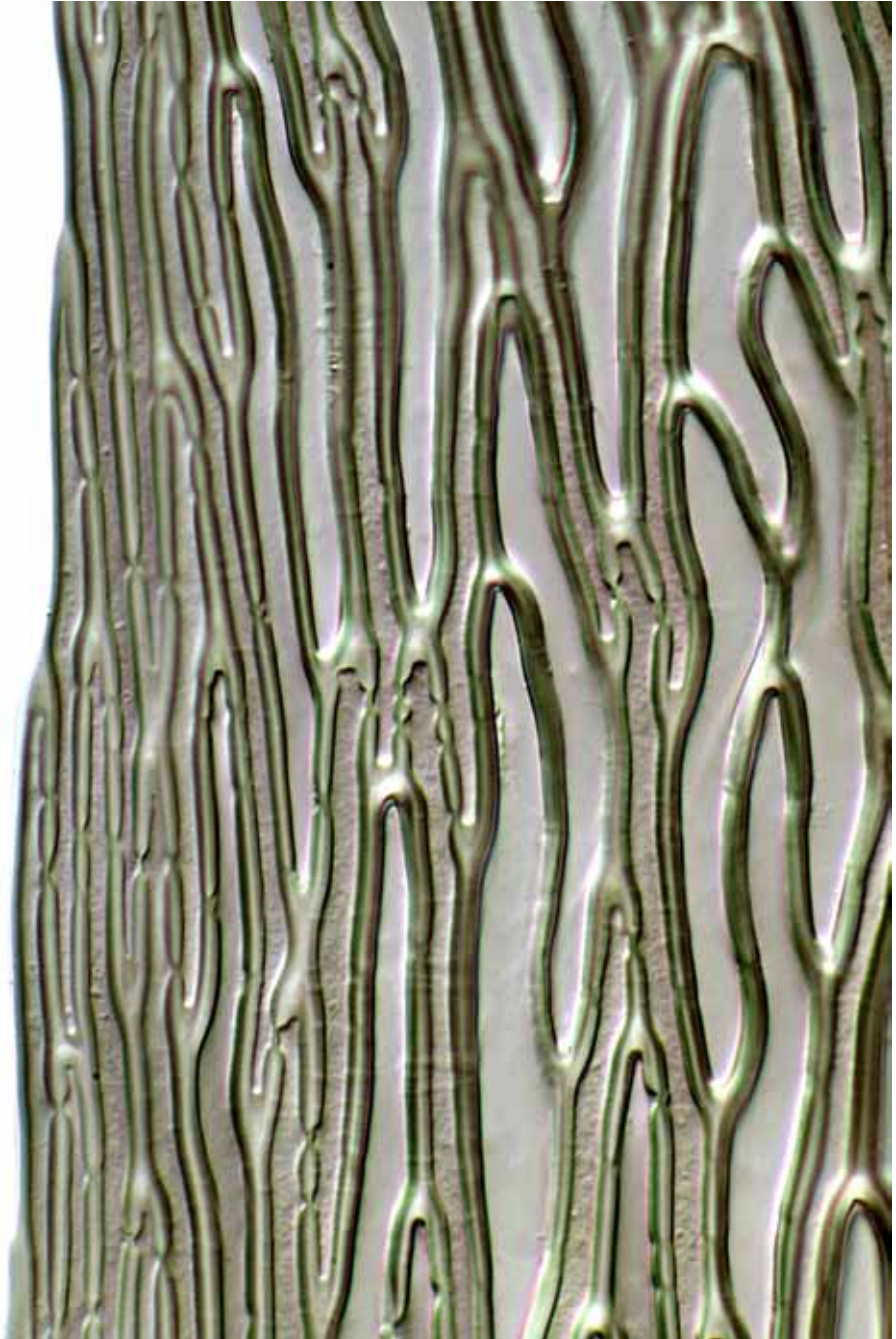
50  $\mu\text{m}$ ,50  $\mu\text{m}$ ,50  $\mu\text{m}$ 

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*Sphagnum subnitens* vegetative shoot (dry)  
1 mm

continued next page



*Sphagnum subnitens* stem leaf margin  
50  $\mu\text{m}$

continued next page

Key\* to the New Zealand species and subspecies of *Andreaea* (12)

- 1 Leaves costate ..... 2  
 1: Leaves ecostate ..... 5
- 2(1) Costa reaching to about midleaf; leaves broadly oval to oblong ● ***Andreaea nitida***  
 2: Costa percurrent or subpercurrent; leaves lanceolate or the blade tapering from the shoulder of an oblong base ..... 3
- 3(2): Leaves lanceolate; costa well-defined, not filling the blade; perichaetial bracts not convolute, not or only slightly sheathing ..... ● ***Andreaea australis***  
 3: Leaves tapering from an oblong base; costa indistinct, filling much of the blade; perichaetial bracts convolute and sheathing ..... 4
- 4(3): Marginal cells in leaf base mostly isodiametric; base of capsule shorter than the valves; costa usually conspicuous in the leaf base ..... ● ***Andreaea subulata***  
 4: Marginal cells in leaf base mostly rectangular; base of capsule equal to or longer than the valves; costa weak or disappearing in the leaf base ..... ***Andreaea heinemannii***
- 5(1): Margins of leaf base partly toothed or crenate from the projecting ends of cells .... 6  
 5: Margins of leaf base entire ..... 9
- 6(5) Turgid spores mostly larger than 35  $\mu\text{m}$  in diam. .... 7  
 6: Turgid spores mostly smaller than 30  $\mu\text{m}$  in diam. .... 8
- 7(6) Leaves mostly 3–4 times as long as wide; leaf blade usually falcate and secund; distal leaf apex unistratose throughout; perigonal paraphyses absent ..... ● ***Andreaea acutifolia* subsp. *acutifolia***  
 7: Leaves less than 3 times as long as wide; leaf blade straight, not or only rarely secund; distal leaf apex bistratose only in patches; perigonal paraphyses present ..... ● ***Andreaea alpina***
- 8(6): Leaves  $\pm$  panduriform, 2–3 times as long as wide; sinus strongly contracted; base distinctly sheathing ..... ● ***Andreaea acutifolia* subsp. *acuminata***  
 8: Leaves linear to oblong-lanceolate, 4–7 times as long as wide; sinus not or only barely contracted; base only weakly sheathing ..... ● ***Andreaea flabellata***
- 9(5): Marginal cells in the leaf base all isodiametric; leaf base not sheathing; sinus absent ..... ● ***Andreaea mutabilis***  
 9: At least some marginal cells in the leaf base  $\pm$  sheathing; sinus well-defined ..... 10
- 10(9:) Leaf apex strongly cucullate ..... 11  
 10: Leaf apex not cucullate ..... 12
- 11(10) Turgid spores mostly 44–50  $\mu\text{m}$  in diam.; leaves widest above and below the sinus ..... ● ***Andreaea amblyophylla***  
 11: Turgid spores mostly 16–29  $\mu\text{m}$  in diam.; leaves widest in the base ..... ● ***Andreaea huttonii***
- 12(10): Leaf apex narrowly acute or acuminate, not rounded; margin incurved, appearing channelled; distal lamina cells unistratose,  $\pm$  papillose in patches ..... ● ***Andreaea flabellata***  
 12: Leaf apex acute, often rounded; margin plane; distal lamina cells bistratose here and there, smooth,  $\pm$  bulging but not papillose ..... ● ***Andreaea flexuosa***

\* based on Murray, BM (2006): *Andreaea*. *Flora of Australia* 51, 109.



*Andreaea  
nitida*



*Andreaea  
alpina*



*Andreaea  
acutifolia  
subsp. acuminata*



*Andreaea  
amblyophylla*



*Andreaea  
huttonii*



*Andreaea  
flabellata*



*Andreaea  
flexuosa*



*Andreaea  
subulata*



*Andreaea  
microvaginata*



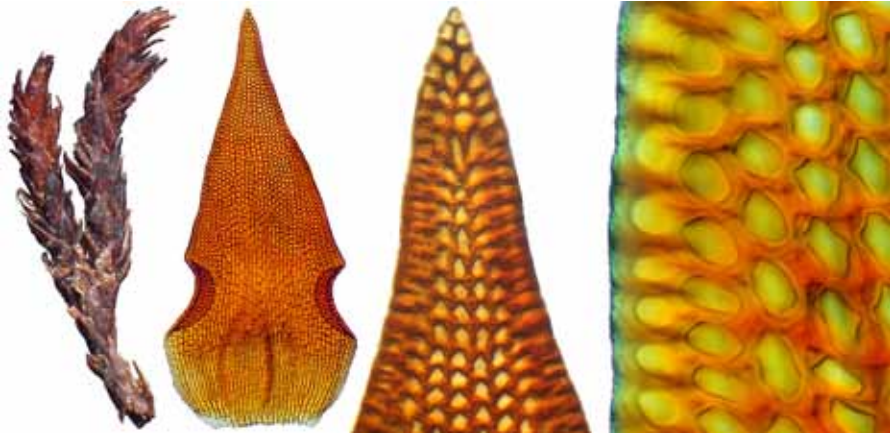
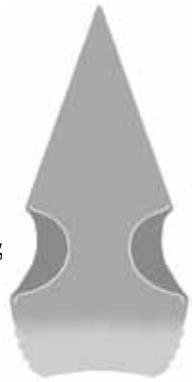
*Andreaea  
acutifolia  
subsp. acutifolia*



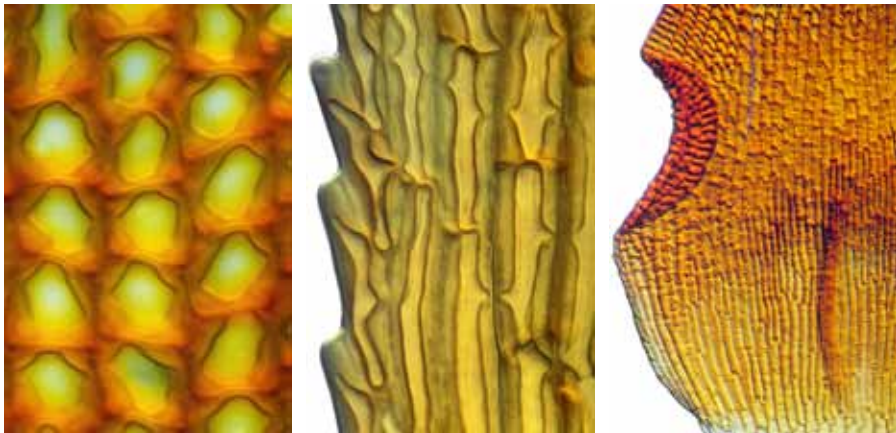
*Andreaea  
mutabilis*



*Andreaea  
australis*

**Andreaea acutifolia** subsp. **acuminata** (Mitt.) Vitt**form:** cushions or turves of erect, sparsely branched, blackish red stems**habitat:** acidic rock at high elevations**leaf:** size: 0.5–1.2 mm**shape:** straight, strongly panduriform, widest at or above the sinus**tip:** acute to acuminate**base:** sheathing**costa:** none**border:** not differentiated**margin:** entire above, bluntly toothed near leaf base, plane to incurved**cells:** 10–15  $\mu\text{m}$ , irregular, thick-walled, distal cells often wider than long**capsule:** 0.5 mm; oval, dark, opening by four valves that bulge outward when dry; pseudopodium undeveloped; spores 16–25  $\mu\text{m}$  in diam.**notes:** subsp. *acutifolia* has mostly falcate, weakly panduriform leaves with distal cells longer than wide, and spores 32–50  $\mu\text{m}$  in diam.

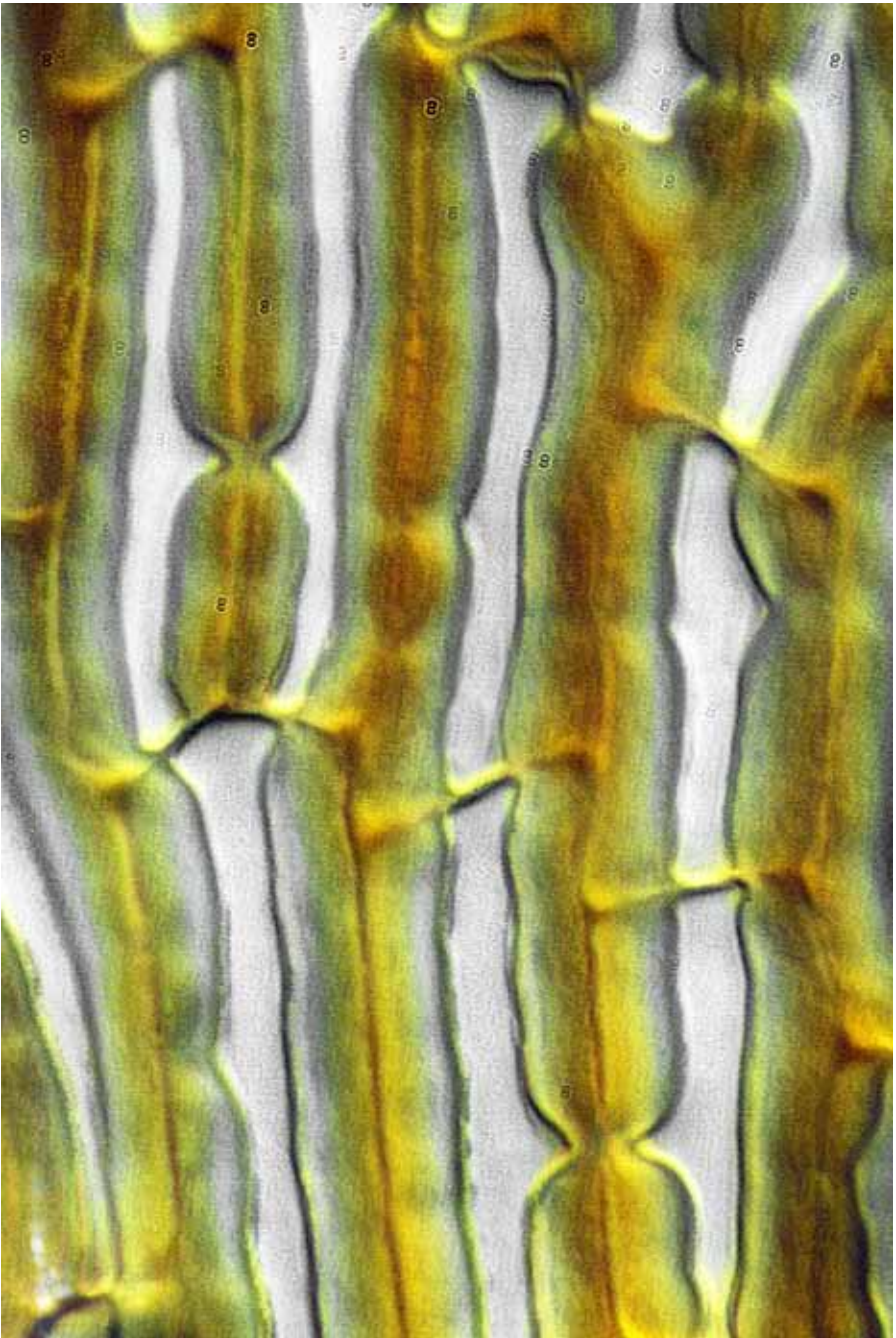
vegetative shoot (dry), panduriform leaf outline, leaf apex, and margin midleaf

 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ 


distal leaf cells, leaf margin near base, and leaf basal angle

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$ 

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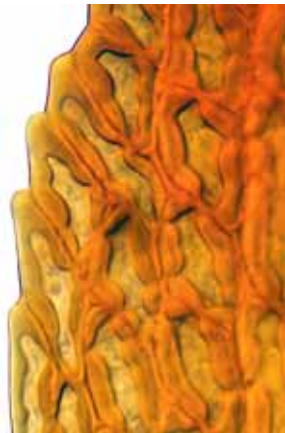
*Andreaea acutifolia* subsp. *acuminata* cells near the leaf base  
10  $\mu\text{m}$

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**Andreaea acutifolia** Hook.f. & Wilson subsp. **acutifolia****form:** cushions or turves of erect, sparsely branched, blackish red stems**habitat:** acidic rock at high elevations**leaf:** size: 0.6–1.2 mm*shape:* falcate, weakly panduriform, widest near the insertion*tip:* acute to acuminate*base:* sheathing*costa:* none*border:* not differentiated*margin:* entire above, bluntly toothed near leaf base, plane to incurved*cells:* 10–15  $\mu\text{m}$ , irregular, thick-walled, distal cells often longer than wide**capsule:** 0.5 mm, oval, dark, opening by four valves that bulge outward when dry; pseudopodium undeveloped; spores 16–25  $\mu\text{m}$  in diam.**notes:** *Andreaea acuminata* has mostly straight, strongly panduriform leaves with distal cells wider than long, and spores 16–25  $\mu\text{m}$  in diam.

vegetative habit, vegetative shoots (2), leaf outline, and leaf apex

 1 mm, 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ 


margin above shoulder, margin at shoulder, and margin below shoulder

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 

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**Andreaea alpina** Hedw.

**form:** tufted erect stems 10–80 mm long, often dark reddish, blackish below  
**habitat:** wet acidic rocks or cliffs in alpine heath and grassland, to 1600 m

**leaf:** size: 1.0–1.3 × 0.4–0.5 mm

**shape:** ± panduriform, straight, upper third to half broadly triangular

**tip:** acuminate

**base:** sheathing, cells rectangular / oblique

**costa:** none

**border:** not differentiated

**margin:** entire above, crenulate or toothed below, plane to ± incurved

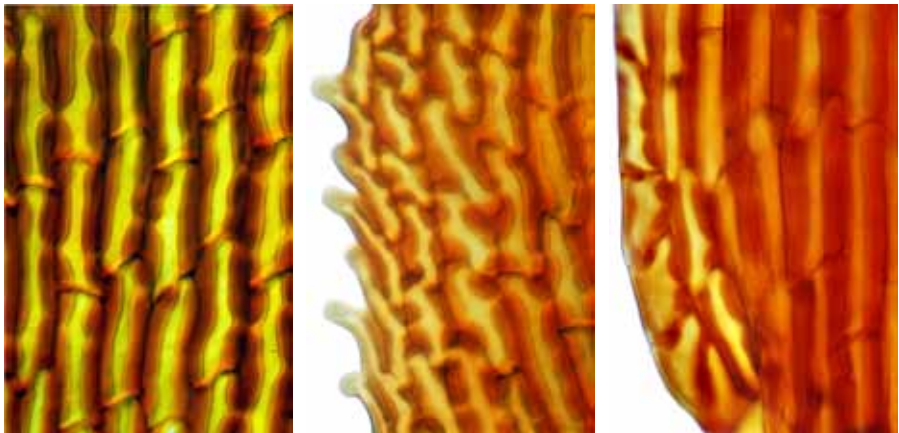
**cells:** 20 × 10 μm above, elsewhere heterogeneous (marginally isodiametric, basally linear, midleaf rectangular), thick-walled, smooth

**capsule:** 1 mm, elliptic to ovate, emergent to excurrent, opening by 4 dark-pigmented valves, fused at their apices, that bulge outward upon drying



vegetative shoots (dry) (5), leaf outline, and leaf apex

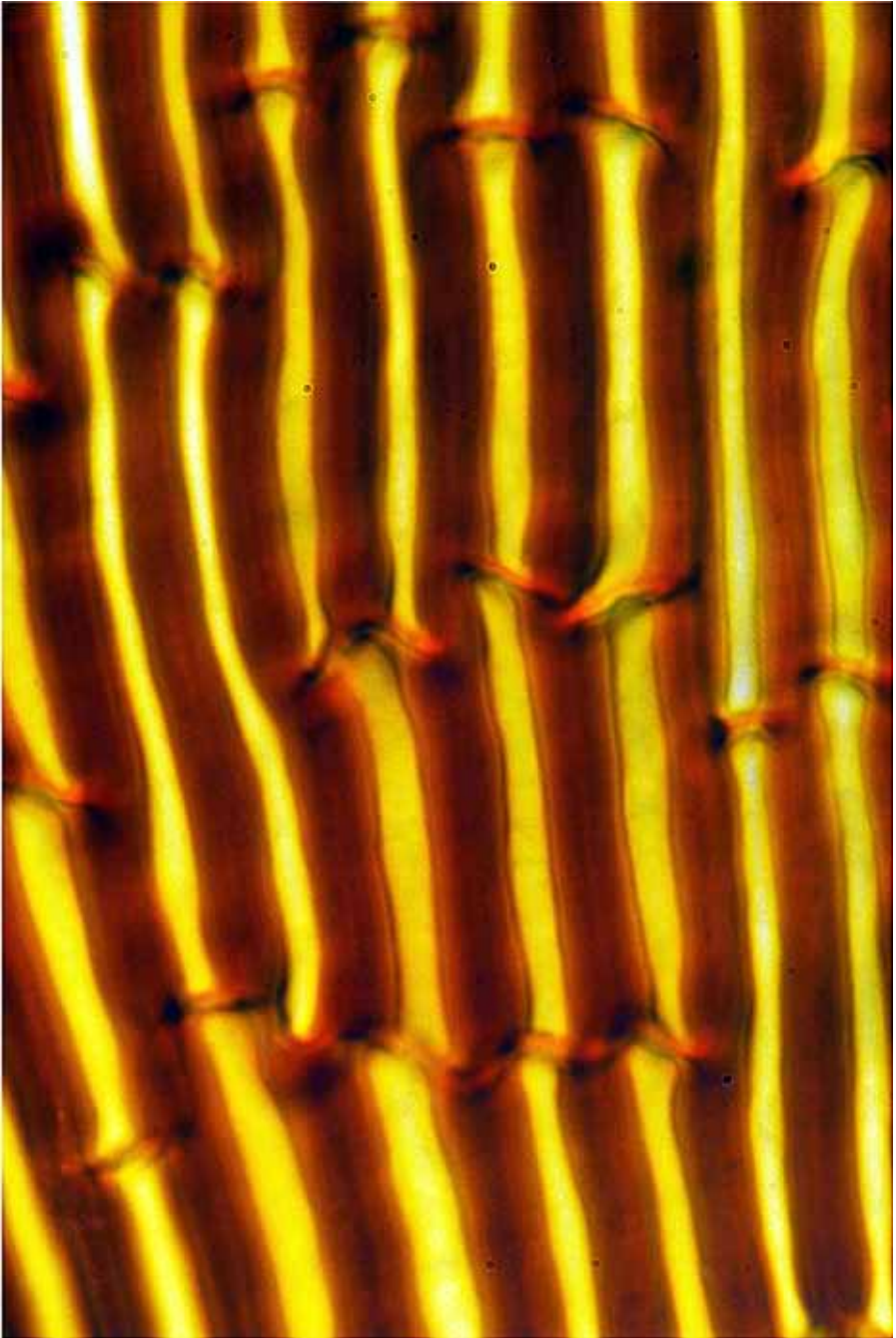
5 mm, 1 mm (3), 1 mm, 0.1 mm, 10 μm



basal lamina cells, toothed-crenulate margin below midleaf, and leaf basal angle

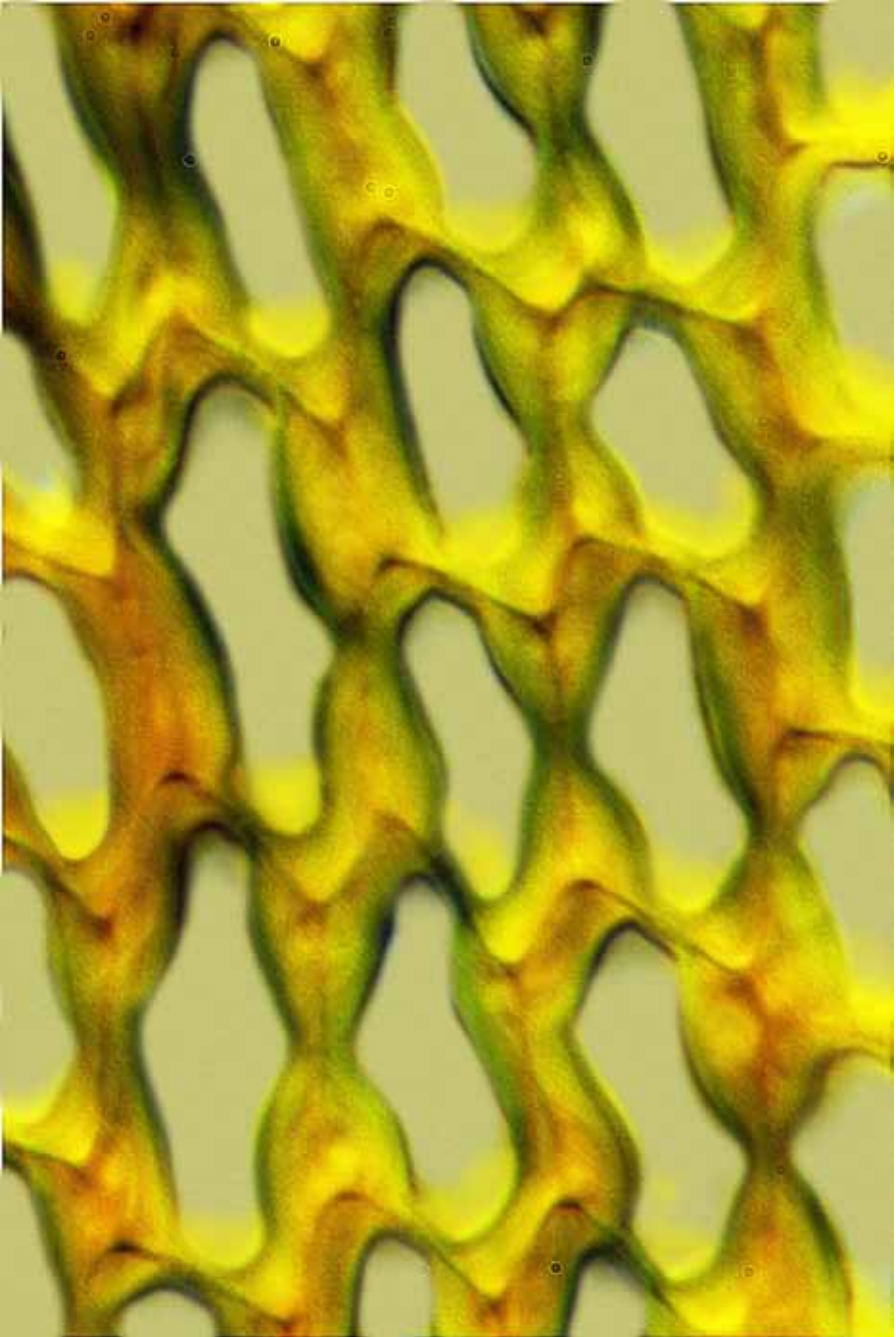
10 μm, 10 μm, 10 μm

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*Andreaea alpina* cells in midbase  
10  $\mu\text{m}$

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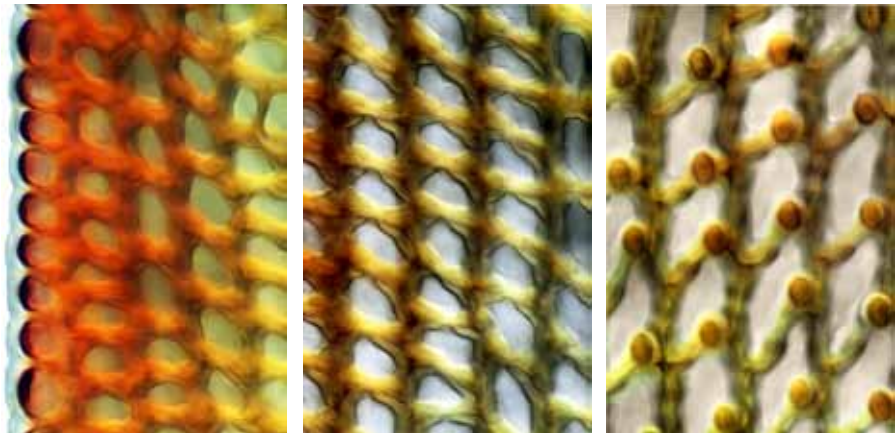


*Andreaea alpina* upper lamina cells  
10  $\mu\text{m}$

**Andreaea amblyophylla** Müll.Hal. ex Broth.**form:** tufts or mats of erect stems, to 10 mm tall, dark red, blackish below**habitat:** siliceous rock in alpine scrub and grassland, to 1600 m elevation**leaf:** size: 0.6–1.4 × 0.2–0.4 mm, distally unistratose*shape:* lanceolate, oblong-lanceolate, or panduriform, straight, ± cucullate*tip:* acute to ± rounded, usually cucullate*base:* sheathing, alar cells not differentiated*costa:* none*border:* not differentiated*margin:* entire, incurved*cells:* 20 × 10 μm above, irregular, thick-walled, distal cells unipapillose**capsule:** 1 mm, elliptic to ovate, emergent to excurrent, opening by 4 dark-pigmented valves, fused at their apices, that bulge outward upon drying; spores 44–50 μm in diam.

vegetative and fertile shoots (dry), leaf outline, leaf apex, and leaf subapex

1 mm, 1 mm (2), 0.1 mm, 50 μm, 50 μm



margin midleaf, lamina cells midleaf, and surface papillae midleaf

10 μm, 10 μm, 10 μm

continued next page



*Andreaea amblyophylla* mature capsules showing valves (dry)  
0.5 mm

**Andreaea australis** F.Muell. ex Mitt.**form:** dense cushions, erect, little branched, purple or blackish red**habitat:** acidic alpine rock, usually damp or wet, sometimes aquatic**leaf:** size: 0.5–2 mm*shape:* lanceolate, widest below midleaf, ± curved*tip:* acute, sometimes ± mucronate*base:* basal cells rectangular*costa:* wide but not filling the blade, projecting abaxially, excurrent*border:* not differentiated*margin:* entire, narrowly reflexed*cells:* 10–15  $\mu\text{m}$ , subquadrate, thick-walled, smooth to ± papillose**capsule:** 0.5 mm, oval, opening by four valves that bulge outward when dry; pseudopodium short

vegetative shoots (dry) (2), leaf outline, leaf apex, and margin midleaf

 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ 


cells midleaf, costa midleaf, and leaf basal angle

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$ 

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**Andreaea flabellata** Müll.Hal.

**form:** dense cushions of erect, branched, dark red stems, to 15 mm tall  
**habitat:** exposed rock in heath-, grass-, and open woodland, to 1900 m

**leaf:** size: 0.8–1.5 × 0.2–0.3 mm

*shape:* linear to oblong-lanceolate, ± flexuose, concave or channelled

*tip:* acute to narrowly acuminate, not broadly rounded

*base:* not or only weakly sheathing

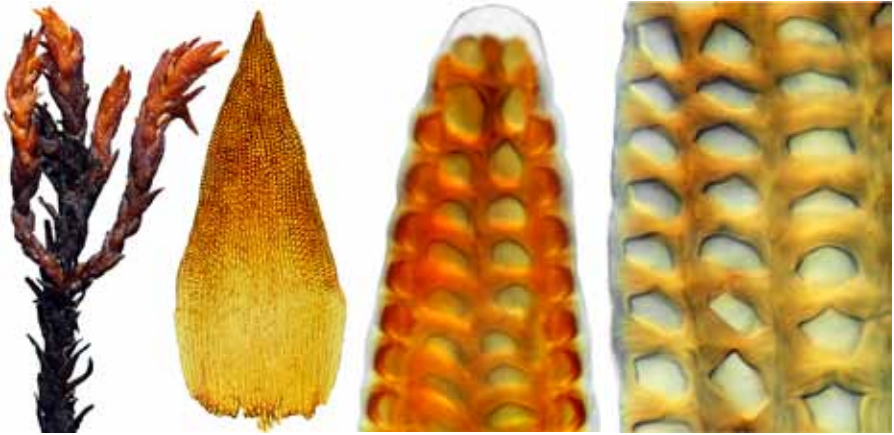
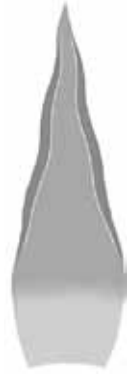
*costa:* none

*border:* not differentiated

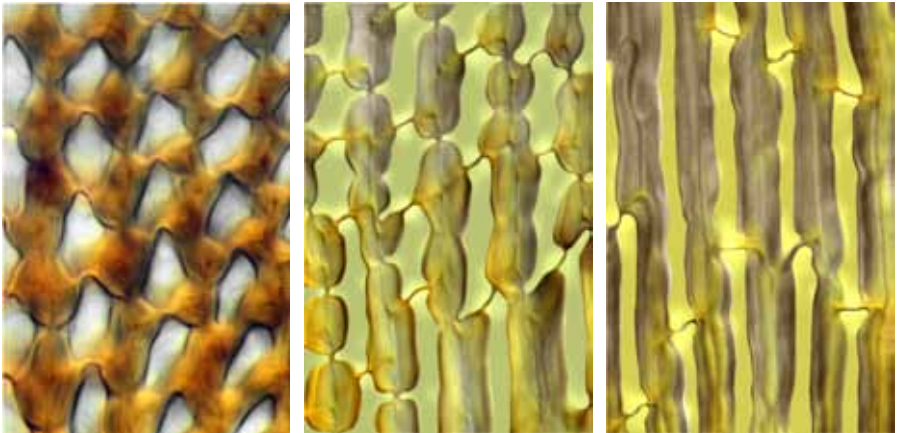
*margin:* entire to ± crenulate, ± incurved on both sides

*cells:* 10 μm, distally isodiametric-irregular, thick-walled and smooth or weakly papillose; proximally rectangular, thin-walled and smooth

**capsule:** 1 mm, elliptic to ovate, excurrent, opening by 4 dark-pigmented valves, fused at their apices, that bulge outward upon drying; viable spores 21–35 μm in diam.



vegetative shoot, (dry), leaf outline, leaf apex, and margin midleaf  
 ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



cells of upper leaf, midleaf, and basal leaf (partly diagrammatic)  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

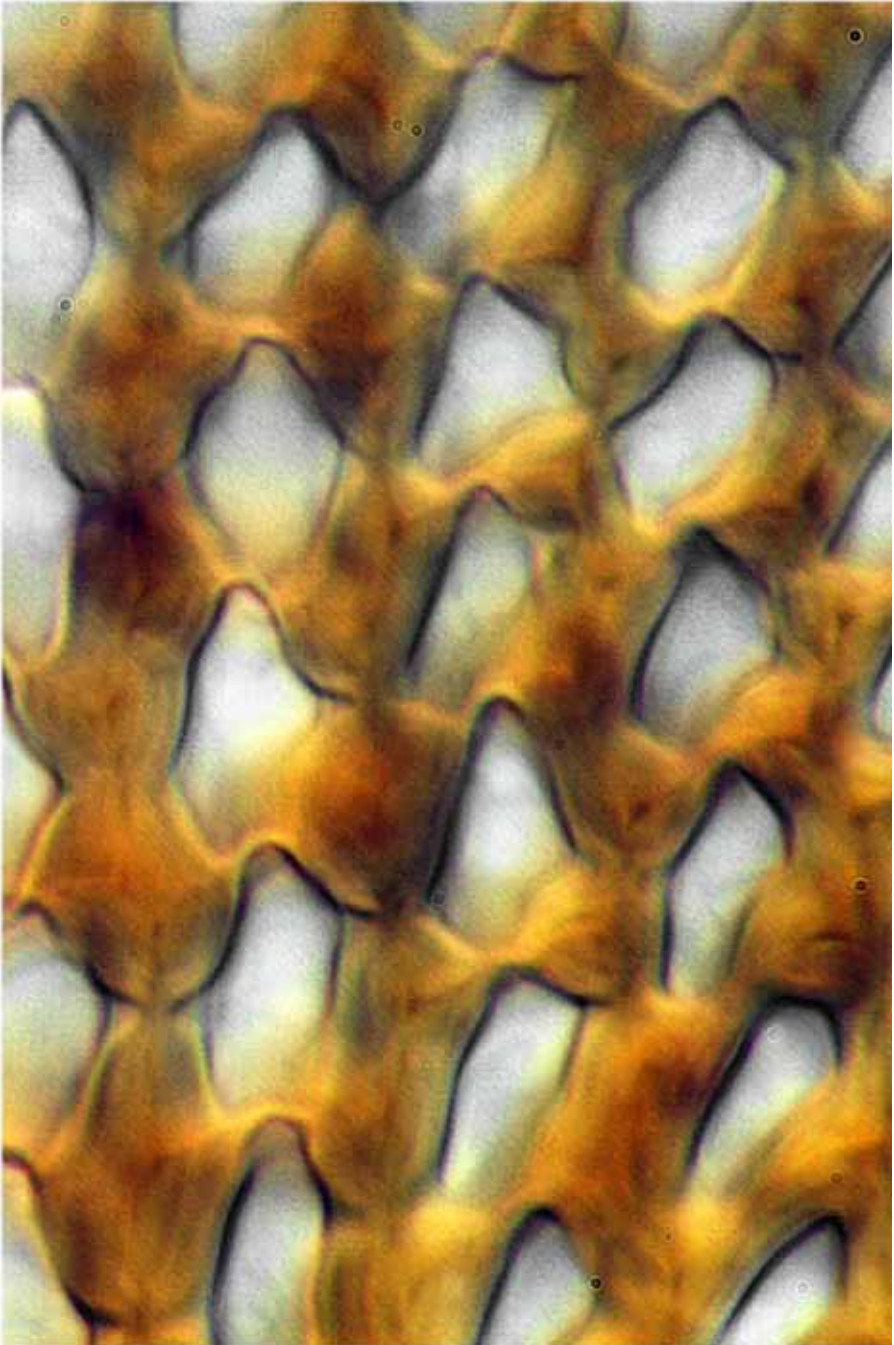
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*Andreaea flabellata* vegetative shoot (dry) and leaf whole-mount  
1 mm, 0.1 mm

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*Andreaea flabellata* upper leaf cells  
10  $\mu\text{m}$

**Andreaea flexuosa** R.Br.bis

**form:** dense velvety turfs of erect, dark red, sparsely branched stems, to 9 mm  
**habitat:** rock in exposed heath-, shrub- and grassland, to 1800 m elevation

**leaf:** size: 1.0–2.4 × 0.2–0.3 mm

*shape:* lanceolate to narrowly lanceolate, ± flexuose when moist

*tip:* acute, ± rounded, often broken off

*base:* not or only weakly sheathing

*costa:* none

*border:* not differentiated

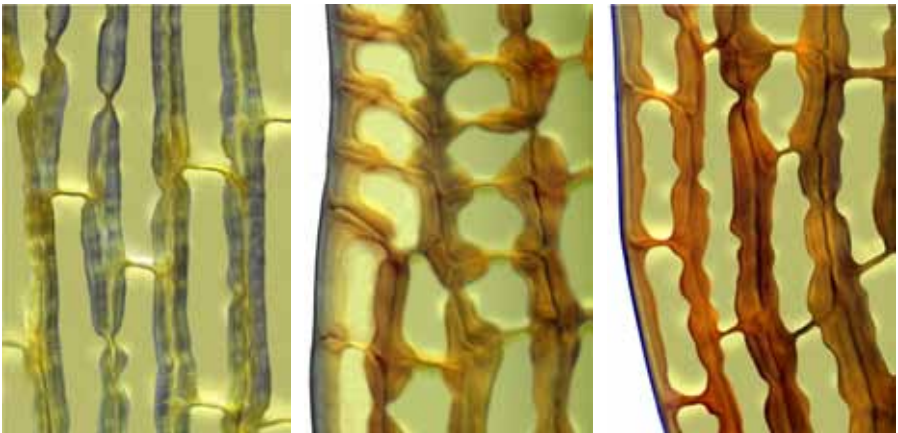
*margin:* entire, plane above, ± incurved below

*cells:* 10 μm, irregular-isodiametric above, rectangular and porose below, thick-walled, smooth

**capsule:** 1 mm, elliptic to ovate, excurrent, opening by 4 dark-pigmented valves, fused at their apices, that bulge outward upon drying; spores 18–22 μm in diam.



vegetative and fertile shoot (tips only, dry), leaf outlines (3), and lamina cells at midleaf  
 1 mm, 1 mm, 0.5 mm (3), 10 μm



cells near leaf base, margin just above basal angle, and cells of basal angle  
 10 μm, 10 μm, 10 μm

continued next page



*Andreaea flexuosa* margin near the leaf base  
10  $\mu\text{m}$

**Andreaea huttonii** R.Br.bis

**form:** tufts or mats of erect stems, to 12 mm tall, dark red, blackish below  
**habitat:** siliceous rock in alpine scrub and grassland, to 1600 m elev.

**leaf:** size: 0.6–2.0 × 0.2–0.4 mm, distally unistratose

**shape:** linear-lanceolate, straight, cucullate

**tip:** acute to ± rounded, strongly cucullate

**base:** sheathing, alar cells not differentiated

**costa:** none

**border:** not differentiated

**margin:** entire, incurved

**cells:** 20 × 10 μm above, irregular, thick-walled, distal cells unipapillose

**capsule:** 1 mm, elliptic to ovate, emergent to excurrent, opening by 4 dark-pigmented valves, fused at their apices, that bulge outward upon drying; spores 13–18 μm in diam.

**notes:** similar to *Andreaea amblyophylla*, but differs in having much smaller spores, fewer papillae, and glossier leaves; an Australasian endemic



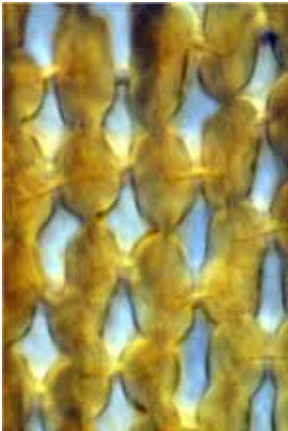
vegetative shoot, leaf outline, leaf apex, and margin at midleaf

1 mm,

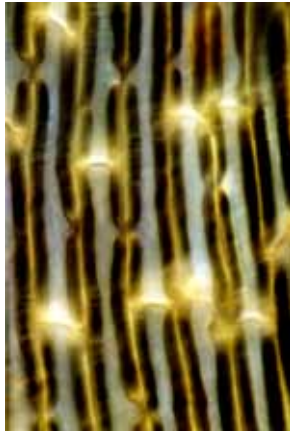
1 mm,

50 μm,

10 μm



10 μm,



10 μm,



10 μm

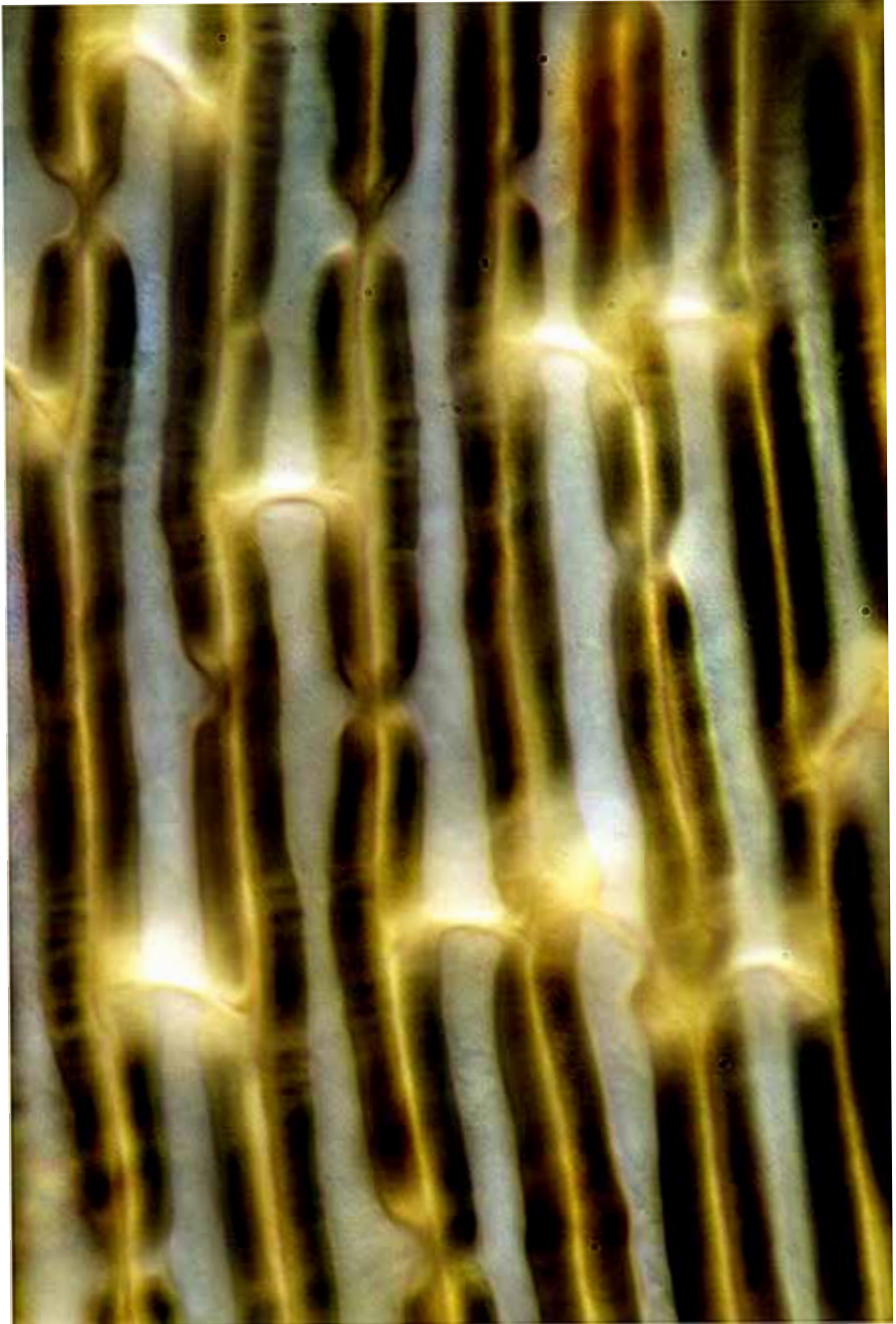
cells of upper leaf, cells near middle of leaf base, and leaf basal angle

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*Andreaea huttonii* vegetative shoots (dry)  
1 mm

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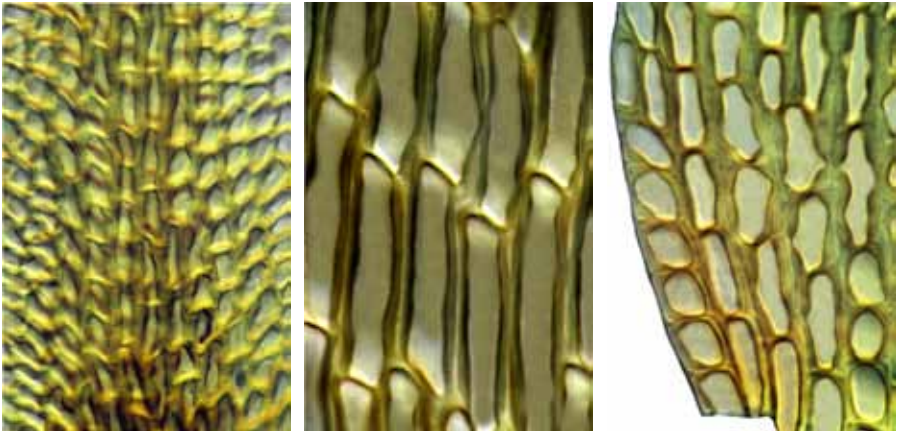


*Andreaea huttonii* cells near leaf base  
10  $\mu$ m

**Andreaea microvaginata** Müll.Hal.**form:** dense cushions of erect, red-orange, falcate-secund shoots, to 20 mm**habitat:** soil or acidic rock in heath-, shrub-, grassland, or forest to 1800 m**leaf:** size: 0.8–1.2 × 0.2–0.3 mm*shape:* an oblong/ovate base tapering gradually to a falcate tip*tip:* acute, minutely rounded*base:* sheathing*costa:* distally ± filling the lamina, proximally weak or absent*border:* not differentiated*margin:* ± crenulate/toothed proximally, entire distally, plane to incurved*cells:* 10–60 × 10 μm, heterogeneous, mostly thick-walled, smooth**capsule:** 1 mm, elliptic to ovate, emergent to excurrent, opening by 4 dark-pigmented valves, fused at their apices, that bulge outward upon drying; spores 20–35 μm in diam.

falcate-secund vegetative shoots (3), leaf outline, leaf apex, and margin at mid-sheath

1 mm (3), 0.1 mm, 50 μm, 10 μm



cells near base of weak costa, cells at midbase, and leaf basal angle

50 μm, 10 μm, 10 μm



**Andreaea mutabilis** Hook.f. & Wilson

**form:** dark-pigmented or blackish cushions or turfs at high elevation  
**habitat:** acidic rock

**leaf:** size: 0.8–1.2 × 0.4 mm

**shape:** ovate or oblong-lanceolate to ± panduriform, straight or falcate

**tip:** acute or obtuse, not cucullate

**base:** undifferentiated, not sheathing

**costa:** absent

**border:** not differentiated

**margin:** entire to ± toothed, incurved, plane at only the tip

**cells:** 10 μm, isodiametric, irregular (elongated toward base), thick-walled, papillose to smooth

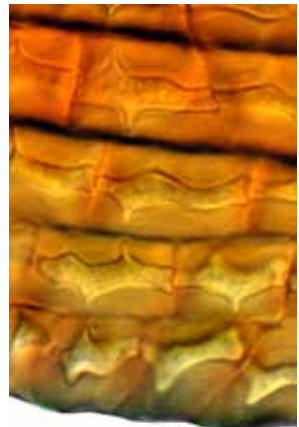
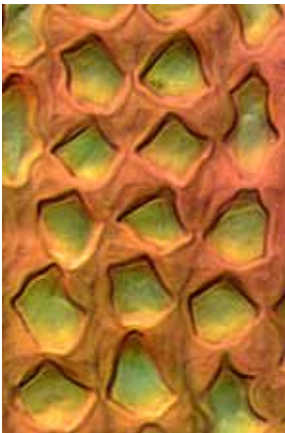
**capsule:** 0.5 mm, opening by four valves that bulge outward when dry; pseudopodium 0.5 mm

**notes:** common in alpine areas; *Andreaea acutifolia* var. *acutifolia* too is ecostate, but has long (not short) cells along the basal margin of its leaf



fertile habit, capsules wet and dry, leaf outline, and leaf apex

0.5 mm, 0.5 mm (2), 0.1 mm, 10 μm



cells midleaf, margin midleaf, and margin lower leaf

10 μm, 10 μm, 10 μm

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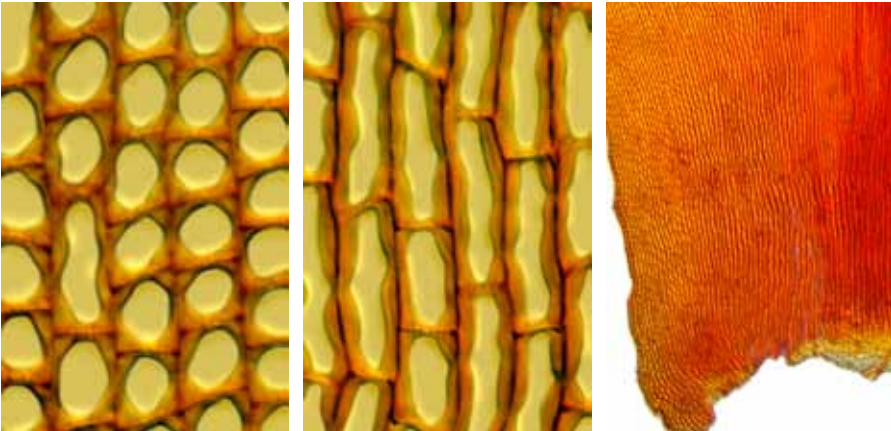


*Andreaea mutabilis* capsules moist and closed (left) and dry and open (right)  
0.1 mm

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**Andreaea nitida** Hook.f. & Wilson**form:** tufted, erect stems, the leaves dark red to nearly black**habitat:** shaded, moist to dripping rock, montane to subalpine**leaf:** size: 1.0–4.0 mm long*shape:* oblong, obovate, orbicular or lingulate*tip:* broadly acute to obtuse, sometimes mucronate*base:* sheathing, alar region not differentiated; juxtacostal cells elongate*costa:* broad, reaching to midleaf, irregularly forked, spurred, or branched*border:* not differentiated*margin:* entire, plane to broadly reflexed; marginal cells isodiametric*cells:* marginal and upper cells 10  $\mu\text{m}$ , isodiametric, thick-walled, smooth**capsule:** 0.5 mm, oval, opening by four valves that bulge outward when dry; capsule base shorter than the valves; pseudopodium short

vegetative shoot (dry), leaf outline, leaf apex, and margin midleaf

 1 mm, 1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 


cells upper leaf, lower juxtacostal cells, and leaf basal angle

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 100  $\mu\text{m}$ 

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**Andreaea subulata** Harv.**form:** dense tufts or cushions of crowded, erect, dark red stems**habitat:** rock at montane to subalpine elevation**leaf:** size: 1.5–2.0 × 0.3–0.4 mm*shape:* subulate from an oblong base, with no sinus, straight to falcate*tip:* narrowly acute or acuminate, not rounded*base:* sheathing; basal cells longer than the laminal cells, up to  $50 \times 10 \mu\text{m}$ *costa:* ± filling the subulate distal half of the leaf*border:* not differentiated*margin:* entire, plane to incurved*cells:*  $15 \times 10 \mu\text{m}$ , ± isodiametric, thick-walled, smooth**capsule:** 0.5 mm, oval, opening by four valves that bulge outward when dry;  
capsule base shorter than the valves; pseudopodium short

vegetative shoots (moist) (3), leaf outlines (2), leaf apex, and leaf subapex  
 1 mm, 1 mm (2), 0.1 mm (2), 10  $\mu\text{m}$ , 50  $\mu\text{m}$



margin midleaf, costa midleaf, and leaf basal angle  
 50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

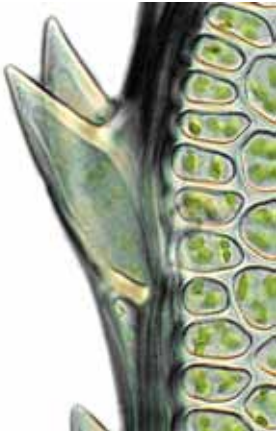
**Atrichum androgynum** (Müll.Hal.) A.Jaeger**form:** robust, loose tufts, dull yellow-green or brown**habitat:** soil in damp forests, often near streams**leaf:** size: 7–10 × 1–2 mm*shape:* lingulate to lanceolate, undulate, crisped when dry, toothed abaxially*tip:* obtuse*lamellae:* 3–6, sinuose, 2–5 rows of cells, the uppermost row entire*base:* basal cells rectangular and thick-walled, otherwise little differentiated*costa:* reaching the apex, spinose on the back above*border:* narrow*margin:* bistratose and the teeth often double, undulate*cells:* 18–20  $\mu\text{m}$ , isodiametric, thick-walled, smooth**capsule:** 3–7 × 0.5–1.0 mm; slightly curved, subcylindric; seta 15–20 mm, sometimes multiple**notes:** readily separated from other austral Polytrichaceae by its leaves that are crisped when dry and have only 3–4 low lamellae

vegetative habit, fertile shoot, leaf outline, and toothed leaf apex

5 mm,

5 mm,

1 mm,

50  $\mu\text{m}$ 

double marginal teeth, lamellae (top view and upended whole-mount), capsule (dry) (2)

50  $\mu\text{m}$ ,50  $\mu\text{m}$ ,10  $\mu\text{m}$ ,

1 mm,

0.5 mm



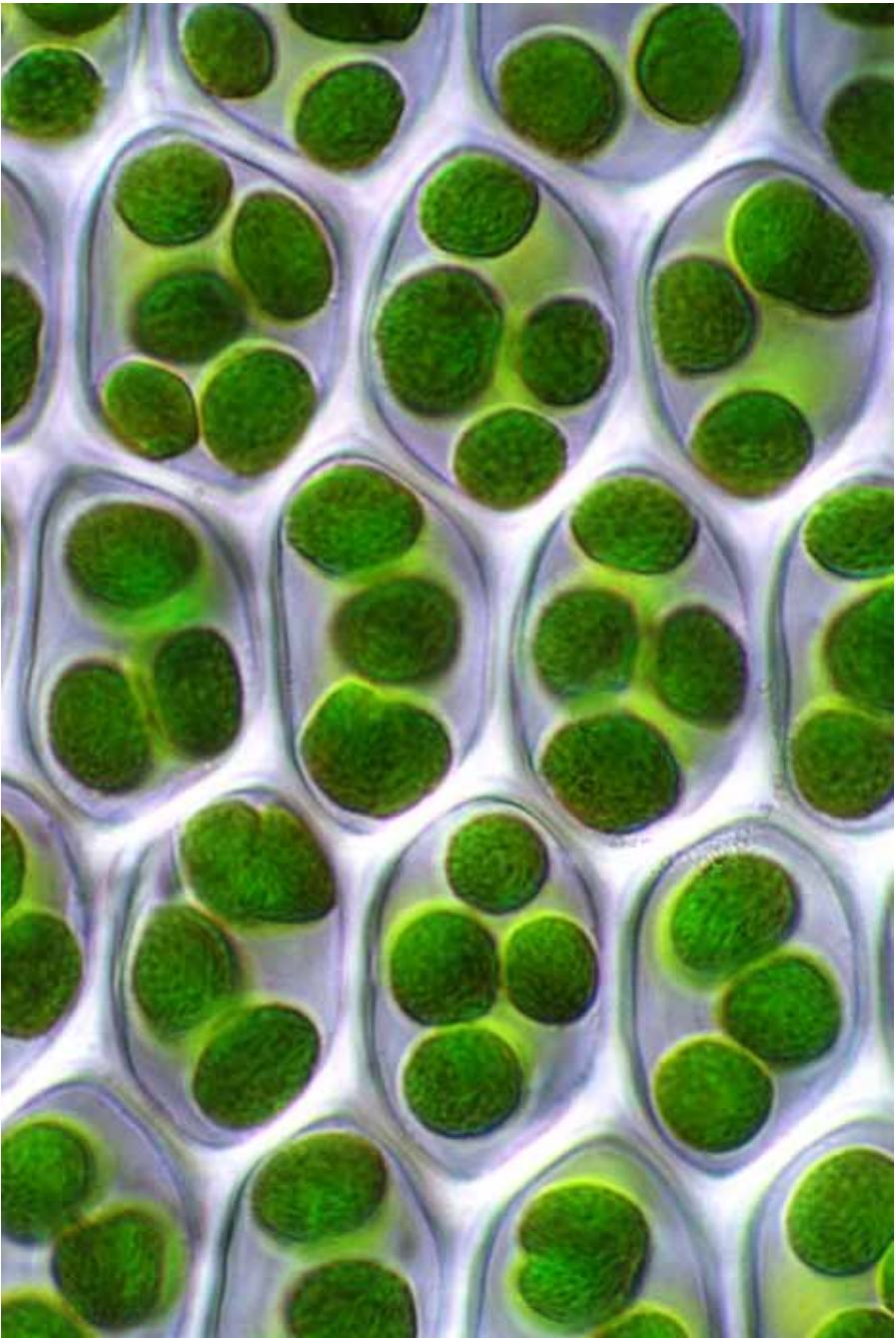
*Atrichum androgynum* vegetative habit  
5 mm

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*Atrichum androgynum* vegetative shoot (moist)  
— mm

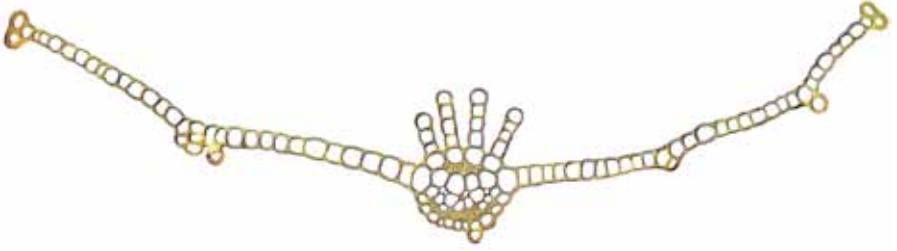
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*Atrichum androgynum* leaf cells with chloroplasts  
10  $\mu$ m

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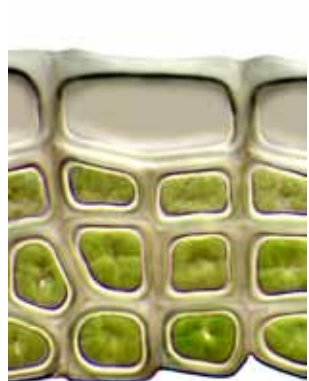
*Atrichum androgynum* leaf, costa, and margin cross-sections  
50  $\mu\text{m}$  (top), 10  $\mu\text{m}$  (middle), 10  $\mu\text{m}$  (bottom)

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**Dawsonia superba** var. **pulchra** (Wijk) Zanten**form:** tall (to 400 mm), gregarious, tomentose below, the stems 3-ribbed**habitat:** soil in shaded forests, especially damp clay banks along tracks and roads**leaf:** size: 25–35 × 2.5–3.5 mm*shape:* linear-subulate*tip:* acute arista*lamellae:* 60–90, each 3–6 cells high*base:* of sheathing base narrowly linear, thin-walled*costa:* excurrent as a toothed arista*border:* not differentiated*margin:* spinulose-serrate, plane but incurved when dry*cells:* 25–80 μm, rectangular, firm-walled, smooth**capsule:** 7–8 mm, ellipsoid, horizontal, flattened when mature; seta 10–35 mm, stout; peristome of densely tufted hairs**notes:** large enough to be mistaken for a pine seedling

vegetative habit, leaf insertions, leaf outline, and immature and mature capsules

30 mm, 1 mm, 1 mm, 1 mm, 1 mm



spinose margin midleaf, marginal spine midleaf, and leaf lamella

0.5 mm, 100 μm, 10 μm

**Dendrologotrichum tongariroense** (Colenso) Tangney

**form:** solitary to tufted, erect, branched, dendroid stems, tomentose below  
**habitat:** soil in montane forest

**leaf:** size: 5–12 mm

*shape:* lanceolate-subulate from a wide oblong sheathing base

*tip:* blunt, strongly toothed

*lamellae:* 30–40 rows, each 3–4 cells high

*base:* sheath cells narrowly linear

*costa:* narrow below, widened above, toothed at the back

*border:* not differentiated

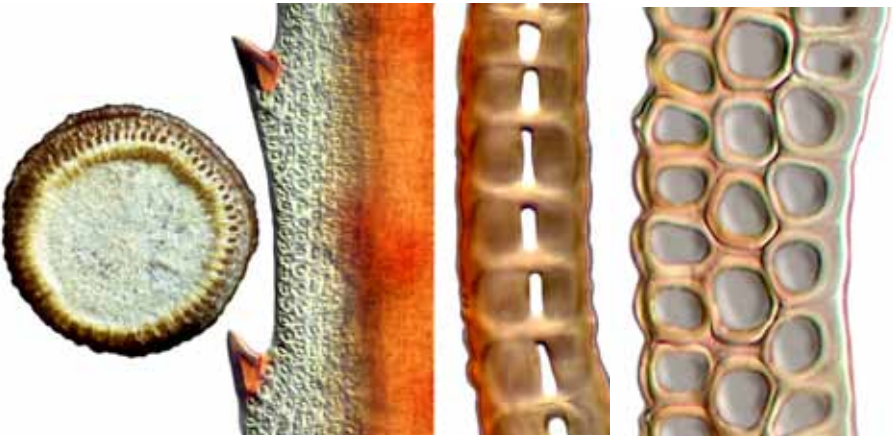
*margin:* bistratose and sharply toothed, plane

*cells:* 8–10  $\mu\text{m}$ , subquadrate, thick-walled, smooth

**capsule:** 5–6 mm, subcylindric,  $\pm$  curved, erect to inclined, smooth, brown; seta 30–50 mm,  $\pm$  flexuose, red; operculum rostrate; calyptra cucullate, slightly hairy; peristome teeth 32, red, darker toward the centre, on a tall basal membrane



vegetative habit, vegetative shoot, leaf outline, and leaf apex  
 10 mm, 5 mm, 1 mm, 50  $\mu\text{m}$

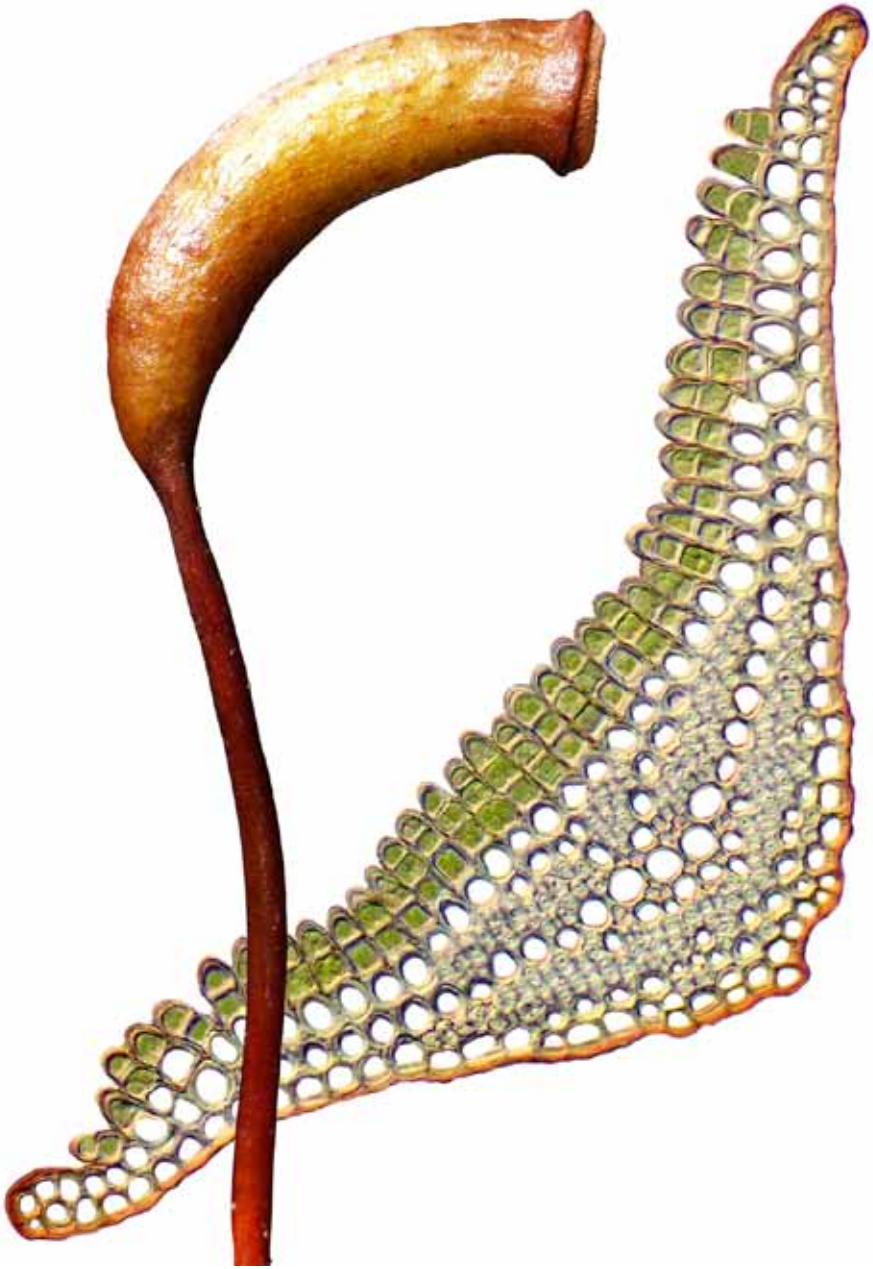


capsule epiphragm, margin midleaf, leaf xs, and lamella wm (upended)  
 1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



*Dendroligotrichum tongariroense* vegetative habit  
10 mm

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*Dendroligotrichum tongariroense* leaf cross-section and mature capsule  
50  $\mu\text{m}$  (section), 1 mm (capsule)

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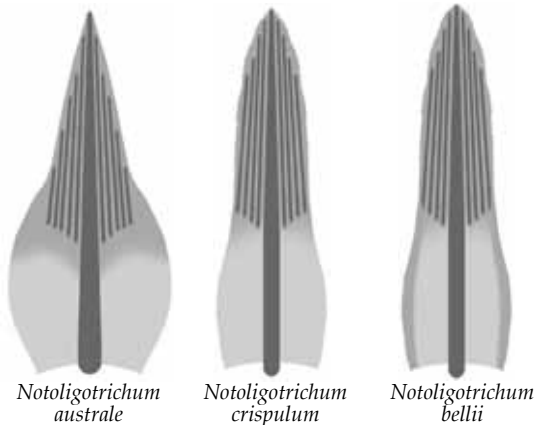
*Dendroligotrichum tongariroense* perigonium  
1 mm

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**Key\* to the New Zealand species of *Notoligotrichum* (3)**

- 1 Leaf margin undulate above; lamellae 40 or fewer; peristome absent..... ● ***Notoligotrichum bellii***
- 1: Leaf margin not undulate above; lamellae 40–70; peristome present ..... 2
- 2(1:) Leaf margin mostly entire; lamellae 40–45, of 5–10 rows of cells..... ● ***Notoligotrichum australe***
- 2: Leaf margin mostly toothed; lamellae 60–70, of 3 rows of cells..... ● ***Notoligotrichum crispulum***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 36.



**Notoligotrichum australe** (Hook.f. & Wilson) G.L.Sm.

**form:** cushion-forming, erect, comose, simple, radiculose below

**habitat:** soil, usually in exposed scrub above tree-line

**leaf:** size: 4–5 × 2.0–2.5 mm

**shape:** narrowly triangular from an ovate sheath

**tip:** acute, incurved

**base:** sheath cells short-rectangular

**lamellae:** 40–45, crowded, 4–5 rows tall, the terminal cell papillose

**costa:** excurrent in a short, red point

**border:** a few rows of hyaline cells on the margin of the sheath

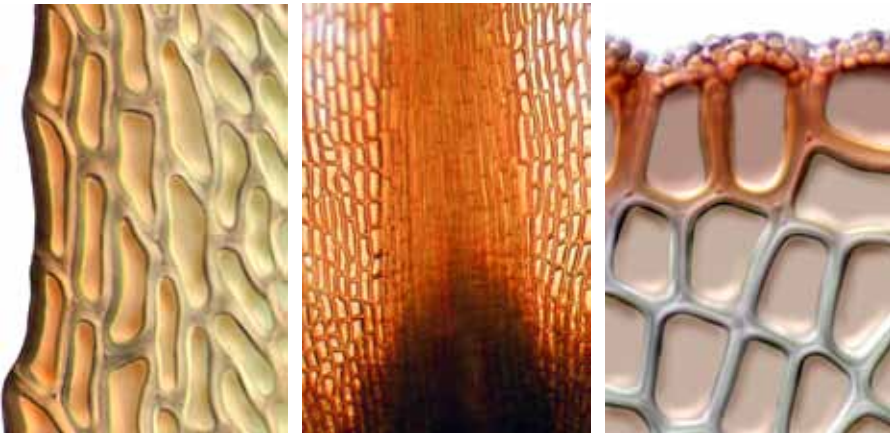
**margin:** entire, plane

**cells:** 12 μm long, rectangular, firm-walled, smooth

**capsule:** 3–4.5 mm, ovoid, symmetrical, small-mouthed, pale brown;  
seta 18–25 mm, straw-coloured, ± flexuose; operculum rostrate;  
calyptra smooth, inflated, bristle-tipped; peristome of 16 long teeth  
alternating with 16 short or rudimentary teeth



vegetative shoot (dry), leaf outline, capsule, epiphragm loss, and margin with lamellae  
1 mm, 1 mm, 1 mm, 0.5 mm (2), 10 μm



margin midleaf, costa near leaf base, and papillose margin of lamella  
10 μm, 50 μm, 10 μm

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*Notoligotrichum australe* capsules with calyptrae  
1 mm

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*Notoligotrichum australe* leaf cross-sections, without lamellae (left) and with (right)  
10  $\mu\text{m}$ , 10  $\mu\text{m}$

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*Notoligotrichum bellii* (Hook.f. & Wilson) G.L.Sm.

**form:** scattered, erect, unbranched stems, brownish, to 50 mm tall

**habitat:** soil in moist sites

**leaf:** size: 4–5 × 2.0–2.5 mm

*shape:* oblong from a weakly sheathing base, unistratose, crisped when dry

*tip:* obtuse

*base:* basal cells short- to long-rectangular, not hyaline at the margin

*lamellae:* 30–40, ± sinuose, 2–3 rows of cells, the terminal cell ± papillose

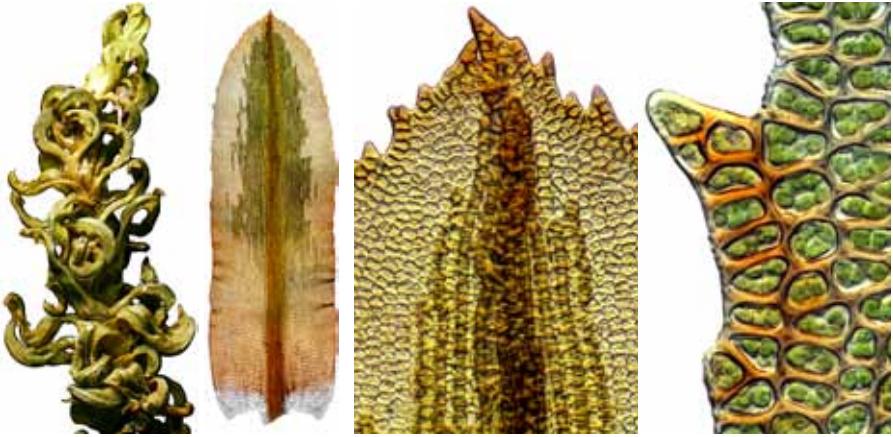
*costa:* percurrent to failing below the apex, ± toothed on the back above

*border:* not differentiated

*margin:* irregularly serrulate above, entire below, ± undulate

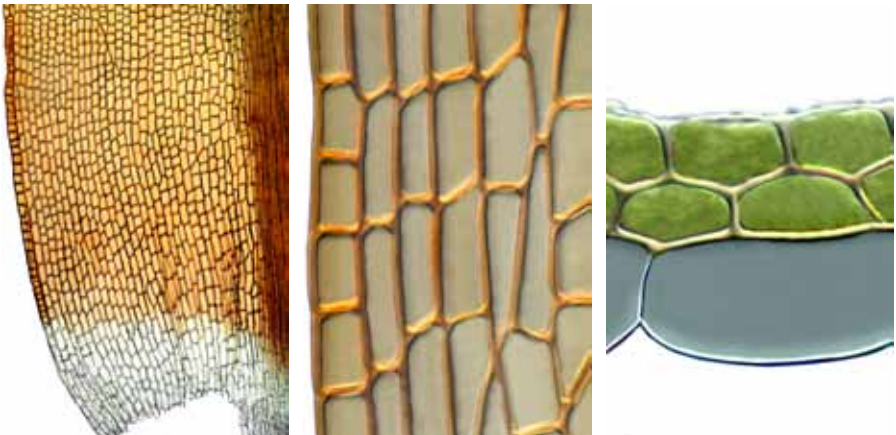
*cells:* 20–25 μm, subquadrate or oval, variably thick-walled, smooth

**capsule:** 4 mm, ovoid, symmetric or nearly so, short-necked, erect, exserted, brown; mouth wide and oblique; seta to 15 mm, stout, curved; peristome none



vegetative shoot (dry), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 1 mm, ■ 50 μm, ■ 10 μm



leaf basal angle, margin near leaf base, and lamella

■ 100 μm, ■ 50 μm, ■ 10 μm

continued next page



*Notoligotrichum bellii* leaf outline  
1 mm

continued next page

**Notoligotrichum crispulum** (Hook.f. & Wilson) G.L.Sm.

**form:** gregarious to loosely tufted, dull green or brown, simple or branched  
**habitat:** soil in shaded sites

**leaf:** size: 5–8 × 1.7–2.7 mm

*shape:* oblong-lanceolate from an oblong, ± sheathing base

*tip:* acute

*lamellae:* 60–70, 2–5 rows high, the uppermost row papillose

*base:* sheath cells short-rectangular to subquadrate

*costa:* percurrent to excurrent, toothed at the back

*border:* not differentiated

*margin:* ± toothed throughout, plane

*cells:* lamina cells 12–15 μm, isodiametric, thick-walled, smooth

**capsule:** 4.5–7 mm, oblong-ovate, erect to inclined, narrow-mouthed; no apophysis; seta 20–35 mm, stout, straw-coloured; calyptra smooth, inflated, reddish, bristle-tipped; operculum finely curved-rostrate; peristome teeth 32, short



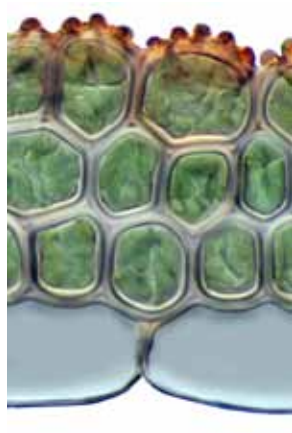
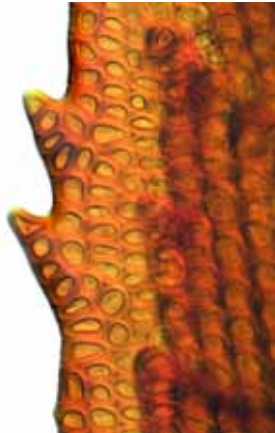
male gametophores, vegetative shoot (moist), capsule, and leaf outline

10 mm,

10 mm,

1 mm,

1 mm

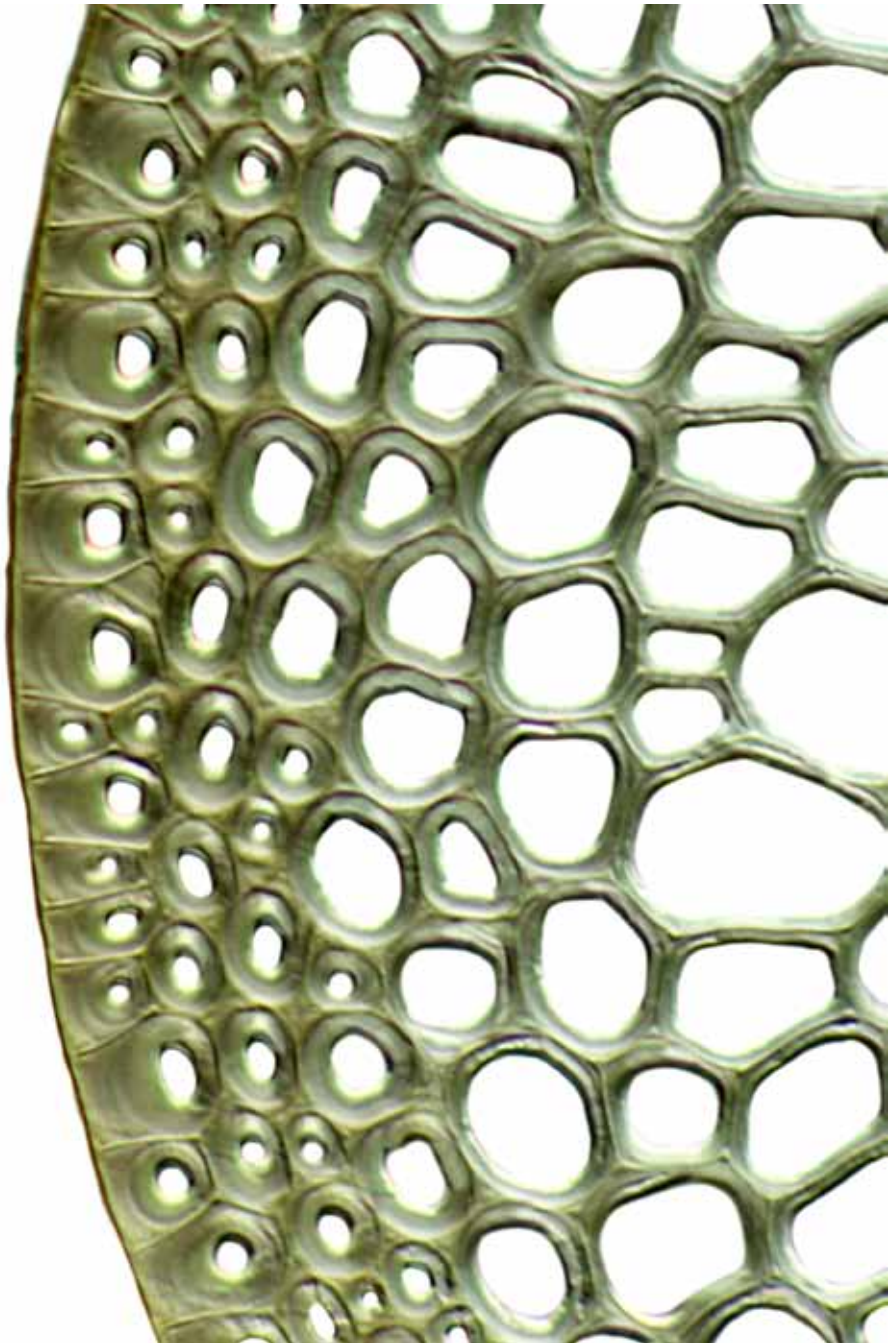


leaf apex, margin upper leaf, and papillose margin of lamella

0.1 mm,

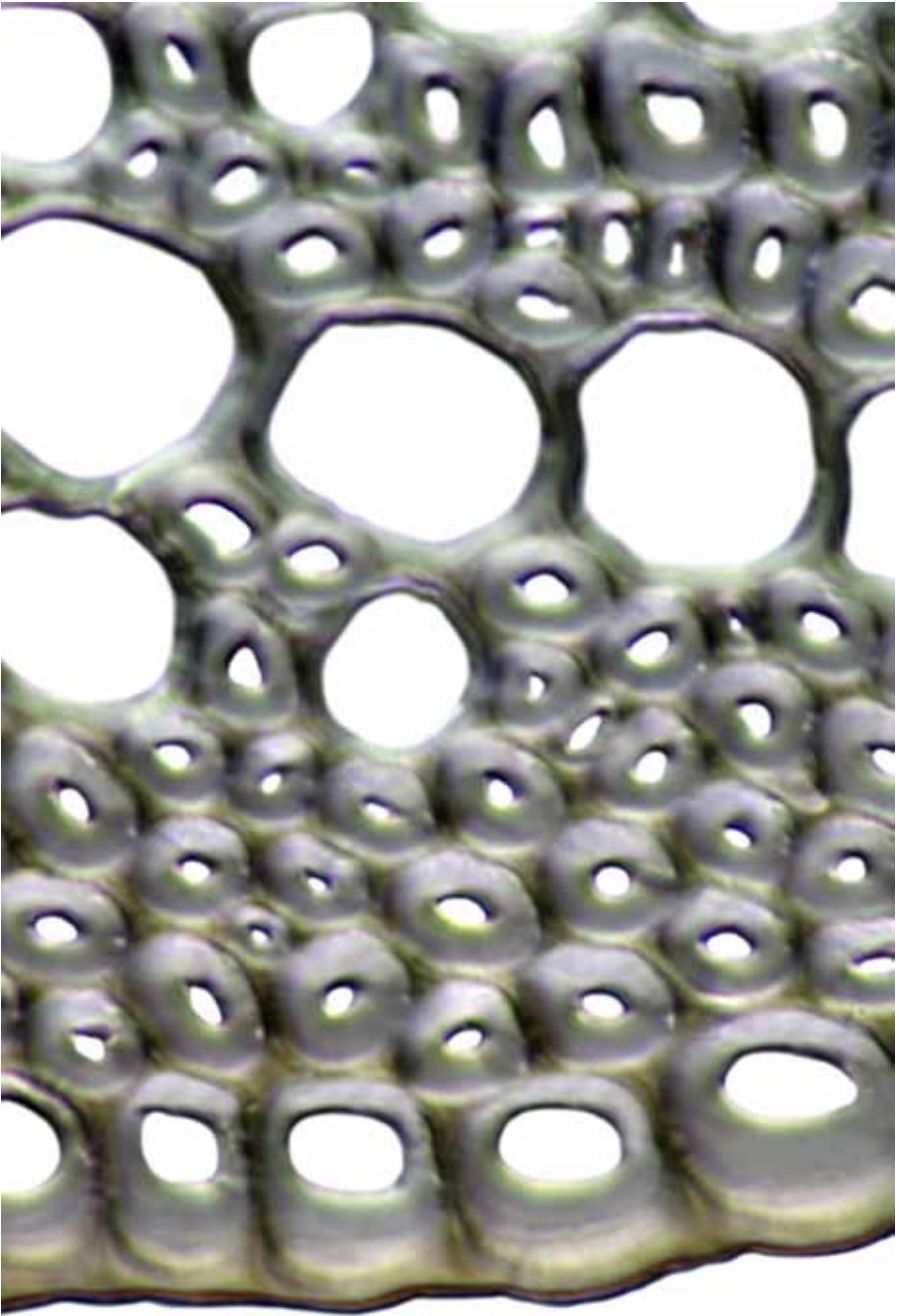
50 μm,

10 μm



*Notoligotrichum crispulum* seta cross-section  
1  $\mu\text{m}$

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*Notoligotrichum crispulum* abaxial leaf surface, cross-section  
10  $\mu\text{m}$

continued next page



*Notoligotrichum crispulum* leaf cross-section, showing papillose lamellae  
10  $\mu\text{m}$



**Oligotrichum tenuirostre** (Hook.) A. Jaeger

**form:** tufted or gregarious, yellow-brown, erect, unbranched stems  
**habitat:** soil

**leaf:** size: 4–6 mm

*shape:* lanceolate to oblong-lanceolate, concave, ± bistratose above

*tip:* acute

*lamellae:* about 10, with 4 rows of cells each, the marginal cells smooth

*base:* basal sheath ill-defined; sheath cells rectangular

*costa:* percurrent

*border:* not differentiated

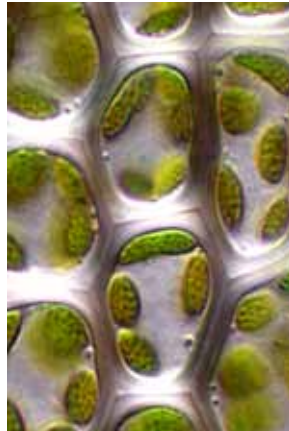
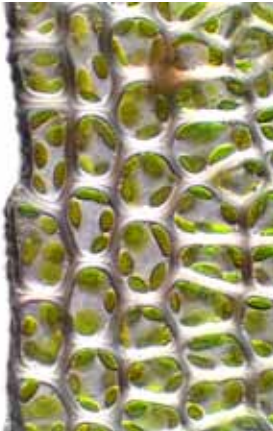
*margin:* entire, plane

*cells:* lamina cells 11–13  $\mu\text{m}$ , subsodiametric, firm-walled, smooth

**capsule:** 2–4 mm, oblong or ovate-oblong, ± gibbous, terete or obscurely angled, erect, with numerous stomata; seta 30–40 mm, yellow-brown, ± curved; calyptra cucullate, bristle-tipped; operculum slender-rostrate; peristome teeth 32, irregular, pale; spores 14–16  $\mu\text{m}$  in diam.



vegetative shoots (moist), capsule, leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10  $\mu\text{m}$



margin midleaf, cells midleaf, and leaf base  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 100  $\mu\text{m}$



*Oligotrichum tenuirostre* capsule and epiphragm  
1 mm (capsule), 100  $\mu\text{m}$  (epiphragm)

continued next page

**Pogonatum subulatum** (Brid.) Brid.

**form:** gregarious, slender, simple stems, dark green above, to 25 mm tall  
**habitat:** clayey soil or rarely rock, in disturbed sites such as road cuttings

**leaf:** size: 6–8 × 1.5–2.0 mm

**shape:** oblong-lanceolate, narrowed from a slightly wider sheath

**tip:** acute

**lamellae:** 40–50, 3–5 rows tall, the uppermost row of cells smooth, entire

**base:** sheath cells subquadrate above, rectangular below

**costa:** percurrent or subpercurrent, serrate on the back above

**border:** not differentiated

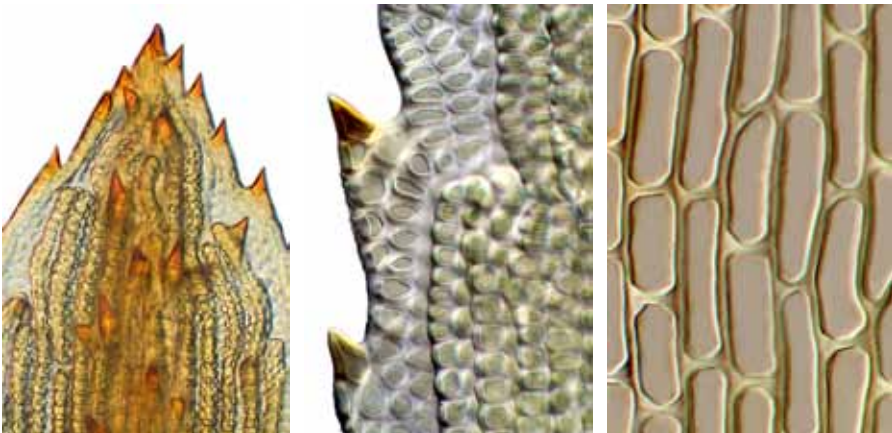
**margin:** sharply toothed, plane

**cells:** 10–12  $\mu\text{m}$  in 3–6 rows,  $\pm$  isodiametric, firm-walled, smooth

**capsule:** 2.5–3.5 mm, calyptra covering the capsule, felted with long, pale, reflexed hairs, cylindric, symmetric, erect to  $\pm$  inclined, light brown, lacking stomata or apophysis; seta 25 mm, dark red or brown; calyptra felted, covering the capsule; peristome teeth narrow



fertile shoot (dry and moist) (3), capsules (3), leaf outline, and lamella (upended)  
 10 mm, 10 mm, 1 mm, 1 mm (3), 1 mm, 10  $\mu\text{m}$



leaf apex, margin midleaf with lamellae, and leaf base cells  
 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



*Pogonatum subulatum* leaf outline  
1 mm

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**Polytrichadelphus magellanicus** (Hedw.) Mitt.

**form:** gregarious, erect, simple or dichotomously branched stems, to 80 mm tall  
**habitat:** soil, usually clay along tracks or roads, to subalpine elevations

**leaf:** size: 6–9 × 1.5–2.2 mm

*shape:* lanceolate-subulate, abruptly narrowed from an oblong sheathing base  
*tip:* acute

*lamellae:* 40–50, 5–8 rows tall, the uppermost cells enlarged, thick-walled

*base:* sheathing

*costa:* percurrent or excurrent in a toothed, reddish arista

*border:* not differentiated

*margin:* serrate, plane

*cells:* 12 μm, in 1–2 rows, subquadrate, thick-walled, smooth

**capsule:** 3–4 mm, oblong, ± erect, no apophysis, 2-angled, semi-lunar in xs;  
 seta 40–70 mm, stout, pink; peristome teeth 64; calyptra smooth below,  
 with a tuft of dark bristles at the apex

**note:** the stacked older inflorescences of male plants often look pagoda-like



vegetative shoots (moist), capsule with calyptra, epiphragm, leaf outline, and leaf apex  
 5 mm (2), 1 mm, 0.1 mm, 1 mm, 50 μm



perigonia (male), margin midleaf, and lamella (upended)  
 5 mm, 10 μm, 10 μm



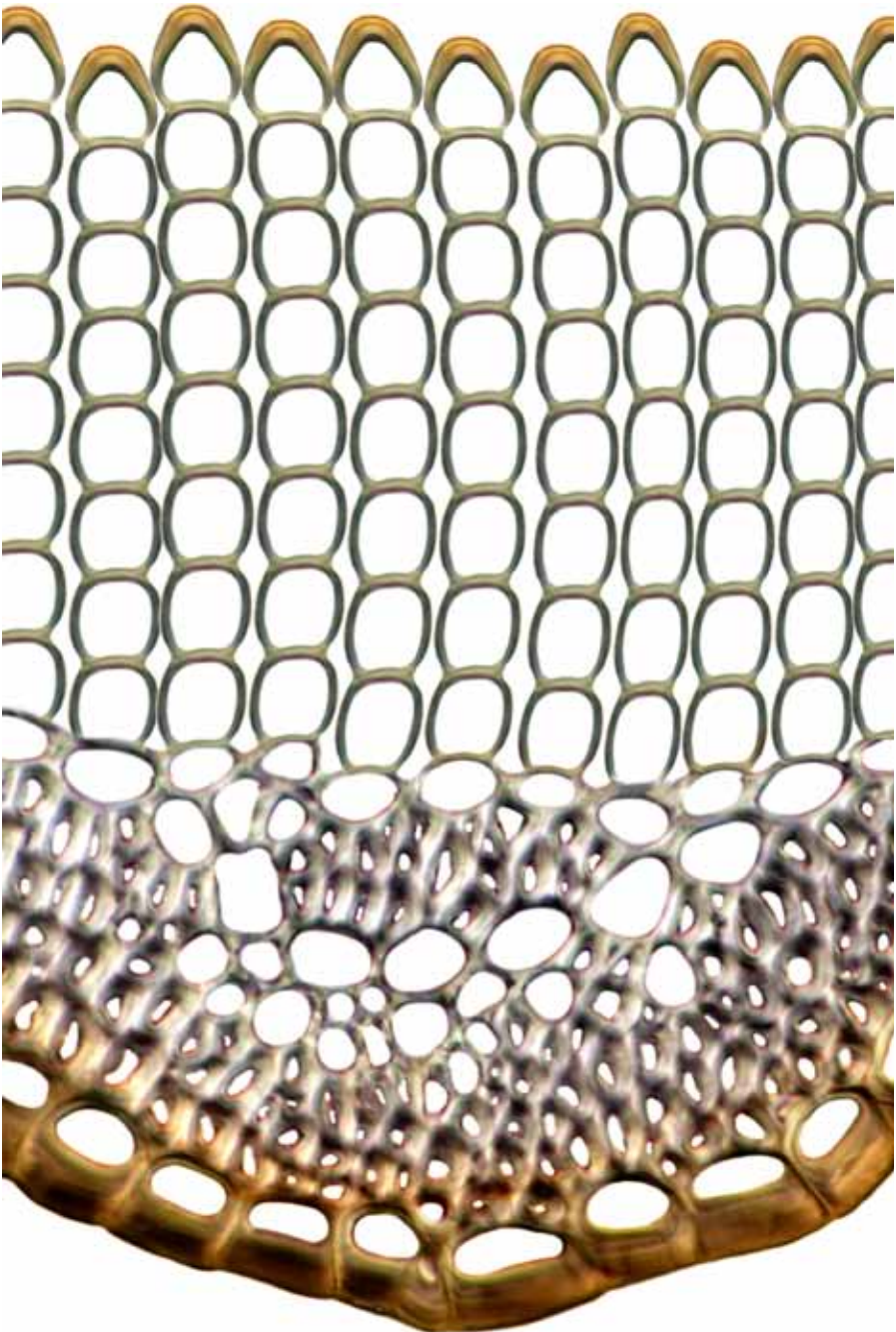
*Polytrichadelphus magellanicus* immature capsules with calyptrae  
0.5 mm

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*Polytrichadelphus magellanicus* leaf cross-section  
50  $\mu\text{m}$

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*Polytrichadelphus magellanicus* leaf cross-section (partly diagrammatic)  
10  $\mu\text{m}$

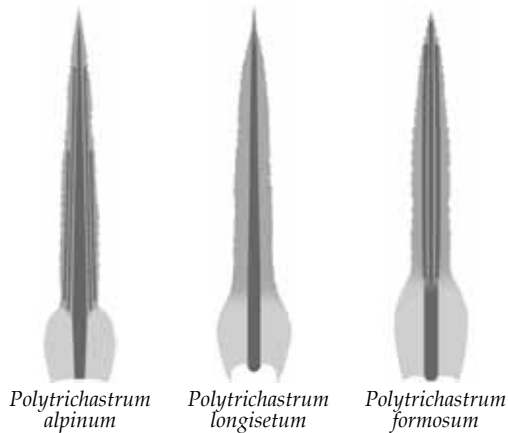
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**Key\* to the New Zealand species of *Polytrichastrum* (3)**

- 1 Lamellae papillose; capsules terete ..... ● ***Polytrichastrum alpinum***  
 1: Lamellae not papillose; capsules 4–6-angled ..... 2  
 2(1:) Marginal lamina 5–9(–20) cells wide; median sheath cells 3–5:1.....  
 ..... ● ***Polytrichastrum longisetum***  
 2: Marginal lamina 2–5 cells wide; median sheath cells 5–9:1.....  
 ..... ● ***Polytrichastrum formosum***

\* based on Smith Merrill, GL (2007): *Polytrichastrum*. *Flora of North America* 27, 125.



**Polytrichastrum alpinum** (Hedw.) G.L.Sm.

**form:** robust, loosely tufted, erect, dull or glaucous, forked, radiculose below  
**habitat:** rock, soil, or humus, usually in damp and shaded sites near streams

**leaf:** size: 7–10 × 1.4–2.0 mm

*shape:* linear-lanceolate, abruptly narrowed from a broadly oval sheathing base

*tip:* acute to acuminate

*lamellae:* 15–25, 3–7 rows tall, the uppermost cells thick-walled, papillose

*base:* cells of the sheath ± linear, the margin involute

*costa:* ending in a short toothed awn

*border:* not differentiated

*margin:* coarsely toothed throughout, plane

*cells:* 10–15 μm, ± isodiametric, thick-walled, smooth

**capsule:** 3–6 mm, erect to inclined, cylindrical, stomatose at the base, 3-angled toward the tip; seta 15–50 mm, yellowish; operculum long-rostrate; peristome teeth 32, irregularly divided; spores 14–16 μm in diam., smooth



habit (moist), fertile shoot (3), capsule (dry), leaf outline, and leaf apex

5 mm, 5 mm, 5 mm, 1 mm, 0.5 mm, 50 μm



margin midleaf (2) and papillose margin of lamella

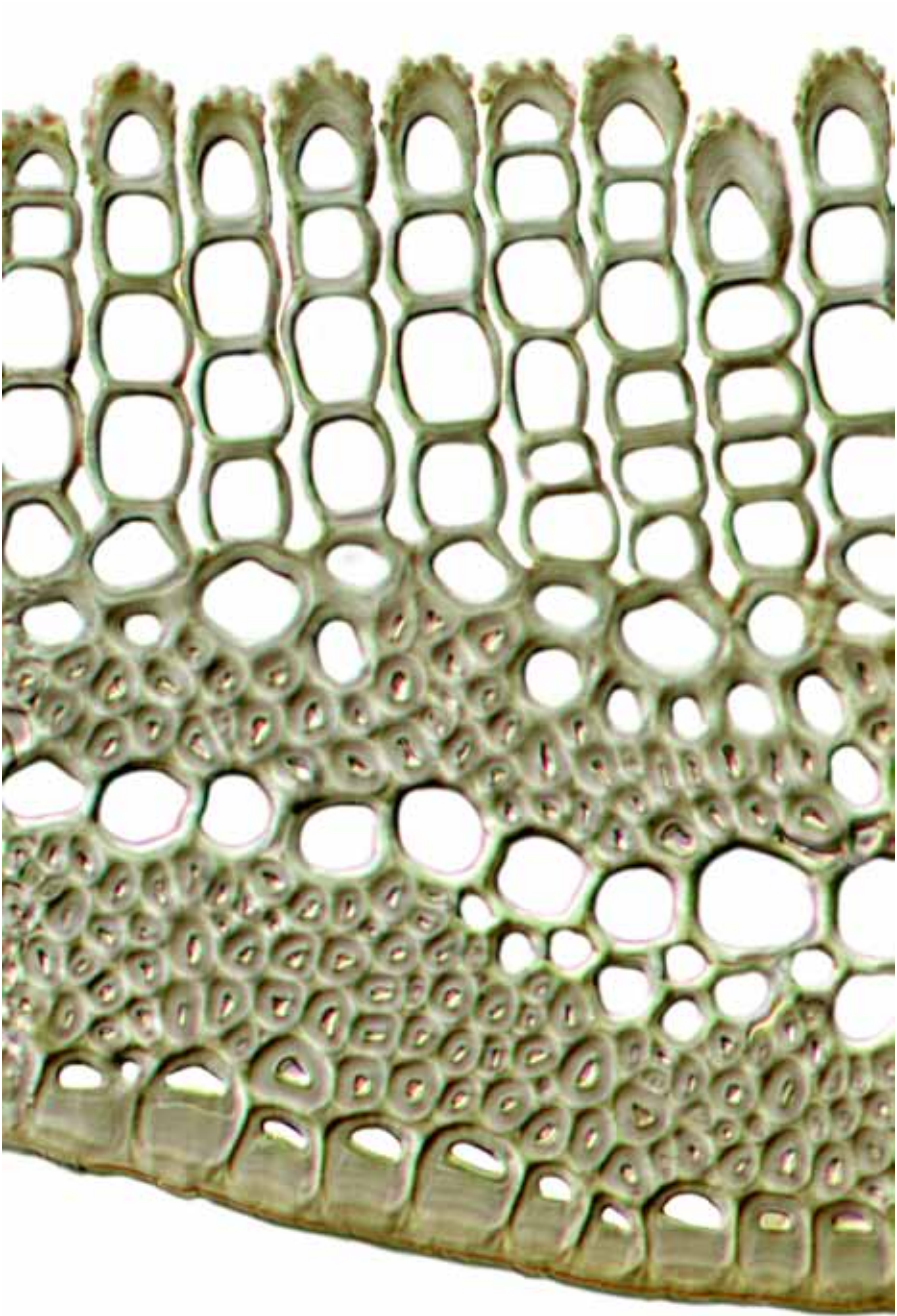
10 μm, 10 μm, 10 μm

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*Polytrichastrum alpinum* vegetative shoot (fully hydrated)  
1 mm

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*Polytrichastrum alpinum* leaf cross-section  
10  $\mu$ m

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*Polytrichastrum alpinum* seta cross-section  
50  $\mu$ m

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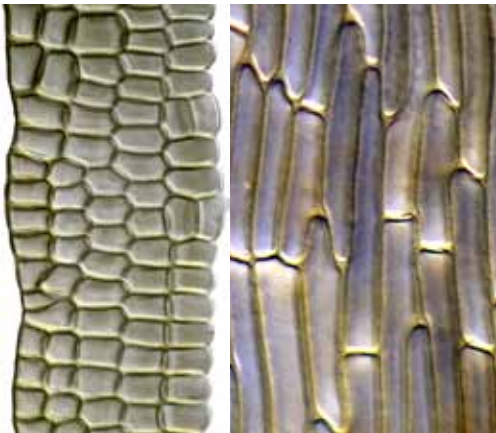


*Polytrichastrum alpinum* seta cross-section (detail)  
10  $\mu\text{m}$

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**Polytrichastrum formosum** (Hedw.) G.L.Sm.**form:** scattered, erect stems, green above, reddish below**habitat:** damp to wet peat in open sites**leaf:** size: 6–12 x 0.7–1.2 mm*shape:* linear from a wide, oblong, sheathing base*tip:* long-acuminate, toothed*lamellae:* 40–65, each 3–7 cells tall, the uppermost not papillose*base:* sheath of long-rectangular (5–9:1) hyaline, thin- to firm-walled cells*costa:* long-excurrent, with abaxial teeth*border:* not differentiated*margin:* sharply dentate, unistratose, 3–10 cells wide*cells:* lamina cells 15–20 x 10–15  $\mu\text{m}$ , short-rectangular, thick-walled, smooth**capsule:** 4.5–6.5 mm, 4-angled, the ridges rounded, cylindric, horizontal, long-exserted, brown; seta 30–50 mm; spores 15–20  $\mu\text{m}$  in diam.

vegetative shoot (moist), leaf outline, leaf apex, and margin midleaf

 5 mm, 1 mm, 100  $\mu\text{m}$ , 10  $\mu\text{m}$ 


lamella (upended), sheath cells, and calyptra hair-cross-section

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 


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*Polytrichastrum formosum* mature capsule and detached calyptra  
1 mm

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*Polytrichastrum formosum* dentate leaf margin plus lamellae (flattened)  
10  $\mu\text{m}$

**Polytrichastrum longisetum** (Brid.) G.L.Sm.**form:** tufts or turves of dark green stems, to 100 mm tall**habitat:** well-drained acidic soil or humus in scrub or forest**leaf:** size: 5–8 mm*shape:* narrowly lanceolate*tip:* acuminate*lamellae:* 25–35, 3–7 cells tall, the marginal row smooth*base:* sheath cells rectangular*costa:* excurrent in a brown, denticulate arista*border:* not differentiated*margin:* toothed, erect, inflexed when dry, recurved when moist*cells:* 15–18  $\mu\text{m}$ , quadrate, firm- to thick-walled, smooth**capsule:** 2.5–5 mm, yellow above, reddish below, oblong, obscurely 5–6-angled, erect when young, inclined when mature, the apophysis well-developed; seta 15–70 mm, flexuose; operculum long-rostrate; spores 20–26  $\mu\text{m}$  in diam.

vegetative shoot (moist), leaf outline, leaf apex, and margin near leaf base  
 ■ 1 mm, ■ 1 mm, ■ 10  $\mu\text{m}$ , ■ 100  $\mu\text{m}$

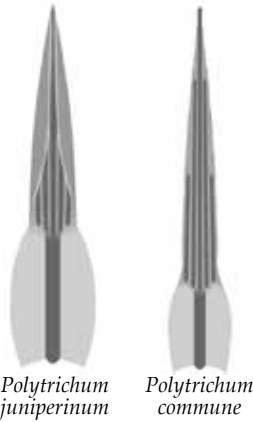


margin upper leaf, margin lower leaf, and leaf lamella  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Key\* to the New Zealand species of *Polytrichum* (2)**

- 1 Leaf margin inflexed, entire..... ● ***Polytrichum juniperinum***  
 1: Leaf margin not inflexed, serrate..... ● ***Polytrichum commune***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 28.



**Polytrichum commune** Hedw.

**form:** robust, tufted, erect, simple, ± flexuose stems, ± radiculose below  
**habitat:** soil or humus in fens and bogs

**leaf:** size: 6–15 × 1.2–3.0 mm

*shape:* narrowly lanceolate from a glossy, sheathing base

*tip:* acuminate, tapering to a spinulose apex

*lamellae:* 30–60, 4–10 cells tall, the uppermost row thick-walled, ± notched

*base:* sheath cells long-linear, distally prorate on the abaxial surface

*costa:* excurrent, toothed at the back

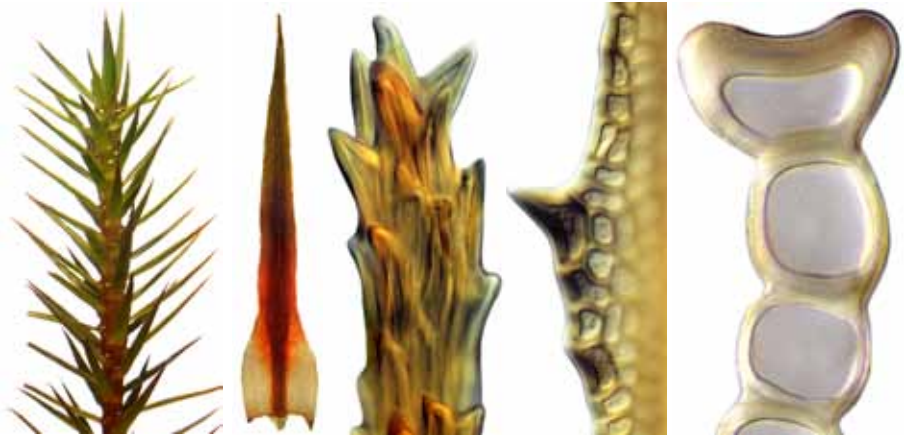
*border:* not differentiated

*margin:* entire in the sheath, sharply serrate to dentate above, plane

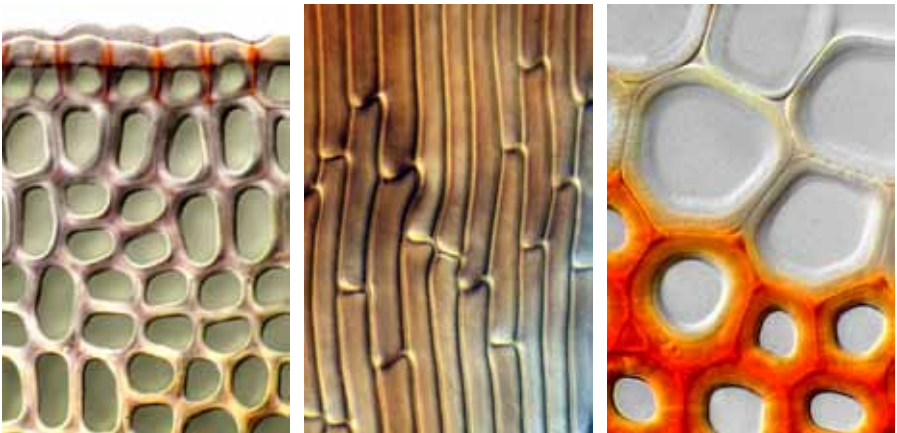
*cells:* blade cells 30 μm, irregularly quadrate, thick-walled, smooth

**capsule:** 3–6 mm, wide-cylindric, 4-angled, hypophysate, inclined to horizontal;  
 seta 50–90 mm; peristome teeth 64; calyptra cucullate, densely long-pilose,  
 covering the capsule

**notes:** nearly cosmopolitan; recognized by the notched uppermost lamella cells



vegetative shoot (moist), leaf outline, leaf apex, margin midleaf, and lamella xs  
 10 mm, 1 mm, 10 μm, 50 μm, 10 μm



lamella, notched upper cells, sheath cells (abaxial view), and seta cross-section (detail)  
 50 μm, 50 μm, 10 μm

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*Polytrichum commune* capsules with calyptrae, and a single calyptra hair in cross-section  
0.5 mm, 1  $\mu$ m

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*Polytrichum commune* mature 4-angled capsule  
1 mm

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**Polytrichum juniperinum** Hedw.

**form:** robust, loosely tufted, often bluish stems, radiculose below, to 130 mm  
**habitat:** soil, humus, or soil over rock, common on tracksides in dry, open sites

**leaf:** size: 5–8 × 1.2–2.0 mm

*shape:* lanceolate, abruptly narrowed from a broad oval sheathing base

*tip:* acuminate

*lamellae:* 23–40, 6–7 rows tall, the uppermost cells thick-walled, strongly crenate

*base:* sheath cells narrowly rhombic, yellowish

*costa:* excurrent, toothed on the back, ending in a reddish toothed awn

*border:* not differentiated

*margin:* entire, broadly infolded, hyaline

*cells:* margin cells 40 × 12 μm, rectangular, incrassate, smooth

**capsule:** 2.5–5 mm, cylindric, erect to horizontal, 4-angled, deeply constricted at apophysis; seta 20–60 mm; calyptra hairy, covering the capsule; operculum stoutly rostrate

**note:** widespread in both hemispheres



vegetative habit (sun form), capsule with hairy calyptra, leaf outline, and leaf apex  
 10 mm, 1 mm, 1 mm, 10 μm



shoot apex showing infolded leaves, cells of infolded margin, and crenate lamella margin  
 1 mm, 10 μm, 10 μm



*Polytrichum juniperinum* mature 4-angled capsule  
0.5 mm

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*Polytrichum juniperinum* (with *Hypnum cupressiforme*) male shoots  
1 mm

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**Tetradontium brownianum** (Dicks.) Schwägr.

**form:** gregarious, minute (< 0.5 mm), erect, linear to spatulate protonemal flaps present and usually persistent, 2–3-stratose; basal flagelliform shoots 2–5 mm long, with 3-ranked linear leaves

**habitat:** damp, shaded crevices and overhangs in siliceous rock at high elev.

**leaf:** size: flaps 70–100 × 0.8–1.5 mm; stem leaves 3-ranked, to 1.2 mm

*shape:* ovate to ovate-lanceolate

*tip:* obtuse to acute or ± mucronate, concave

*base:* basal cells little differentiated

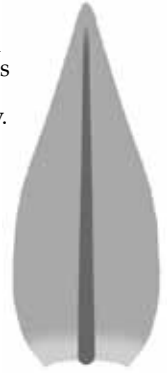
*costa:* none or faint, spinose above abaxially

*border:* not differentiated

*margin:* obscurely denticulate above, plane

*cells:* 20–30 × 10 μm, irregularly oblong, firm-walled, smooth

**capsule:** 0.8–1.3 mm, oblong-cylindric, straight, erect, dark brown; seta 5–8 mm, brown, flexuose; calyptra covering capsule; operculum conic; peristome teeth 4, erect wet or dry, ± triangular; spores multicellular, 14–16 μm



fertile shoots, capsule (dry) (3), persistent protonematal flaps (2), leaf outline, leaf apex  
 1 mm, 0.1 mm, 1 mm, 1 mm (2), 0.1 mm, 10 μm



margin upper leaf, margin midleaf, and margin lower leaf  
 10 μm, 10 μm, 10 μm

**Key\* to the New Zealand species of Buxbaumia (2)**

- 1 Capsule 3–7 mm long, flattened above; seta coarsely papillose; stomata immersed.....  
 ..... ● **Buxbaumia aphylla**
- 1: Capsule 6–9 mm long, not flattened above; seta smooth; stomata superficial .....  
 ..... ● **Buxbaumia novae-zelandiae**

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 26.

**Buxbaumia aphylla** Hedw.

**form:** loose patches of capsules on tall stalks; usually no gametophytes visible

**habitat:** mineralized soil or soil over rock, rotting logs or tree stumps in open scrub, to 1100 m

**capsule:** 3–7 mm, broadly ovoid, chestnut brown with a glossy outer rim, inclined to horizontal; seta 4–11 mm, ± straight; stomata immersed (cryptopore), 1–2-celled; spores 5–12  $\mu\text{m}$  in diam.

**note:** seemingly rare, but probably just overlooked



mature capsule  
1 mm

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**Buxbaumia novae-zelandiae** Dixon

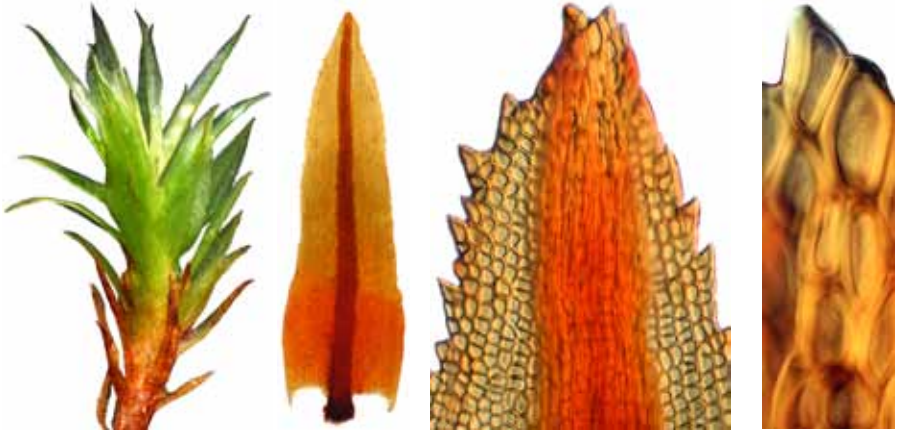
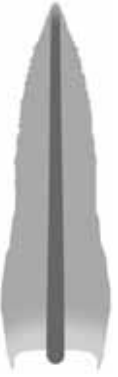
**form:** solitary to gregarious capsules on tall stalks with  $\pm$  persistent basal leaves

**habitat:** shaded rock or gravel in open scrub or forest, often growing among other bryophytes, to 600 m

**capsule:** 6–9 mm, ovoid, pale brown, suberect to inclined; stomata superficial (phaneroporose), 2-celled, sometimes absent; seta 10–24 mm,  $\pm$  straight, reddish, smooth; spores 10–12  $\mu$ m in diam.

**note:** seemingly rare but probably just overlooked



**Timmia norvegica** J.E.Zetterst.**form:** curves of erect, yellowish, sparsely branched stems, radiculose**habitat:** calcareous soil in forests at high altitude, 1200–1800 m**leaf:** size: 3–10 × 0.8–1.1 mm*shape:* linear-lanceolate, base sheathing, ± crisped when dry*tip:* acute or acuminate*base:* cells of sheath long-rectangular, 60–100 × 10–17 μm, incrassate, ± porose*costa:* failing just below the apex, strongly prorate on the back above*border:* not differentiated*margin:* coarsely dentate above, entire below, plane, incurved when dry*cells:* 9–16 × 7–9 μm, irregularly quadrate, firm-walled, mammillose adaxially**capsule:** 2.5–3.0 mm including the weak neck, oblong-oval, horizontal to pendent, brownish, stomatose; seta 15–20 mm, smooth; operculum high-conic, mammillate; annulus large and revoluble; peristome double; exostome teeth 16, yellow, pale above, perforated centrally, to 100 μm long, papillose above; endostome yellow, 64 ± apically fused cilia; spores 17–20 μm in diam.

vegetative shoot (moist), leaf outline, and leaf apex (2)

1 mm, 1 mm, 50 μm, 10 μm



margin upper leaf (2), and prorate abaxial costa cells

50 μm, 10 μm, 10 μm

**Gigaspermum repens** (Hook.) Lindb.

**form:** gregarious, bud-like, erect stems from a fleshy, creeping, perennial, underground primary stem

**habitat:** soil, bare and often calcareous, to 360 m

**leaf:** size: 2.5(-3.5) × 1 mm, wrinkled when dry

*shape:* ± orbicular, abruptly narrowed to a long acumen, papery

*tip:* acuminate, ± hyaline

*base:* not differentiated

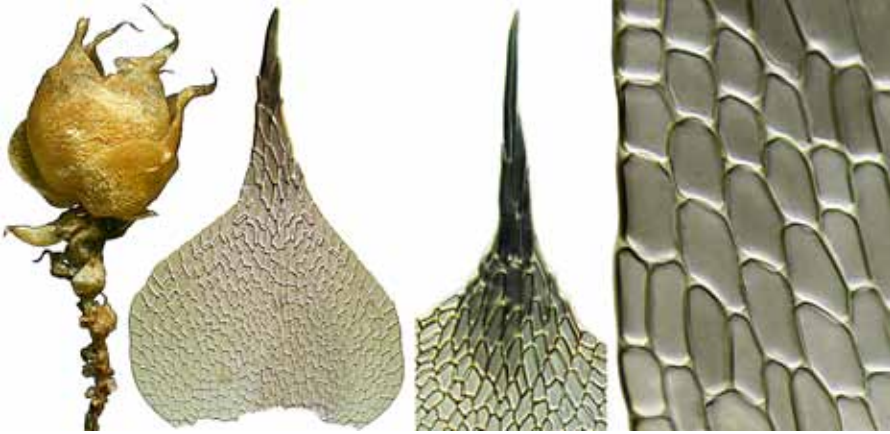
*costa:* none or single

*border:* not differentiated

*margin:* entire, plane

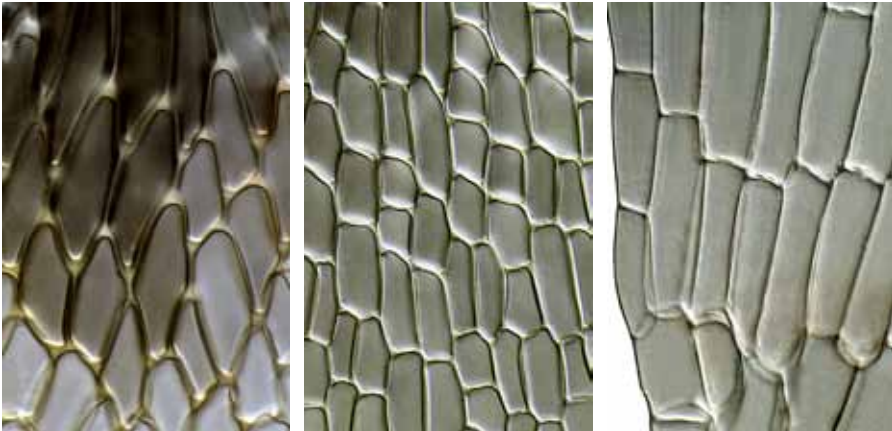
*cells:* 50–120 × 18–25 μm, rhombic, thin-walled, smooth

**capsule:** 1 mm; hemispherical when open, wide-mouthed, immersed among the perichaetial bracts, stomatose below; seta 0.2 mm; calyptra small, falling early; operculum conic, apiculate; peristome absent; spores to 190 μm in diam.



fertile shoot, leaf outline, leaf apex, and margin midleaf

1 mm, 0.1 mm, 50 μm, 50 μm



subapex leaf cells, midleaf cells, and leaf basal angle

50 μm, 50 μm, 50 μm



*Gigaspermum repens* habit (dry)  
10 mm

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*Gigaspermum repens* leaf apex (interference optics)  
50  $\mu\text{m}$

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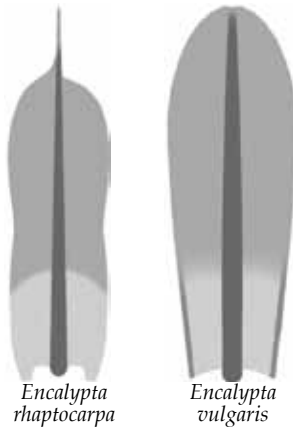
*Gigaspermum repens* leaf subapex (interference optics)  
10  $\mu\text{m}$

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**Key\* to the New Zealand species of Encalypta (2)**

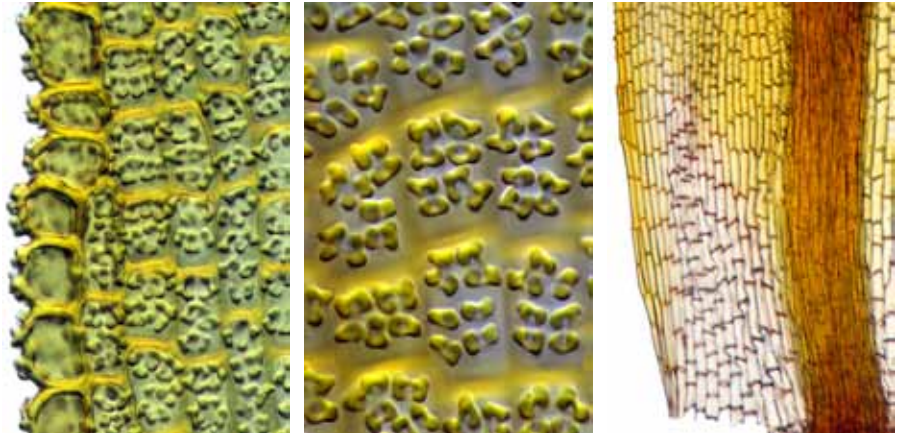
- 1 Some or all vegetative leaves long-awned; costa smooth abaxially ..... ● **Encalypta raptocarpa**  
 1: Vegetative leaves not awned; costa prorate abaxially ..... ● **Encalypta vulgaris**

\* based on Magill, RE (2007): Encalyptaceae. *Flora of North America* 27, 173.



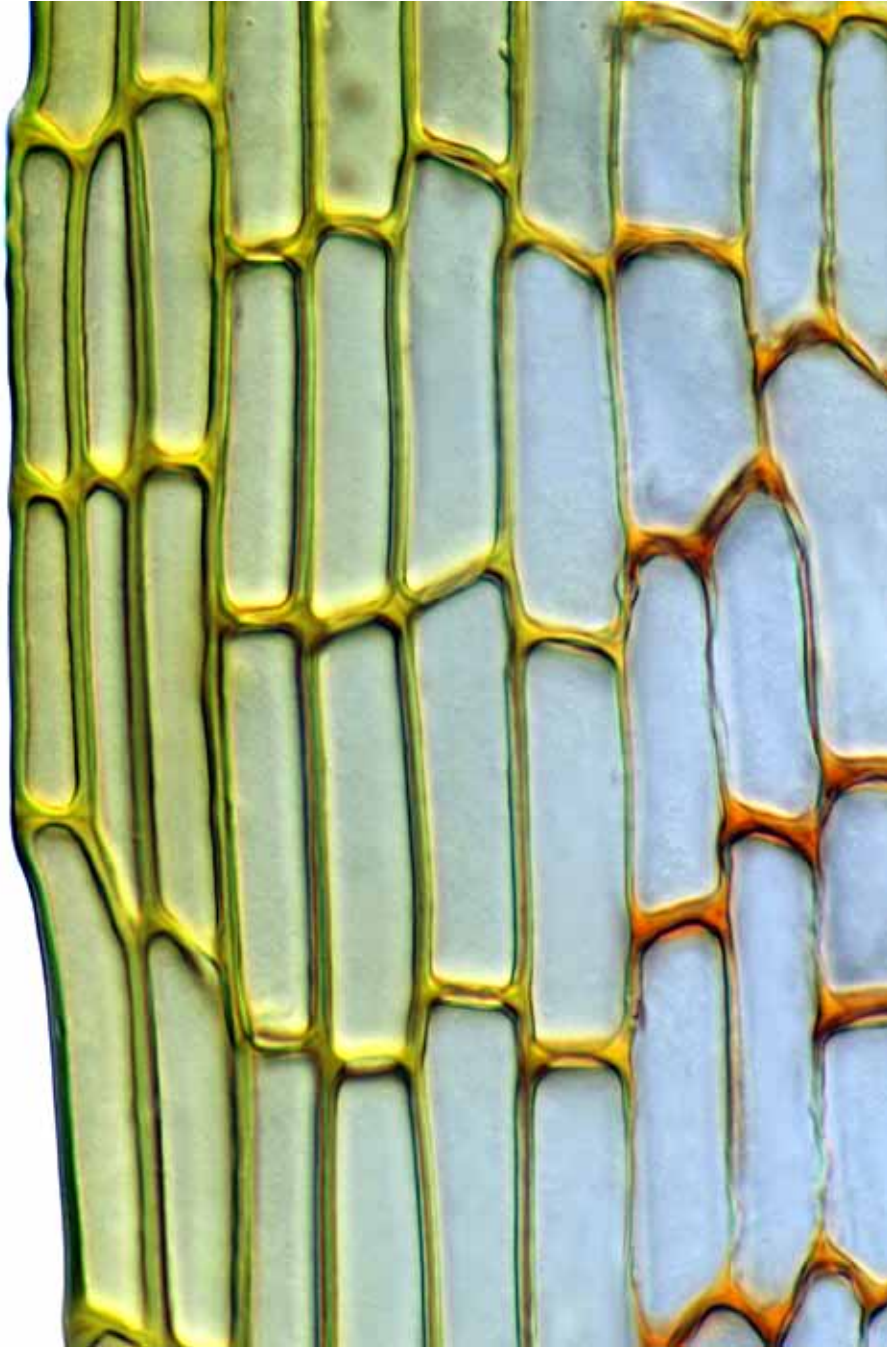
**Encalypta raptocarpa** Schwägr.**form:** tufted, erect, branched stems, to 8 mm tall, dull, brownish above**habitat:** limey soil and rock in open forests or scrub, to subalpine elevations**leaf:** size: 2.2–3.5 × 1.0 mm (including awn)**shape:** oblong-lanceolate to lingulate, unistratose, contorted when dry**tip:** acute, ending in a stout awn**base:** basal cells long-rectangular, smooth; no distinct alar region**costa:** strong, percurrent to excurrent in the awn, prominent abaxially, red**border:** not differentiated**margin:** entire to crenulate, plane**cells:** upper cells 12–21 × 11–16 μm, subquadrate, firm-walled, pluripapillose**capsule:** 2–3 mm, cylindric, erect, exserted, ribbed when dry, dark brown; seta 3–6 mm, reddish brown, smooth; peristome single; operculum 1–2 mm, long-rostrate; calyptra up to 5.0 mm long, completely covering the capsule, smooth below, dark and scabrous above; spores to 40 μm in diam., ± reniform, coarsely warty-papillose

fertile shoot (dry), calyptra, mature capsule, leaf outline, awn (2), and base of awn



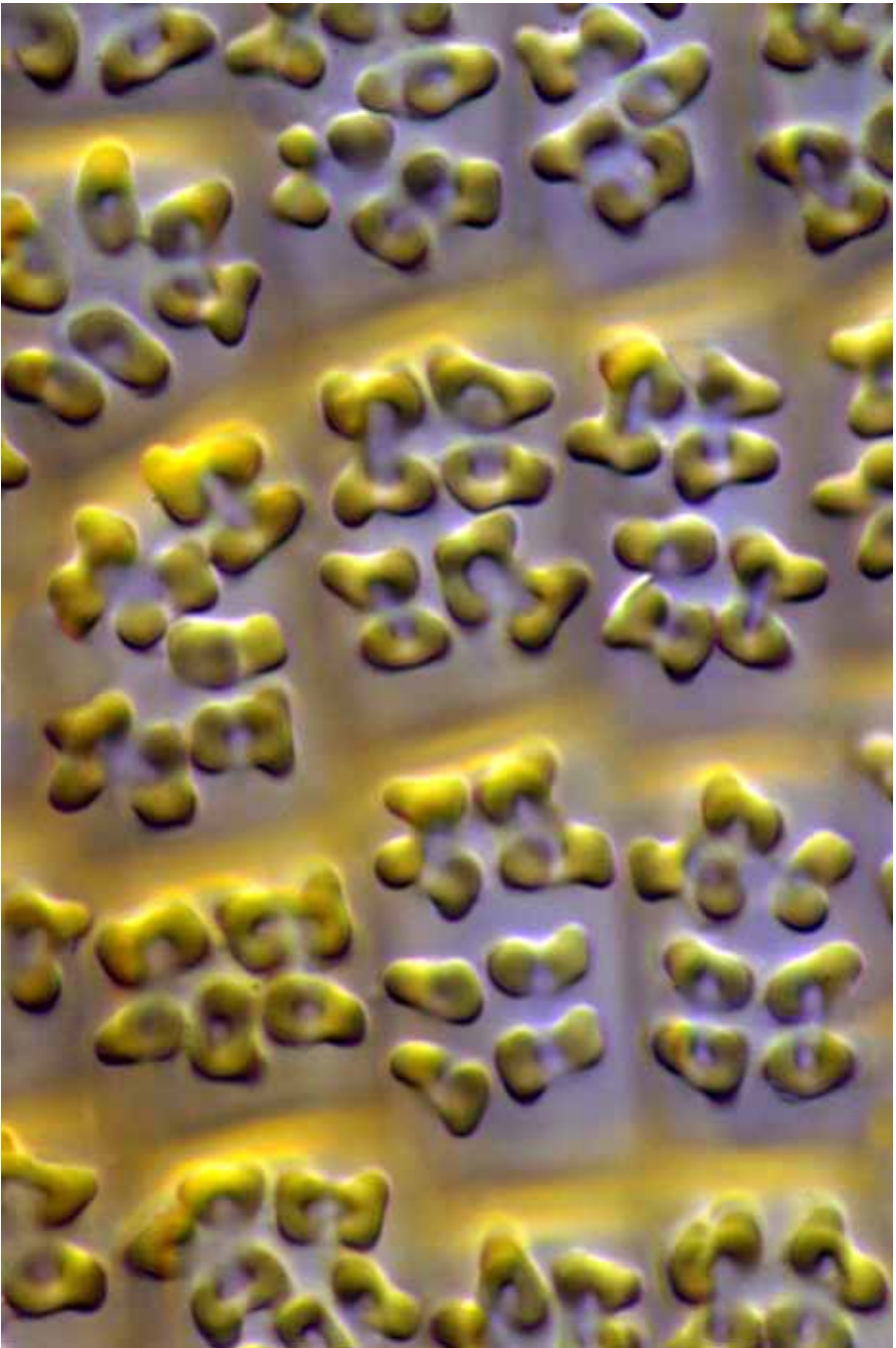
margin midleaf, leaf surface papillae, and leaf basal angle

continued next page



*Encalypta rhamnifolia* margin near leaf base  
10  $\mu\text{m}$

continued next page



*Encalypta raptocarpa* leaf surface papillae  
10  $\mu\text{m}$

continued next page

**Encalypta vulgaris** Hedw.

**form:** tufted, erect, ± simple stems, densely foliate, yellowish, to 20 mm

**habitat:** soil or calcareous rock in open forest or scrub, to 2400 m

**leaf:** size: 2.5–3.5 × 1.0–1.2 mm

*shape:* oblong to lingulate, concave above

*tip:* rounded to obtuse, or broadly acute and mucous

*base:* lower cells rectangular, hyaline; transverse walls coloured, thickened

*costa:* failing below the apex, prominent abaxially

*border:* several rows of narrow cells in lower third of the margin

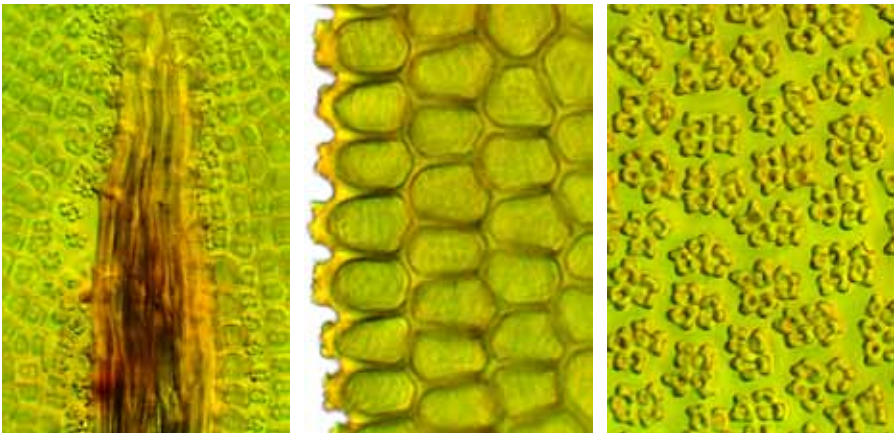
*margin:* entire except for papillae, plane to weakly recurved

*cells:* 12–17 × 10–12 μm, isodiametric, firm-walled, bulging, distal cell ends projecting abaxially, papillose, the papillae branched

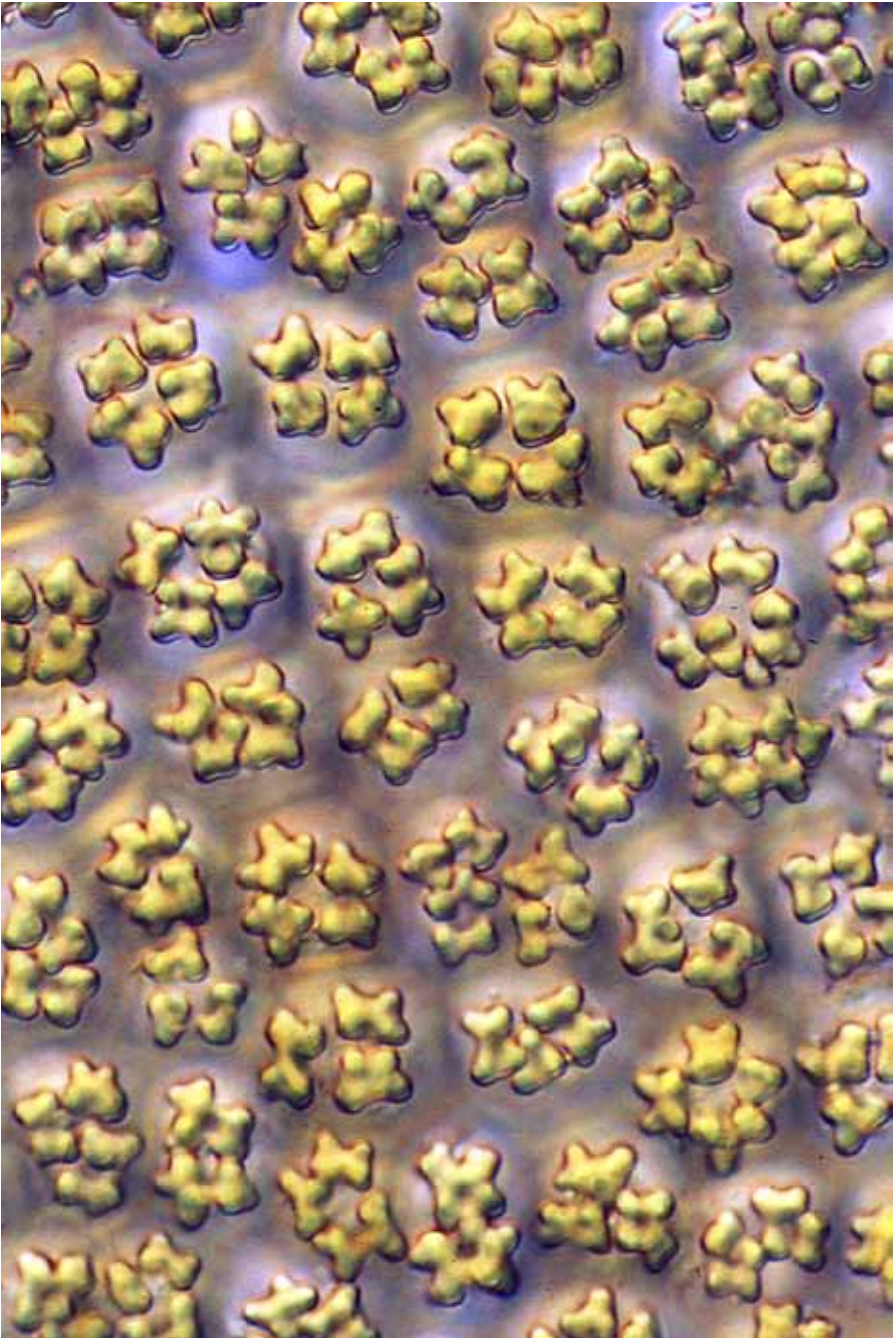
**capsule:** 2.5–3.0 × 10–12 mm; narrowly cylindrical, erect, ± striate; calyptra large, resembling an old-fashioned candle-snuffer and completely covering the capsule; seta to 10 mm, yellow, smooth; peristome none; operculum long-rostrate; spores to 39 μm in diam.



fertile shoot (dry) (2), calyptra, leaf outline, and leaf apex showing costa terminus  
 1 mm, 1 mm, 0.5 mm, 0.5 mm, 50 μm



costa near apex, margin midleaf, and leaf papillae  
 50 μm, 10 μm, 10 μm



*Encalypta vulgaris* leaf papillae  
10  $\mu$ m

continued next page



**Bryobeckettia bartlettii** (Fife) Fife**form:** gregarious, unbranched, erect, radiculose stems, to 4 mm**habitat:** damp, disturbed silt or clay, streams or ditches, to 200 m**leaf:** size: 1.5–2.8 × 0.6–1.6 mm, contorted when dry*shape:* obovate or spatulate*tip:* obtuse or rounded*base:* basal cells rectangular and longer than the other blade cells*costa:* failing below the apex*border:* not differentiated*margin:* entire to toothed toward the apex, plane*cells:* 30–80 × 20–40 μm, subhexagonal, thin-walled, smooth**capsule:** 2 mm, reddish, oval, apiculate, erect, slightly exserted,

cleistocarpous, brown; seta to 1.5 mm; calyptra mitriform,

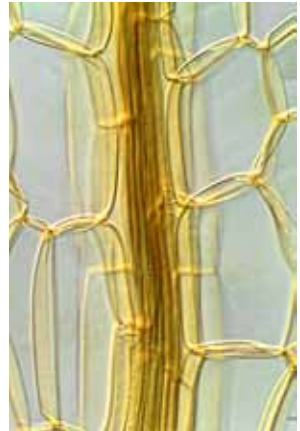
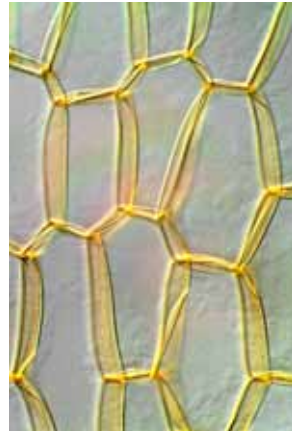
covering only a small part of the capsule; operculum none;

spores 30–37 μm, dark, finely spiny

**note:** differs from *Physcomitrella* in having ± immersed stomata

fertile shoot, leaf outline, and leaf apex

1 mm, 0.5 mm, 25 μm



margin midleaf, cells midleaf, and costa midleaf

10 μm, 10 μm, 10 μm

**Key\* to New Zealand species and varieties of *Entosthodon* (8)**

- 1 Capsule gymnostomous..... 2  
 1: Capsule peristomate ..... 3
- 2(1) Leaves ovate to obovate; seta shorter than capsule... ● ***Entosthodon apophysatus***  
 2: Leaves lanceolate, subulate; seta much longer than capsule.....  
 ..... ● ***Entosthodon jamesonii* subsp. *productus***
- 3(1:) Capsule neck well-developed..... 4  
 3: Capsule neck only weakly developed ..... 5
- 4(3) Leaf apex slenderly acuminate; capsule curved-asymmetric .....  
 ..... ● ***Entosthodon muhlenbergii***  
 4: Leaf apex acute; capsule symmetric ..... ● ***Entosthodon laxus***
- 5(3:) Leaf ± obovate, incurved above, the apex acute to acuminate; capsules straight.... 6  
 5: Leaf lingulate, plane, the apex acute to shortly apiculate; capsules arcuate.....  
 ..... ● ***Entosthodon radians***
- 6(5) Seta > 9 mm long ..... ● ***Entosthodon subnudus* var. *gracilis***  
 6: Seta < 6 mm long..... 7
- 7(6:) Spores 39–45 µm in diam..... ***Entosthodon subnudus* var. *subnudus***  
 7: Spores 22–25 µm in diam. .... ***Entosthodon subnudus* var. *subcuspidatus***

\* based on Catcheside, DG (1980): *Mosses of South Australia*. Government Printer, Adelaide. 219, and Fife, AJ; Seppelt, RD (2001): A revision of the family Funariaceae (Musci) in Australia. *Hikobia* 13, 473–490.



*Entosthodon  
subnudus* var.  
*gracilis*



*Entosthodon  
subnudus* var.  
*subnudus*



*Entosthodon  
subnudus* var.  
*subcuspidatus*



*Entosthodon  
jamesonii* subsp.  
*productus*



*Entosthodon  
laxus*



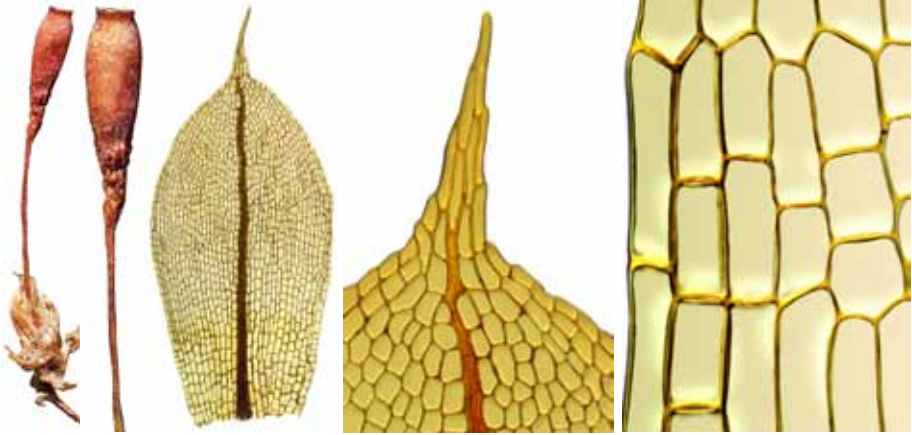
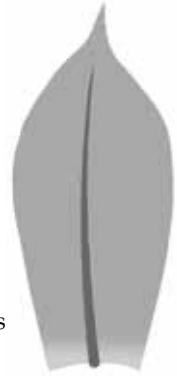
*Entosthodon  
apophysatus*



*Entosthodon  
muhlenbergii*



*Entosthodon  
radians*

**Entosthodon apophysatus** (Taylor) Mitt.**form:** gregarious, erect, radiculose, comose shoots, to 7 mm**habitat:** damp silt or clay in disturbed sites, to 300 m**leaf:** size: 1.5–3.5 × 0.8–0.9 mm*shape:* oblong to obovate, concave*tip:* acuminate, ending with an arista*base:* alar cells ± inflated, 2–4 on each side*costa:* disappearing in the arista, or failing just below it*border:* not differentiated*margin:* entire to faintly crenate*cells:* 20–60 × 20–30 μm, irregularly hexagonal, thin-walled, smooth**capsule:** 3–4 mm, clavate, erect, exserted, reddish brown, apophysis as long as the spore sac; seta 2–4(–7) mm; peristome usually none; operculum convex; calyptra inflated, with a long, oblique beak; spores 27–43 μm in diam.

fertile shoot and capsule (dry), leaf outline, leaf apex, and margin midleaf



costa midleaf, costa detail, and leaf basal angle

continued next page



*Entosthodon apophysatus* undehiscent capsules  
1 mm

continued next page

**Entosthodon jamesonii** subsp. **productus** (Mitt. in Wilson) Fife**form:** gregarious, minute, erect, mostly simple stems, to 4 mm tall**habitat:** shaded clayey soil in damp grassland or scrub, to 250 m**leaf:** *size:* 0.7–2.0 × 0.2–0.5 mm*shape:* ovate-lanceolate, ± curved, concave*tip:* tapering to a subula; apical cell 30–50 μm long*base:* basal cells rectangular, thin-walled; alar cells not differentiated*costa:* failing in the subula*border:* weak, 1–2 rows of narrow cells*margin:* entire, plane*cells:* 25–70 × 12–15 μm, oblong-hexagonal to rhombic, thin-walled, smooth**capsule:** to 1.3 mm, oblong-pyriform, erect, exserted, brown; peristome none; annulus none; seta 3–9 mm; operculum convex; calyptra inflated, cucullate; spores 32–36 μm in diam., wrinkled**note:** an ephemeral species

fertile shoots (dry) (2), capsule (dry), leaf outline, leaf apex, and leaf subapex  
 1 mm (2), 1 mm, 0.5 mm, 10 μm, 10 μm



costa midleaf, margin near leaf base, and leaf basal angle  
 50 μm, 50 μm, 50 μm

**Entosthodon laxus** (Hook.f. & Wilson) Mitt.

**form:** gregarious, erect, radiculose, forked stems, yellow-green, to 15 mm  
**habitat:** waterlogged, shady soil in forest or scrub, to 1900 m

**leaf:** size: 1.5–3.5 × 0.6–1.0 mm, slightly concave

*shape:* lingulate

*tip:* acute to obtuse, the apical cell 25–50(–100) μm long

*base:* alar cells little differentiated

*costa:* failing 5–10 cells below the apex

*border:* not differentiated

*margin:* entire to ± crenulate above, ± plane

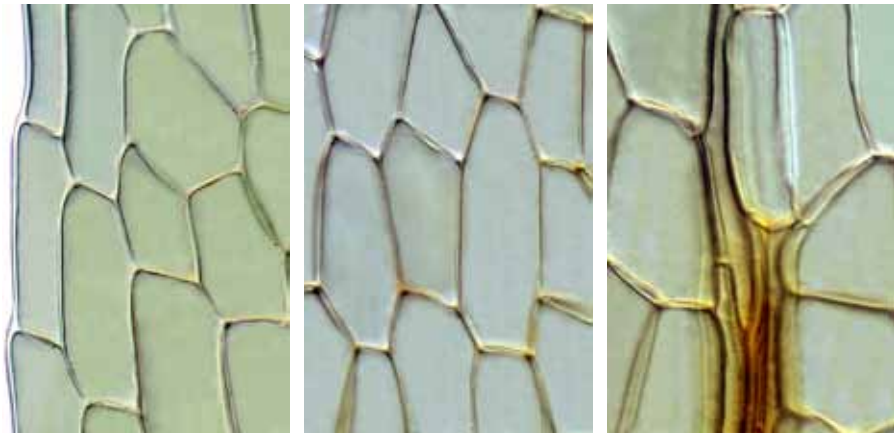
*cells:* 70–100 × 25–40 μm, oblong-hexagonal, thin-walled, smooth

**capsule:** 1.5–2.5 mm, oblong-obovoid, with a distinct neck, erect, symmetric, strangulate when dry; seta 10–20 mm; calyptra mitrate or cucullate; operculum convex to mammillate; peristome double, the exostome teeth red, to 300 μm long, weakly striate, falling away quickly, the endostome rudimentary; spores 25–35 μm in diam.



fertile and vegetative shoots, capsule (dry), leaf outline, and leaf apex

5 mm, 1 mm, 0.5 mm, 1 mm, 10 μm



margin midleaf, cells midleaf, and costa terminus

10 μm, 10 μm, 10 μm

continued next page

**Entosthodon muhlenbergii** (Turner) Fife

**form:** loose tufts of erect, radiculose, comose, ± branched stems, to 4 mm

**habitat:** on exposed, seasonally damp soil and rock underhangs, to 2700 m

**leaf:** size: 2.0–2.9 × 0.7–1.0 mm

*shape:* ovate to obovate-lanceolate, concave

*tip:* acuminate, ending in a filiform point; apical cell 100–200 μm long

*base:* basal cells rectangular, ± hyaline; alar cells weakly differentiated

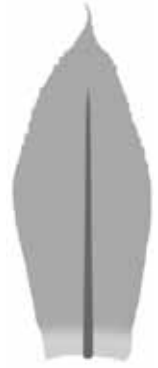
*costa:* failing below the acumen

*border:* weakly differentiated

*margin:* entire below, bluntly toothed above, plane

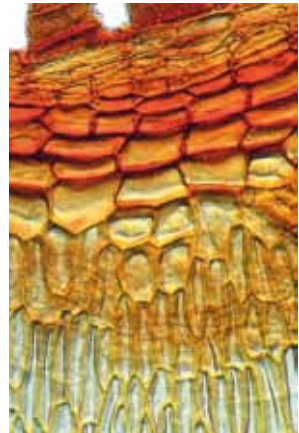
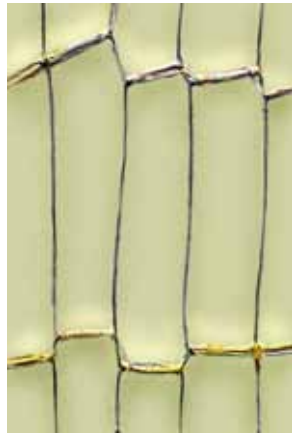
*cells:* 40–90 × 20–30 μm, ± hexagonal, often with oblique end walls, thin-walled, smooth

**capsule:** 2(–3) mm, pyriform, not ribbed, asymmetric, curved, erect to inclined, sulcate at the neck, narrowed below the mouth when dry; seta 5–7 mm; calyptra inflated, cucullate; operculum high-conic; peristome double, exostome teeth sigmoid, red; spores 24–27 μm in diam.



shoot (dry), mature capsule (dry), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 50 μm, ■ 10 μm



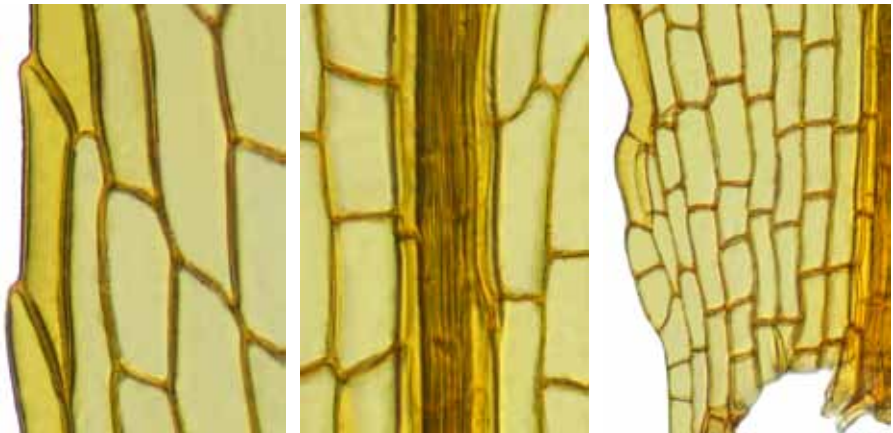
cells midleaf, basal cells, and exothelial cells

■ 10 μm, ■ 10 μm, ■ 50 μm



**Entosthodon radians** (Hedw.) Müll.Hal.**form:** scattered, erect, light green, comose stems**habitat:** steep, acidic silt and clay banks, to 1500 m**leaf:** size: to 3 mm*shape:* lanceolate-spathulate, widest above midleaf, concave*tip:* acute to short-apiculate; apical cell 30–90  $\mu\text{m}$  long*base:* basal cells rectangular*costa:* failing below the apiculus*border:* weak, 1–3 rows of narrow, elongate cells*margin:* entire to weakly toothed above, plane*cells:* 45–90  $\times$  30–36  $\mu\text{m}$ , irregularly hexagonal, thin-walled, smooth**capsule:** 1.5–2.3 mm, obovoid, the neck weakly developed ( $< 1/3$  the length of the capsule), exerted, reddish brown, inclined to horizontal, strongly curved when dry and empty; seta 5–14 mm; operculum convex; peristome double; spores 24–35  $\mu\text{m}$  in diam.

fertile shoot (2), capsule (dry), leaf outline, and leaf apex

 1 mm, 1 mm, 0.5 mm, 0.1 mm, 50  $\mu\text{m}$ 


margin midleaf, costa midleaf, and leaf basal angle

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

**Entosthodon subnudus** var. **gracilis** (Hook.f. & Wilson) Fife

**form:** scattered to gregarious, erect, sparsely branched, bulb-like shoots, yellow-green, to 5 mm

**habitat:** silt or clay in open scrub, to 1000 m

**leaf:** size: 1.3–2.1 × 0.6–0.8 mm

**shape:** ovate to obovate, the uppermost leaves broadest, concave

**tip:** short-cuspidate or aristate; apical cell 60–150 μm long

**base:** alar cells ± inflated; basal cells rectangular and ± red-pigmented

**costa:** failing below apex, to percurrent or excurrent as a cusp or arista

**border:** not differentiated

**margin:** entire to weakly crenulate above, plane

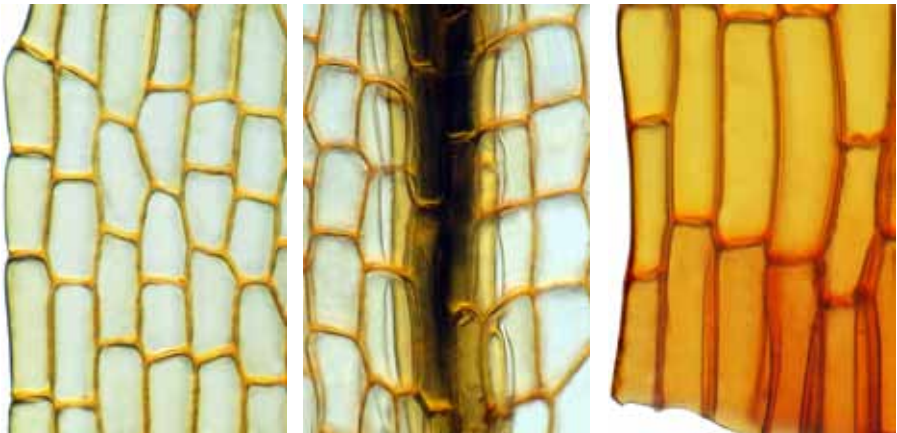
**cells:** 24–70 × 15–18 μm, oblong to rectangular, thin-walled, smooth

**capsule:** 1.5–2 mm, cylindrical to obovoid, erect, symmetric, long-exserted, red-brown, necked; annulus none; seta 9–22 mm, reddish; peristome double; teeth lanceolate, papillose above; spores 30–45 μm in diam.



fertile shoot (dry) (2), capsules (dry) (3), leaf outline, and leaf apex

■ 0.5 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 10 μm



margin midleaf, costa midleaf, and leaf basal angle

■ 50 μm, ■ 50 μm, ■ 50 μm

**Funaria hygrometrica** Hedw.

**form:** gregarious, bulb-like, yellowish green, simple or branched stems  
**habitat:** soil, often in burnt or otherwise disturbed sites, to 2100 m

**leaf:** size: 2–4 × 1.0–2.0 mm

*shape:* oblong-ovate to broadly obovate, deeply concave

*tip:* acute to mucronate

*base:* basal cells longer and narrower than the other blade cells

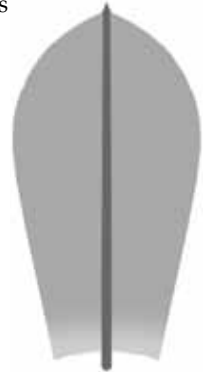
*costa:* thin, subpercurrent to shortly excurrent in the mucro

*border:* 1–2 rows of cells narrower and longer than nearby lamina cells

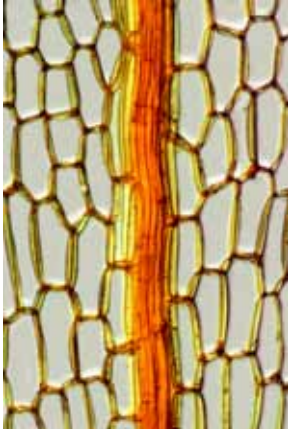
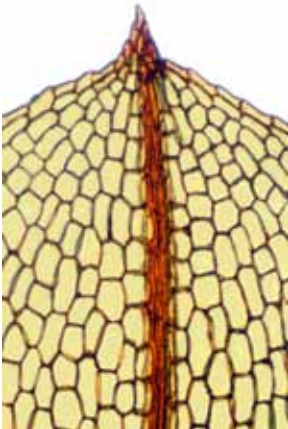
*margin:* entire to ± serrulate above, plane

*cells:* 40–90 × 30–36 μm, hexagonal to oblong, thin-walled, smooth

**capsule:** 2–4.5 mm, pyriform, asymmetric, inclined to cernuous, the mouth oblique, sulcate when dry, orange to reddish brown; seta 10–60 mm, straight at first, later arcuate or flexuose; peristome double, the exostome teeth trabeculate, spirally arranged, united at their apices in a disc; spores 10–40 μm long, ± reniform



habit (cutaway view) capsules (young and mature), and leaf outline  
 1 mm, 1 mm, 1 mm, 1 mm

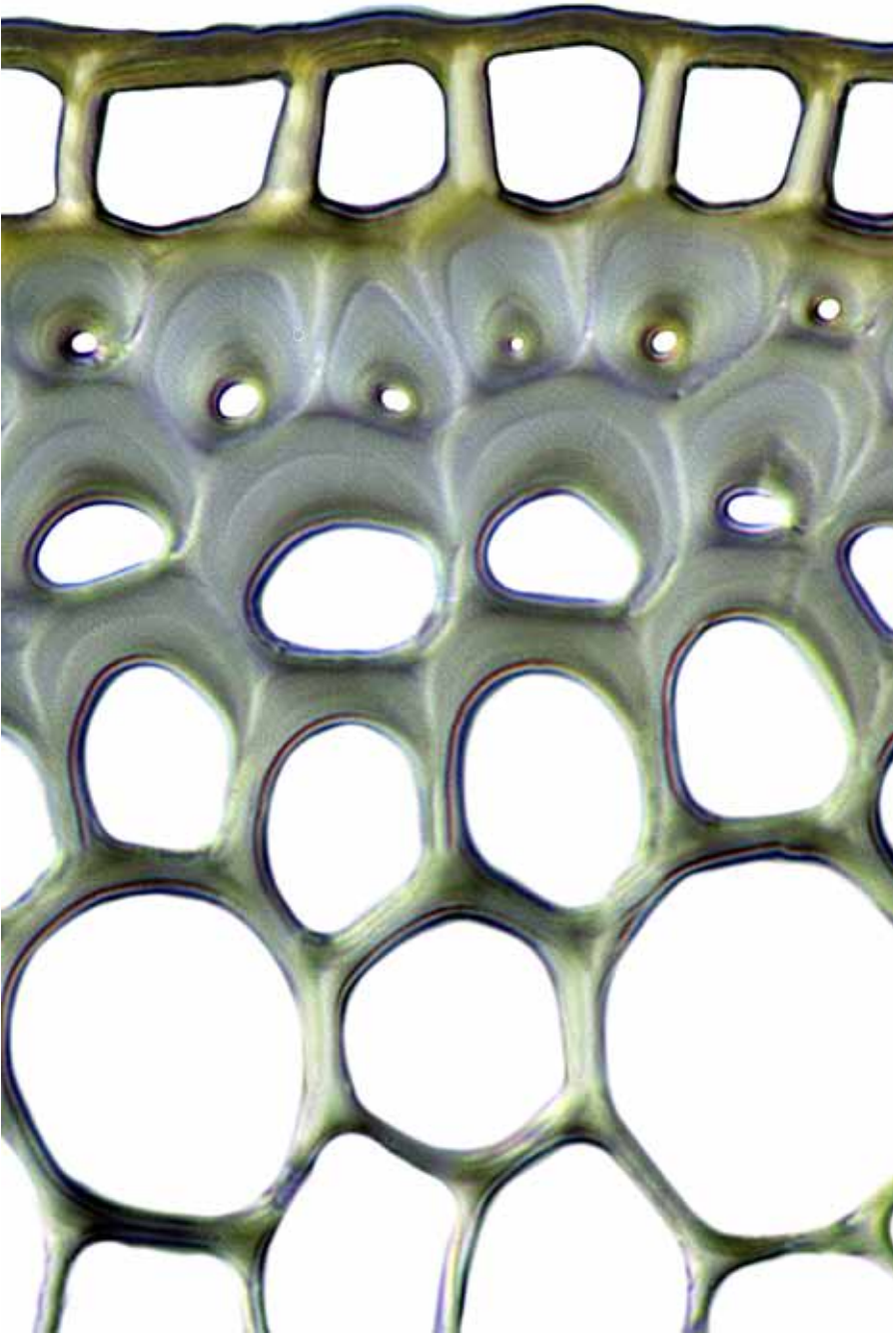


leaf apex, costa, costa midleaf, and leaf basal angle  
 100 μm, 50 μm, 100 μm



*Funaria hygrometrica* immature capsule  
0.5 mm

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*Funaria hygrometrica* stem cross-section showing surface hyaloderm  
10  $\mu\text{m}$

**Goniomitrium acuminatum** Hook. & Wilson

**form:** gregarious, pale to yellow-green, radiculose stems, leaves in low rosettes, to 2 mm

**habitat:** bare damp soil

**leaf:** size: 1.0–2.2 × 0.3–0.8 mm

*shape:* ovate to ovate-lanceolate, strongly concave

*tip:* tapering to a short acumen

*base:* outer 1–2 rows of basal cells quadrate

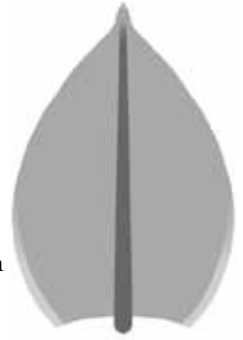
*costa:* failing below the apex to excurrent in the acumen

*border:* 1–2 rows of smaller cells

*margin:* entire to minutely serrulate, plane

*cells:* 20–100 × 15–27 μm, irregularly hexagonal, firm-walled, smooth

**capsule:** 1 mm, globose to obovoid, orange, erect, cleistocarpous, immersed; seta to 1 mm; calyptra campanulate, plicate, naked; operculum low-conic; peristome absent; spores to 80–100 μm in diam., the surface reticulate



vegetative habit (2) and leaf outline

5 mm, 1 mm, 0.5 mm



leaf apex, costa midleaf, and leaf basal angle

50 μm, 50 μm, 50 μm

**Physcomitrella readeri** (Müll.Hal.) Stone & Scott

**form:** gregarious, minute, radiculose, unbranched stems, with terminal rosettes, to 1.5 mm

**habitat:** damp, exposed silt or clay, low elevation

**leaf:** size: 1.5–1.8 × 0.4–0.5 mm

*shape:* oblong-lanceolate to spatulate

*tip:* acute

*base:* alar cells ± inflated, basal cells longer than the blade cells

*costa:* weakly branched above, failing well below the apex

*border:* not differentiated

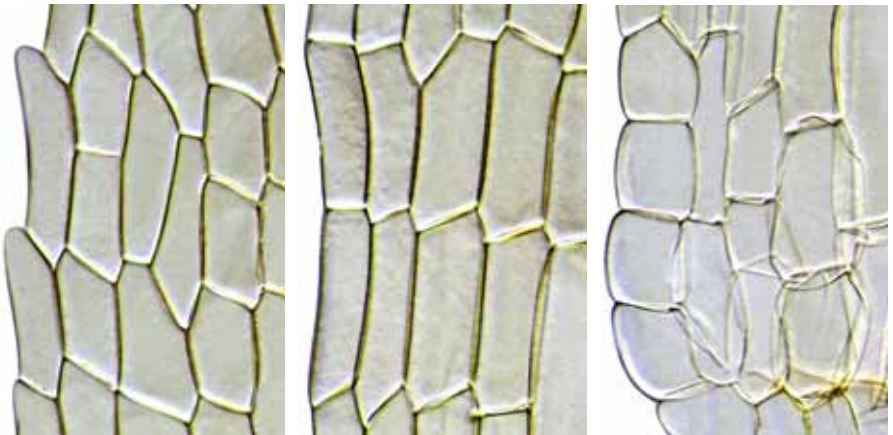
*margin:* entire below, serrulate toward the apex, plane

*cells:* 40–60 × 18–27 μm, subhexagonal above, rectangular below, thin-walled, smooth

**capsule:** 0.5 mm, subglobose, erect, apiculate, emergent, light brown, cleistocarpous; seta 0.1 mm; calyptra minute; operculum none; spores 30–40 μm in diam.



fertile shoot (hydrated), leaf outline, leaf apex, and margin of upper leaf  
 ■ 1 mm, ■ 50 μm, ■ 10 μm, ■ 10 μm

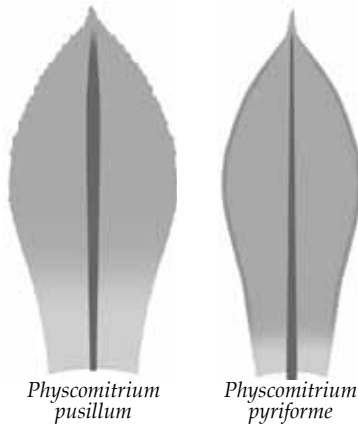


margin midleaf, margin lower leaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

**Key\* to New Zealand species and varieties of *Physcomitrium* (2)**

- 1 Seta < 1 mm; capsule mouth 1/3 of capsule diam.; capsule subglobose.....  
 ..... ● ***Physcomitrium pusillum***
- 1: Seta > 3 mm; capsule mouth as wide as the capsule; capsule pyriform .....  
 ..... ● ***Physcomitrium pyriforme***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 247:





**Physcomitrium pusillum** Hook.f. & Wilson

**form:** scattered, minute (to 4 mm), sparsely branched, radiculose, bulb-like, pale green

**habitat:** silt or clay in open stream edges, in damp, lowland sites, to 100 m

**leaf:** size: 2.0–3.1 mm

*shape:* spatulate, obovate, or ovate-oblong

*tip:* acute

*base:* basal cells rectangular, thin-walled

*costa:* failing below the apex

*border:* not differentiated

*margin:* bluntly serrulate above, entire below, plane at margins

*cells:* 25–50 × 18–25 μm, irregularly rhombic to rectangular, thin-walled, smooth

**capsule:** 0.9–1.5 mm, subglobose, erect, immersed, reddish brown, glossy; seta to 0.5 mm; peristome none; operculum conic; calyptra mitriform, covering only the operculum; spores 37–49 μm in diam., spinose



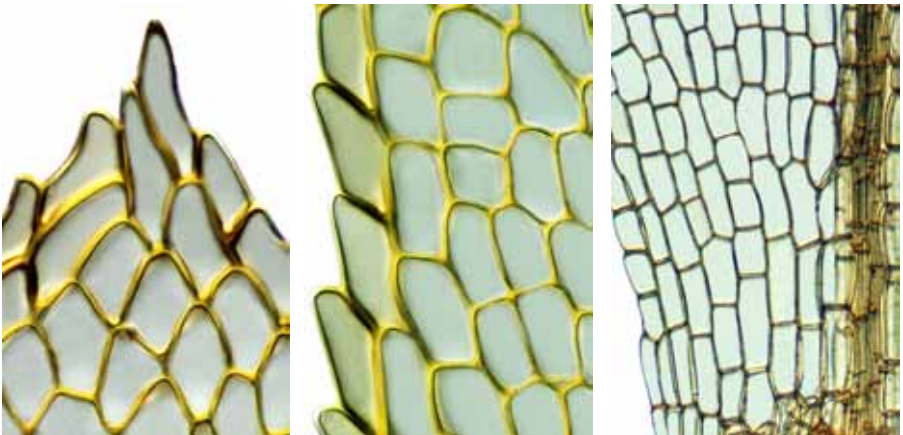
fertile shoot (moist), capsule, leaf outline, and leaf apex

1 mm,

0.5 mm,

0.5 mm,

50 μm



leaf apex detail, margin midleaf, and leaf basal angle

50 μm,

50 μm,

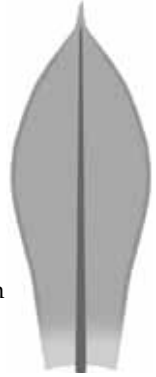
50 μm

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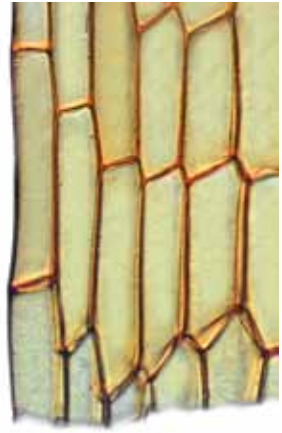


*Physcomitrium pusillum* margin midleaf  
10  $\mu\text{m}$

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**Physcomitrium pyriforme** (Hedw.) Hampe**form:** gregarious or tufted, comose, radiculose, ± simple stems, to 11 mm**habitat:** bare silt or clay on exposed streambanks or along drains, often in disturbed sites, to 400 m**leaf:** size: 2.0–3.8 × 0.7–1.5 mm*shape:* oblong-lanceolate to oblong-obovate*tip:* acute*base:* basal cells longer and thinner-walled than the other lamina cells*costa:* subpercurrent to shortly excurrent*border:* faint, 1–2 rows of elongate cells*margin:* entire below, serrulate above, plane*cells:* 40–70 × 26–30 μm, oblong-hexagonal, thin-walled, smooth**capsule:** 1–2 mm, globose-pyriform, short-necked, the mouth flaring when dry; annulus narrow and persistent; seta 4–14(–30) mm; peristome none; spores 25–50 μm in diam., spinose

fertile shoots (2), leaf outline, leaf apex, and costa midleaf  
 ■ 1 mm (2), ■ 0.5 mm, ■ 10 μm, ■ 10 μm

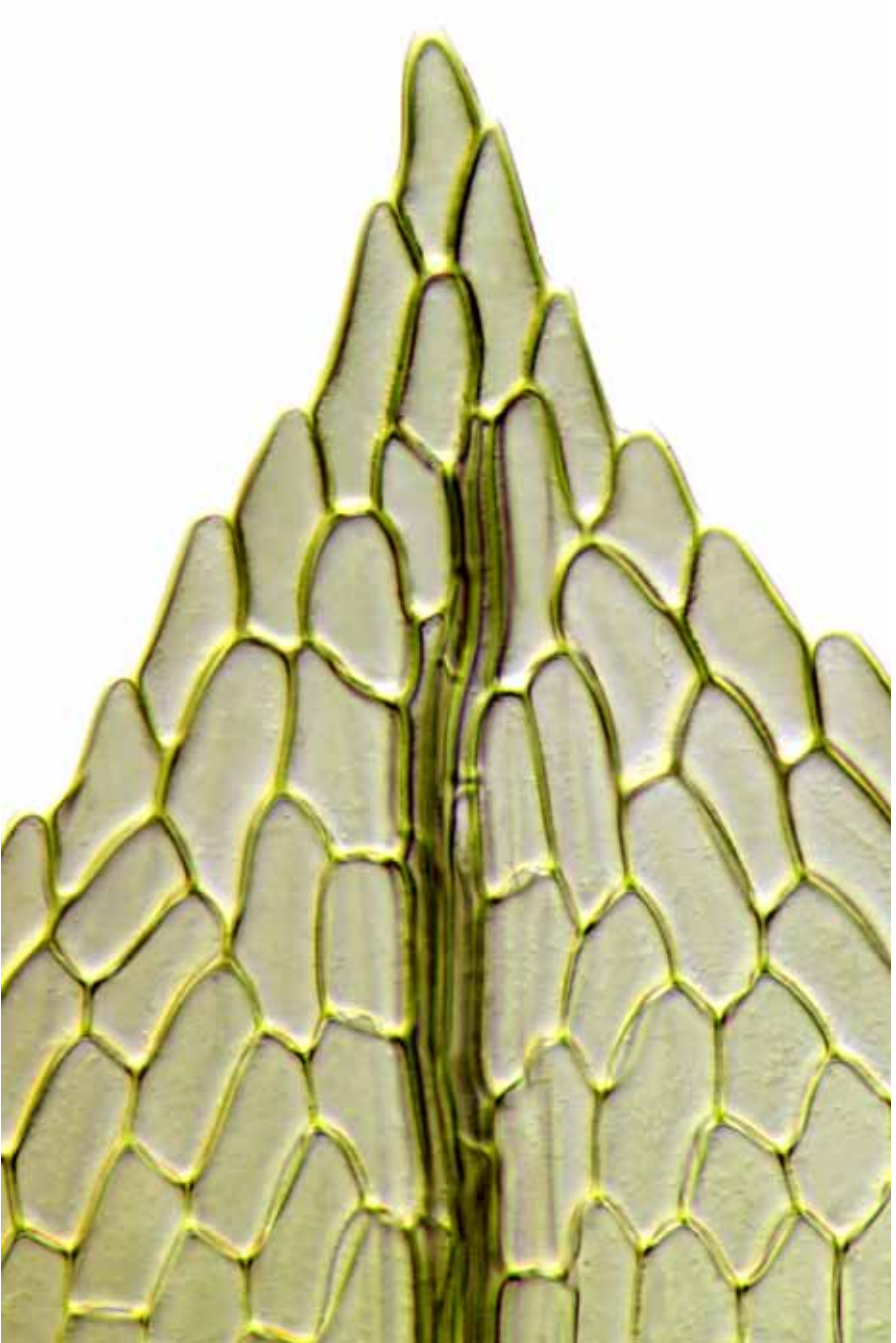


border midleaf (2), and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm



*Physcomitrium pyriforme* fertile habit  
1 mm

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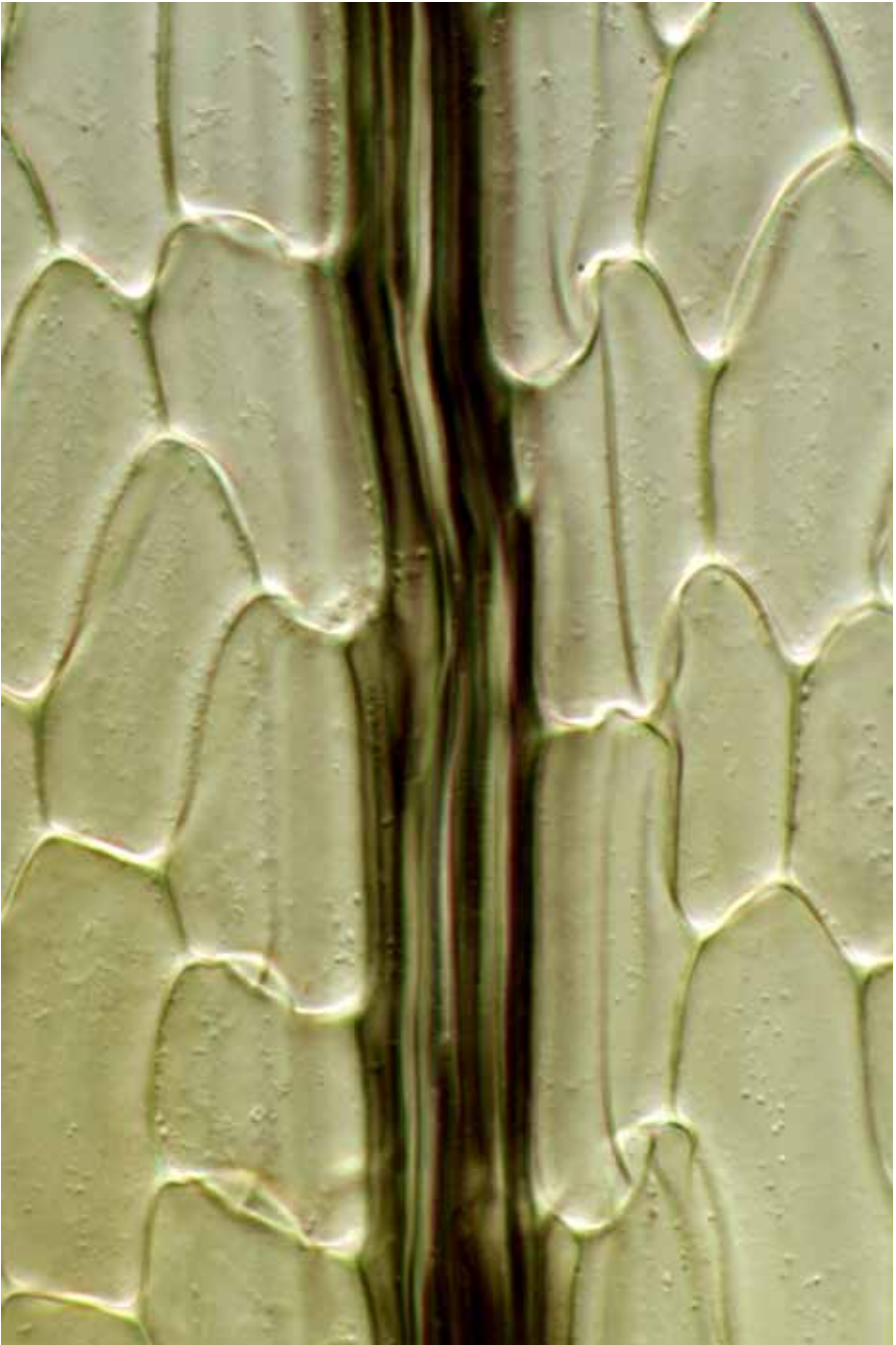
*Physcomitrium pyriforme* leaf apex  
10  $\mu\text{m}$

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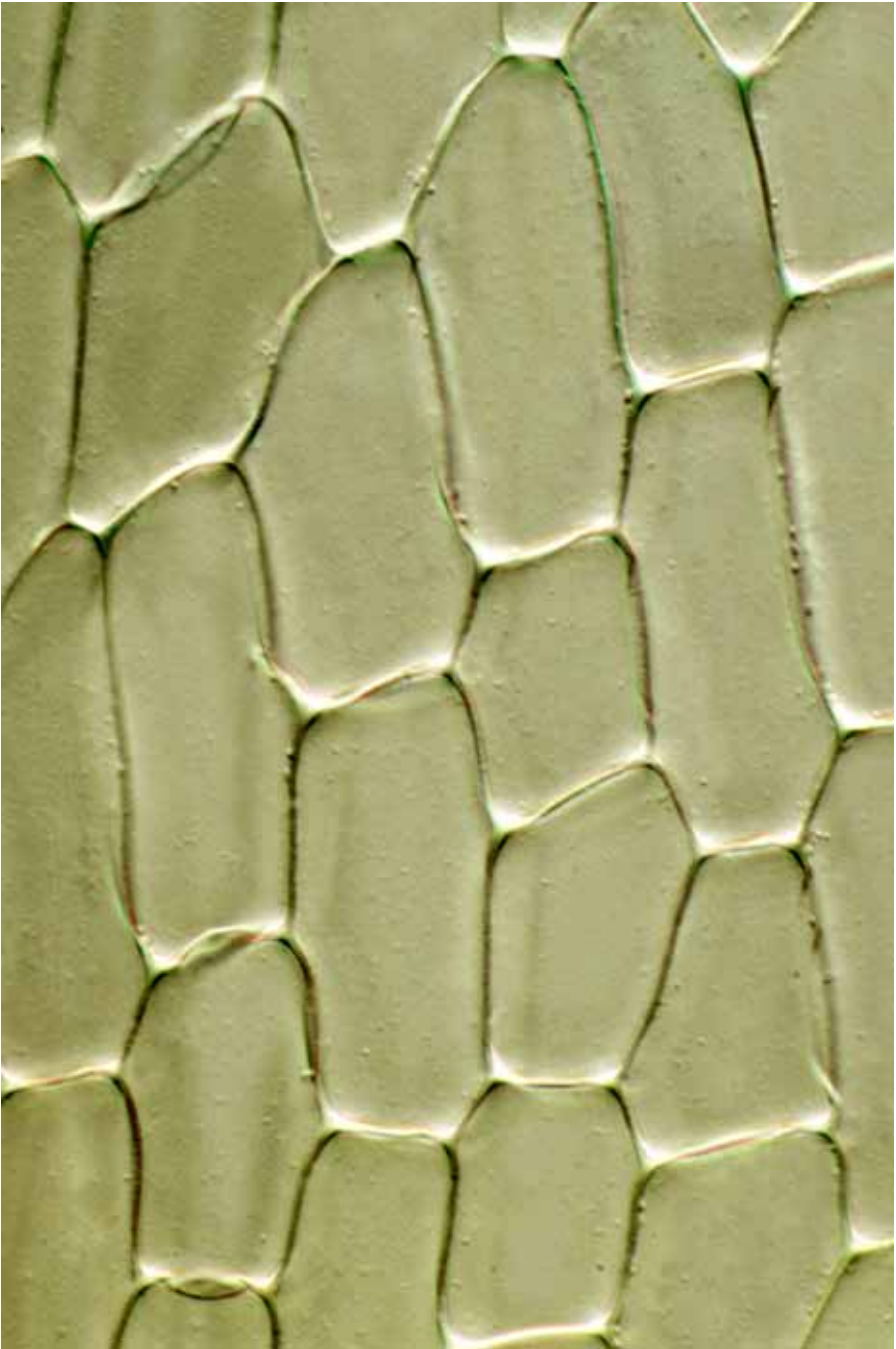
*Physcomitrium pyriforme* margin midleaf  
10  $\mu\text{m}$

continued next page



*Physcomitrium pyriforme* costa midleaf  
10  $\mu\text{m}$

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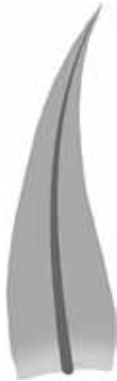
*Physcomitrium pyriforme* cells midleaf  
10  $\mu\text{m}$



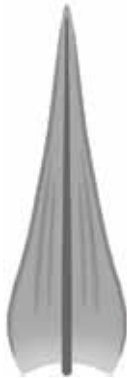
**Key\* to New Zealand species of *Racomitrium* (9)**

- 1 Leaf tip ending in a hyaline, toothed hair-point ..... 2  
 1: Leaf tip not hyaline ..... 6
- 2(1) Hair-point short, striate below ..... ● ***Racomitrium striatipilum***  
 2: Hair-point long, not striate below ..... 3
- 3(2:) Alar region triangular, composed of 3–6 rows of quadrate to short-rectangular,  
 firm-walled, nodulose, ± pigmented cells ..... ● ***Racomitrium elongatum***  
 3: Alar region otherwise ..... 4
- 4(3:) Alar cells decurrent; hair-point short-spinose ..... ● ***Racomitrium curiosissimum***  
 4: Alar cells not forming decurrencies; hair-point coarsely dentate ..... 5
- 5(4:) Hair-point teeth perpendicular to the margin, bluntly pointed, and densely papill-  
 ose ..... ● ***Racomitrium lanuginosum***  
 5: Hair-point teeth curved toward the apex, sharply pointed, and only sparsely or not at  
 all papillose ..... ● ***Racomitrium pruinosum***
- 6(1:) Leaf curved ..... ● ***Racomitrium crispulum***  
 6: Leaf straight ..... 7
- 7(6:) Leaves plicate on only one side, with a single fold ..... 8  
 7: Leaves 4-plicate ..... ● ***Racomitrium ptychophyllum***
- 8(7) Leaf-tips fragile; basal border cells straight-walled, swollen and elongate .....  
 ..... ● ***Racomitrium crumianum***  
 8: Leaf-tips not fragile; basal border cells sinuose-walled, not swollen or elongate .....  
 ..... ● ***Racomitrium didymum***

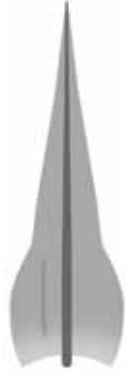
\* based partly on Beever, J; Allison, KW; Child, J (1992): *The Mosses of New Zealand*. University of Otago Press, Dunedin, 107.



*Racomitrium  
crispulum*



*Racomitrium  
ptychophyllum*



*Racomitrium  
didymum*



*Racomitrium  
crumianum*



*Racomitrium  
striatipilum*



*Racomitrium  
curiosissimum*



*Racomitrium  
lanuginosum*



*Racomitrium  
pruinosum*



*Racomitrium  
elongatum*

**Racomitrium crispulum** (Hook.f. & Wilson) Hook.f. & Wilson

**form:** tufted or matted, creeping or decumbent, much-branched

**habitat:** rock or thin soil over rock

**leaf:** size: 1.8–2.3 mm

*shape:* lanceolate to narrowly triangular, ± curved

*tip:* acuminate

*base:* pigmented, not differentiated except for 1–2 marginal rows of ± straight- and firm-walled cells

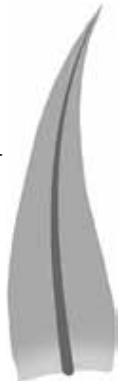
*costa:* percurrent

*border:* not differentiated

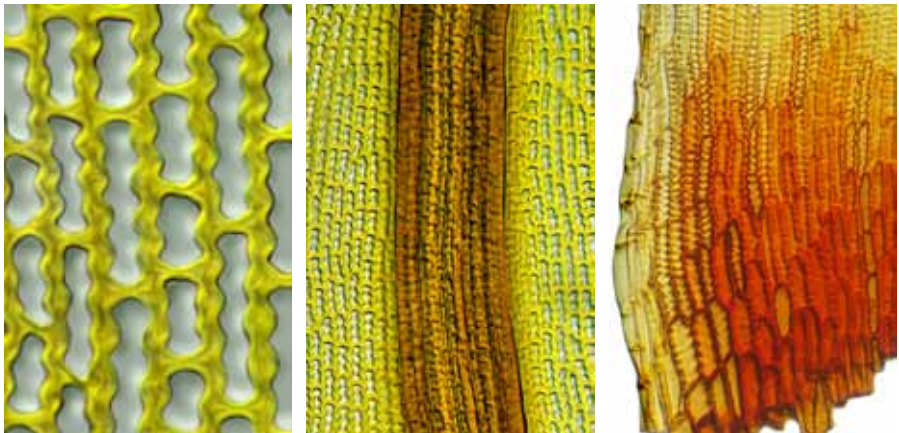
*margin:* entire, ± revolute on one or both sides

*cells:* 8–32 × 5 μm, short- to long-rectangular, incrassate, sinuose, smooth

**capsule:** 2 mm, cylindric, long, erect, exserted, lateral, brown; seta 4–5 mm, smooth; peristome tall (up to 0.5 mm), cleft into two papillose, filiform prongs



shoots (dry), capsule (dry), exostome tooth, leaf outline, leaf apex, and margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 50 μm, ■ 0.1 mm, ■ 10 μm, ■ 5 μm



cells midleaf, costa midleaf, and leaf basal angle  
 ■ 5 μm, ■ 50 μm, ■ 50 μm

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*Racomitrium crispulum* vegetative shoot and mature capsule with peristome  
1 mm, 1 mm

continued next page

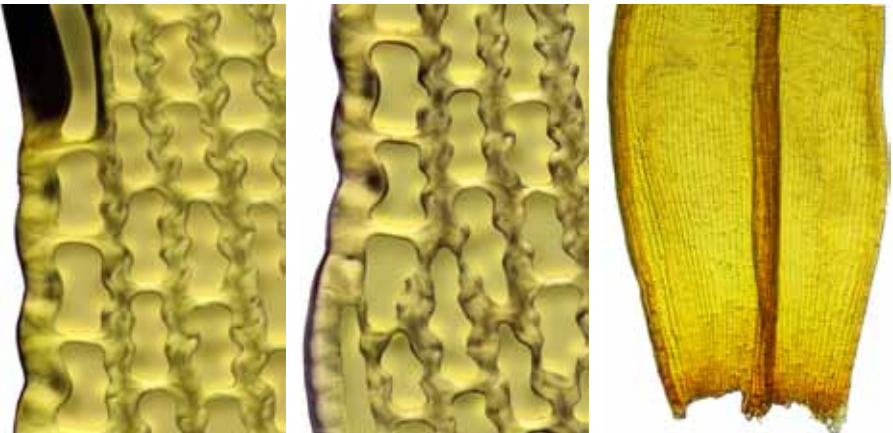


*Racomitrium crispulum* cells near leaf base  
10  $\mu\text{m}$

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**Racomitrium crumianum** Fife**form:** tufts of ± upright sparsely branched stems, to 20 mm tall**habitat:** moist rock (granite)**leaf:** *size:* to 3 mm long, imbricate, fragile at the tips, lamina unistratose*shape:* lanceolate, carinate, 1-plicate from base to apex*tip:* acuminate, the acumen bistratose*base:* not differentiated except for 1–2 marginal rows of ± straight- and firm-walled cells*costa:* failing a few cells below the apex*border:* one row of elongate, thick-walled cells from about midleaf to the apex;  
one row of straight- and thin-walled cells near the leaf base*margin:* entire, recurved*cells:* 20–40 × 10 μm, ± rectangular, walls thick and strongly sinuose, smooth**capsule:** fertile plants not known

vegetative shoots (dry), leaf outline, leaf apex, and margin above and at about midleaf  
 1 mm (2), 1 mm, 0.1 mm, 50 μm, 50 μm, 10 μm



marginal cells transition, margin below about midleaf, and leaf base  
 10 μm, 10 μm, 0.1 mm

continued next page



*Racomitrium crumianum* vegetative shoot (dry)  
1 mm

continued next page

**Racomitrium curiosissimum** Bednarek-Ochyra & Ochyra

**form:** in cushions or tufts, hoary, erect, laterally branched stems, ± olive-green  
**habitat:** gravel in riverbeds, tussockland, and dune slacks

**leaf:** size: 3–4 mm including the hair-point

*shape:* lanceolate to ovate-lanceolate, unistratose, deeply plicate

*tip:* acuminate, ending in a hyaline, decurrent, spinose, 1.2–1.8 mm hair-point

*base:* alar cells orange, quadrate to rectangular, ± inflated, decurrent, and

auriculate, cells above the alars in 1–4 rows of esinuose, firm-walled cells

*costa:* narrow (60 μm), prominent abaxially, bistratose above, tristratose below

*border:* 1–4 rows of esinuose, hyaline cells in basal margins above alar cells

*margin:* entire, narrowly recurved on one or both sides

*cells:* 20–80 × 6–10 μm, short- to long-rectangular, thick-walled, strongly

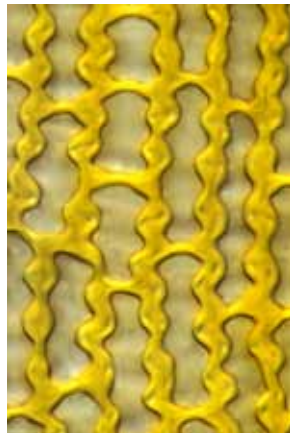
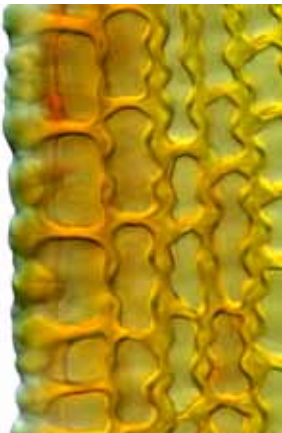
sinuose, smooth to pseudopapillose

**capsule:** to 1.3–1.5 mm, ovoid to oblong-cylindric, erect, long-exserted, brown;  
 seta 4–5 mm; calyptra mitrate, 4–6-lobed, plicate below; operculum beak  
 straight, 1 mm; peristome teeth 16, orange, forked to mid-tooth, coarsely  
 papillose



fertile shoots (2), capsule (dry) (2), leaf outline, and base of hair-point

■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm



margin midleaf, cells midleaf, and leaf basal angle

■ 5 μm, ■ 5 μm, ■ 50 μm

continued next page





*Racomitrium curiosissimum* shoot (re-wetted herbarium specimen)

1 mm

continued next page



*Racomitrium curiosissimum* shoot (dry)  
1 mm

continued next page



*Racomitrium curiosissimum* hair-point apex and margin (interference optics)  
10 µm (left), 10 µm (middle), 10 µm (right)

continued next page

**Racomitrium didymum** (Mont.) Lorentz

**form:** loosely tufted, branched dichotomously, yellowish or brownish  
**habitat:** rock

**leaf:** size: 1.3–3.0 × 0.4–0.8 mm

*shape:* oblong-lanceolate from a widened base, keeled above

*tip:* gradually tapered to a narrow apex and variable hair-point

*base:* 1–3 rows of hyaline, rectangular cells along the margin

*costa:* reaching the apex

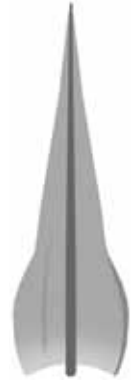
*border:* not differentiated

*margin:* entire, variably revolute on one side

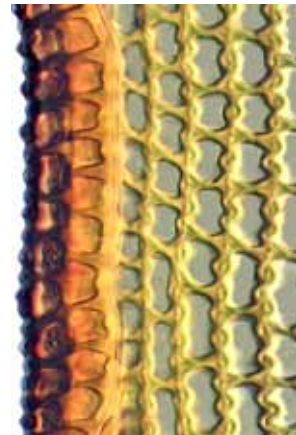
*cells:* 9–22 μm, thick-walled, sinuose, incrassate, smooth

**capsule:** 1.5–2 mm, erect, narrowly oblong to cylindric, pale, smooth; seta 2–5 mm, slender; peristome of 16 red, papillose teeth divided nearly to the base

**notes:** highly variable in habit; resembles *Racomitrium ptychophyllum*, but differs in being only weakly plicate, with a single fold on one side



habit (with *Polytrichum juniperinum*), shoot (dry), capsule, peristome, and leaf outline  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 0.25 mm



leaf base, revolute margin midleaf, and leaf basal angle showing sinuose walls  
 ■ 0.25 mm, ■ 10 μm, ■ 10 μm

continued next page

**Racomitrium elongatum** Frisvoll

**form:** tufts or mats, creeping, procumbent to erect,  $\pm$  branched, hoary when dry  
**habitat:** dry sandy or gravelly soil, lowland to subalpine

**leaf:** size: 2–3.2  $\times$  0.8–1.2 mm

*shape:* ovate-lanceolate to subtriangular,  $\pm$  curved

*tip:* subulate, denticulate, hair-point long-decurrent and papillose

*base:* basal cells quadrate to short-rectangular, 20–50  $\times$  20  $\mu\text{m}$ ,  $\pm$  nodulose; alar

cells hyaline, firm-walled, in a triangular group of 3–6 rows

*costa:* percurrent, channeled, 85–120  $\mu\text{m}$  wide at the base

*border:* not differentiated

*margin:* entire, broadly recurved throughout

*cells:* 6–20  $\times$  5–8  $\mu\text{m}$ , rectangular, sinuose, thick-walled, pluripapillose

**capsule:** 1.4–1.8 mm, long-cylindric, erect, exserted, rust-red, sulcate when dry;

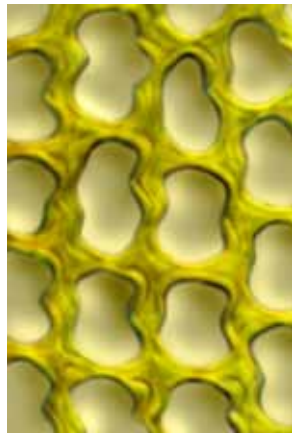
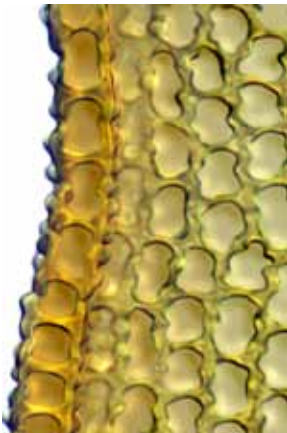
seta 10–15 mm, brown, glossy; peristome teeth to 0.8 mm long, split to the base into two filiform, papillose prongs

**note:** capsules not seen in New Zealand



habit (moist), vegetative shoots (dry) (2), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 50  $\mu\text{m}$



recurved margin midleaf, cells midleaf, and leaf basal angle

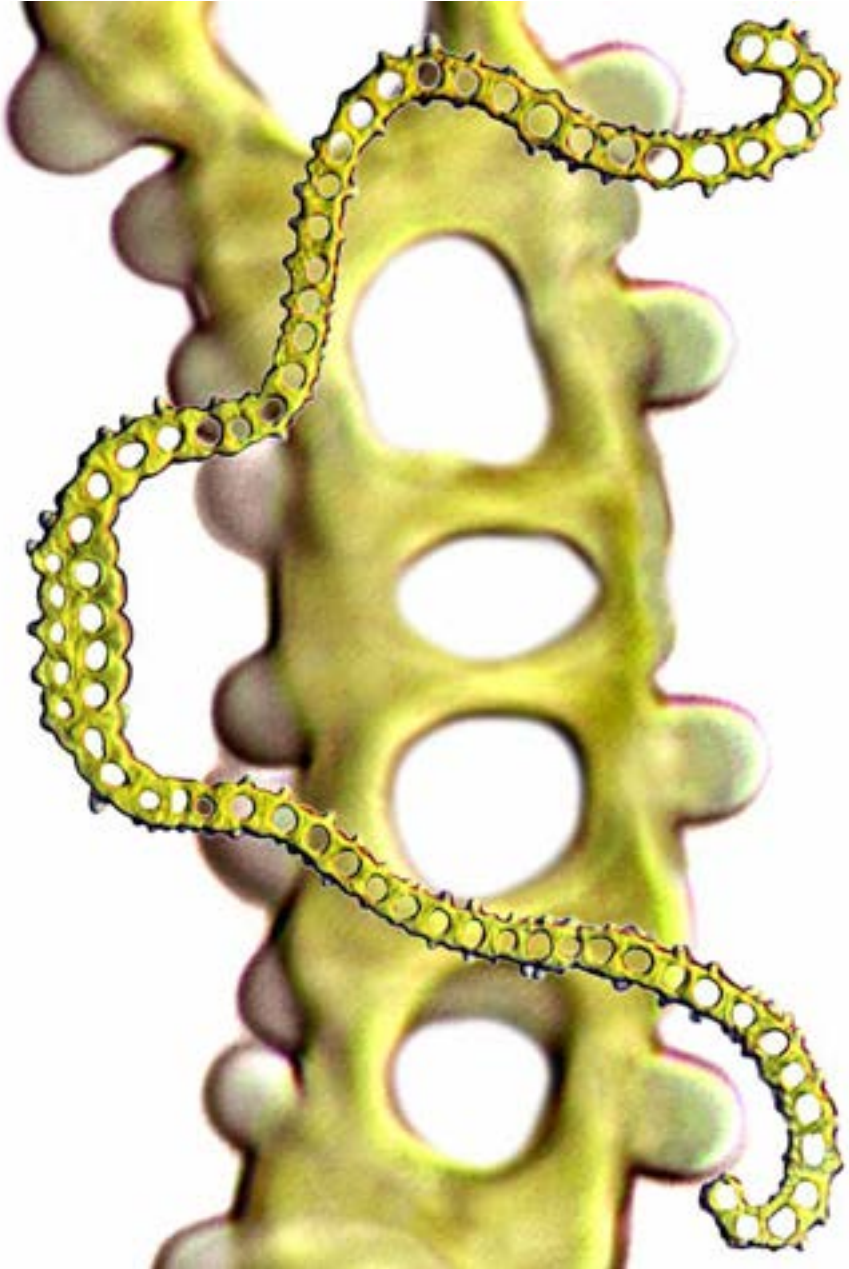
■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Racomitrium elongatum* vegetative shoot (dry)  
1 mm

continued next page



*Racomitrium elongatum* leaf cross-sections

50  $\mu\text{m}$  (whole leaf),

10  $\mu\text{m}$  (detail)

continued next page

**Racomitrium lanuginosum** (Hedw.) Brid.

**form:** robust, in cushions or carpets, hoary when dry, grey-green to yellowish, with many short, tufted, horizontal branches

**habitat:** soil or rock, often in dry sites

**leaf:** size: 3.5–4.0 × 0.6–1.0 mm

*shape:* narrowly lanceolate

*tip:* long-acuminate, ending in a decurrent, hyaline, papillose acumen tipped by a hyaline decurrent hair-point that reflexes 90° when dry

*base:* not differentiated

*costa:* ending in the hyaline acumen

*border:* not differentiated

*margin:* hyaline acumen coarsely dentate and papillose, ± revolute below

*cells:* 35–40 × 4–5 μm, linear, incrassate, sinuose, smooth, papillose in acumen

**capsule:** 1–1.7 mm, ovoid-cylindric, truncate at the base, smooth, red-brown;

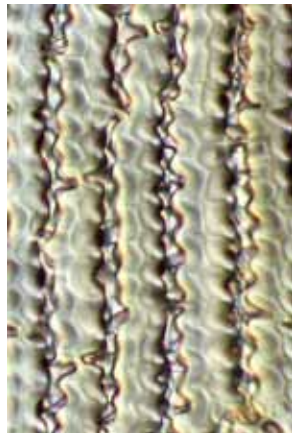
seta 4–8 mm, flexuose, papillose, often paired

**note:** often forming extensive carpets on scree or in fell-fields



vegetative habit, vegetative shoot (dry), leaf outline, and leaf apex

100 mm, 5 mm, 0.25 mm, 10 μm



upper leaf margin and costa, marginal papillae midleaf, and sinuose cells in leaf base

50 μm, 10 μm, 5 μm

continued next page





*Racomitrium lanuginosum* habit on Mt Ruapehu

continued next page



*Racomitrium lanuginosum* xs of leaf hyaline decurrency (above) and lamina margin (below)  
5 µm (above), 5 µm (below)

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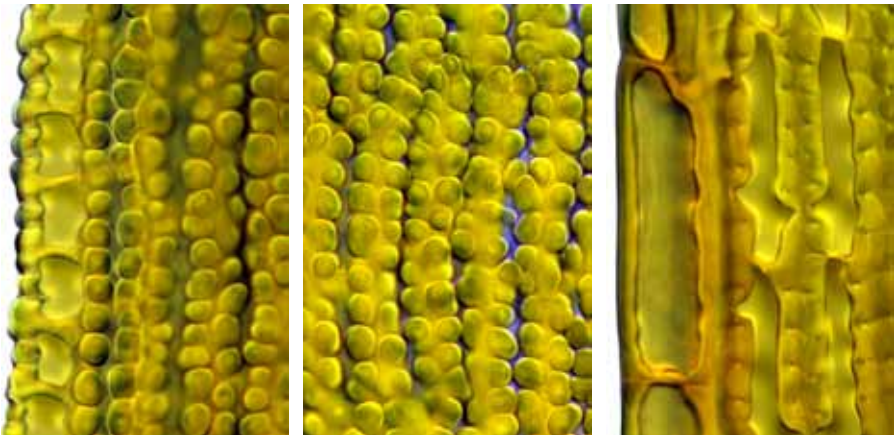


*Racomitrium lanuginosum* decurrent margin of hair-point (midleaf)  
10  $\mu$ m

continued next page

**Racomitrium pruinosum** (Hook.f. & Wilson) Müll.Hal.**form:** loose tufts, hoary, with short, pinnate, recurved lateral branchlets**habitat:** exposed soil or rock, sometimes dominating subalpine vegetation**leaf:** size: 3.5–4.0 mm*shape:* narrowly lanceolate, with two folds below*tip:* long-acuminate, ending in a long-decurrent hyaline hair-point*base:* basal cells less papillose than the other laminal cells*costa:* broad, continuing through the hyaline hair-point, ending below the apex*border:* a single row of oblong, thin-walled cells in only the basal margin*margin:* entire below, ± dentate above, variably recurved or revolute*cells:* 30–50 × 4–5 μm, linear, incrassate, sinuose, papillose throughout**capsule:** 1.0–1.7 mm, ovoid, erect, smooth, excurrent, brown; seta 4–8 mm, papillose; calyptra mitriform; operculum subulate-rostrate; peristome teeth divided to the base into two long, filiform, papillose segments; spores 7–10 μm in diam., smooth

vegetative shoot (dry) (2), leaf outline, leaf apex, and margin of hair-point  
 1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



margin midleaf, papillose cells midleaf, and margin near leaf base  
 10 μm, 10 μm, 10 μm

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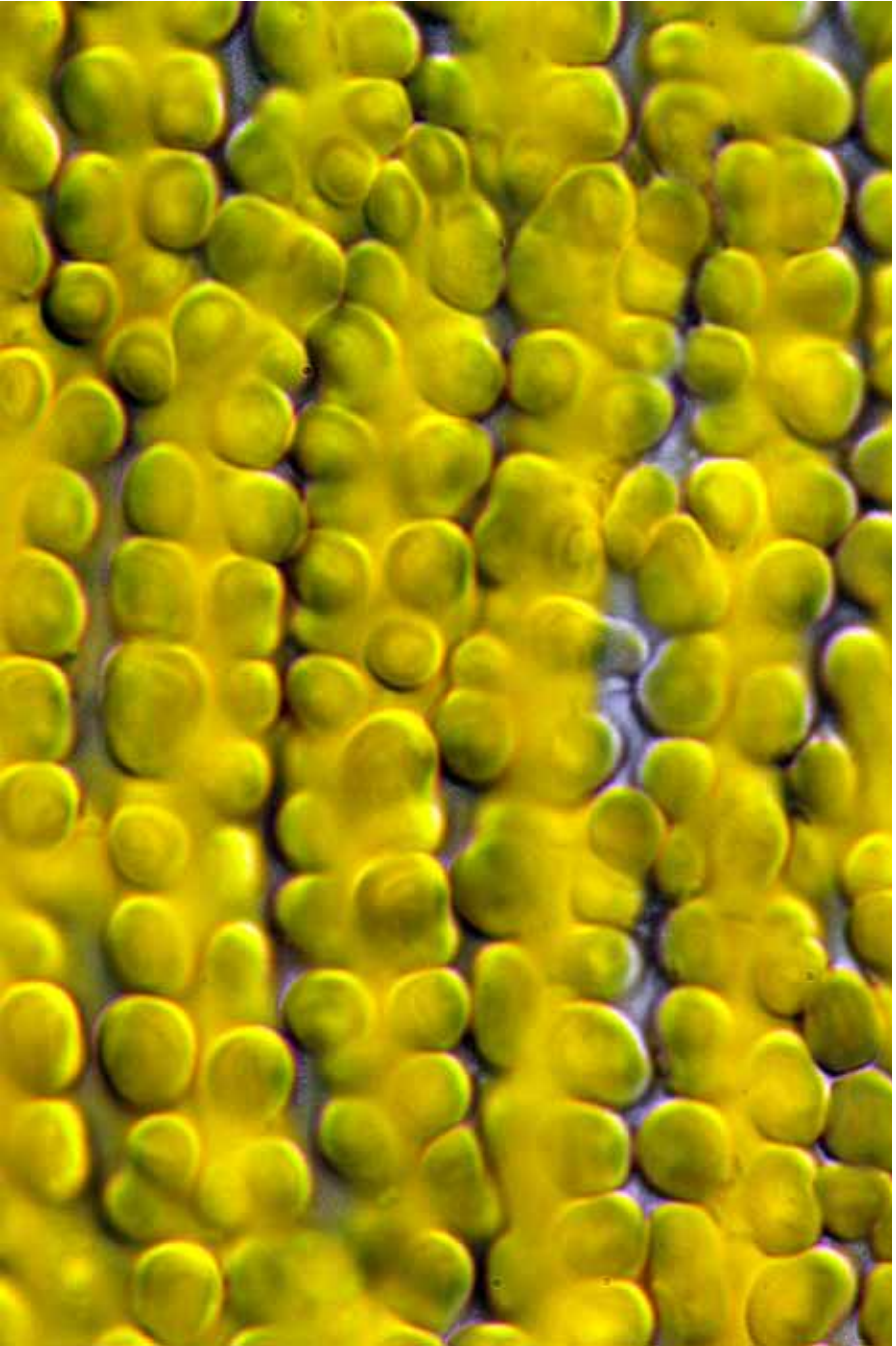


*Racomitrium pruinatum* leaf cross-sections

10  $\mu\text{m}$  (above),

5  $\mu\text{m}$  (below)

continued next page



*Racomitrium pruinatum* papillose cells midleaf  
10  $\mu\text{m}$

continued next page

**Racomitrium ptychophyllum** (Mitt.) Hook.f.

**form:** tufted, yellow-brown, erect, sparsely branched, highly variable  
**habitat:** rock in subalpine vegetation

**leaf:** size: 3–3.5 mm

**shape:** lanceolate, long-plicate, with two folds on each side of the costa

**tip:** gradually tapered, bluntly pointed, without a hair-point

**base:** cells in the basal angles not or only weakly differentiated

**costa:** robust, failing just below the apex

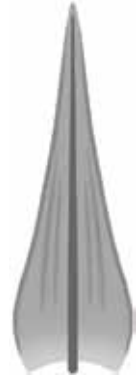
**border:** not differentiated

**margin:** entire to minutely crenulate, recurved to nearly the apex

**cells:** 20–40 × 10 μm, rectangular to linear, incrassate, sinuose, smooth

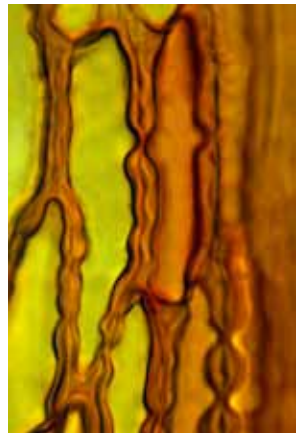
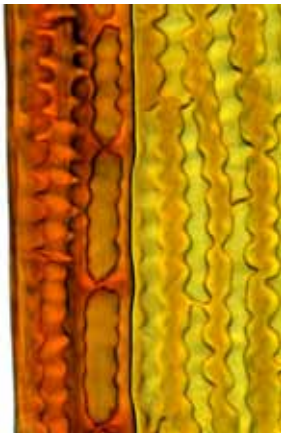
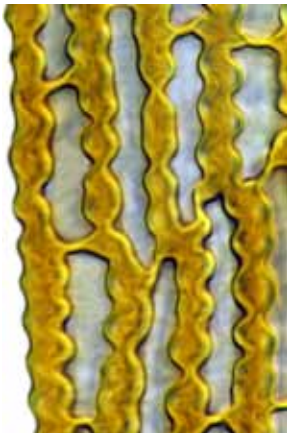
**capsule:** 2 mm, narrowly oblong to cylindrical, erect, exserted, pale brown;  
 seta 2–5 mm; peristome of 16 dark red, coarsely papillose teeth divided  
 nearly to their base

**notes:** resembles *Racomitrium crispulum*, but differs in lacking a hyaline  
 hair-point and (usually) having 1–2 plications on both sides of the costa



habit (on left with *Celmisia sessiliflora*) (2), leaf outline, and leaf apex

10 mm, 1 mm, 0.5 mm, 10 μm



margin midleaf, reflexed margin of lower leaf, and cells of leaf basal angle

10 μm, 10 μm, 10 μm

continued next page

**Racomitrium striatipilum** Cardot

**form:** matted to tufted, prostrate to erect stems, densely branched, often hoary  
**habitat:** exposed rock, mostly at 1200–1600 m in grassland or shrubland

**leaf:** *size:* 1.5–2.1 (excluding hair-point) × 0.4–0.6 mm

*shape:* narrowly lanceolate to ovate-lanceolate, unistratose throughout

*tip:* long-acuminate, ending in a hyaline, non-decurrent 1.5 mm hair-point

*base:* basal cells long-rectangular, 40–60 × 6–10 μm

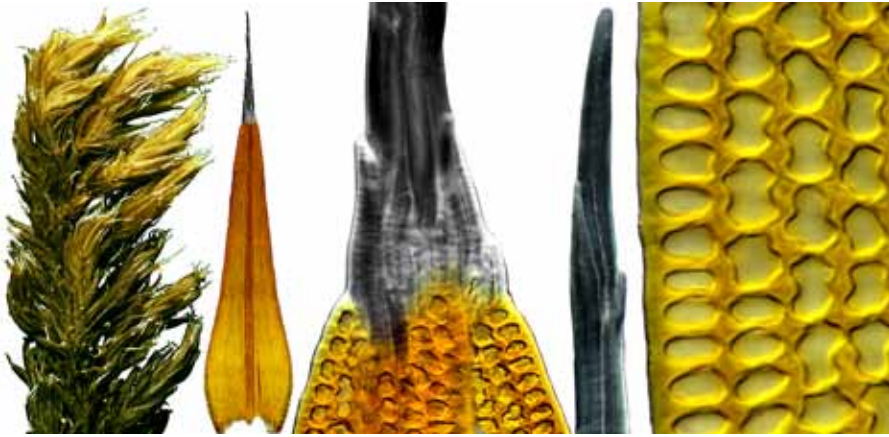
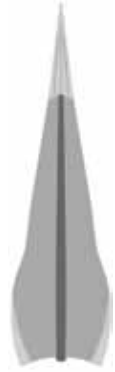
*costa:* percurrent

*border:* not differentiated

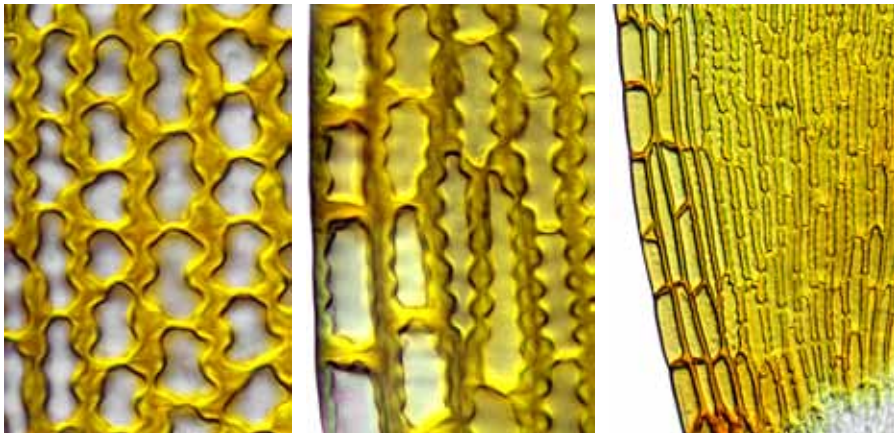
*margin:* entire, plane on one side, ± recurved on the other in the lower 2/3

*cells:* 6–10 μm, isodiametric above, thick-walled, sinuose, ± striate

**capsule:** 1.5–2.0 mm, ellipsoid to cylindric, erect, shortly exserted, dark brown; seta 2.5–6.0 mm, yellowish to pale brown; peristome single, 16 yellowish, deeply cleft, narrowly lanceolate teeth; operculum beaked; stomata superficial; calyptra smooth, naked, 5-lobed at base



vegetative shoot (dry), leaf outline, hair-point junction and tip, and margin midleaf  
 1 mm, 1 mm, 50 μm, 10 μm, 10 μm



cells midleaf, margin near leaf base, and leaf basal angle  
 10 μm, 10 μm, 50 μm

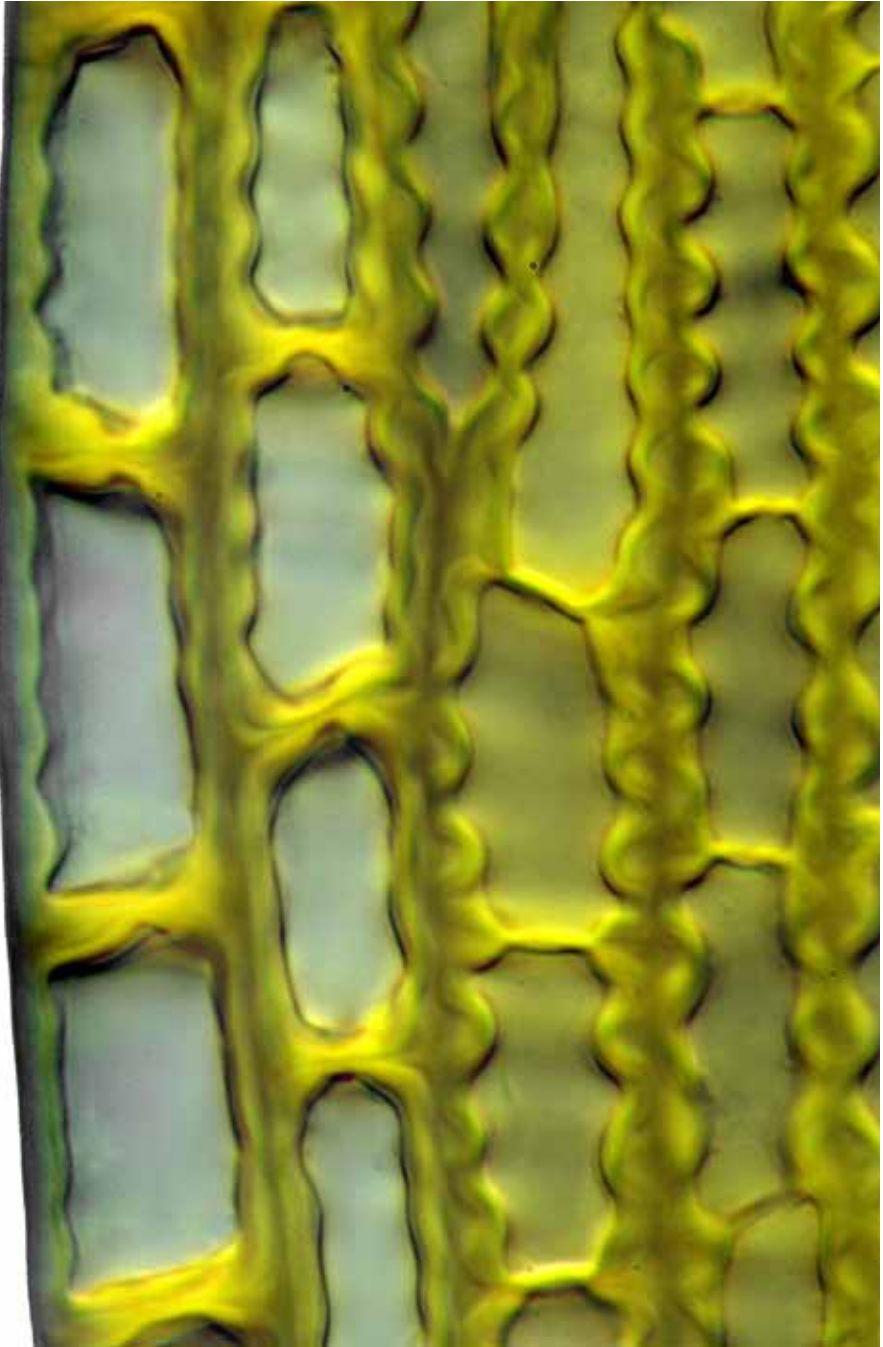
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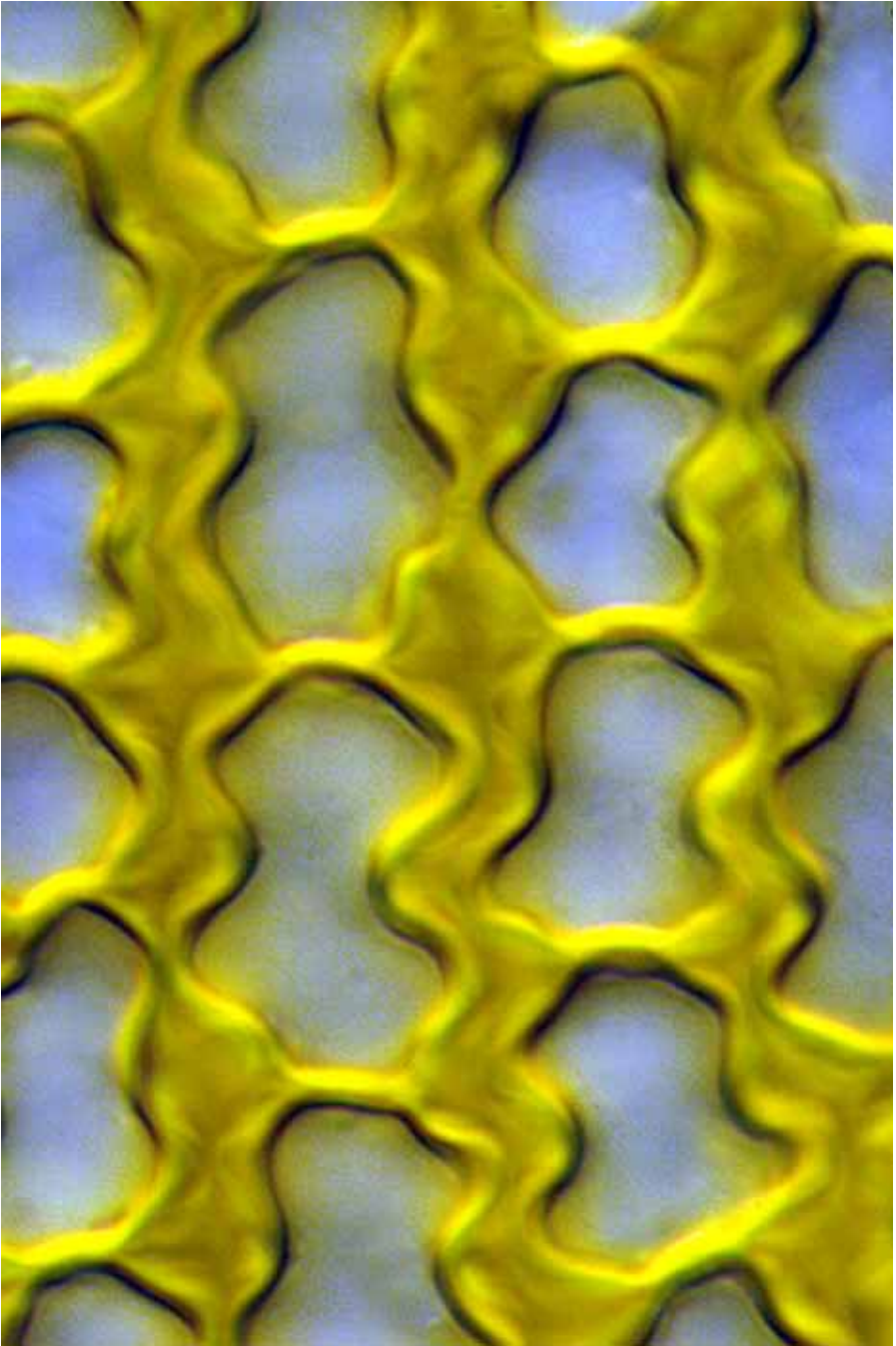
*Racomitrium striatipilum* vegetative shoot (dry), and an immature and mature capsule  
1 mm (left), 1 mm (right) (2)

continued next page



*Racomitrium striatipilum* margin near leaf base  
10  $\mu\text{m}$

continued next page



*Racomitrium striatipilum* lamina cells midleaf  
10  $\mu\text{m}$

**Coscinodon calyptratus** (Hook.) C.Jens.

**form:** hoary cushions of erect, branched, dark olive-green stems, to 25 mm tall  
**habitat:** dry, exposed rock or soil-covered rock to high elevations

**leaf:** size: 1.5–2.5 mm

*shape:* ligulate to lanceolate-ligulate, keeled above, ± bistratose, ± mucinous

*tip:* gradually to abruptly contracted to a hair-point

*base:* basal cells oblong to quadrate; alar cells little differentiated

*costa:* long-excurrent in a hair-point

*border:* not differentiated

*margin:* entire, plane or recurved on one side, bistratose

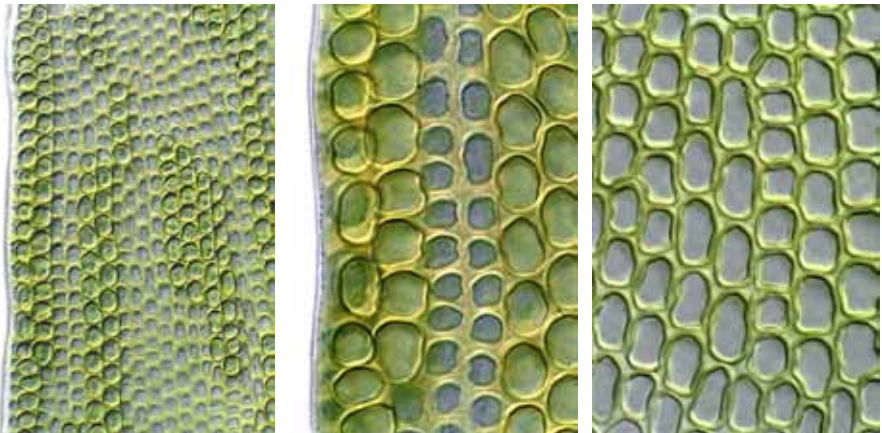
*cells:* 6–8  $\mu\text{m}$ , ± rounded, firm-walled, ± sinuose, smooth

**capsule:** 1–1.7 mm, oblong-elliptic, immersed to shortly exserted, reddish brown, smooth to ribbed when dry; seta 2–3 mm, straight; calyptre straw-coloured, later darkening at the tip, covering the entire capsule, fringed at the base; annulus none; stomata none; operculum rostrate; peristome teeth reddish; spores 12–14  $\mu\text{m}$  in diam., granular



fertile shoots (dry) (2), leaf outlines (2), and base of hair-point

1 mm, 1 mm, 1 mm (2), 100  $\mu\text{m}$



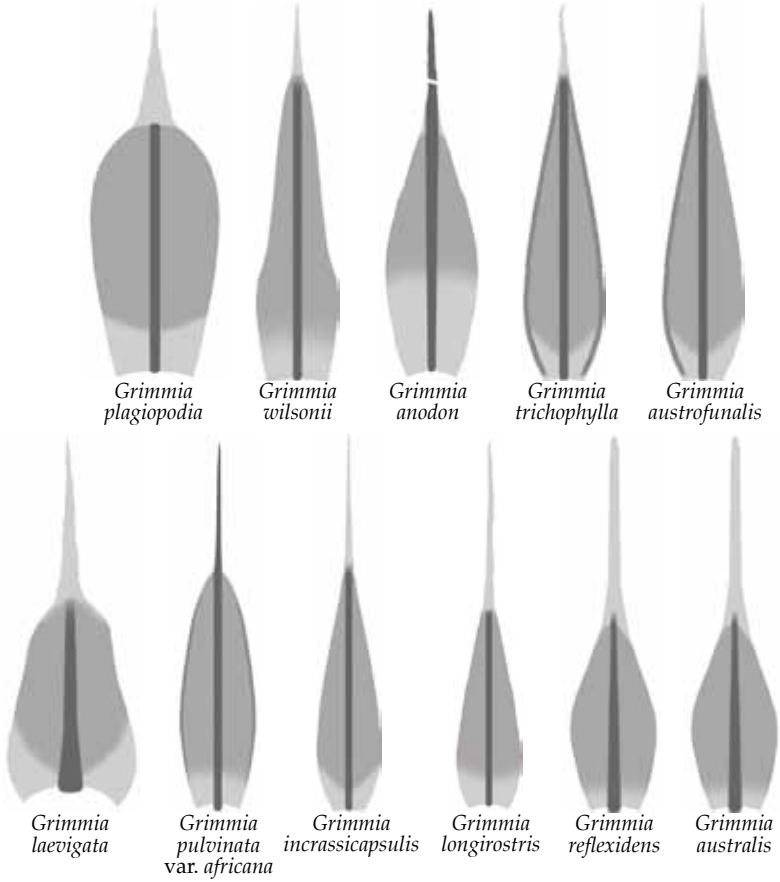
upperleaf bistratose patches, bistratose upper leaf margin, and unistratose lamina cells

50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

Key\* to New Zealand species and varieties of *Grimmia* (11)

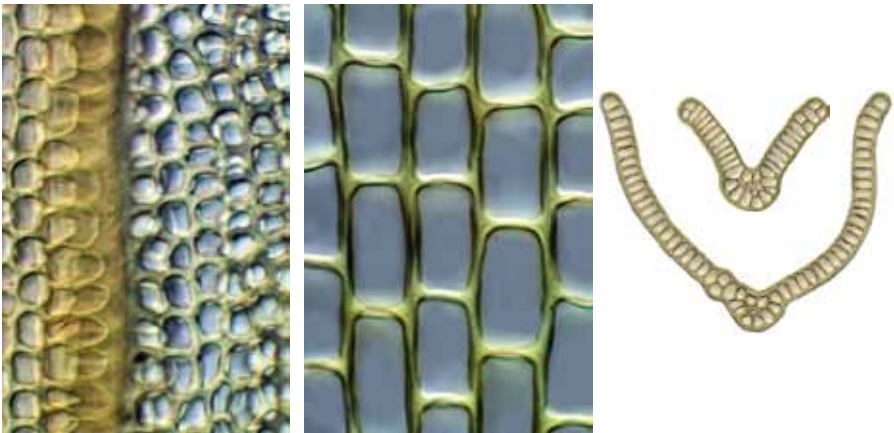
- 1 Leaves unistratose throughout..... 2  
 1: Leaves at least partly 2–3-stratose distally ..... 8
- 2(1) Leaves lacking awns, or only distal leaves with very short awns or hyaline tips .....  
 ..... ● ***Grimmia trichophylla*** 3  
 2: At least distal or perichaetial leaves with distinct awns ..... 3
- 3(2:) Awns up to or longer than the lamina; margin plane; seta straight to flexuose ..... 4  
 3: Awns shorter than the lamina; margin recurved; seta arcuate to cygneous..... 6
- 4(3) Hair-points rough to sharply denticulate ..... 5  
 4: Hair-points smooth or nearly so ..... ● ***Grimmia reflexidens***
- 5(4) Plants hoary-white, on limestone..... ● ***Grimmia plagiopodia***  
 5: Plants not hoary-white, not on limestone ..... ● ***Grimmia australis***
- 6(3:) Lamina abruptly narrowed to the awn; apex rounded.....  
 ..... ● ***Grimmia pulvinata* var. *africana***  
 6: Lamina gradually narrowed to the awn; apex acute ..... 7
- 7(6:) Margin recurved on only one side; hair-point smooth.. ● ***Grimmia austrofunalis***  
 7: Margin usually recurved on both sides; hair-point denticulate to spinulose .....  
 ..... ● ***Grimmia trichophylla***
- 8(1:) Costa prominent abaxially ..... 10  
 8: Costa not prominent abaxially ..... 9
- 9(8:) Basal marginal cells quadrate to rectangular ..... ● ***Grimmia wilsonii***  
 9: Basal marginal cells oblate (wider than long)..... ● ***Grimmia laevigata***
- 10(8) Capsule immersed, seta < 1 mm long ..... 11  
 10: Capsule emergent to exserted, seta 1–4 mm long ..... ● ***Grimmia longirostris***
- 11(10) Exothecial cells thin-walled; seta arcuate; midleaf cell walls straight.....  
 ..... ● ***Grimmia anodon***  
 11: Exothecial cells incrassate; seta straight; midleaf cell walls sinuose .....  
 ..... ● ***Grimmia incrasscapsulis***

\* based on Hastings, RI; Greven, HC (2007): *Grimmia*. *Flora of North America* 27, 226, and Greven, HC (1998): Synopsis of *Grimmia* Hedw. in New Zealand, including *Grimmia wilsonii* sp. nov. *Journal of Bryology* 20, 389–402.



**Grimmia anodon** Bruch & Schimp.**form:** tufts or cushions of dark green, branched, hoary stems, to 12 mm tall**habitat:** exposed soil or soil over rock, usually in full sun, to high elevations**leaf:** size: 1.0–1.8 mm, awn to 1.2 mm*shape:* ovate-lanceolate, with bistratose streaks, concave, ± keeled near the apex*tip:* acuminate, upper leaves piliferous, lower leaves mucicose, much smaller*base:* basal cells rectangular to linear, thin-walled, hyaline; the transverse walls are thicker than the lateral walls in cells near the margins*costa:* in lower leaves percurrent; in upper leaves excurrent in a hair-point*border:* absent*margin:* entire, plane to at least slightly recurved at the base*cells:* 6–12  $\mu\text{m}$ ,  $\pm$  quadrate, firm-walled, smooth**capsule:** urn 1 mm, globose, immersed, stomatose below; seta short and bent, hidden by the perichaetial leaves; calyptra small, mitrate; peristome absent; operculum convex; annulus a single row of cells

fertile shoot, leaf outline, leaf apex, hair-point detail, and margin midleaf



costa midleaf, cells just below midleaf, and xs of upper leaf (above) and midleaf (below)

continued next page

**Grimmia australis** (Dixon & Sainsbury) J.M. Muñoz & Ochrya

**form:** compact hairy cushions of erect stems, dark brown below, to 20 mm tall  
**habitat:** exposed acidic rock in dry sites

**leaf:** size: 2.5–3.5 mm, including hair-point

*shape:* narrowly lanceolate, vegetative leaves strongly crisped when dry

*tip:* denticulate, hyaline hair-point

*base:* basal cells  $\pm$  rectangular; transverse walls of the outer 3–6 rows of basal cells thickened

*costa:* strong, reaching the base of the hair-point

*border:* not differentiated

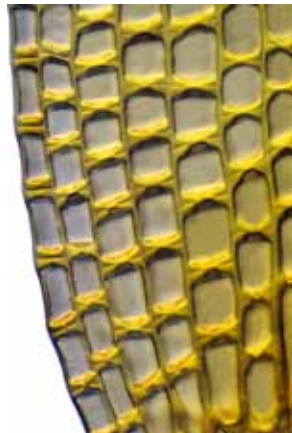
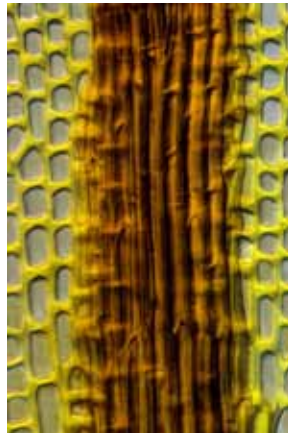
*margin:* entire,  $\pm$  recurved on both sides

*cells:* 9–12  $\mu\text{m}$ , rounded-quadrate, thick-walled,  $\pm$  sinuose, smooth

**capsule:** to 2 mm, cylindrical, erect, immersed, brown, not stomatose, annulus a single row of quadrate, thick-walled cells; seta very short; operculum mammillate to rostrate; peristome teeth split and perforate toward the apex, papillose



fertile shoot (dry) (2), leaf outline, leaf apex, leaf subapex, and margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



cells midleaf, costa midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$





*Grimmia australis* leaf basal angle  
10  $\mu\text{m}$

continued next page

**Grimmia austrofunalis** Müll.Hal.**form:** loosely to densely tufted, blackish green stems, hoary when dry**habitat:** exposed acidic rock, at subalpine to alpine elevations**leaf:** size: 2–2.8 mm*shape:* lanceolate, sharply keeled above*tip:* acuminate, ending in a smooth, hyaline, slightly denticulate hair-point*base:* basal cells longer and thinner-walled than other lamina cells*costa:* reaching the base of the hair-point*border:* not differentiated*margin:* entire, recurved on one side*cells:* 10–20 × 10 μm, subquadrate to rectangular, incrassate, sinuose, smooth**capsule:** 1.5 mm, ovoid, erect, exserted, brown; seta 3–5 mm, flexuose when dry; operculum rostrate; columella not attached; calyptra irregularly lobed at the base; peristome teeth papillose

vegetative shoots (3, moist on right), mature capsule, peristome, and leaf apex (3)

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 50 μm, ■ 50 μm, ■ 50 μm



margin midleaf, cells midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page

**Grimmia incrasscapsulis** B.G.Bell

**form:** compact hoary cushions 5–15 mm deep, of  $\pm$  unbranched stems, the leaves nearly identical, erect wet or dry, crowded, imbricate

**habitat:** on exposed rock

**leaf:** *size:* 2.0–2.7  $\times$  0.3–0.4 mm plus a hair-point up to 5 mm long

*shape:* narrowly oblong-lanceolate

*tip:* acute, with a smooth to denticulate, hyaline hair-point

*base:* basal cells long-rectangular, thin-walled, lax, 40–70  $\times$  9–12  $\mu$ m

*costa:* channelled above, ending at the base of the hair-point

*border:* not differentiated

*margin:* entire, plane, often bistratose from midleaf to apex

*cells:* 8  $\times$  10,  $\pm$  isodiametric, incrassate, sinuose in midleaf, smooth

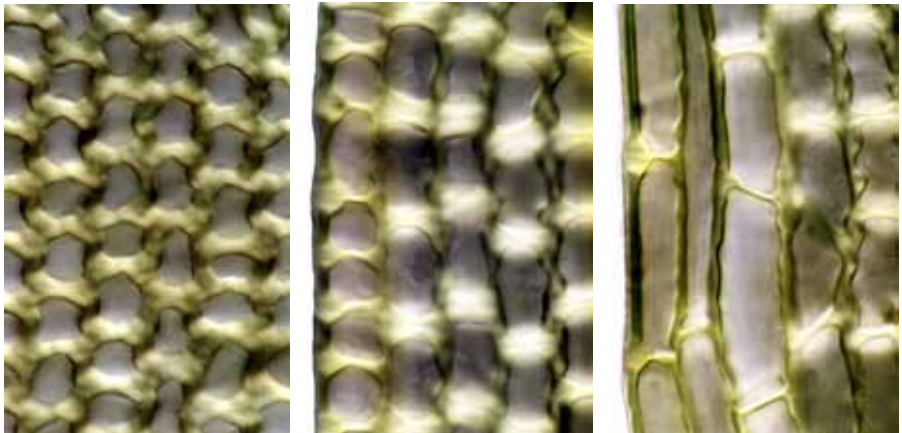
**capsule:** ovoid, immersed, 0.9–1.2  $\times$  0.8–0.9 mm, asymmetric on the seta; seta 0.3–0.4 mm; columella persistent

**notes:** widespread but rare New Zealand endemic



vegetative shoots (2), leaf outline, leaf apex, tip of awn, and margin above midleaf

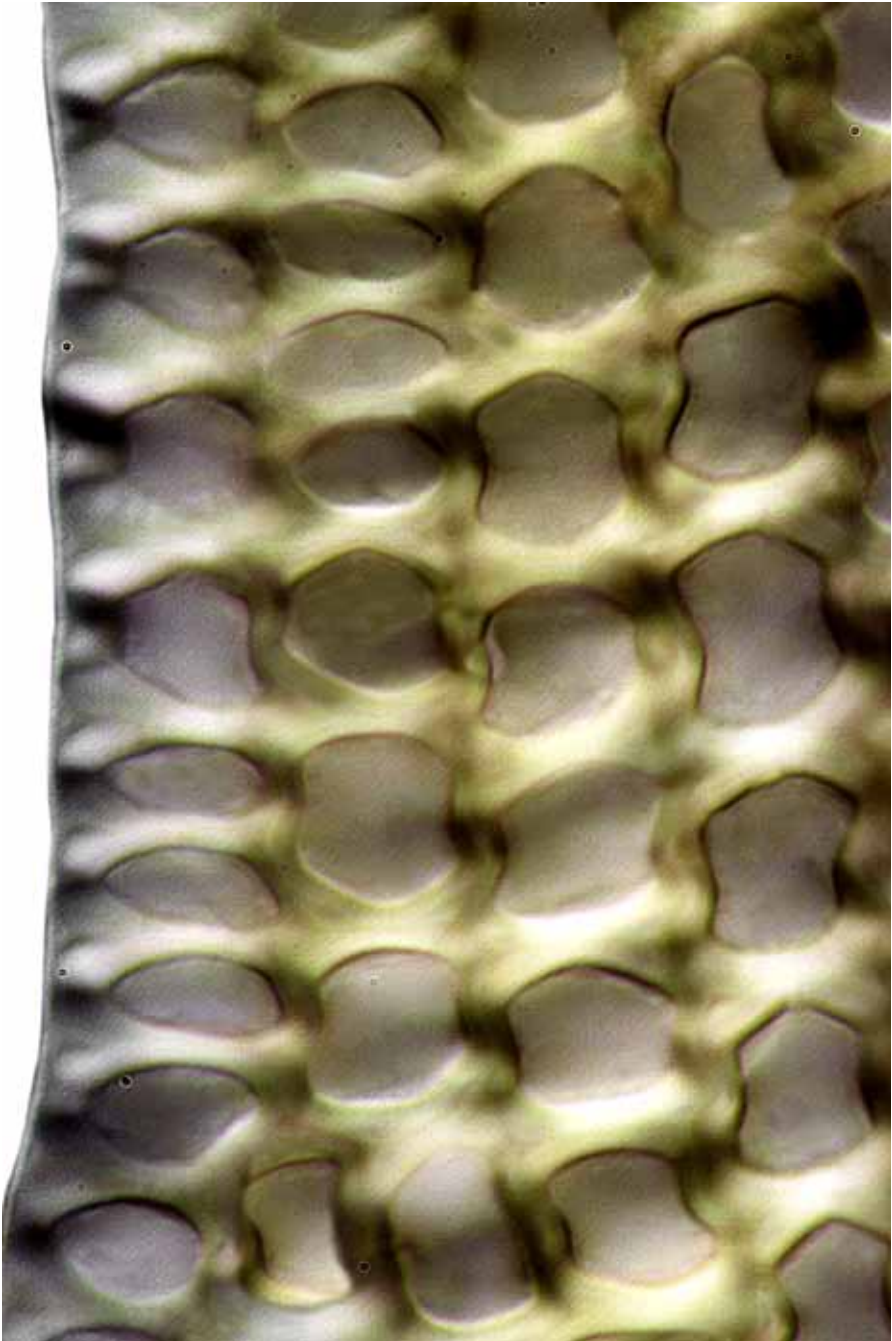
1 mm, 1 mm, 1 mm, 100  $\mu$ m, 100  $\mu$ m, 10  $\mu$ m



lamina cells, lower leaf margin, and margin close to base showing elongate basal cells

10  $\mu$ m, 10  $\mu$ m, 10  $\mu$ m

continued next page



*Grimmia incrassicapsulis* margin midleaf and sinuose lamina cells  
10  $\mu\text{m}$

**Grimmia laevigata** (Brid.) Brid.

**form:** tufted, erect, dark green to brown stems with hoary tips, to 15 mm tall  
**habitat:** exposed, dry acidic rock in forests and scrub to moderate elevations

**leaf:** size: 1.5–3.0 × 0.7–1.3 mm excluding the awn

**shape:** oblong-ovate to ± triangular; bistratose except at margins and base

**tip:** acute, ending in a denticulate, hyaline, decurrent, broad-based awn

**base:** basal cells oblate to rectangular, with thick transverse walls

**costa:** flattened from base to midleaf

**border:** not differentiated

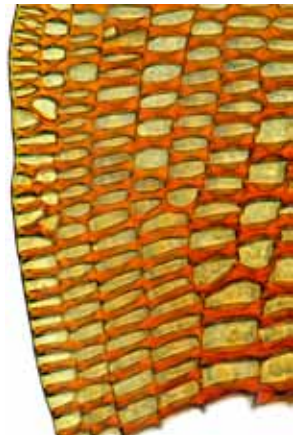
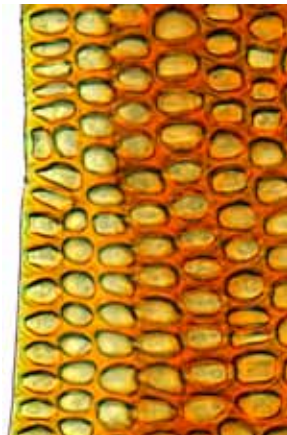
**margin:** entire, plane to erect

**cells:** 6–10 μm, ± quadrate, thick-walled, smooth

**capsule:** to 3 mm, oblong-ovoid to cylindric, emergent, erect, stomatose;  
 annulus of 2–3 rows of quadrate, incrassate cells; seta 1.5–3 mm, straight;  
 calyptra mitrate; operculum short-rostrate; peristome teeth irregularly  
 split and perforate above



habit (dry), sterile shoot (dry), leaf outline, awn tip, and awn decurrency  
 ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



margin midleaf and leaf basal angle (2)  
 ■ 10 μm, ■ 50 μm, ■ 10 μm

continued next page

**Grimmia longirostris** Hook.

**form:** cushions of erect, branched, yellow- to olive-green stems, to 30 mm tall  
**habitat:** exposed, dry, acidic granite and quartzite rock to high elevations

**leaf:** size: 1.5–3.0 mm

*shape:* ovate-lanceolate, keeled, distal half of leaf bistratose

*tip:* hyaline hair-point 1/6 to 1/2 the blade length

*base:* basal juxtacostal cells long-rectangular, sinuose, incrassate; transverse walls of basal marginal cells thickened

*costa:* reaching to the base of the hair-point

*border:* not differentiated

*margin:* entire, plane or one side recurved below

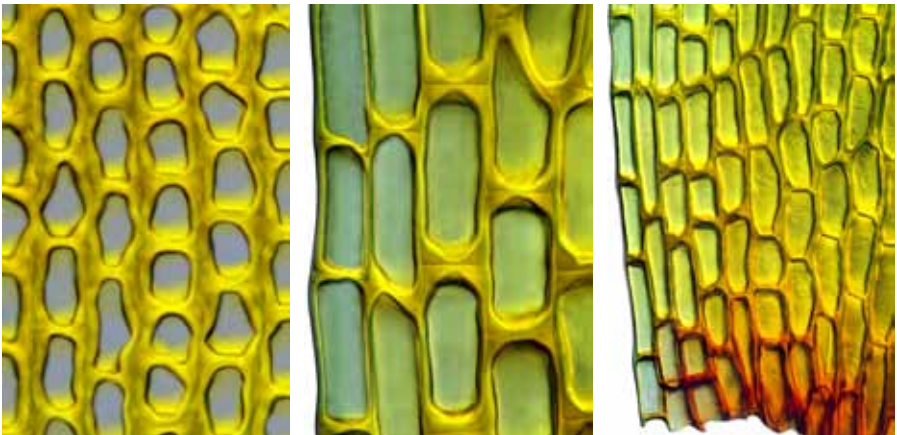
*cells:* 8–12  $\mu\text{m}$ , isodiametric to short-rectangular, incrassate,  $\pm$  sinuose, smooth

**capsule:** to 1.5 mm, oblong-ovoid, erect, emergent to exerted, brown; seta 1–4 mm; 2–3 rows of stomata; operculum long-rostrate; calyptra cucullate; peristome teeth perforate and split in their upper half



fertile shoots (dry) (2), leaf outline, hair-point apex (2), and margin midleaf

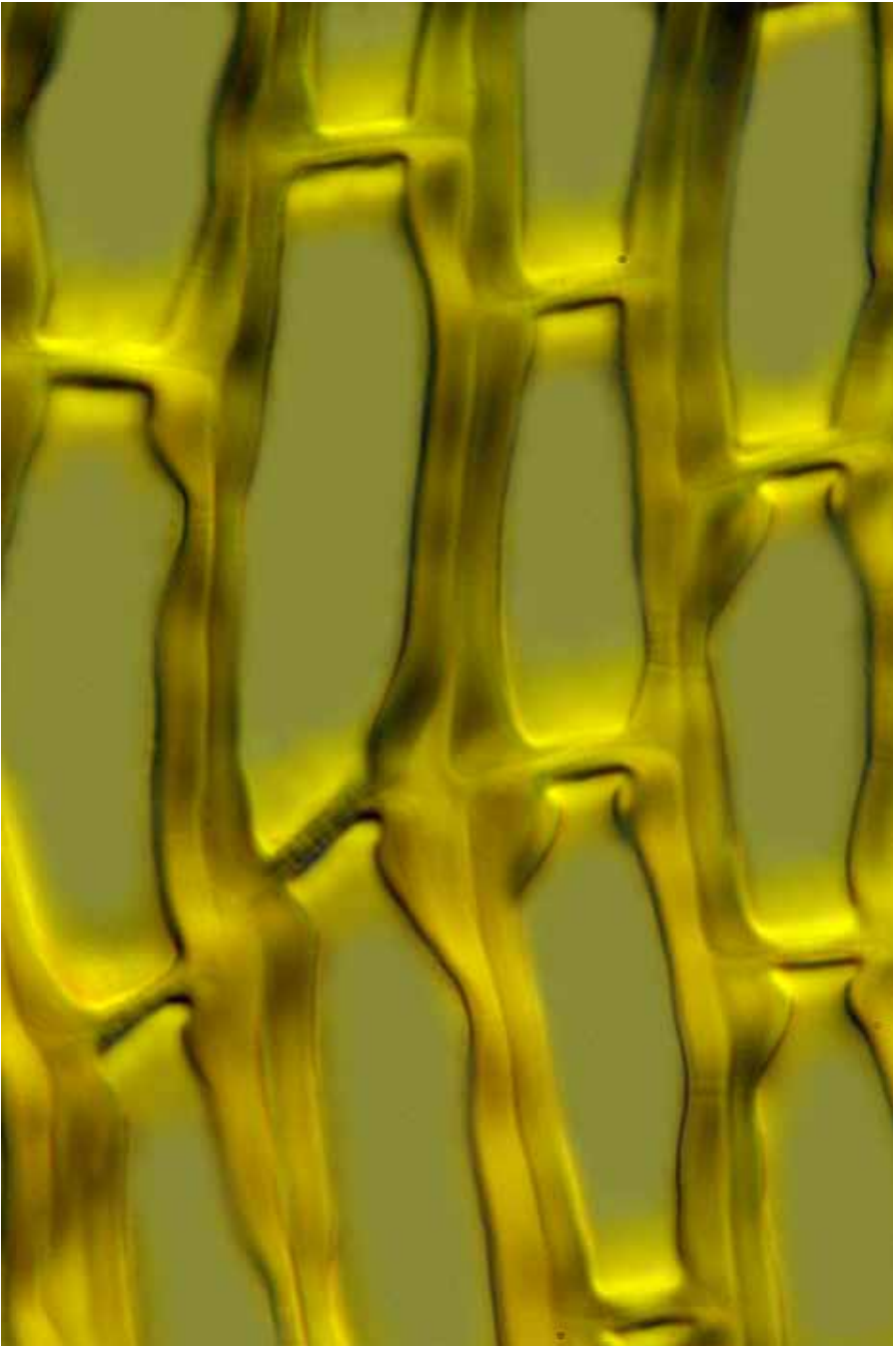
1 mm, 1 mm, 1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



cells upper leaf, margin near leaf base, and leaf basal angle

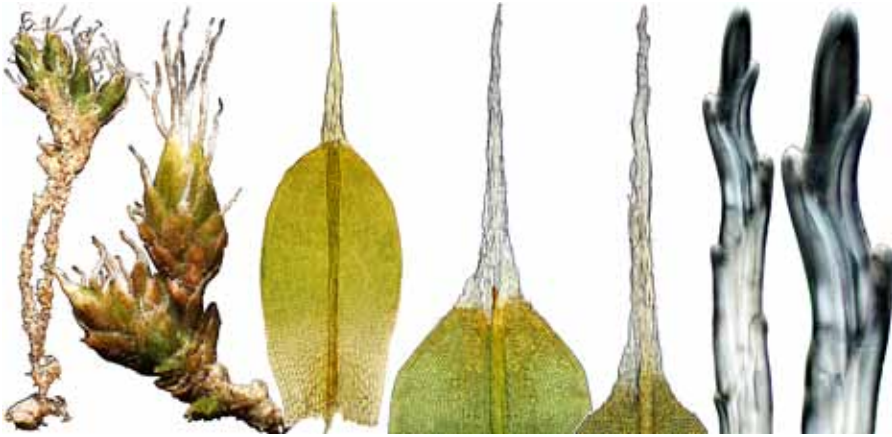
10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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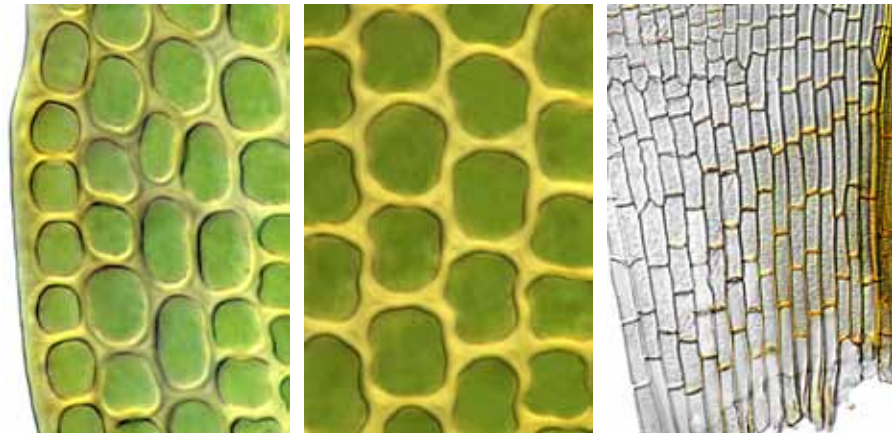
*Grimmia longirostris* basal juxtacostal cells  
10  $\mu\text{m}$

continued next page

**Grimmia plagiopodia** Hedw.**form:** tufts or cushions of erect stems, green above, reddish below, to 20 mm**habitat:** rock, usually limestone**leaf:** size: 1.2–2 mm*shape:* oblong to ovate-lanceolate, unistratose throughout*tip:* obtuse to mucicous or hair-pointed, the hair-point sometimes broad-based*base:* basal cells quadrate to short-rectangular, thin-walled, ± hyaline*costa:* slender above, weak below, percurrent*border:* not differentiated*margin:* entire, plane to ± incurved*cells:* 10–12 μm, quadrate to rounded, ± sinuose, firm-walled, smooth**capsule:** 1 mm, ovoid to subglobose, ± gibbous, inclined, immersed, brown;  
seta < 1 mm, curved to sigmoid, yellowish; calyptra mitrate, barely covering  
the operculum; operculum short-rostrate; peristome teeth reddish, perforate  
and 2–5-cleft

vegetative shoot (dry) (2), leaf outline, leaf apex (2), and hair-point apex (2)

1 mm, 1 mm, 0.1 mm, 50 μm, 50 μm, 10 μm, 10 μm



margin midleaf, cells midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm



**Grimmia pulvinata** (Hedw.) Sm. var. **africana** (Hedw.) Hook.f. & Wilson

**form:** densely tufted, soft, hoary, olive-green, erect stems, to 25 mm tall  
**habitat:** exposed acidic rock (less often calcareous rock or concrete)

**leaf:** size: 1.5–2 × 0.3–0.4 mm plus 1.5 mm hair-point, ± concave, keeled

**shape:** oblong-lanceolate

**tip:** hyaline, denticulate hair-point

**base:** undifferentiated

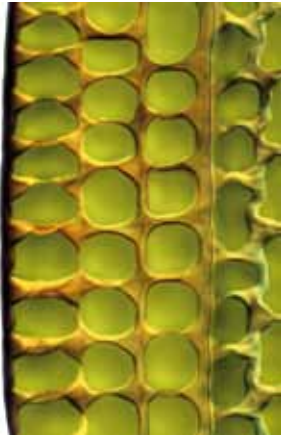
**costa:** prominent at the back, excurrent in a hyaline hair-point

**border:** not differentiated

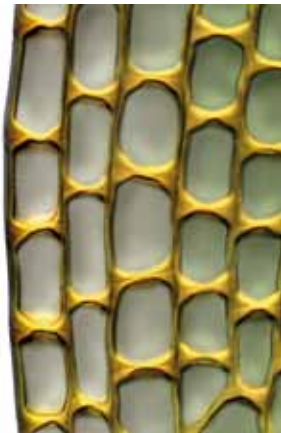
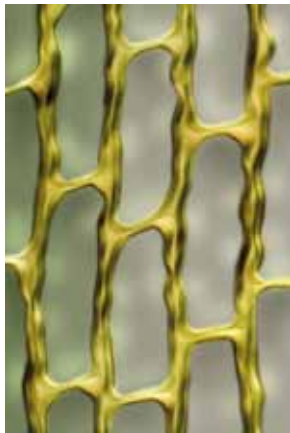
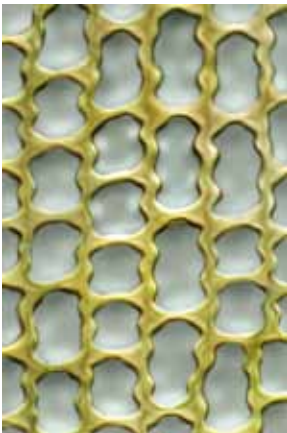
**margin:** entire, variably recurved in midleaf, bistratose above

**cells:** 6–11 μm, rounded-quadrate, incrassate, sinuose, smooth

**capsule:** 1–1.6 mm, oblong-cylindric, symmetric, wrinkled-striate when dry, erect, immersed to exerted, brown, stomatose below; seta 3–6 mm, twisted when dry; annulus well-developed; calyptra cucullate, smooth; operculum stout, long-rostrate; peristome teeth spreading when dry, reddish, split and perforate; spores 9–10 μm in diam., smooth



fertile habit, mature capsule, leaf outline, leaf apex, and recurved margin  
 1 mm, 1 mm, 0.1 mm, 50 μm, 10 μm



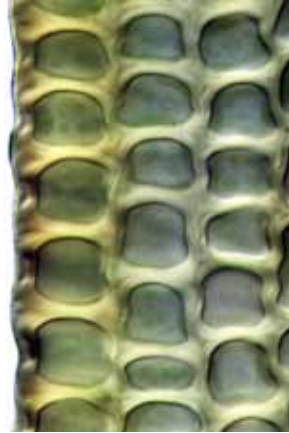
patchy sinuose cells midleaf, juxtacostal cells near base, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Grimmia pulvinata* var. *africana* fertile habit  
1 mm

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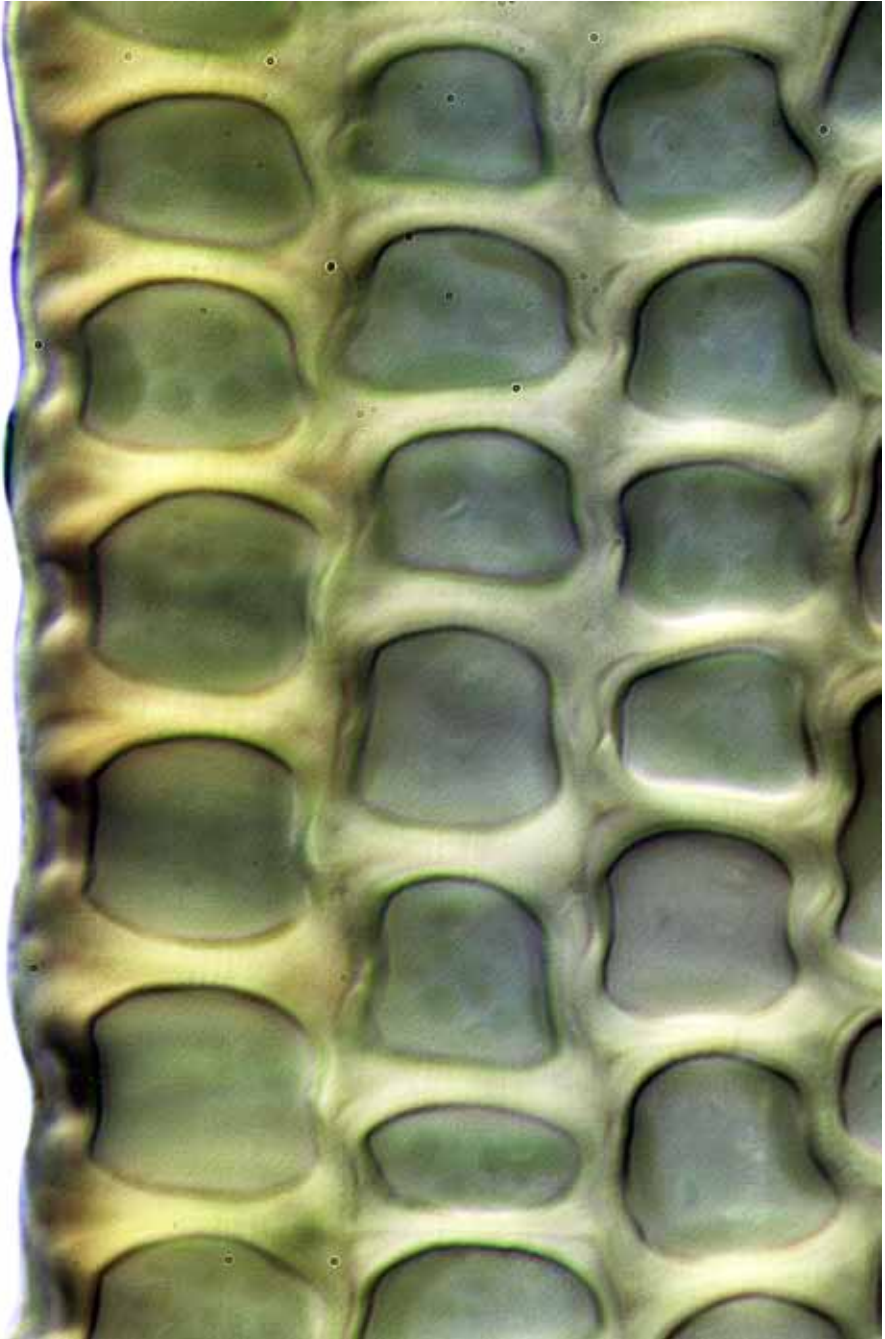
**Grimmia reflexidens** Müll.Hal.**form:** dense, hairy cushions of erect stems, gray-green, to 20 mm tall**habitat:** siliceous rock in dry sites**leaf:** size: 1–2 mm, plus 1–2 mm awn*shape:* ovate to oblong-lanceolate, keeled, plane, unistratose distally*tip:* acute, ending with a narrow, usually smooth, ± flexuose, decurrent, hyaline awn*base:* 2–4 rows of pellucid marginal cells, short-rectangular, with thickened transverse walls*costa:* failing at the base of the awn*border:* not differentiated*margin:* entire, plane, ± bistratose*cells:* 8–12 μm in diam., rounded-quadrate, thick-walled, ± sinuose, smooth**capsule:** 1–2 mm, wider than long, brownish, emergent to short-exserted, lacking stomata; seta straight, 1.5–2 mm long; operculum bulging to rostrate; peristome teeth papillose, split-perforate toward the tip

vegetative shoot (dry), leaf outline, awn, base of awn, and margin midleaf



costa midleaf, cells below midleaf, and leaf basal angle with transverse wall thickenings

continued next page



*Grimmia reflexidens* leaf margin  
10  $\mu\text{m}$

**Grimmia trichophylla** Grev.

**form:** densely tufted, erect stems, radiculose below, separating easily, to 35 mm  
**habitat:** exposed acidic rock

**leaf:** size: 2.5–4.0 × 1.0–2.0 mm

*shape:* narrowly lanceolate, carinate

*tip:* gradually tapering to a short or long, hyaline, entire to denticulate hair-point

*base:* basal cells rectangular, smooth to sinuose, ± pellucid

*costa:* prominent at the back, excurrent in a hair-point of variable length

*border:* not differentiated

*margin:* entire, recurved on one or both sides, 2–3 cell rows often bistratose

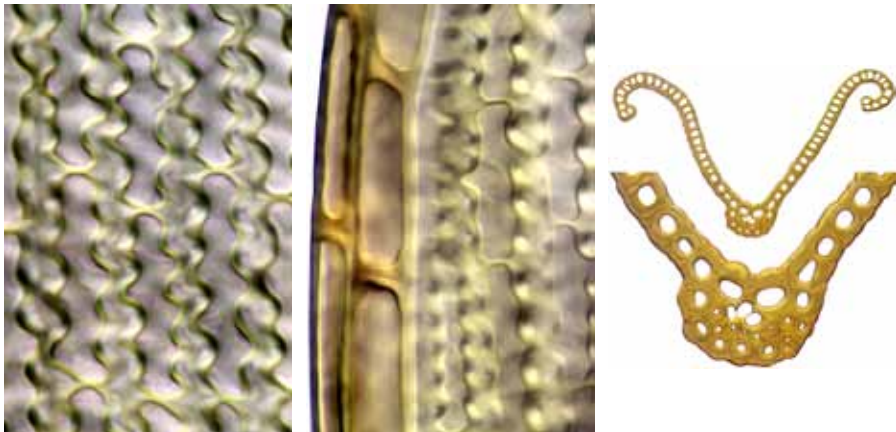
*cells:* 8–10 μm, quadrate, incrassate, sinuose, smooth

**capsule:** 1.3 mm, oval-oblong, striate when dry, yellow-green to stramineous;  
 operculum red, rostrate; annulus wide; seta 3–4 mm, cygneous or flexuose  
 wet or dry, yellow; calyptra mitriform; peristome teeth pale red, papillose,  
 irregularly 2–3-split

**note:** capsules common; the adaxial costa width of only two cells is diagnostic

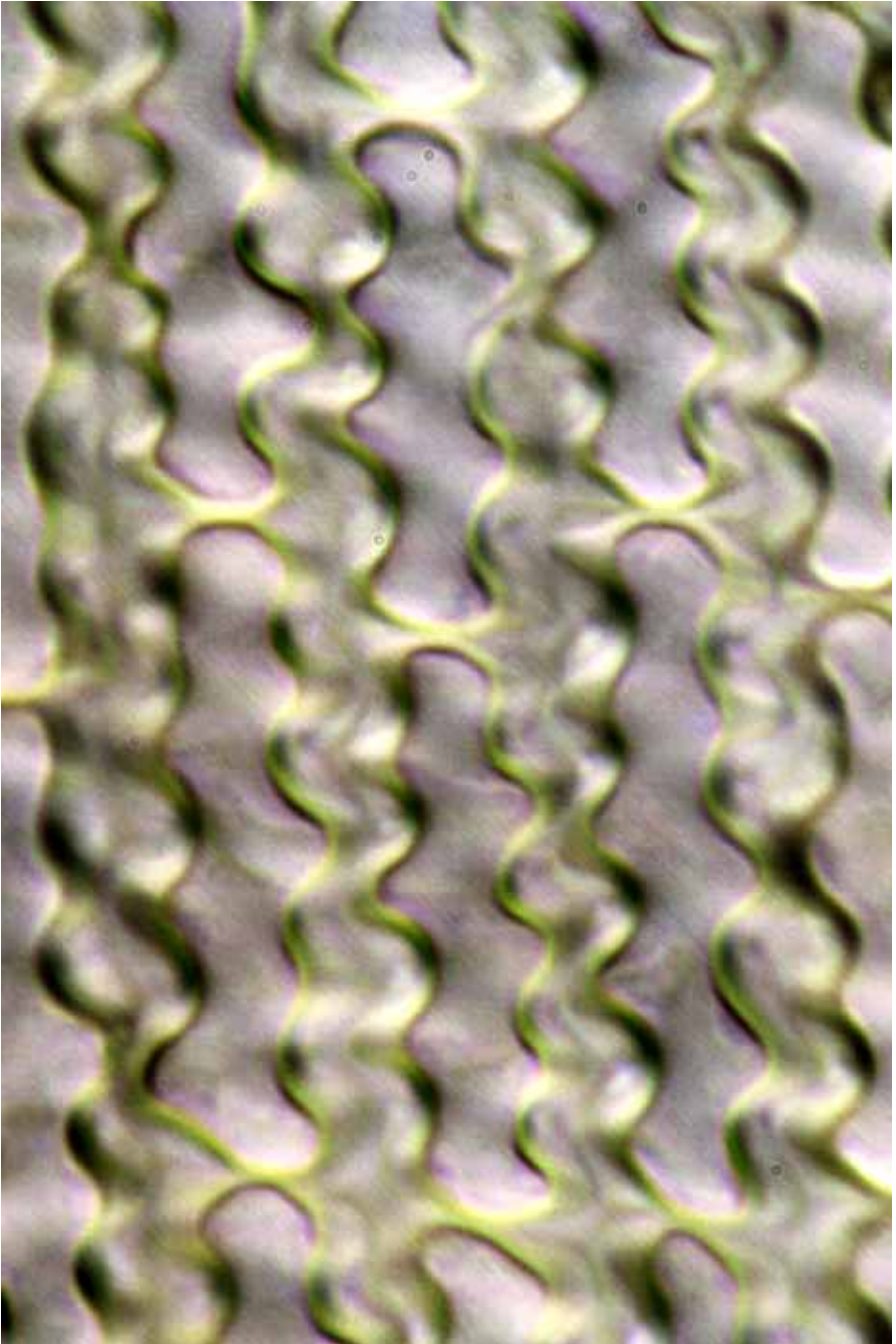


fertile shoot, capsule (dry), vegetative shoot (moist), leaf outline, leaf apex, upper cells  
 1 mm, 0.5 mm, 1 mm, 0.1 mm, 50 μm, 10 μm, 10 μm



sinuose cells below midleaf, margin near leaf base, and leaf and costa cross-sections  
 10 μm, 10 μm, 50 μm (upper), 10 μm (lower)

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*Grimmia trichophylla* sinuose cells in lower leaf  
10  $\mu\text{m}$

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**Grimmia wilsonii** H.Greven

**form:** round patches of erect, ± branched stems, dark green, black when dry  
**habitat:** rock (greywacke and diorite) in exposed alpine sites, 800–1200 m

**leaf:** size: about 2 mm

*shape:* linear-lanceolate, bistratose in the subula

*tip:* hair-point short, smooth to bluntly denticulate, brittle

*base:* marginal cells elongate, thin-walled; paracostal cells  $10 \times 40 \mu\text{m}$ , incrassate

*costa:* not prominent abaxially

*border:* not differentiated

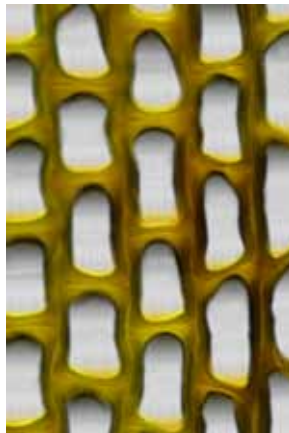
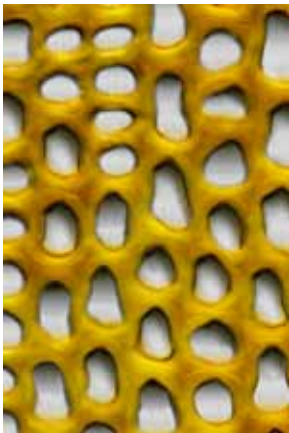
*margin:* entire, plane below, slightly incurved above

*cells:* 4–6  $\mu\text{m}$ , rounded, thick-walled, smooth

**capsule:** 1.0 mm, rare, ovoid, emergent to exserted, erect, yellowish; seta about 1 mm, straight; operculum rostrate; peristome teeth lanceolate, orange, finely papillose, irregularly perforate above; spores 14–18  $\mu\text{m}$  in diam.

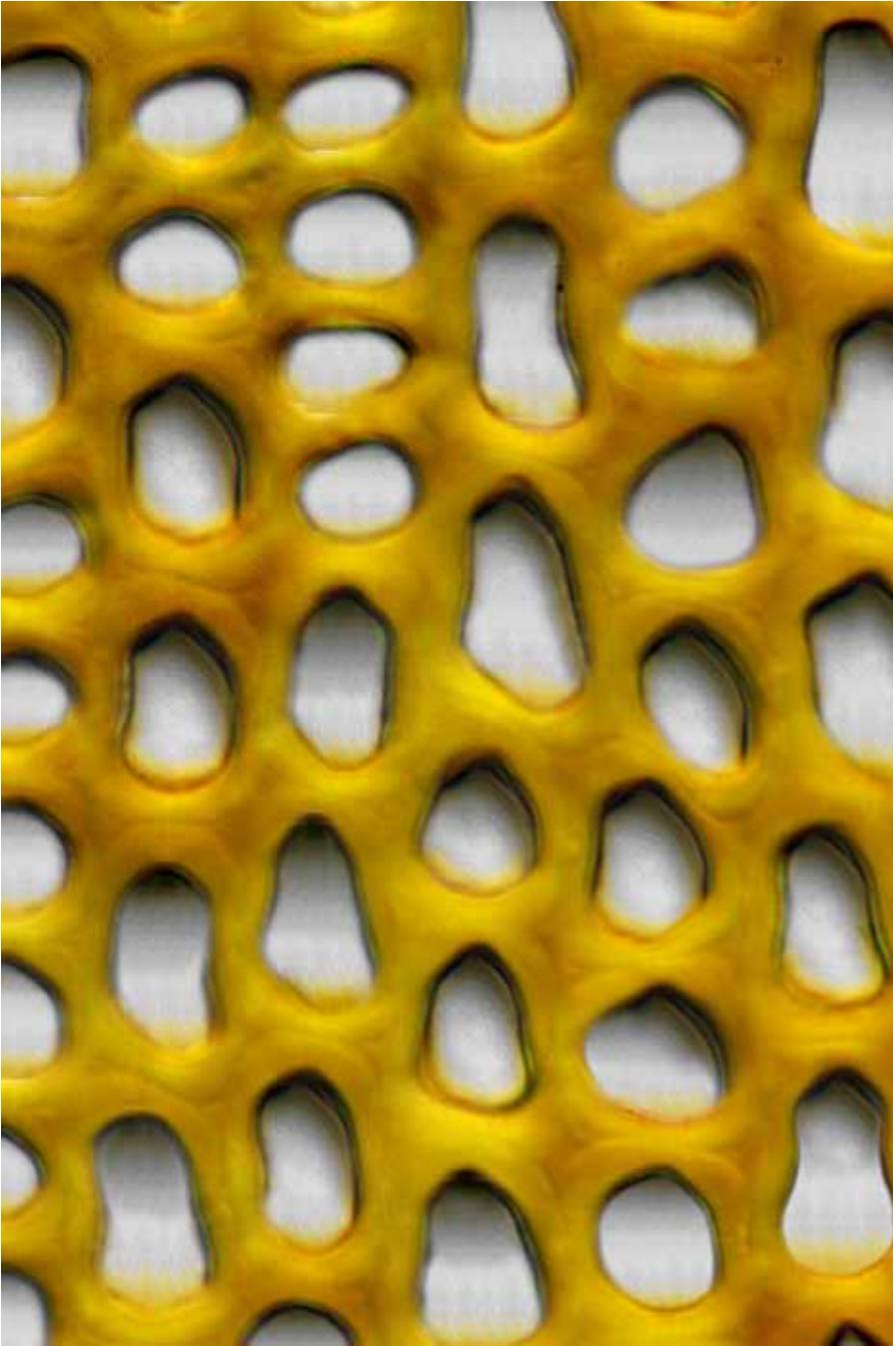


vegetative shoot (moist), leaf outline, leaf hair-point (2), and margin midleaf  
 1 mm, 0.1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



cells midleaf, juxtacostal cells midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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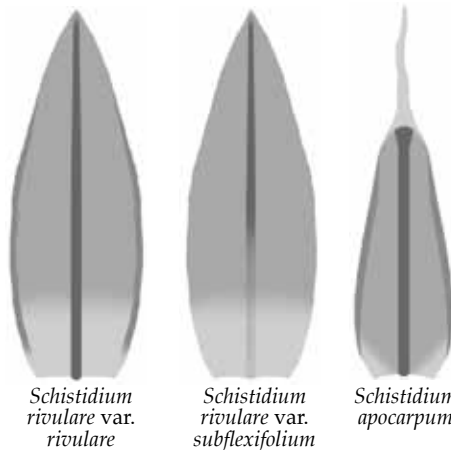
*Grimmia wilsonii* midleaf cells  
10  $\mu\text{m}$



### Key to New Zealand species and varieties of *Schistidium* (3)

- 1 Leaf usually ending in a hyaline awn; spores < 15  $\mu\text{m}$  in diam ..... ● ***Schistidium apocarpum***  
 1: Leaf not usually ending in an awn; spores > 15  $\mu\text{m}$  in diam. .... 2
- 2(1:) Leaves ovate-lanceolate, keeled above; margins 2–3-stratose; upper lamina mostly bistratose; costa well-defined in lower half ..... ● ***Schistidium rivulare* var. *rivulare***  
 2: Leaves oblong-lingulate, broadly U-shaped above; margins unistratose; upper lamina mostly unistratose; costa ill-defined in lower half ..... ● ***Schistidium rivulare* var. *subflexifolium***

\* based on McIntosh, TT (2007): *Schistidium*. *Flora of North America* 27, 208; and Fife, AJ (2000): A synopsis of the New Zealand species of *Schistidium* (Grimmiaceae; Musci), with observations on a little-known species of *Racomitrium*. *New Zealand Journal of Botany* 38, 191–204:



**Schistidium apocarpum** (Hedw.) Bruch & Schimp.

**form:** tufts or mats of erect, rigid, branched stems, olive-green, to 60 mm tall  
**habitat:** mostly dry rock but sometimes semi-aquatic, to alpine elevations

**leaf:** size: 1.5–2 × 0.5–0.7 mm

*shape:* ovate to lanceolate

*tip:* tapering to an acute apex, usually with a hyaline hair-point

*base:* basal cells longer and more sinuose than the other blade cells

*costa:* failing just below the hair-point

*border:* absent

*margin:* ± entire to bluntly toothed near the apex, bistratose above, recurved on one or both sides below

*cells:* 7–10 μm, quadrate, incassate, sinuose, smooth to low-papillose

**capsule:** 1.2–1.6 mm, oblong-ellipsoid, erect, immersed, systylious; seta 0.5 mm; peristome teeth inserted below the capsule rim, red; operculum rostrate; calyptra mitrate

**note:** nearly cosmopolitan, widespread in New Zealand



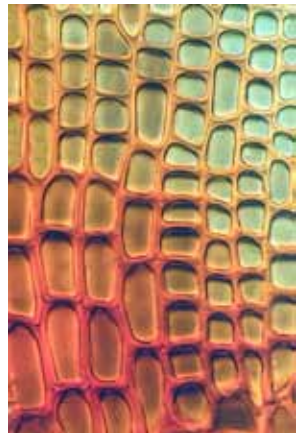
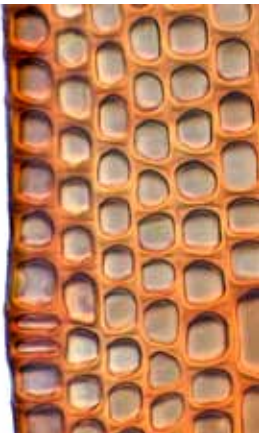
fertile shoot, dehiscent capsules (top view), systylious capsule, and leaf outline

0.5 mm,

1 mm,

0.25 mm,

0.25 mm



margin midleaf, cells midleaf, and leaf base cells

10 μm,

10 μm,

10 μm

**Schistidium rivulare** (Brid.) Podp. var. **rivulare**

**form:** loosely matted, well-branched stems, dark above, to 80 mm long  
**habitat:** wet rock, subalpine to alpine

**leaf:** size: 1.5–3.0 × 0.6–1.0 mm

*shape:* lanceolate to ovate-lanceolate, ± decurrent

*tip:* bluntly acute, lacking a hair-point

*base:* juxtacostal basal cells long-rectangular; alar cells not differentiated

*costa:* well-defined, percurrent

*border:* not differentiated

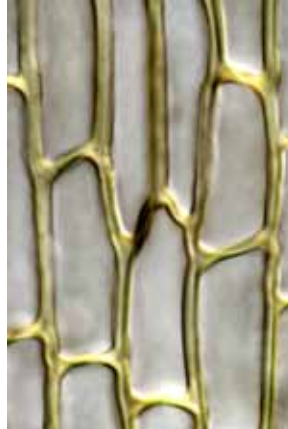
*margin:* entire to faintly denticulate above, 2–3-stratose, plane to recurved

*cells:* 5–10 μm, irregularly subquadrate, thick-walled, sinuose, smooth

**capsule:** 1.3–2.0 mm, cylindric to obovoid, erect, immersed, brown; seta short, to 0.5 mm; peristome single, red, perforate, papillose; strongly recurved when dry, incurved when wet; columella attached to and shed with the operculum; calyptra mitrate to weakly cucullate

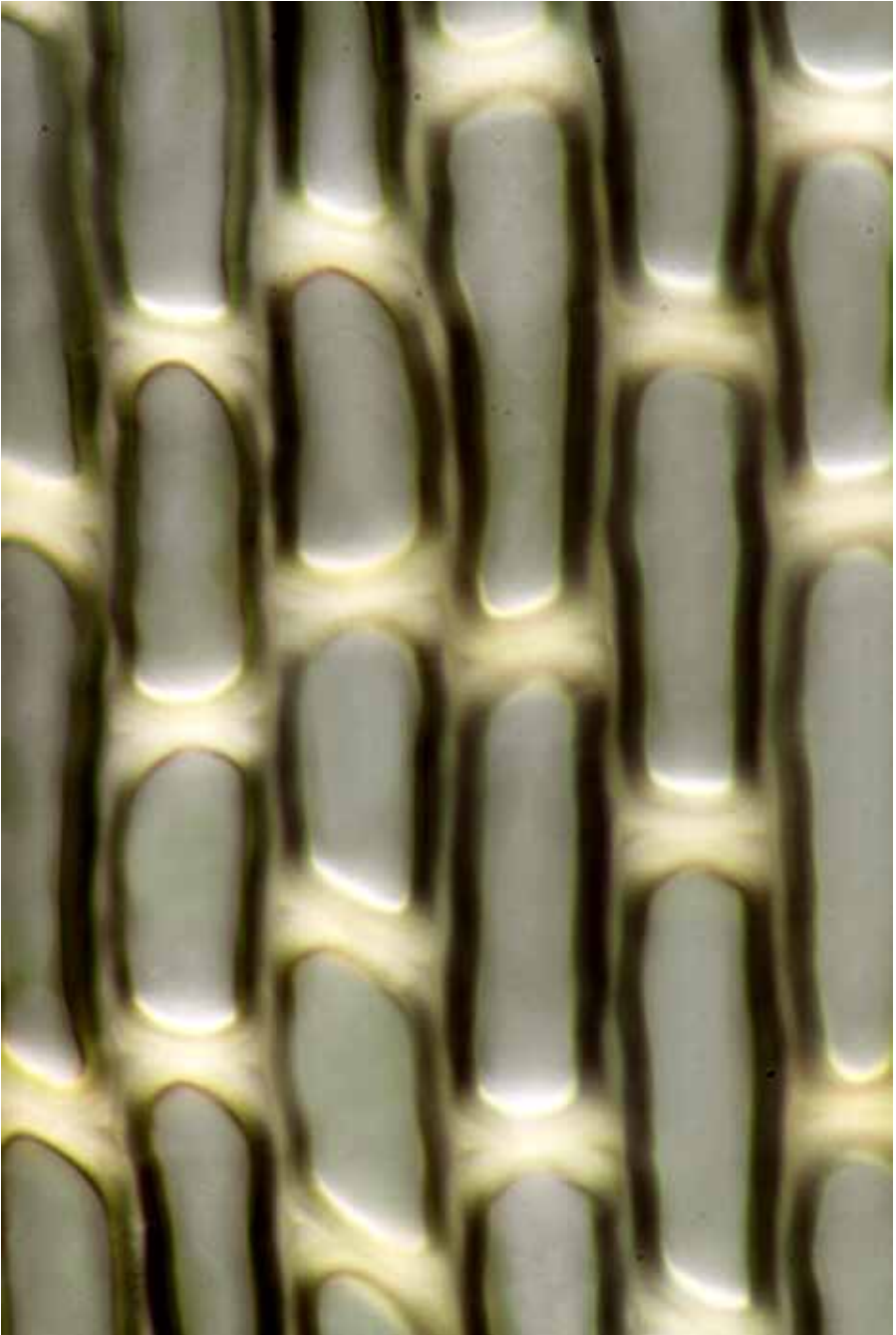


fertile shoots (dry), leaf outline, leaf margin and leaf xs, leaf apex with bistratose patches  
 1 mm, 1 mm, 0.5 mm, 10 μm (upper), 10 μm, 50 μm



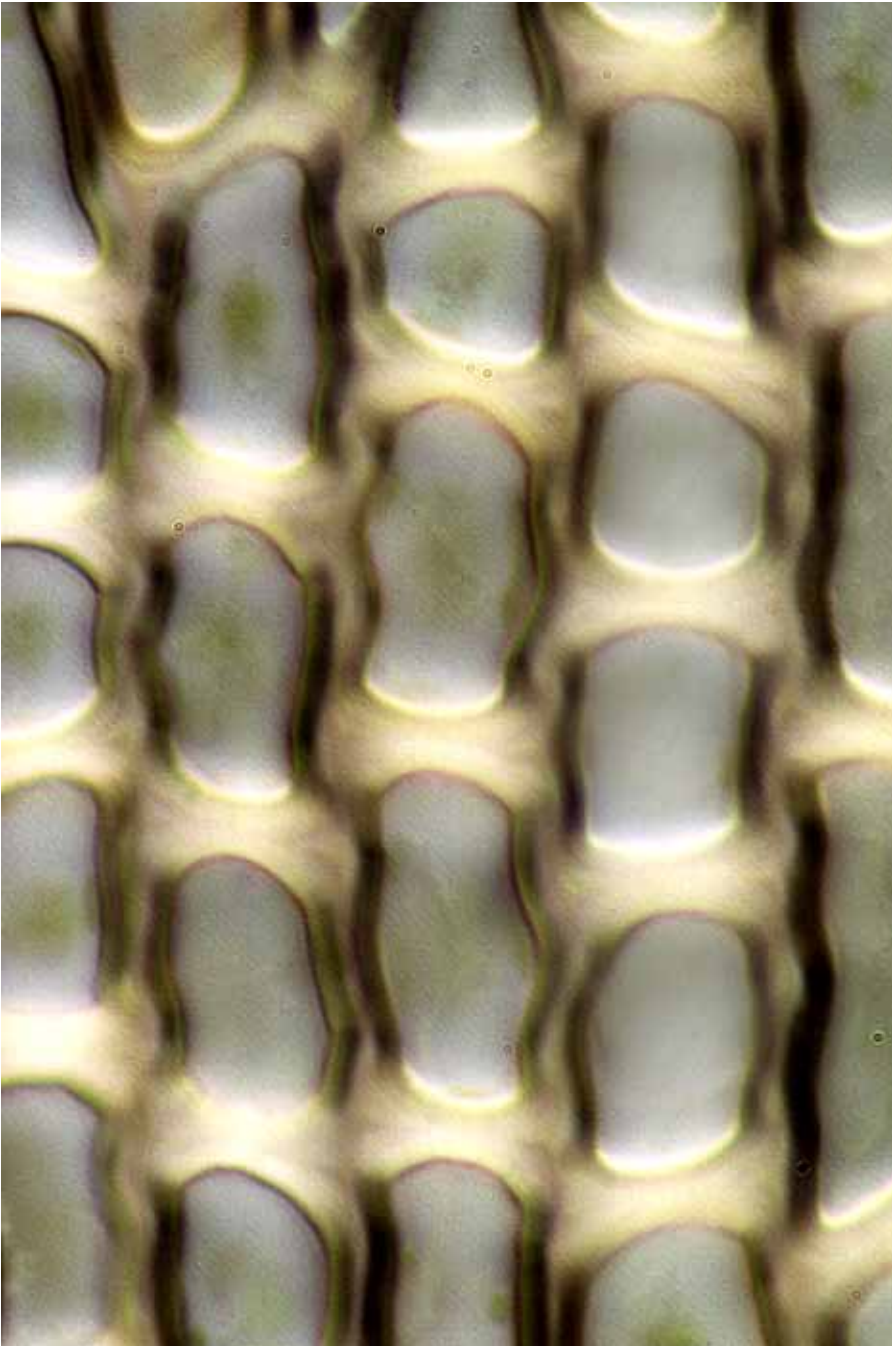
cells above midleaf, cells toward leaf base, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Schistidium rivulare* var. *rivulare* cells in lower leaf  
10  $\mu\text{m}$

continued next page



*Schistidium rivulare* var. *rivulare* cells above midleaf  
10  $\mu$ m

**Schistidium rivulare** var. **subflexifolium** (Müll.Hal.) Fife

**form:** loose mats of reddish brown, erect, sparsely branched stems, to about 50 mm tall, the lower leaves often eroded to costal remnants

**habitat:** dry rock in exposed subalpine and alpine sites

**leaf:** size: 2–3 × 0.8–1.1 mm

*shape:* oblong-ligulate, channelled

*tip:* acute, ± cucullate

*base:* not differentiated

*costa:* weak below, subpercurrent; adaxial cells long-rectangular

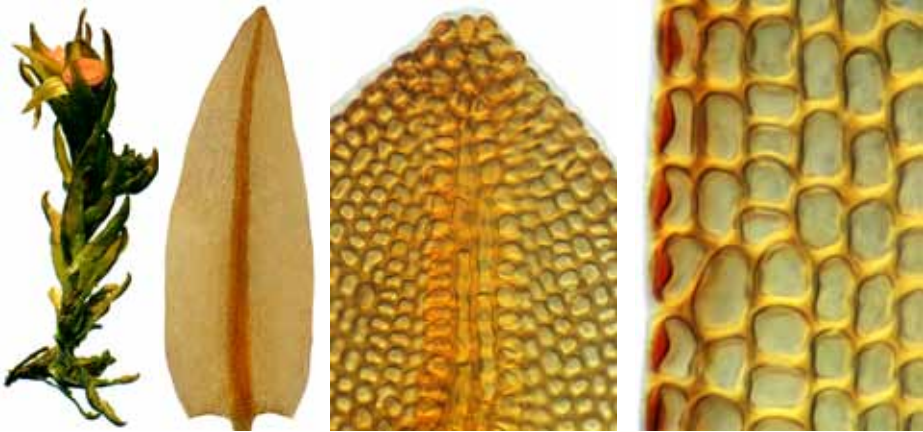
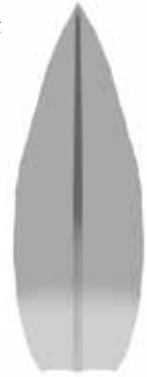
*border:* not differentiated

*margin:* entire, plane to weakly deflexed

*cells:* 6–12 μm, irregularly subquadrate, firm-walled, smooth

**capsule:** 1–2 mm, hemispherical to obovoid, reddish brown at maturity; seta short; peristome teeth perforate; calyptra cucullate

**notes:** considered to be a New Zealand endemic



fertile shoot (dry), leaf outline, leaf apex, and margin midleaf

1 mm, 1 mm, 50 μm, 10 μm



costa above midleaf, margin near leaf base, and systylious capsule (dry)

50 μm, 10 μm, 1 mm

**Ptychomitrium australe** (Hampe) A.Jaeger

**form:** cushions or turves of forked stems, to 7 mm tall, radiculose below

**habitat:** rock or rarely rotting logs in open sites, to 1800 m

**leaf:** size: 3.5–5 × 0.5–1.0 mm

*shape:* ovate-lanceolate, concave, strongly crispate when dry

*tip:* acute to rounded, ± cucullate

*base:* basal cells rectangular to hexagonal, thin-walled; alar cells not differentiated

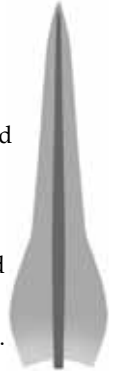
*costa:* percurrent or failing below the apex

*border:* not differentiated

*margin:* entire, plane, bistratose above

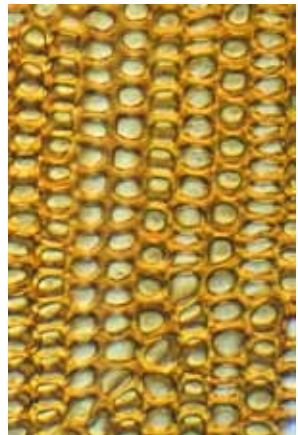
*cells:* upper cells 6 μm, oblate, firm-walled, smooth, bulging adaxially

**capsule:** 1.5 mm, ± ovate, smooth, pale brown, red-mouthed, abruptly narrowed to the seta; seta 2.5–5 mm, straight; annulus present; operculum straight long-rostrate; calyptra mitriform or split, plicate, lobed; peristome teeth lanceolate, orange, smooth below, papillose, ± cleft or perforate; spores 12–16 μm in diam.



fertile shoot, capsules (dry) (2), leaf outline, leaf apex, and leaf base

■ 1 mm, ■ 0.5 mm (2), ■ 0.25 mm, ■ 50 μm, ■ 50 μm



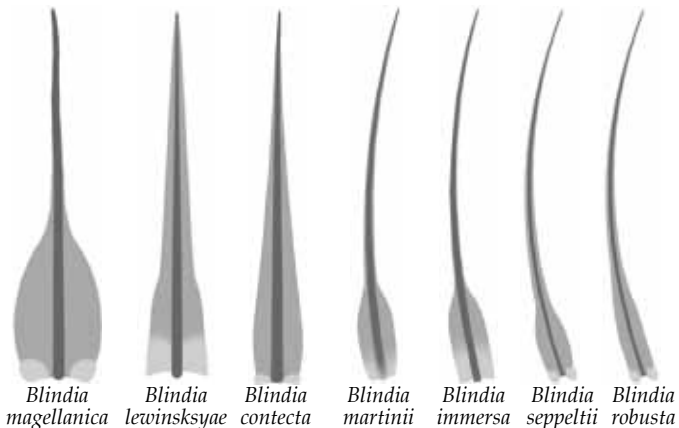
midleaf bistratose streaks, costa midleaf, and bistratose patches midleaf

■ 50 μm, ■ 10 μm, ■ 10 μm

Key\* to the New Zealand species of *Blindia* (7)

- 1 Capsule exserted .....2  
 1: Capsule immersed .....5
- 2(1) Stems 10–30 mm long; seta arcuate when moist..... ● *Blindia magellanica*  
 2: Stems 30–200 mm long; seta straight or flexuose when moist .....3
- 3(2:) Cells of the basal angles  $\pm$  inflated, forming a distinct and  $\pm$  decurrent group;  
 subula 2–2.5 times the length of the base .....4  
 3: Cells of the basal angles not inflated, not forming a distinct group; subula 3–5 times  
 the length of the base..... ● *Blindia seppeltii*
- 4(3) Leaves 4–8 mm long, falcate-secund ..... ● *Blindia robusta*  
 4: Leaves 9–15 mm long,  $\pm$  straight..... ● *Blindia lewinskyae*
- 5(1:) Leaves strict; alar cells distinct ..... ● *Blindia contecta*  
 5: Leaves  $\pm$  falcate-secund; alar cells not or only weakly differentiated .....6
- 6(5:) Plants gymnostomous ..... ● *Blindia immersa*  
 6: Plants peristomate..... ● *Blindia martinii*

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*. RSNZ Bull. 5, 87, and Seppelt, RD (1994): *The Moss Flora of Macquarie Island*. Australian Antarctic Division, Kingston, 254.





**Blindia contecta** (Hook.f. & Wilson) Müll.Hal.

**form:** stiff, sparsely branched stems to 35 mm long, golden above, dark below

**habitat:** subaquatic, on wet rock faces and near waterfalls

**leaf:** size: 5.0–6.0 × 0.7–0.9 mm

**shape:** subulate from a narrowly ovate base; lamina extending up both sides of the subula to ± half the leaf length; weakly secund, little changed when dry

**tip:** obtuse or rounded

**base:** weakly clasping, ± auriculate; alar cells pigmented, thin-walled, often left behind on the stem when the leaves are pulled off

**costa:** strong; cells on both ad- and abaxial surfaces quadrate to short-rectangular

**border:** not differentiated

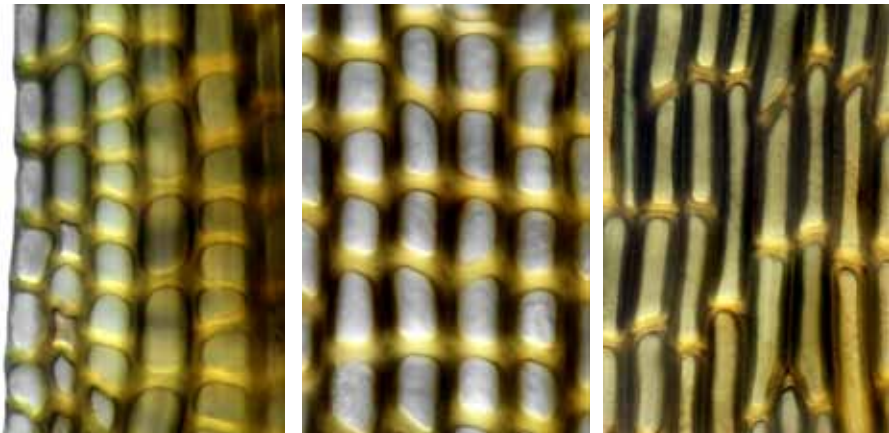
**margin:** entire, plane

**cells:** 12–20 × 6 μm above, to 60 μm long below, short-rectangular to rectangular, thick-walled, smooth

**capsule:** 1.0 × 0.9 mm, erect, obovate to hemispherical, immersed; seta 1–2 mm; operculum conic, long-beaked



fertile shoots (dry), leaf outline, apex, and subapex with ± quadrate superficial costa cells  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm



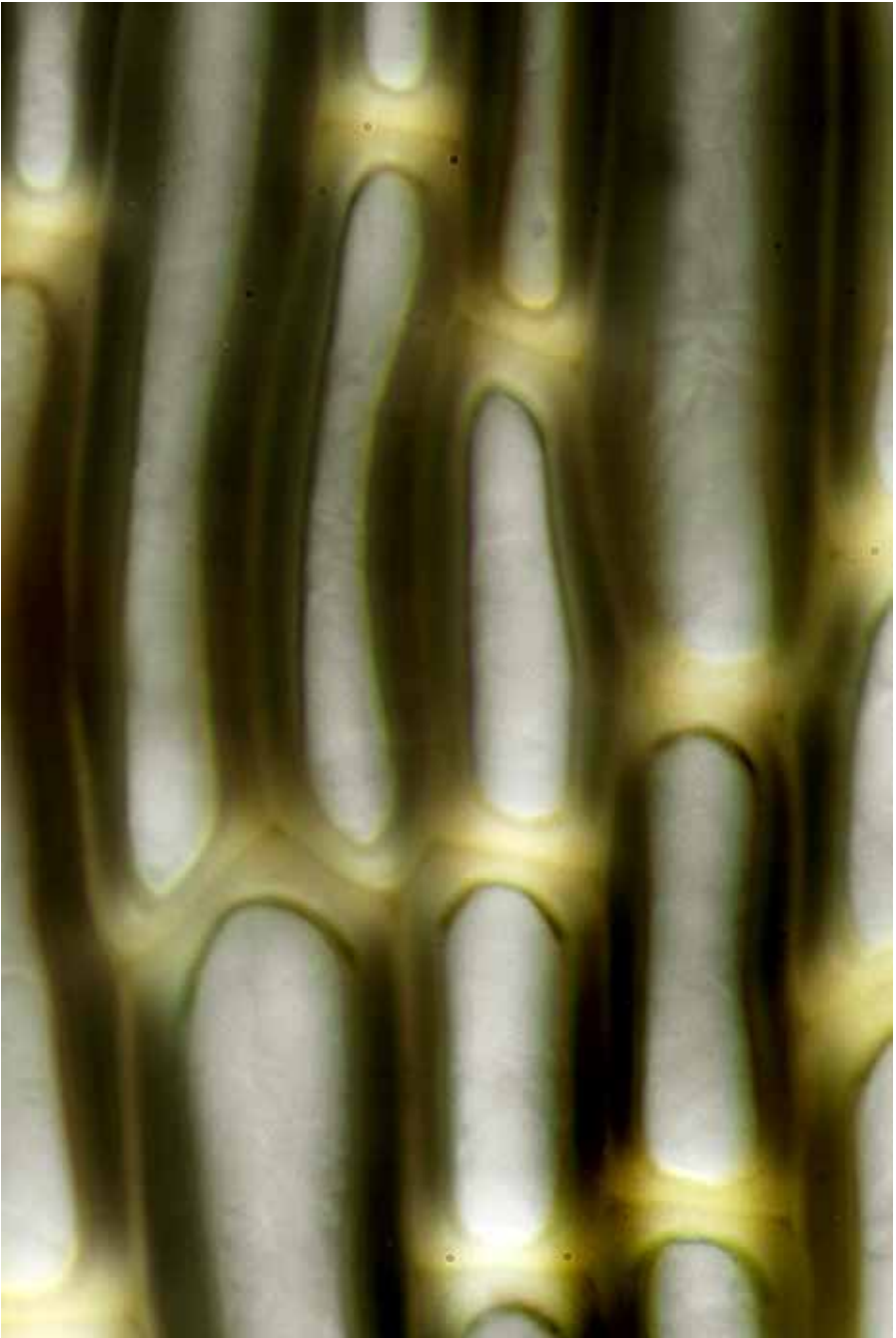
margin below midleaf, lamina cells, and cells near leaf base  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

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*Blindia conlecta* lamina margin and short-rectangular cells on costa surface  
10  $\mu\text{m}$

continued next page



*Blindia contecta* elongate lamina cells near leaf base  
10  $\mu$ m

**Blindia immersa** E.B.Bartram & Dixon

**form:** tufted, branched, yellow-brown to blackish green, flexuose, soft, to 180 mm  
**habitat:** rock submerged or occasionally inundated, waterfalls, streams, to 700 m

**leaf:** size: 8–14 mm

*shape:* oblong-lanceolate, narrowed to a long, fine, ± flexuose subula

*tip:* bluntly acute, the terminal cells ± isodiametric

*base:* angle cells wider than the lamina cells but not forming a distinct alar group

*costa:* wide, ill-defined below, nearly filling the subula above

*border:* not differentiated

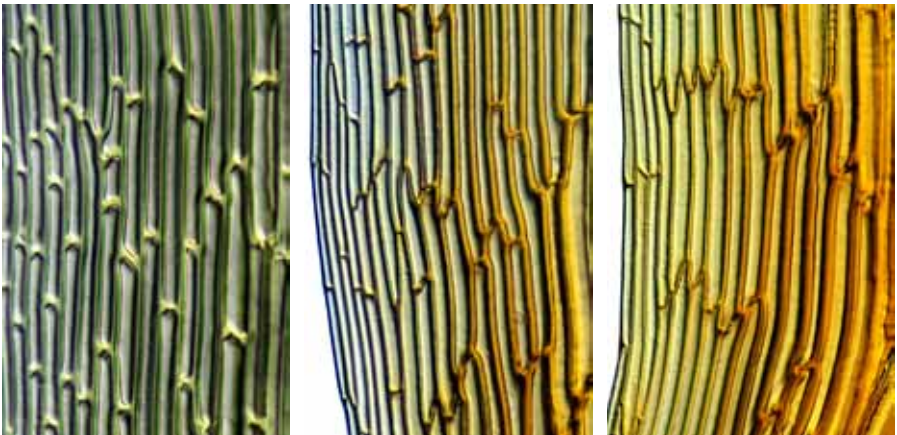
*margin:* entire, plane

*cells:* subula cells 45–90 × 6–10 μm, rectangular, thick-walled, smooth; sheath cells 120–160 × 10–20 μm, linear-rectangular, firm- to thick-walled, smooth

**capsule:** 0.8–1.0 mm, hemispherical-turbinate, cyathiform when empty, the mouth thickened, erect, immersed, brown; seta 1.5–2.0 mm, thick; columella persistent; peristome none or rudimentary; operculum long-rostrate; spores 24–36 μm in diam., green

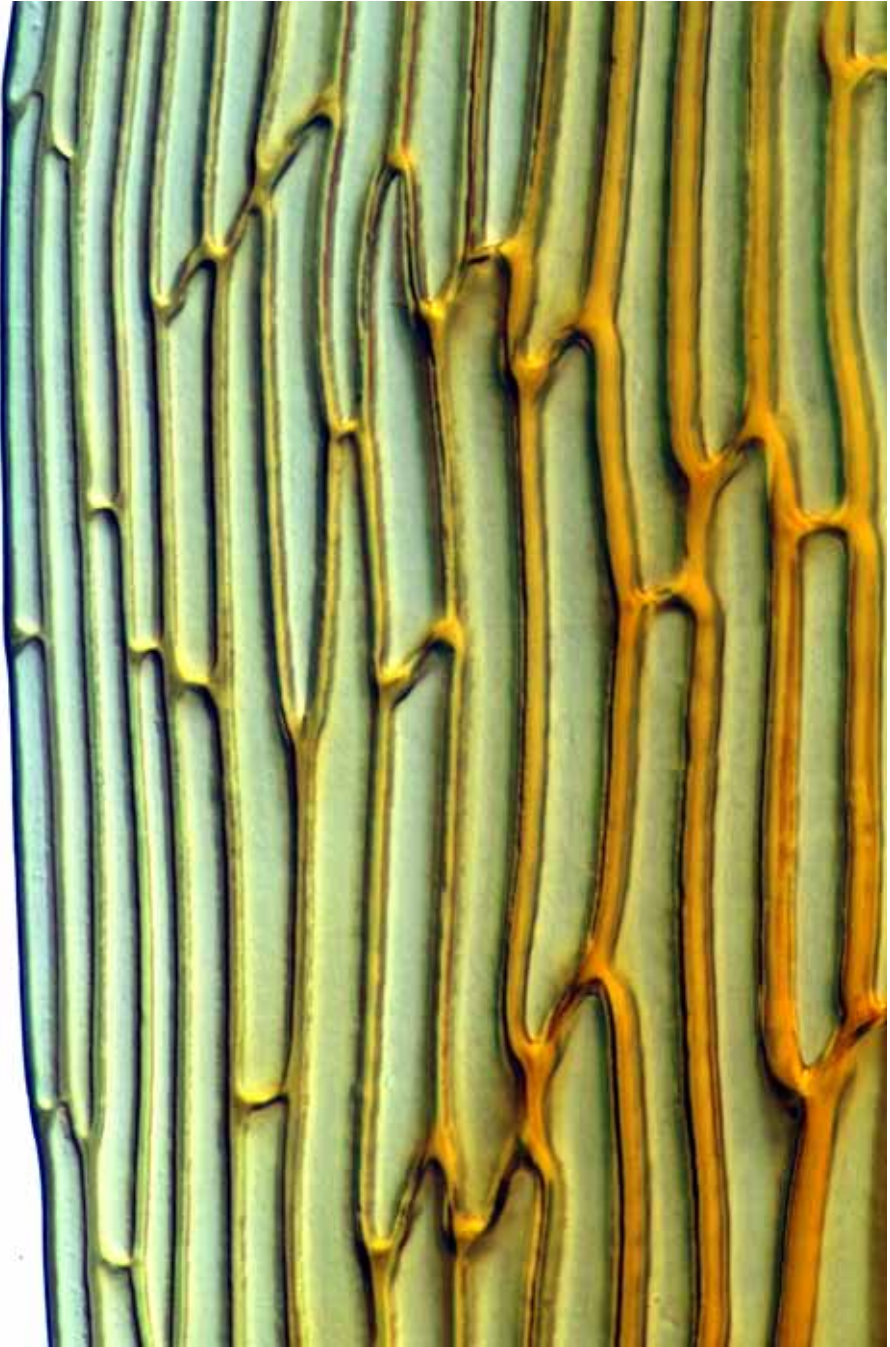


vegetative shoots (2), leaf outline, leaf apex, leaf subapex, and mid-sheath margin  
 ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm, ■ 10 μm



upper sheath cells, mid-sheath margin, and just above sheath basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Blindia immersa* margin of leaf sheath near base  
10  $\mu$ m

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**Blindia lewinskyae** J.K.Bartlett & Vitt

**form:** tufted, glossy, flexuose, dark, sparsely branched stems, to 100 mm long  
**habitat:** wet or submerged rock in shallow subalpine or alpine streams. to 900 m

**leaf:** size: 9–12 × 0.5–0.6 mm

*shape:* flexuose-filiform subula narrowing from an oblong-lanceolate base

*tip:* acute

*base:* not clasping or decurrent; alar cells 30–70 × 10–20 μm, thin-walled

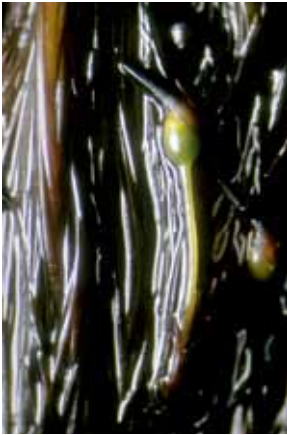
*costa:* filling the subula toward the tip

*border:* not differentiated

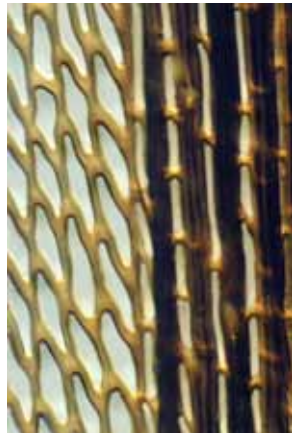
*margin:* entire, plane

*cells:* 60–100 × 3 μm (larger toward leaf base), linear to elongate, thin-walled, smooth

**capsule:** 0.6–0.9 × 0.7 mm, subglobose, straight, exserted, not stomatose; seta 4–7 mm, stout, not twisted; operculum long-rostrate; peristome reduced to only a few hyaline cells; spores 27–36 μm in diam., smooth, green



fertile habit (aquatic), capsule, leaf outlines (2), and leaf apex  
 ■ 1 mm, ■ 0.5 mm, ■ 1 mm, ■ 10 μm



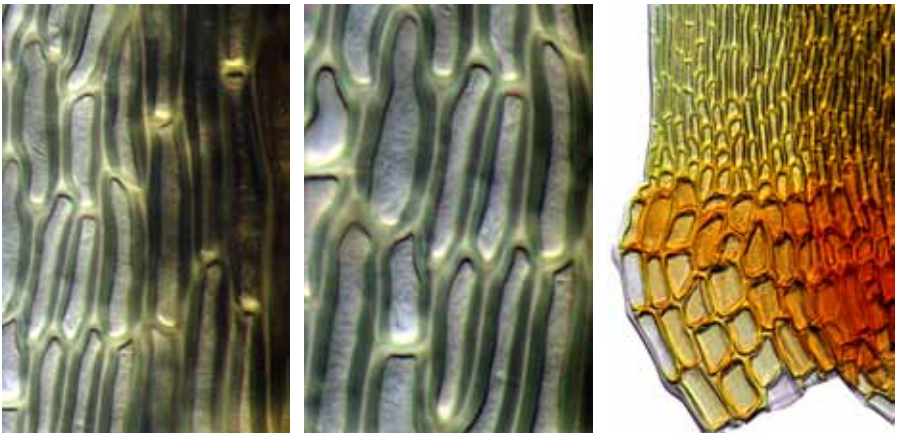
margin midleaf, costa midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

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**Blindia magellanica** Schimp.**form:** densely tufted, branched, golden brown, glossy stems, to 40 mm long**habitat:** wet or damp rock, rarely truly aquatic**leaf:** size: 2–5 mm*shape:* subulate from a lanceolate base, ± falcate-secund*tip:* bluntly acute at the tip of the subula*base:* alar cells conspicuous, large, firm-walled, coloured, ± in auricles*costa:* excurrent, nearly filling the subula above*border:* not differentiated*margin:* entire below, crenulate or denticulate near tip, plane*cells:* 20–60 × 3–4 μm, rhombic to linear, thick-walled, ± sinuose, smooth**capsule:** 0.7–0.9 × 0.7 mm, urceolate when dry, subglobose when wet, erect, thick-necked, turbinate when empty, exserted; seta 4–5 mm, flexuose when dry; calyptra cucullate; operculum long-beaked; peristome teeth 16, inserted below the rim, smooth, fragile, red; spores 18–24 μm in diam., smooth, green

vegetative shoots (dry) (2), leaf outline, leaf apex, and margin of upper shoulder

1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



juxtacostal cells midleaf, cells midshoulder, and leaf basal angle

10 μm, 10 μm, 50 μm

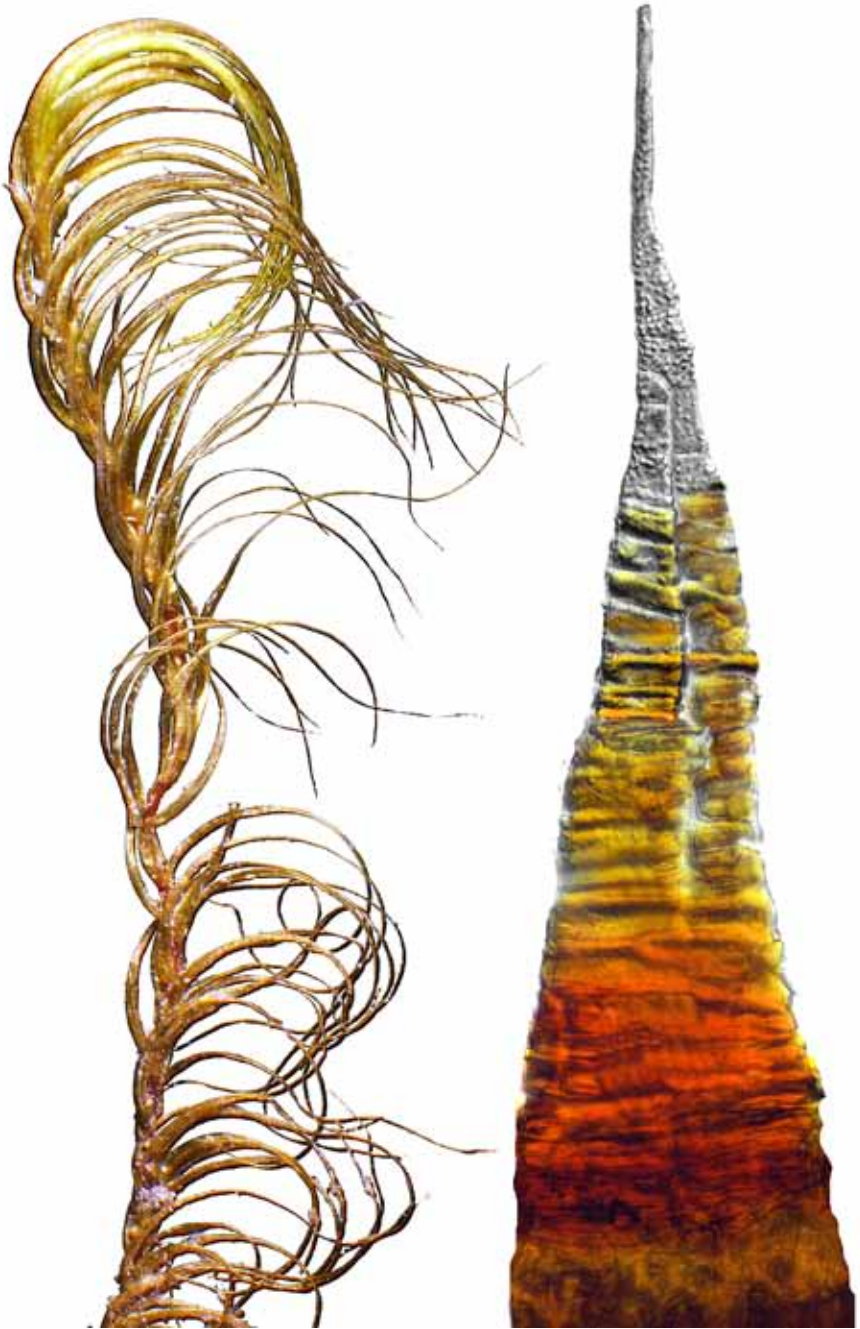
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*Blindia magellanica* fertile habit  
1 mm

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*Blindia magellanica* vegetative shoot (dry) and peristome tooth  
1 mm, 10  $\mu$ m

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**Blindia martinii** Sainsbury

**form:** tufts of branched, wiry, flexuose stems, to 30 mm, the leaves crowded, falcate-secund, golden

**habitat:** rock near subalpine to alpine streams and seepages, not a true aquatic

**leaf:** size: 3.5–5 mm

**shape:** narrowly oblong base tapered to a long, filiform subula, falcate-secund

**tip:** bluntly acute

**base:** clasping, ± auriculate; basal cells variable, rectangular to subquadrate

**costa:** weak below, strong above, filling the subula

**border:** not differentiated

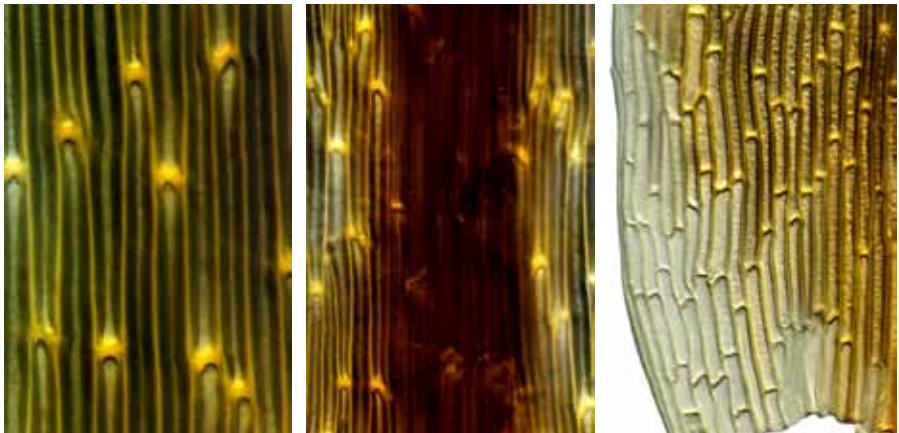
**margin:** entire, plane above, ± tubulose below

**cells:** upper cells  $40\text{--}60 \times 3\text{--}5 \mu\text{m}$ , long-rectangular, firm-walled, smooth; lower cells  $35\text{--}70 \times 5\text{--}8 \mu\text{m}$ , narrowly linear, thick-walled, smooth

**capsule:** 0.6–0.8 × 0.7 mm, hemispherical, erect, immersed, reddish brown, wide-mouthed when dry; seta to 0.7 mm; operculum conic; calyptra cucullate, naked; exostome red, the teeth lanceolate, smooth, trabeculate; spores 18–24  $\mu\text{m}$  in diam.

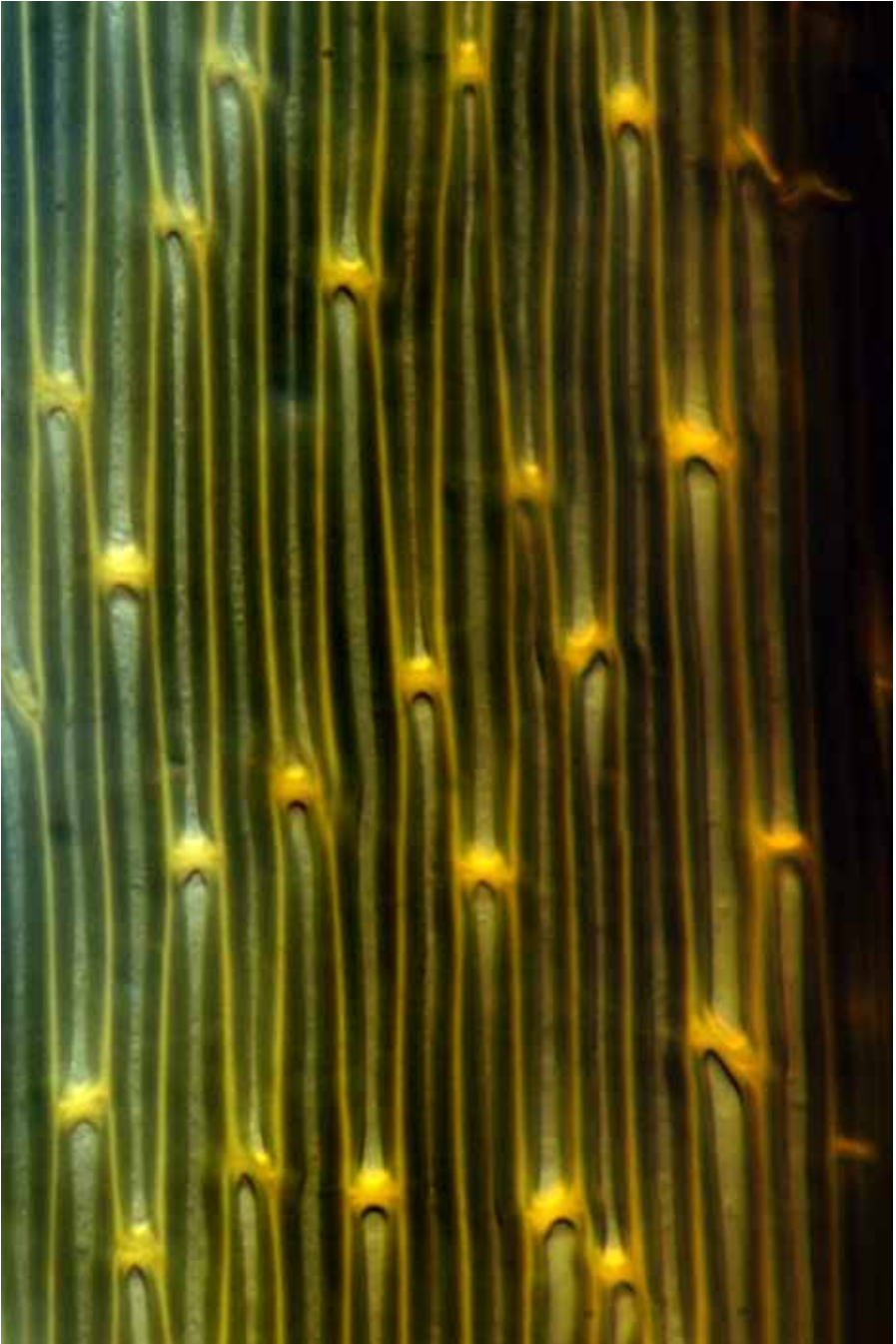


fertile shoots (dry), capsule, leaf outline, leaf apex, leaf subapex, and margin near base  
 5 mm, 1 mm, 1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



leaf base juxtacostal cells, costa in lower leaf, and leaf basal angle  
 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$

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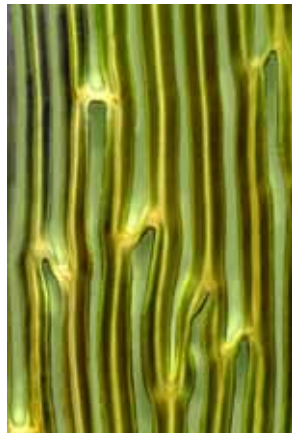
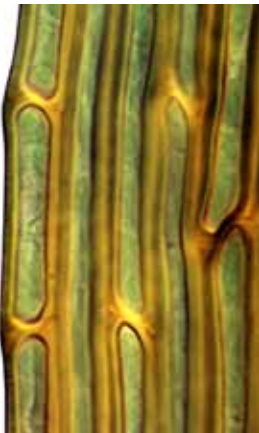


*Blindia martinii* juxtacostal cells in lower leaf  
10  $\mu$ m

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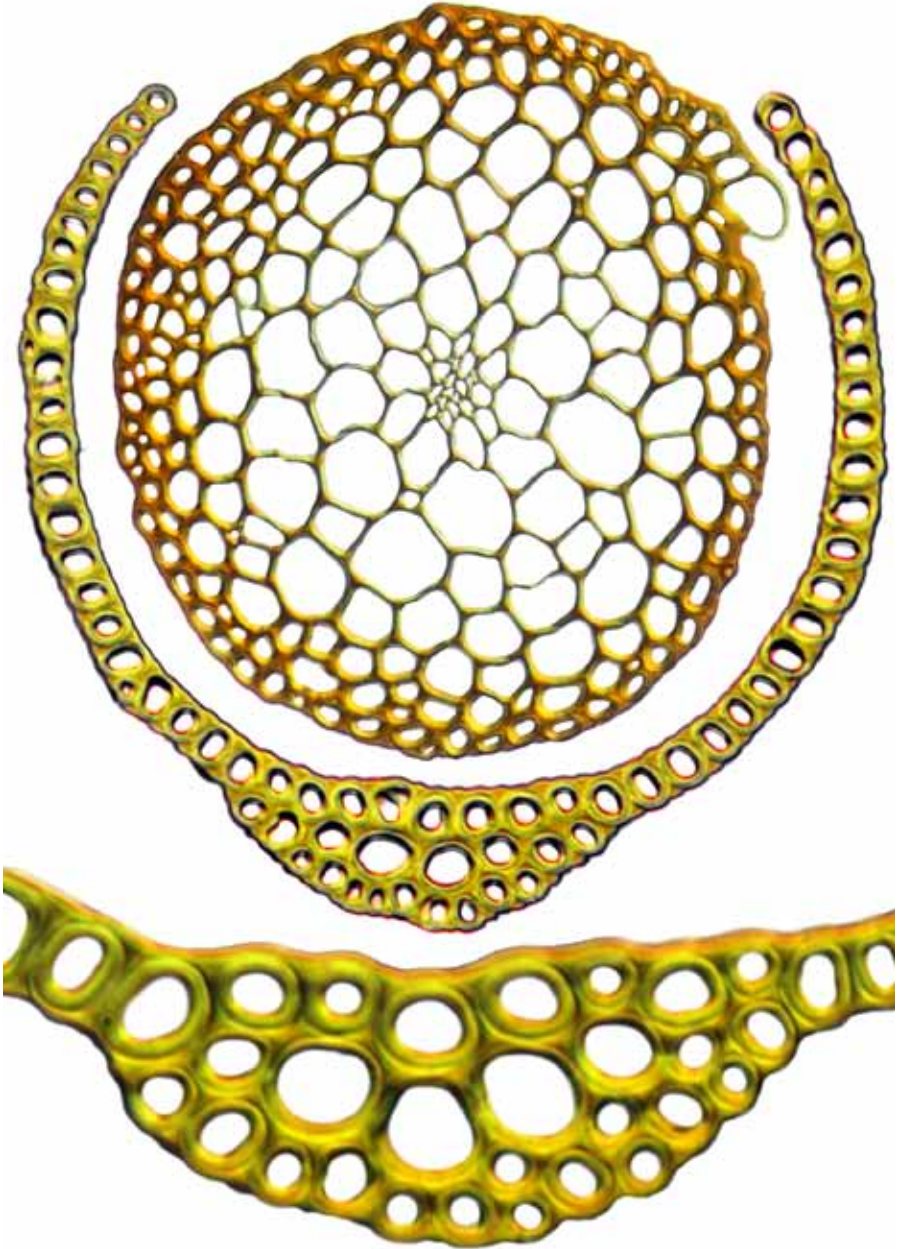
**Blindia robusta** Hampe**form:** tufted, glossy, flexuose, dark stems, sparsely branched, to 70 mm long**habitat:** wet rock in alpine seepages or margins of streams and pools, to 1900 m**leaf:** size: 4–10 × 0.3–0.8 mm*shape:* canaliculate-filiform subula narrowed from an oblong base, falcate-secund*tip:* narrowly acute*base:* clasping; alar cells subquadrate, brown, forming distinct auricles*costa:* filling the upper subula*border:* not differentiated*margin:* entire, plane above ± tubulose below*cells:* 36–60 × 3 μm, linear, incrassate, smooth**capsule:** 0.8–1 mm, ± urceolate, turbinate and systylious when empty, long-exserted; seta 8–16 mm, straight, orange; operculum long-rostrate; peristome teeth 16, red, lanceolate, split or perforate above; spores 27–45 μm in diam., smooth, green**note:** can form golden-brown, soggy mats in alpine pools

vegetative habit, leaf outline, leaf apex, leaf subapex, and systylious capsule  
 1 mm, 1 mm, 10 μm (2), 0.5 mm



margin midleaf, cells midleaf, and alar region  
 10 μm, 10 μm, 30 μm

continued next page



*Blindia robusta* stem, leaf, and costa cross-sections  
■ 10  $\mu\text{m}$  (top), ■ 10  $\mu\text{m}$  (middle), ■ 10  $\mu\text{m}$  (bottom)

**Blindia seppeltii** J.K.Bartlett & Vitt

**form:** mats or cushions of long (to 60 mm), glossy  $\pm$  branched stems, greenish (on land) or blackish (in water)

**habitat:**  $\pm$  aquatic, on moist or submerged rocks in or near seepages and lakes

**leaf:** size: 5–8 mm long,  $\pm$  erect, little altered when dry

**shape:** base decurrent and clasping, oblong-lanceolate, gradually narrowing to a narrow subula up to 4 times longer than the leaf base

**tip:** acute

**base:** alar cells weakly differentiated,  $20\text{--}40 \times 10\text{--}18 \mu\text{m}$ , thin-walled, hyaline, usually missing from leaves pulled off the stem

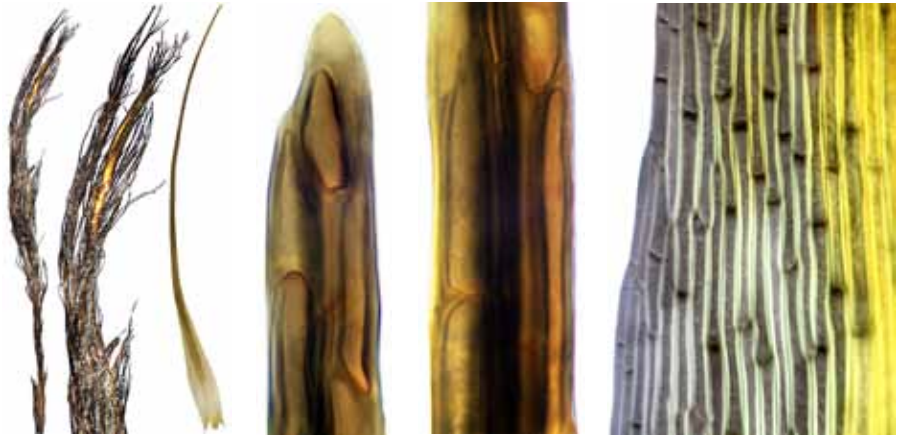
**costa:** to  $100 \mu\text{m}$  wide at leaf base, filling the subula above

**border:** not differentiated

**margin:** entire, plane

**cells:**  $60\text{--}120 \times 4 \mu\text{m}$ , linear, straight, thick-walled, smooth

**capsule:**  $1 \times 0.8\text{--}1 \text{ mm}$  long, exserted, turbinate, wide-mouthed, dark; seta 5–13 mm long; operculum obliquely beaked; spores  $16\text{--}40 \mu\text{m}$  in diam.



vegetative shoots (2), leaf outline, leaf apex, leaf subapex, and margin below shoulder  
 1 mm, 0.5 mm, 1 mm, 5  $\mu\text{m}$ , 5  $\mu\text{m}$ , 10  $\mu\text{m}$



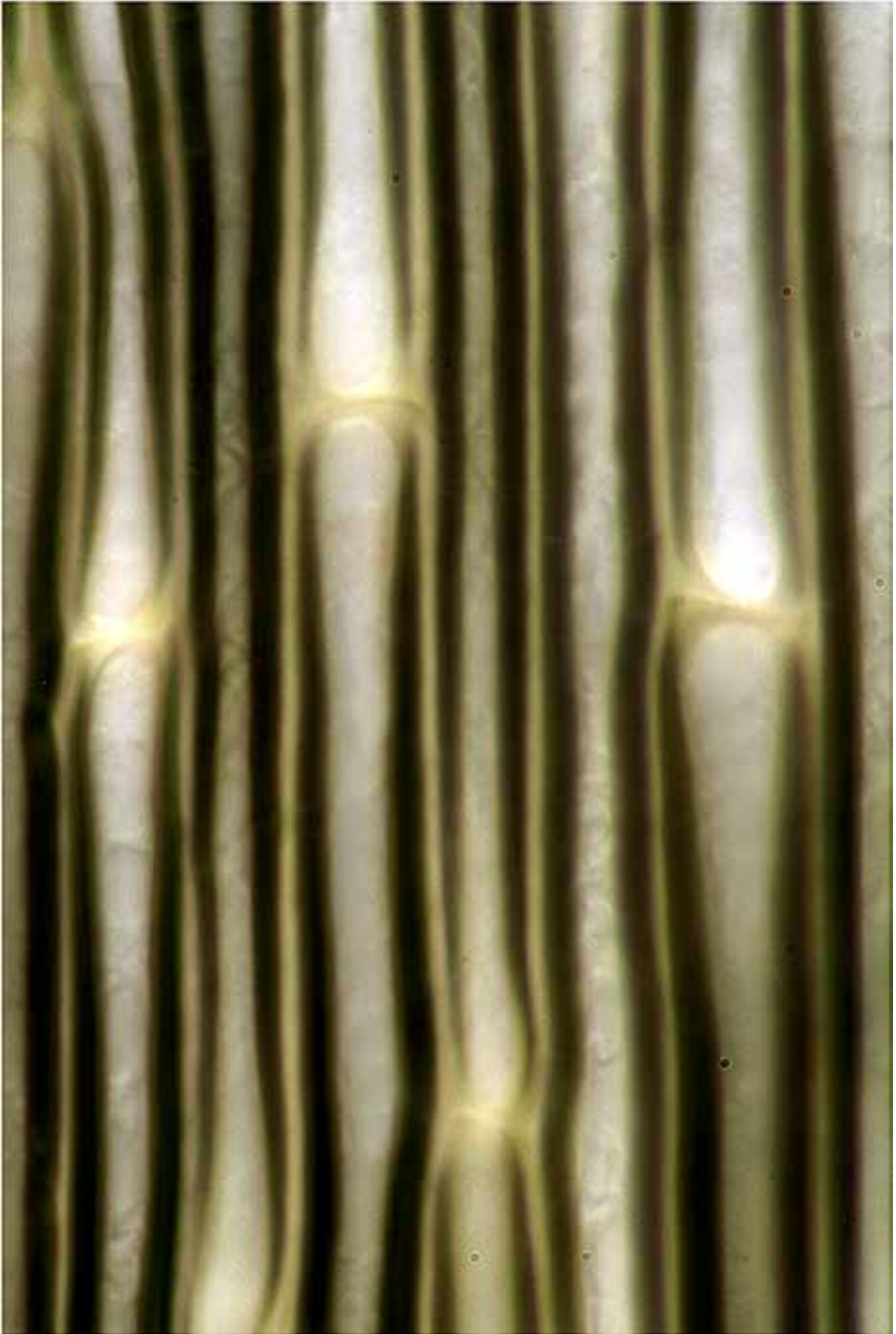
sheath cells, leaf basal angle, and margin just above basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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*Blindia seppeltii* vegetative shoots and leaf outline  
1 mm, 1 mm, 1 mm

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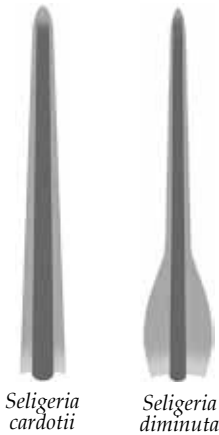
*Blindia seppeltii* lamina cells  
10  $\mu\text{m}$



**Key\* to New Zealand species of Seligeria (2)**

- 1 Leaves linear; median cells mostly longer than wide; lamina unistratose; seta erect, straight..... ● **Seligeria cardotii**
- 1: Leaves subulate from an ovate base; median cells mostly isodiametric; lamina partly bistratose; seta cygneous, flexuose..... ● **Seligeria diminuta**

\*based on Vitt, DH; Bartlett, JA (1983): The genus *Seligeria* in New Zealand. *Bryologist* **86**, 107.



**Seligeria cardotii** R.Br.ter.

**form:** gregarious, pale, bluish green, glossy, sparingly branched stems, to 1.5 mm

**habitat:** wet, usually calcareous rock faces, lowland forest to alpine scrub, to 1500 m

**leaf:** size: 1.3–2.2 × 0.05–0.1 mm

**shape:** subulate from a widened base, ± flexuose

**tip:** acute

**base:** not sheathing; basal cells slightly longer than the blade cells

**costa:** ending at or just below the apex, filling the upper subula

**border:** not differentiated

**margin:** entire to ± crenulate, plane

**cells:** 10–25 × 4–8 μm, subquadrate to rectangular, thin-walled, smooth

**capsule:** 0.3–0.6 mm, exserted, ovate or turbinate, necked, wide-mouthed when empty; seta 1.5–0.8 mm, ± curved; peristome of 16 fragile, orange teeth; calyptra cucullate, naked, smooth; operculum obliquely rostrate; spores 10–15 μm in diam., green



vegetative shoot, leaf outline, leaf apex, and leaf subapex

1 mm, 0.1 mm, 10 μm, 10 μm



margin, cells, and costa midleaf

10 μm, 10 μm, 10 μm

continued next page

**Seligeria diminuta** (R.Br.bis) Dixon

**form:** loosely tufted, erect, matt, simple stems, dark olive-green, to 1 mm tall  
**habitat:** sloping calcareous rock or the roof of rock crevices, to 2200 m

**leaf:** *size:* 1–2 mm

*shape:* ± abruptly subulate from a sheathing, ± ovate base

*tip:* bluntly acute

*base:* basal sheath cells ± rectangular, thin-walled

*costa:* filling most of the subula, ending at or below the apex

*border:* not differentiated

*margin:* entire, plane

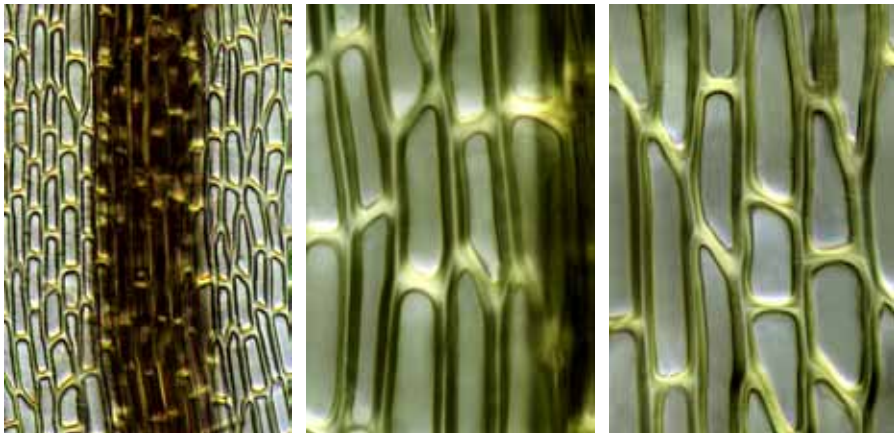
*cells:* subula cells 6–12 × 5–6 μm, rounded-quadrate, firm-walled, smooth; sheath cells irregularly rectangular to rhombic, 25 × 12 μm, firm-walled

**capsule:** 0.5–0.8 mm, oblong-ovate, inclined to pendent, long-exserted, brown; seta 2.5–3.2 mm, cygneous or curved wet or dry; peristome single, of 16 reddish, fragile, rigid, lanceolate teeth; operculum obliquely rostrate; calyptra cucullate, naked, smooth, shorter than the capsule; spores 8–12 μm in diam.



fertile shoot with mature capsule, leaf outline, leaf apex, and margin mid-sheath

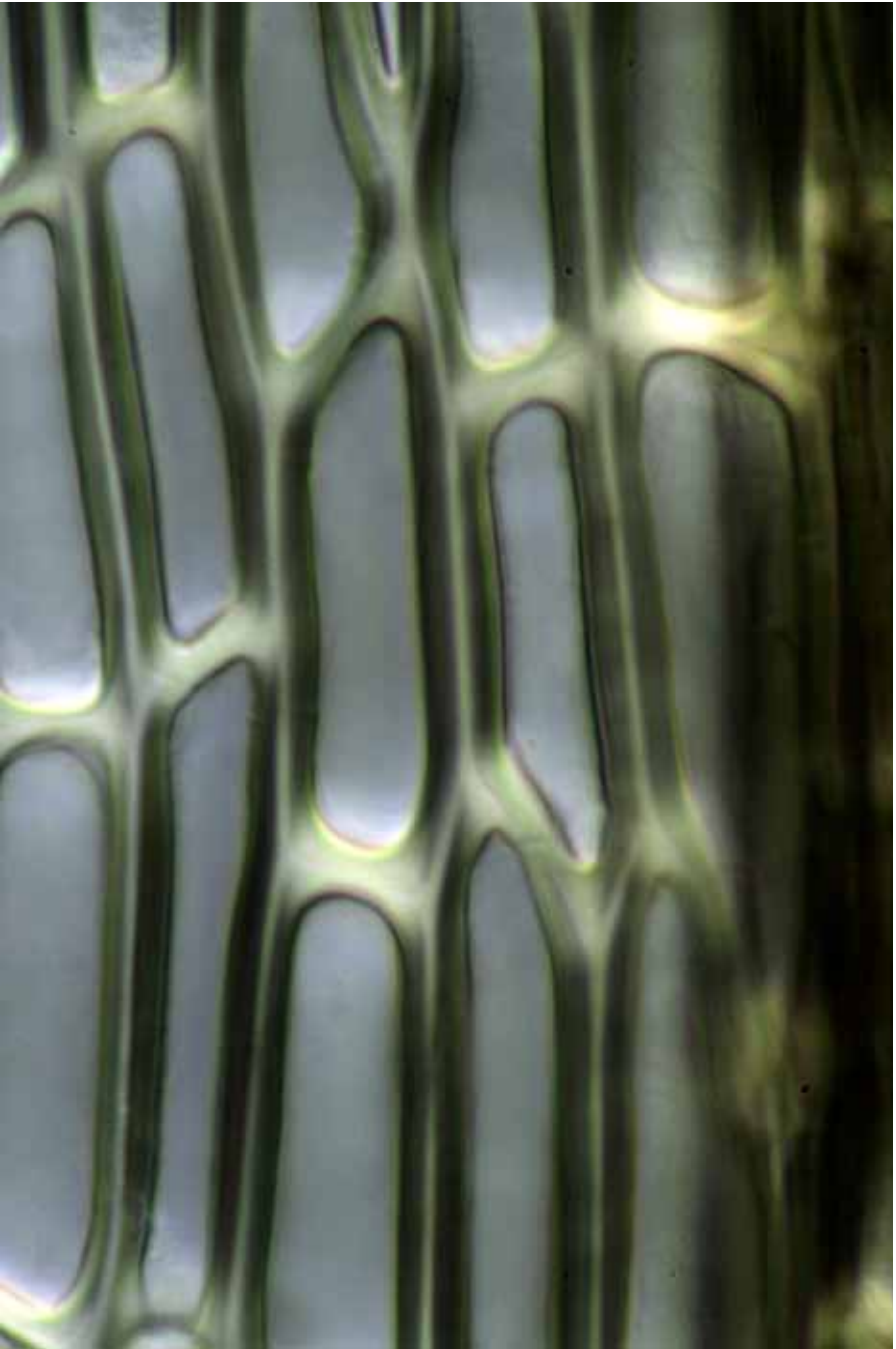
1 mm, 0.1 mm, 10 μm, 10 μm



costa mid-sheath, juxtacostal cells mid-sheath, and cells of mid-sheath

10 μm, 10 μm, 10 μm

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*Seligeria diminuta* juxtacostal cells midleaf  
10  $\mu\text{m}$

**Archidium elatum** Dixon & Sainsbury

**form:** dense tufts of dull, highly branched, zigzag stems, to 18 mm tall; the leaf costa wide and stout; barren in New Zealand

**habitat:** pool edges and damp depressions in coastal volcanic rock

**leaf:** size: 1.0–1.5 × 0.2–0.3 mm

*shape:* triangular-lanceolate

*tip:* acuminate

*base:* basal angle cells quadrate to short-rectangular, 10–15 × 12 μm

*costa:* strong, to 1/3 the leaf base width, homogeneous xs, ± reaching the apex

*border:* not differentiated; quadrate basal cells extending up margin in 2–4 rows

*margin:* entire or faintly crenulate, narrowly recurved

*cells:* 25–40 × 9–12 μm, oblong-rectangular, firm-walled, smooth

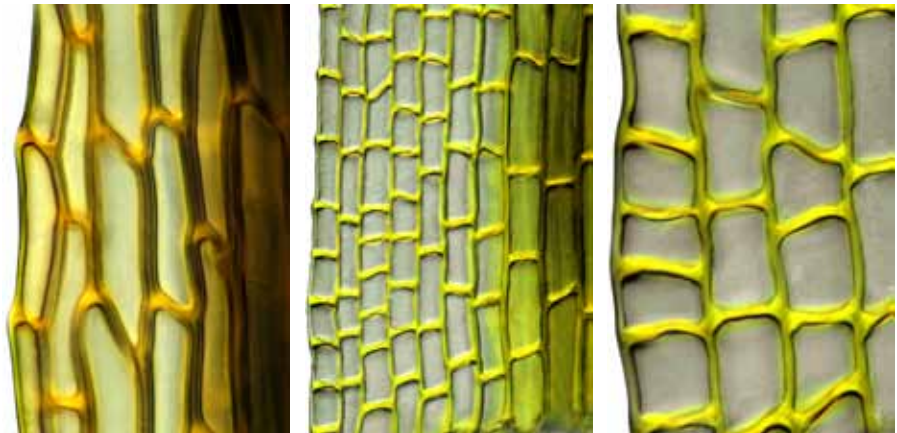
**capsule:** no capsules have been found in New Zealand

**note:** thought to be rare, but easily missed because of its small size



vegetative zig-zag shoots (dry) (3), leaf outline, leaf apex, and leaf subapex

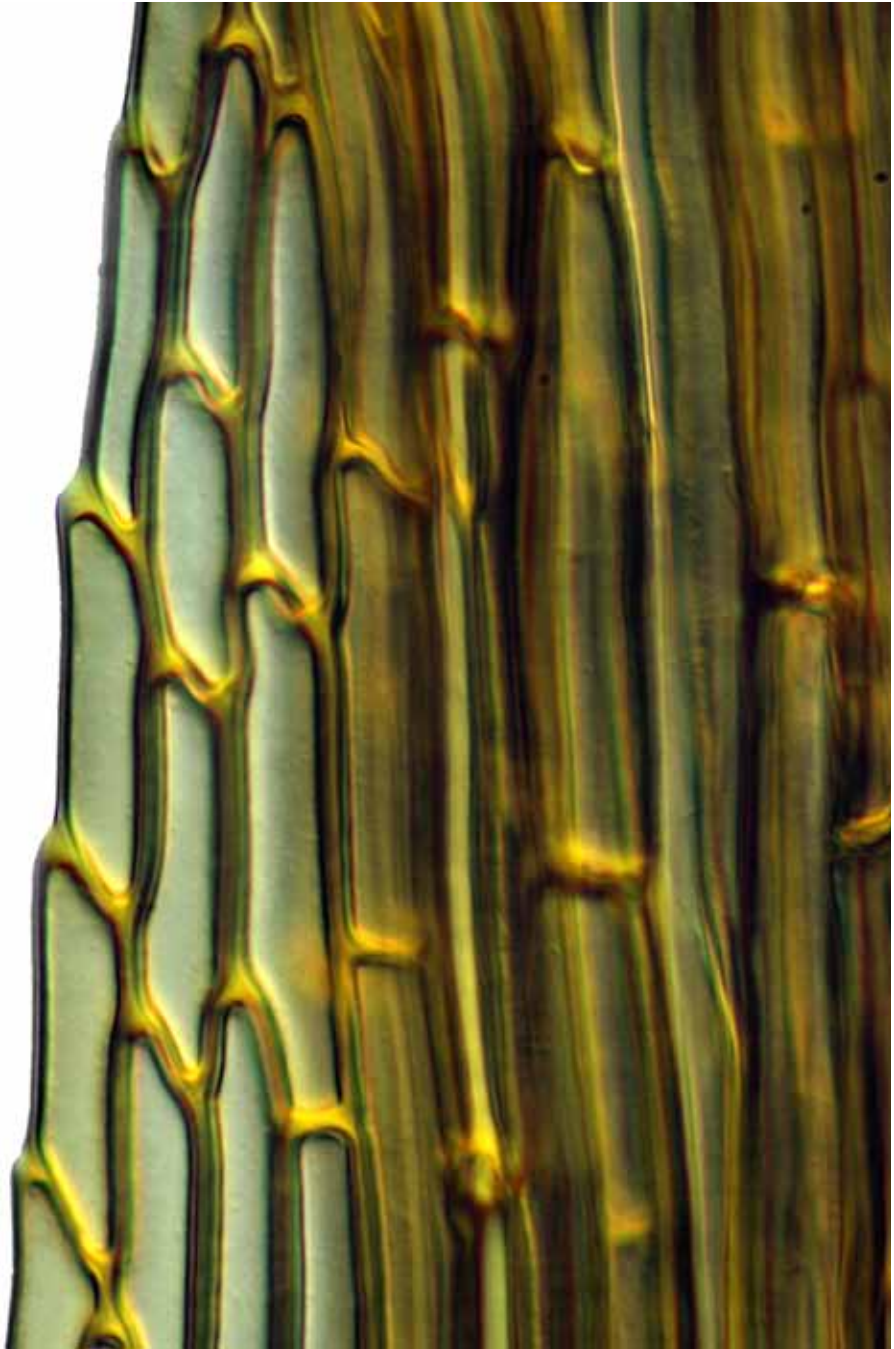
1 mm, 1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



margin midleaf, margin just above leaf basal angle, and margin detail near leaf base

10 μm, 10 μm, 10 μm

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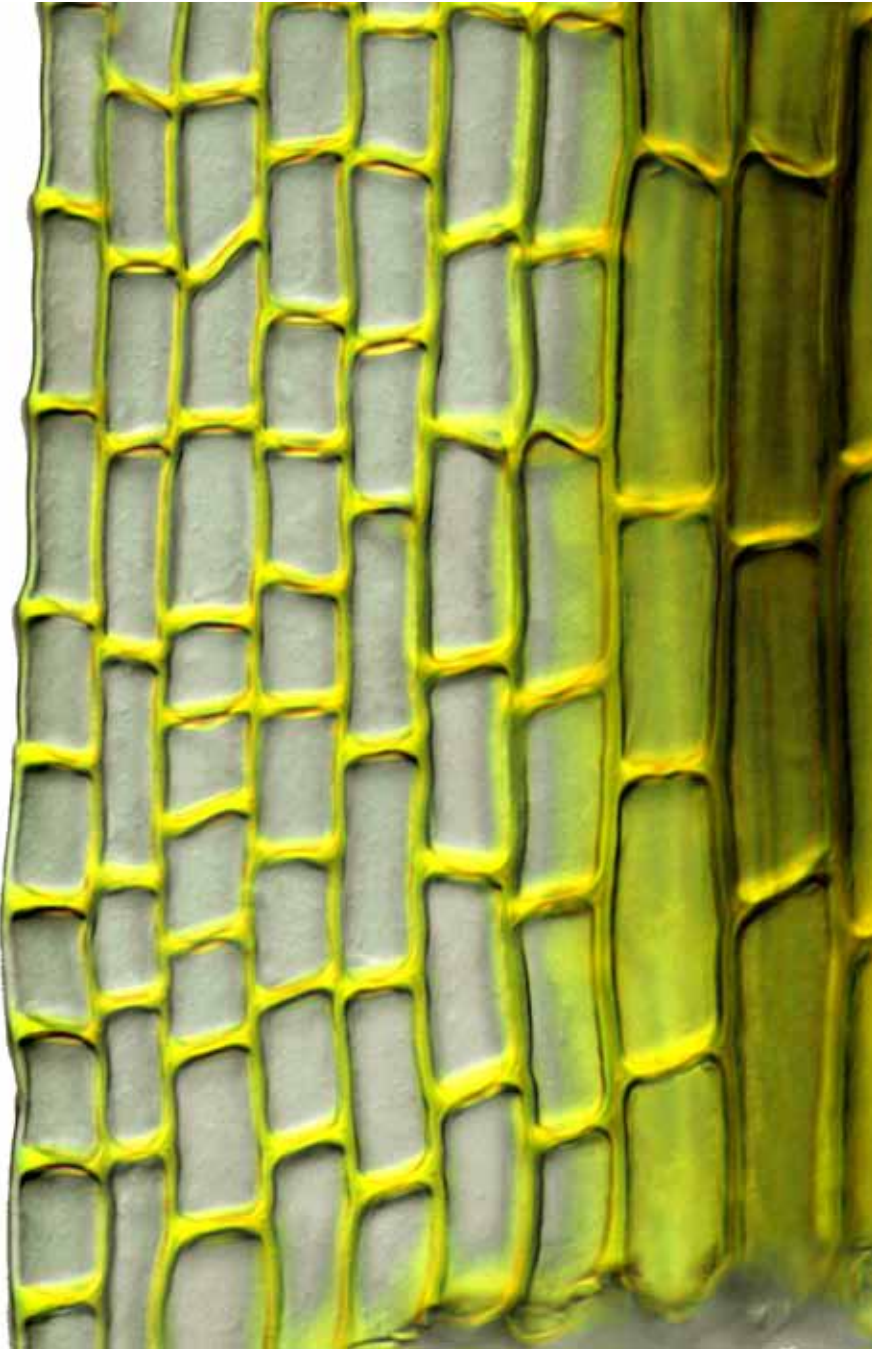
*Archidium elatum* margin above midleaf  
10  $\mu$ m

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*Archidium elatum* margin midleaf  
10  $\mu\text{m}$

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*Archidium elatum* quadrate to short-rectangular basal angle cells.  
10  $\mu\text{m}$



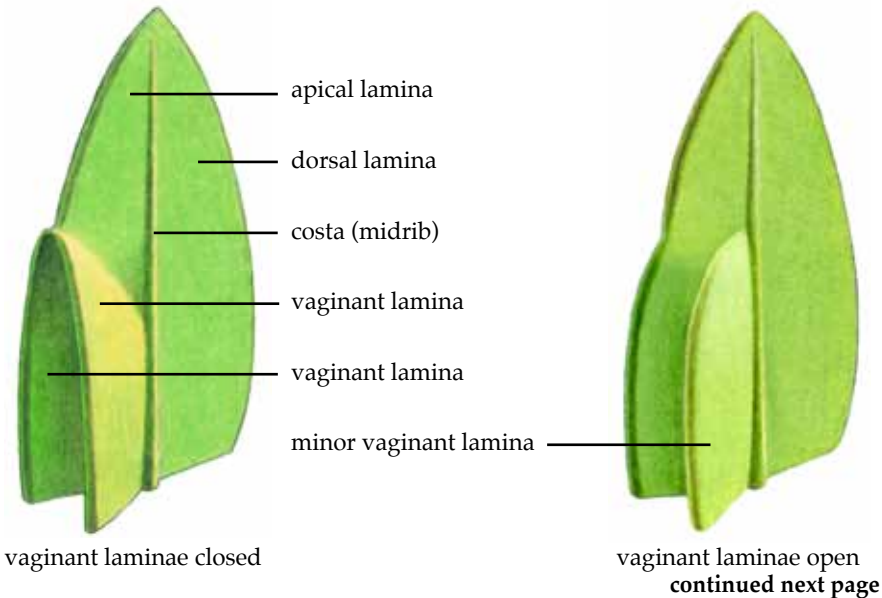
## Fissidens

Every leaf of a *Fissidens* moss has a deep slot in its forward edge that can clasp the trailing edge of the leaf lying just above it on the stem (below), rather like a dovetailed joint in a finely crafted wooden cabinet. That's unique among all the world's mosses.



Because the *Fissidens* leaf is so distinctive, botanists have named its parts. The two sides of the slotted forward edge are called **vaginant laminae** (*vagina* in Latin means “sheath”, *lamina* means “blade”, and *laminae* is the plural of *lamina*). The slot is always located at the base of the leaf's forward edge (below), and the unslotted remainder of that same half of the leaf is called the **apical** (or **ventral**) **lamina**. The trailing edge of the leaf never has a slot in it, and is called the **dorsal lamina**.

If the two vaginant laminae are fused together along only the leaf's costa (midrib), they're said to be *open* (below, right). In that case, one of the two vaginant laminae merges seamlessly at its tip into the apical lamina, whereas the other at its tip is left dangling, and is re-named the *minor vaginant lamina*. If on the other hand the two vaginant laminae are fused together along their tops right out to the leaf's forward edge (below, left), they're said to be *closed*. The leaves of most *Fissidens* mosses have vaginant laminae that are somewhere in between the extremes of fully open or fully closed, hence are said to be *partially open* or *closed*.



## Key\* to the New Zealand species and infraspecies of Fissidens (34)

\* based on Beever, J; Malcolm, B; Malcolm, N (2002): *The Moss Genus Fissidens in New Zealand, an Illustrated Key*. Micro-Optics Press, Nelson. For a key that's more detailed and makes more use of capsule traits, see Beever, J (2014): Fissidentaceae. *Flora of New Zealand – Mosses*. Fascicle 8, Manaaki Whenua Press, Lincoln.

- 1 Base of dorsal lamina strongly undulate (sometimes other laminae are undulate as well)..... ● **Fissidens taxifolius**  
 1: Base of dorsal lamina plane or nearly so..... 2
- 2(1): Leaves 5–9 mm long..... ● **Fissidens berteroi**  
 2: Leaves shorter than about 4 mm..... 3
- 3(2): Axillary hyaline nodules present (see glossary under *axillary*.); known in New Zealand from Kermadec Islands only..... ● **Fissidens crispulus** var. **robinsonii**  
 3: Axillary hyaline nodules not present..... 4
- 4(3): Dorsal lamina border fused to costa near leaf base.. ● **Fissidens perangustus**  
 4: Dorsal lamina border not fused to costa near leaf base..... 5
- 5(4): Protonema persistent..... ● **Fissidens exilis**  
 5: Protonema not persistent..... 6
- 6(5): Peristome *sainsburia*-type (see glossary under *sainsburia*-type peristome.....)..... ● **Fissidens taylorii** var. **sainsburyanus**  
 6: Peristome not *sainsburia*-type, or capsules not present..... 7
- 7(6): Leaves ecostate..... 8  
 7: Leaves costate..... 9
- 8(7) Plants 5–8 mm tall; leaf margins entire, the marginal cells long and narrow, forming a distinct border..... ● **Fissidens dealbatus**  
 8: Plants to only 3 mm tall; leaf margins toothed above, with no border..... ● **Fissidens hylogenes**
- 9(7): All laminae bordered with elongate or thick-walled cells for most or all of their length..... 10  
 9: No laminae or only some laminae bordered with elongate or thick-walled cells..... 18
- 10(9) Leaves overlapping at mid-stem..... 11  
 10: Leaves not overlapping at mid-stem..... 15
- 11(10) Plants aquatic or frequently submerged..... 12  
 11: Plants not aquatic..... 13
- 12(11) Laminae bordered with elongate cells; lamina cells flat; laminae more than one cell layer thick in patches or near the costa... ● **Fissidens rigidulus** var. **rigidulus**  
 12: Laminae bordered with isodiametric, thick-walled cells; lamina cells bulging; laminae one cell layer thick throughout..... ● **Fissidens adianthoides**
- 13(11:): Vaginant laminae open, with intramarginal borders..... ● **Fissidens megalotis** subsp. **megalotis**  
 13: Vaginant laminae partially or fully closed, with no intramarginal borders..... 14
- 14(13:): Plant on soil; leaves distorted when dry; laminae only one cell layer thick throughout; leaf border cells elongate; lamina cells flat..... ● **Fissidens curvatus** var. **curvatus**  
 14: Plant on rock; leaves little changed when dry; laminae more than one cell layer thick in patches or near the costa; leaf border cells isodiametric and thick-walled; lamina cells bulging..... ● **Fissidens dubius**

continued next page

- 15(10:) Plants aquatic; leaf pairs mostly more than about 15... ● **Fissidens dietrichiae**  
 15: Plants usually not aquatic; leaf pairs mostly fewer than about 15 ..... 16
- 16(15:) Leaf length-to-width ratio about 2:1 ..... ● **Fissidens bryoides**  
 16: Leaf length-to-width ratio more than 4:1 ..... 17
- 17(16:) Plants 2–6 mm tall, the leaves in 4–10 pairs; dorsal lamina failing above the leaf insertion, tapered to its base; lamina cells pellucid, flat, thin-walled .....  
 ..... ● **Fissidens anisophyllus**  
 17: Plants 3–15 mm tall, the leaves in 4–30(–45) pairs; dorsal lamina reaching the leaf insertion and sometimes shortly decurrent; lamina cells obscure, bulging, firm-walled ..... ● **Fissidens leptocladus**
- 18(9:) No laminae bordered with elongate cells ..... 19  
 18: At least one lamina bordered with elongate cells ..... 28
- 19(18) Vaginant laminae open ..... 20  
 19: Vaginant laminae partially or fully closed ..... 21
- 20(19) Fronds 10–60 mm tall; leaves > 2 mm long, in 10–25 pairs .....  
 ..... ● **Fissidens asplenioides**  
 20: Fronds 1–3 mm tall; leaves < 1.5 mm long, in 3–6(–14) pairs .....  
 ..... ● **Fissidens tenellus** var. **australiensis**
- 21(19:) Cells of dorsal and apical laminae multipapillose ..... 22  
 21: Cells of dorsal and apical laminae smooth ..... 23
- 22(21) Leaves linear (length-to-width ratio > 5:1), 0.1–0.2 mm wide, the apices narrowly acute and often asymmetric ..... ● **Fissidens linearis** var. **angustifolius**  
 22: Leaves oblong-lanceolate (length-to-width ratio < 5:1), 0.2–0.3 mm wide, the apices acute and symmetric ..... ● **Fissidens linearis** var. **linearis**
- 23(21:) Plants aquatic ..... 24  
 23: Plants not aquatic ..... 25
- 24(23) Costa distinct, white to yellow, often reddening with age; vaginant laminae unistratose ..... ● **Fissidens strictus**  
 24: Costa indistinct, partly overlain with shortly rectangular, thin-walled cells; vaginant laminae pluristratose ..... ● **Fissidens rigidulus** var. **pseudistrictus**
- 25(23:) Plants usually on bark or exposed roots ..... ● **Fissidens hyophilus**  
 25: Plants usually on soil or rock ..... 26
- 26(25:) Leaves pale to dark grey-green, glossy, little altered when dry, in 5–10(–17) pairs; leaf margins ± entire ..... ● **Fissidens pallidus**  
 26: Leaves medium to yellow-green, not glossy, the tips rolled when dry, in 12–30(–40) pairs; leaf margins crenulate from bulging cells ..... 27
- 27(26:) Plants usually on rock; dorsal lamina often failing above the leaf insertion..  
 ..... ● **Fissidens oblongifolius**  
 27: Plants usually on soil; dorsal lamina usually reaching the leaf insertion .....  
 ..... ● **Fissidens capitatus**
- 28(18:) Border of vaginant laminae intramarginal ..... 29  
 28: Border of vaginant laminae marginal ..... 30
- 29(28) Plants aquatic, 5–15 mm tall, with 10–45 pairs of leaves that overlap at mid-stem; lamina cells flat ..... ● **Fissidens integerrimus**  
 29: Plants only rarely aquatic, 1–6 mm tall, with fewer than 15 pairs of leaves that do not overlap at mid-stem; lamina cells bulging .....  
 ..... ● **Fissidens tenellus** var. **tenellus**

- 30(28:) Plants on rock, aquatic or frequently submerged; laminae more than one cell layer thick in patches near the costa..... ● **Fissidens waiensis**  
 30: Plants on soil, not aquatic; laminae unistratose throughout ..... 31
- 31(30:) Vaginant laminae open; lamina cells bulging ..... ● **Fissidens blechnoides**  
 31: Vaginant laminae partially or fully closed; lamina cells flat..... 32
- 32(31:) Leaves distorted when dry; dorsal lamina border rudimentary or lacking ...  
 ..... ● **Fissidens curvatus** var. **inclinabilis**  
 32: Leaves little changed when dry; dorsal lamina border lacking ..... 33
- 33(32:) Sterile shoots with leaves in 15–25 pairs ● **Fissidens taylorii** var. **epiphytus**  
 33: Sterile shoots with leaves in 8–12(–17) pairs ..... 34
- 34(33:) Peristome *sainsburia*-type (see glossary under *sainsburia*-type peristome).....  
 ..... ● **Fissidens taylorii** var. **sainsburyanus**  
 34: Peristome not *sainsburia*-type ..... ● **Fissidens taylorii** var. **taylorii**



*Fissidens rigidulus* var. *rigidulus* cross-sections of leaves (detail of costa on right) (partially schematic and computer-assembled). The costa (midrib) is about midway in both sections, with the dorsal lamina facing downwards and the vaginant laminae facing upwards.

50 μm (left),

50 μm (right)

continued next page

**Fissidens adianthoides** Hedw.

**form:** densely gregarious, yellow- to dark green, ± branched, to 90 mm long

**habitat:** aquatic, floating or on submerged rock or soil in depressions and lakes to 1600 m

**leaf:** size: 2.0–3.5 × 0.5–1.2 mm, in 10–50 pairs on the stem

*shape:* oblong-lanceolate, asymmetric

*tip:* acute

*vaginant laminae:* up to 0.7 of the leaf length, partially closed

*base:* not differentiated

*costa:* failing 2–4 cells below the apex

*margin:* with several rows of thicker-walled cells forming a pale band, irregularly and coarsely serrulate near the apex, plane

*cells:* 12–20 μm, rounded-isodiametric, firm-walled, bulging, smooth

**capsule:** 1.0–1.6 mm, asymmetric, erect to horizontal, brown; seta 15–20 mm, orange-brown, sinuose; calyptra smooth, cucullate; operculum curved-rostrate



vegetative shoot (dry) (2), leaf outline, and leaf apex

1 mm, 1 mm, 1 mm, 10 μm



margin midleaf, costa midleaf, and junction of apical and vaginant laminae

10 μm, 10 μm, 50 μm

continued next page

**Fissidens anisophyllus** Dixon

**form:** loosely gregarious, seldom-branched stems, with leaves in 4–10 pairs, not overlapping in mid-stem, 2–6 mm long

**habitat:** soil of lowland roadside banks, to 200 m

**leaf:** size: 0.8–1.4 × 0.2–0.3 mm

**shape:** oblong-lanceolate, crisped when dry, plane when moist

**tip:** acute

**vaginant laminae:** up to 0.7 of the leaf length, half-open to closed

**base:** dorsal lamina tapered, failing above the leaf insertion

**costa:** percurrent or failing a few cells below the apex

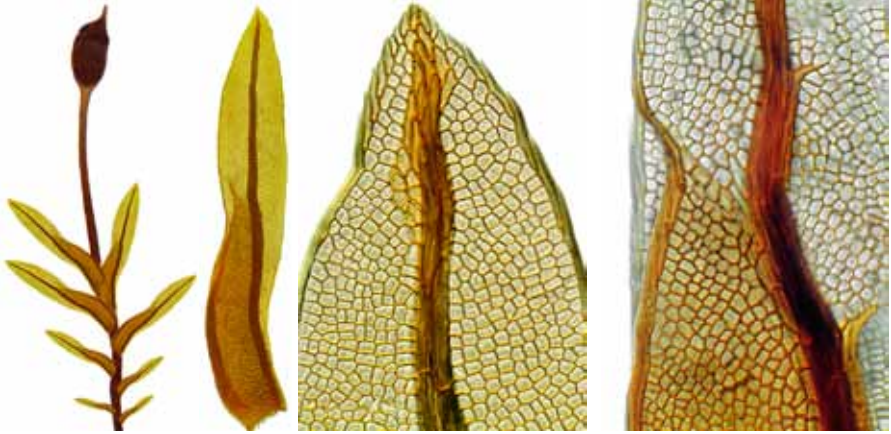
**border:** 1–2 rows of prosenchymatous cells, often absent on lower dorsal lamina

**margin:** entire below, serrulate near the apex, plane

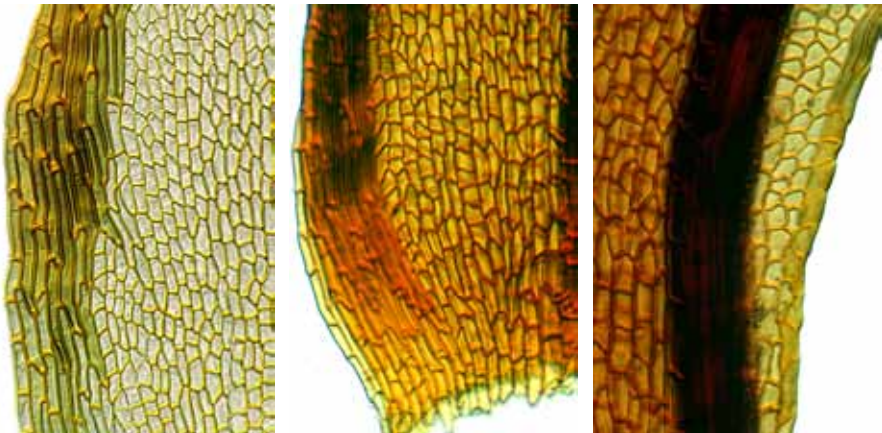
**cells:** 5–12 μm, quadrate to hexagonal, firm-walled, smooth

**capsule:** 0.3–0.5 mm, symmetric, erect, exserted, brown; seta 1.5–2.0 mm; operculum long-beaked; spores 10–14 μm in diam.

**capsule:** known from only a few collections in central Wairarapa



fertile shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 50 μm, 50 μm



margin of vaginant lamina, base of vaginant lamina, and base of dorsal lamina  
 50 μm, 50 μm, 50 μm

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**Fissidens asplenioides** Hedw.

**form:** gregarious, rarely branched, rhizoidal below; up to 20 mm long when growing on soil, up to 60 mm long growing in water

**habitat:** soil or rock in forest, scrub, pasture, and lawns, from dry to very wet

**leaf:** size: 2.0–4.0 × 0.3–0.7 mm, in 10–25 pairs

**shape:** oblong-lingulate, ± curved, unistratose

**tip:** obtuse

**vaginant laminae:** up to 0.7 of the leaf length, ± open, the minor lamina rounded

**base:** dorsal lamina tapered, usually failing above the insertion

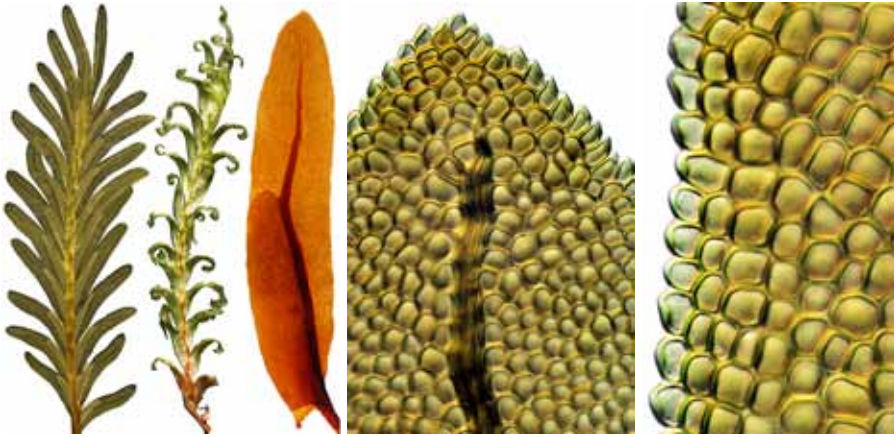
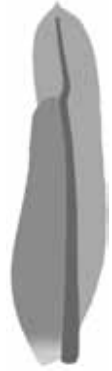
**costa:** failing 4–8 cells below the apex

**border:** not differentiated

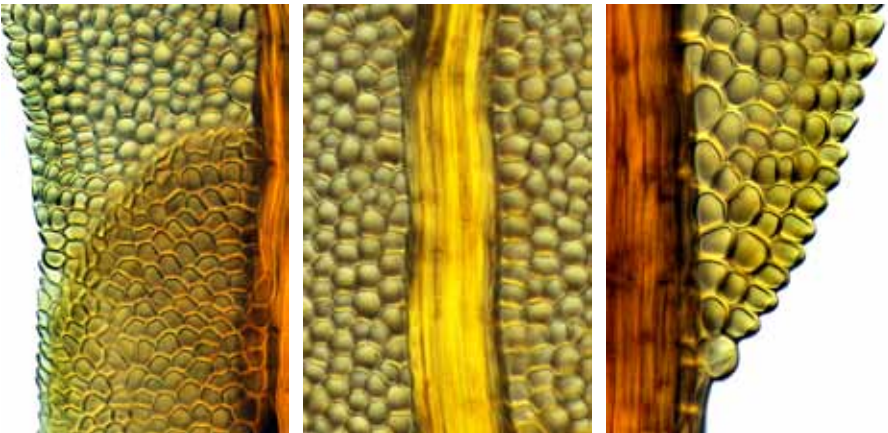
**margin:** serrulate throughout, plane

**cells:** 7–11 μm, rounded-hexagonal, firm-walled, bulging, smooth

**capsule:** 0.8–1.5 mm, ovoid, inclined, symmetric, exserted; seta 3–5 mm, stout, arcuate; operculum obliquely rostrate; peristome single, dicranoid; spores 14–19 μm in diam.



vegetative frond (moist and dry), leaf outline, leaf apex, and apical lamina margin  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm



junction of apical and vaginant laminae, costa midleaf, and base of dorsal lamina  
 ■ 50 μm, ■ 10 μm, ■ 10 μm

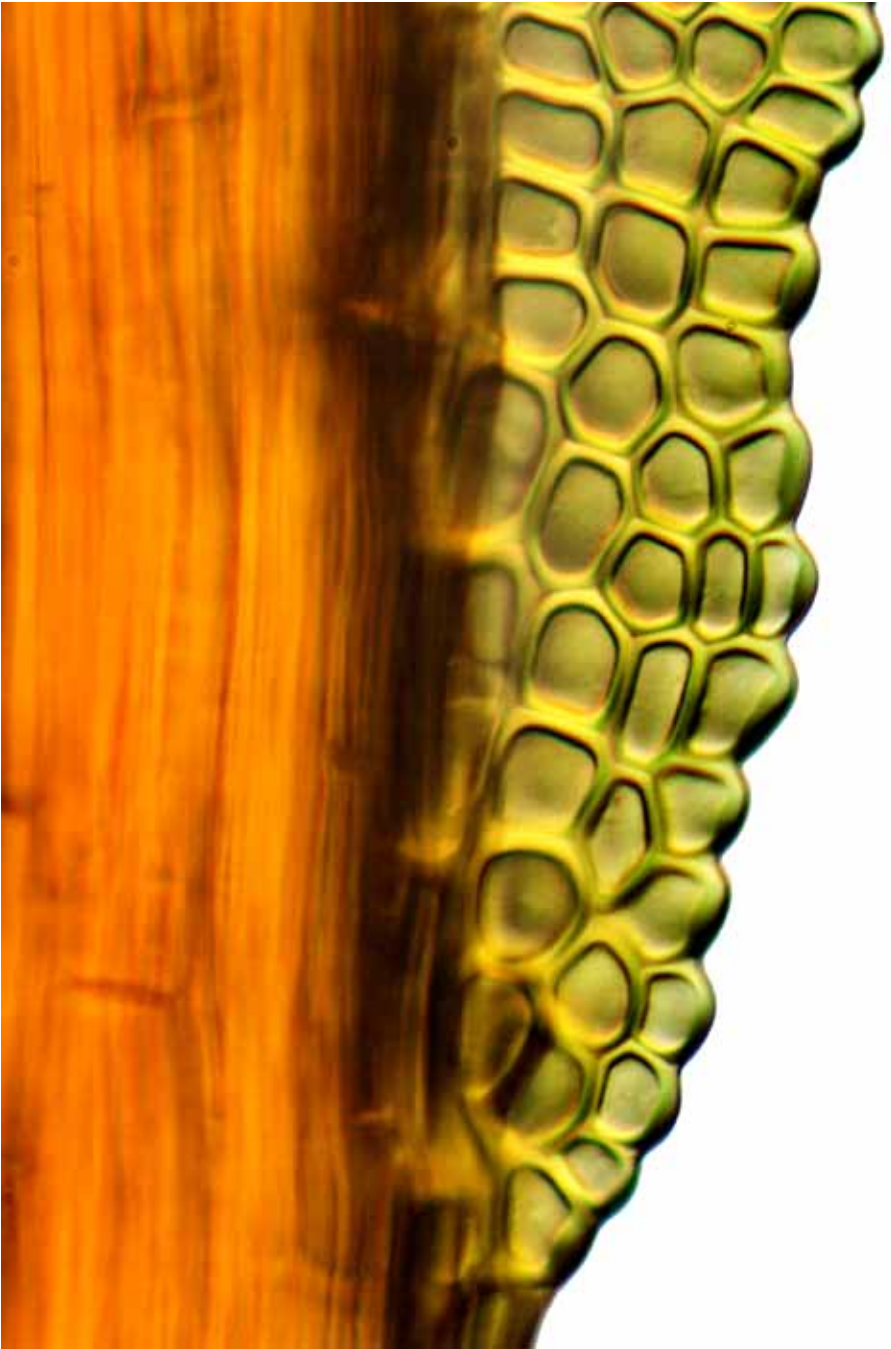
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*Fissidens asplenioides* habit  
1 mm

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*Fissidens asplenioides* base of dorsal lamina  
10  $\mu\text{m}$

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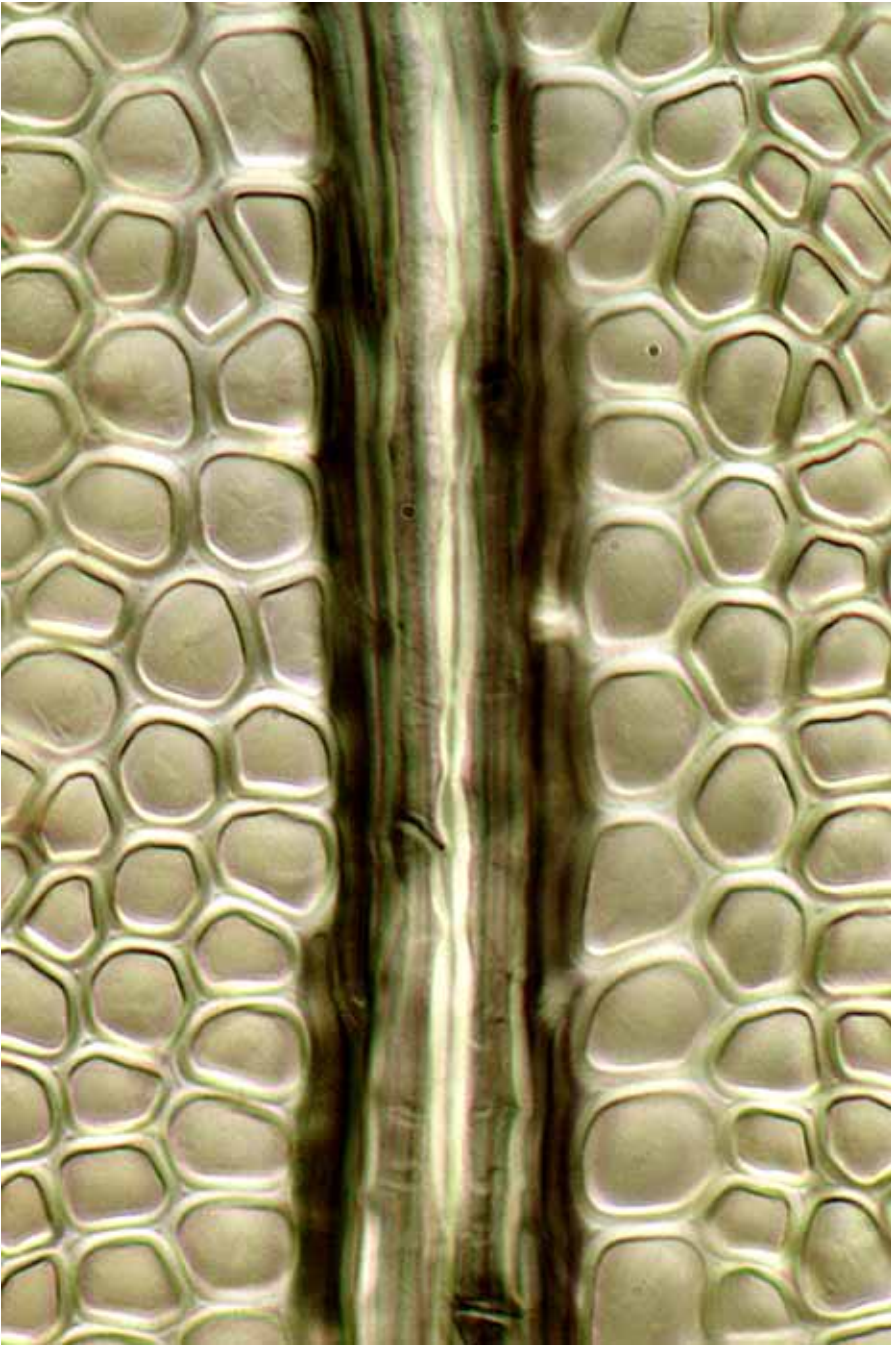
*Fissidens asplenioides* apical lamina margin  
10  $\mu\text{m}$

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*Fissidens asplenioides* leaf apex showing costa terminus  
10  $\mu\text{m}$

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*Fissidens asplenioides* costa midleaf  
10  $\mu\text{m}$

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**Fissidens berteroi** (Mont.) Müll.Hall.

**form:** tufted or matted; branched; leaf-pairs distant on frond axis, green to yellow, up to 100 mm long

**habitat:** on wood, rock, or concrete submerged in fast-flowing lowland streams

**leaf:** size: 5.0–9.0 × 0.5–0.9 mm

*shape:* linear-lanceolate, unistratose

*tip:* acuminate

*vaginant laminae:* 0.4–0.5 the leaf length, almost closed

*base:* the dorsal lamina fails above the leaf insertion

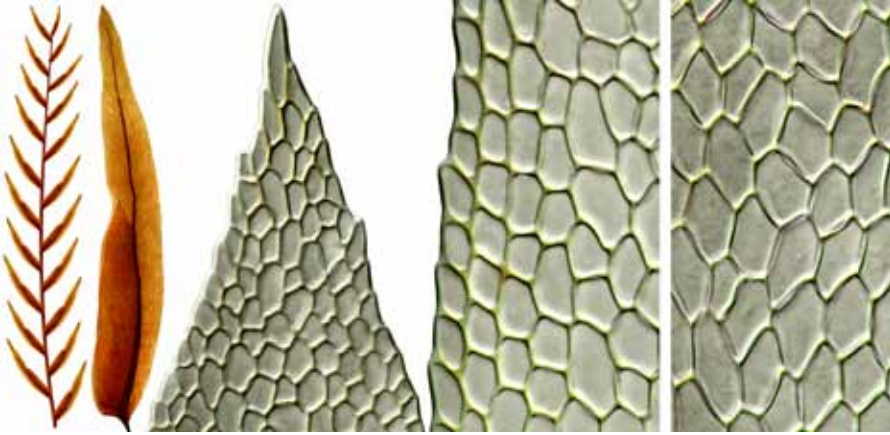
*costa:* failing 15–40 cells below the apex

*border:* not differentiated

*margin:* entire except for occasional serrations (especially near the apex), plane

*cells:* 12–20 μm, quadrate to irregularly hexagonal, thin-walled, smooth

**capsule:** 0.8–1.0 mm, ovoid, erect to horizontal, exserted, brown; seta 0.8–1.5 mm, stout, fleshy; operculum short-beaked; calyptra cucullate; spores 16–25 μm in diam.



vegetative frond, leaf outline, leaf apex, and margin and cells of apical (ventral) lamina  
 5 mm, 1 mm, 10 μm, 10 μm, 10 μm



junction of apical and vaginant laminae, costa upper leaf, vaginant lamina basal angle  
 10 μm, 10 μm, 50 μm

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*Fissidens berteroi* frond (moist) and leaf whole-mount  
1 mm, 1 mm

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**Fissidens blechnoides** J.E.Beever

**form:** scattered to gregarious, rarely branched, yellow- to dark green stems up to 16 mm long; leaves in 6–15(–23) pairs,  $\pm$  overlapping in mid-stem

**habitat:** soil on sloping banks in shaded forest and lawns, to 600 m

**leaf:** size: 1.0–1.6  $\times$  0.3–0.4 mm

*shape:* oblong-lanceolate, unistratose,  $\pm$  curved, little altered when dry

*tip:* acute to broadly acute, sometimes mucronate

*vaginant laminae:* up to 0.7 of the leaf length, open

*base:* dorsal lamina decurrent down the stem

*costa:* percurrent

*border:* differentiated on only the vaginant laminae

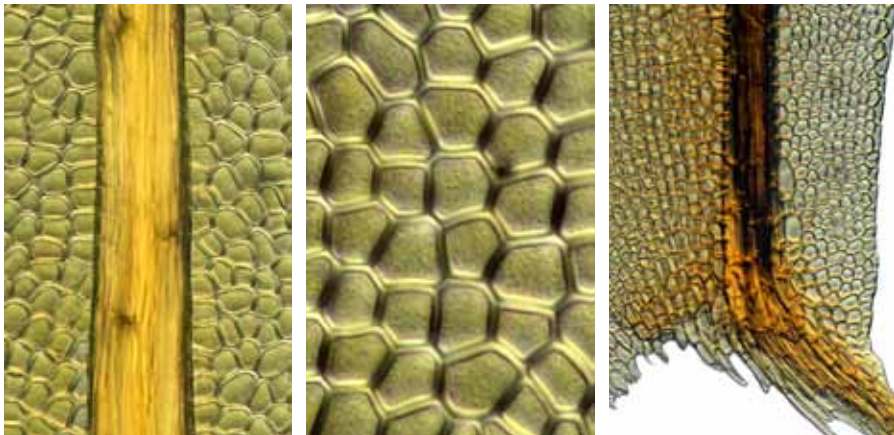
*margin:* entire on the vaginant laminae, minutely serrulate elsewhere, plane

*cells:* 5–11  $\mu$ m, quadrate to hexagonal, firm-walled, bulging, smooth

**capsule:** 0.6–1.0 mm, ovoid, erect to inclined, exserted; seta 2–3 mm, wiry; operculum obliquely rostrate; peristome single, dicranoid; spores 14–21  $\mu$ m in diam.



vegetative shoot (moist/dry), leaf outline, leaf apex, and apex of minor vaginant lamina  
 1 mm, 1 mm, 0.1 mm, 50  $\mu$ m, 50  $\mu$ m



costa midleaf, cells midleaf, and decurrent base of dorsal lamina  
 50  $\mu$ m, 10  $\mu$ m, 50  $\mu$ m

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*Fissidens blechnoides* immature and mature capsules and leaf whole-mount  
1 mm (2), 0.1 mm

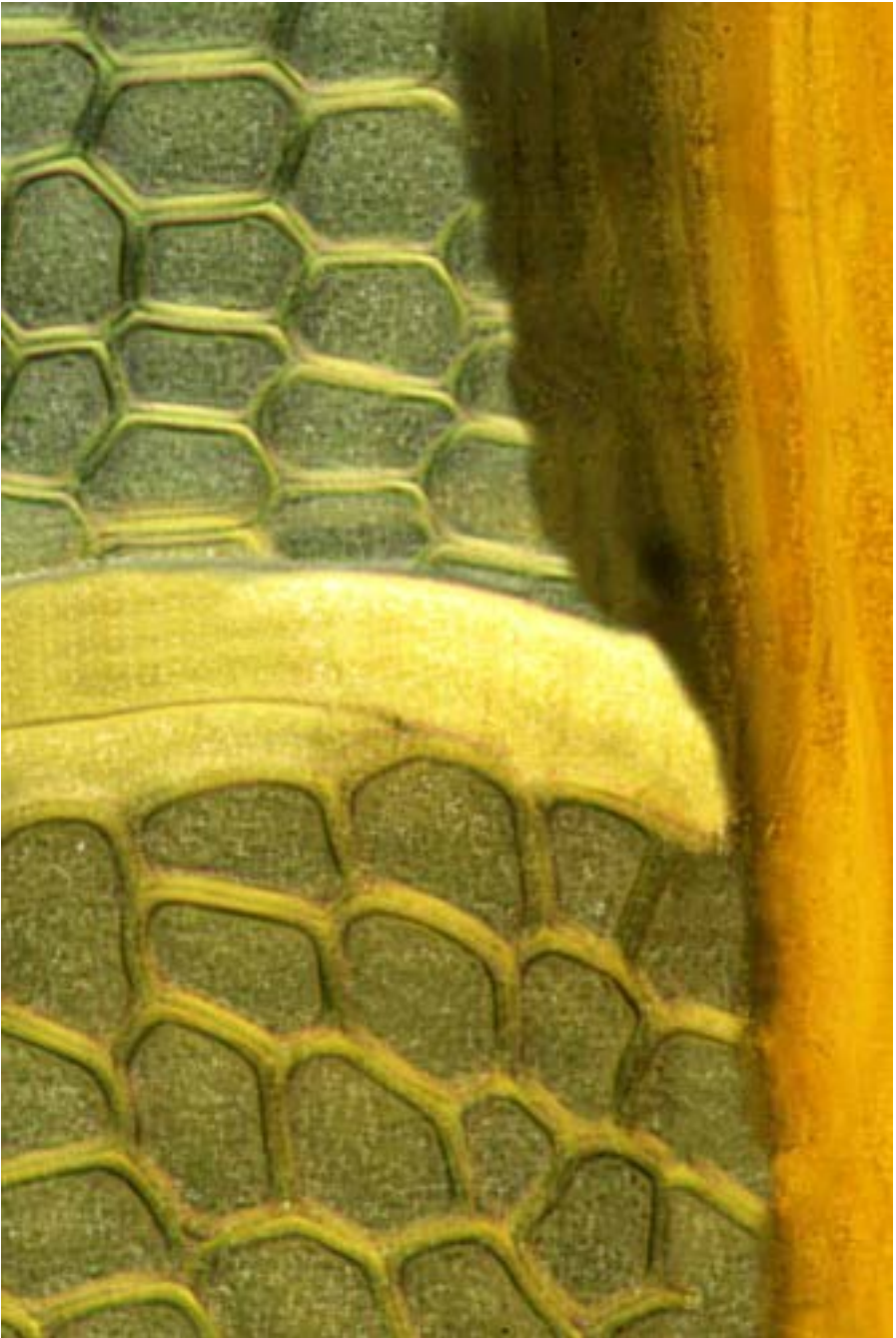
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*Fissidens blechnoides* apex of vaginant lamina  
50  $\mu\text{m}$

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*Fissidens blechnoides* apex of vaginant lamina (detail)  
10  $\mu$ m

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**Fissidens bryoides** Hedw.

**form:** loosely gregarious, base-branched stems, 2–10 mm long; leaves in 3–20 pairs, not overlapping in mid-stem, green to yellow-green, radiculose  
**habitat:** soil, in lawns, pastures, roadsides, and disturbed sites, to 600 m

**leaf:** size: 0.6–1.2 × 0.2–0.5 mm

*shape:* oblong-lanceolate, unistratose, crisped when dry

*tip:* broadly acute, apiculate

*vaginant laminae:* up to 0.7 of the leaf length, closed

*base:* dorsal lamina tapered, reaching the insertion or failing just above

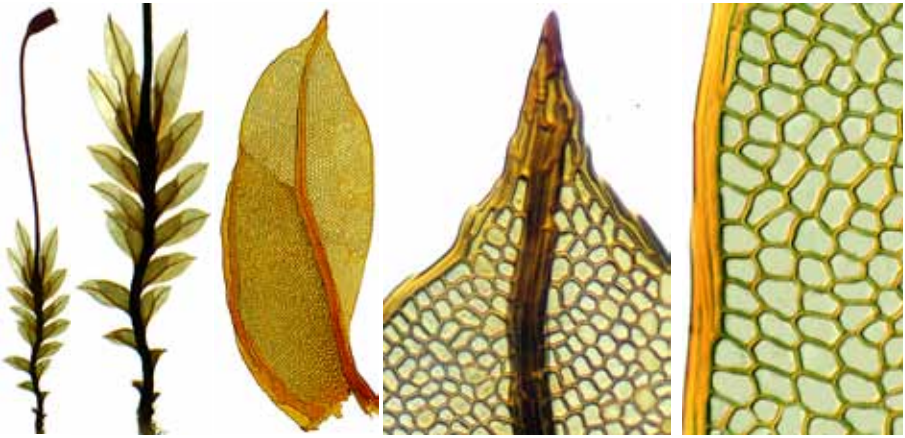
*costa:* percurrent to excurrent

*border:* pluristratose, 3–6 rows of narrow cells, ± fusing with costa at tip

*margin:* entire throughout, plane

*cells:* 5–12 μm, irregularly hexagonal, firm-walled, smooth, not bulging

**capsule:** 0.8–1.0 mm, asymmetric, inclined, long-exserted, brown; seta 5–13 mm, orange-brown, stiff; operculum apiculate; calyptra scabrous at the apex, cucullate; spores 15–18 μm in diam.



fertile shoot (moist) (2), leaf outline, leaf apex, and margin midleaf  
 1 mm, 1 mm, 0.1 mm, 50 μm, 10 μm



junction of apical and vaginant laminae, costa upper leaf, and dorsal lamina base  
 50 μm, 10 μm, 50 μm

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*Fissidens bryoides* dorsal lamina base (detail)  
10  $\mu\text{m}$

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**Fissidens capitatus** Hook.f. & Wilson

**form:** densely gregarious, branched stems, leaves in 12–20(–30) pairs, overlapping in mid-stem, green to yellow-green, radiculose, 5–15 mm long

**habitat:** soil (rarely rock) in shaded lowland forest, upper North Island to 440 m

**leaf:** size: 2.0–3.0 × 0.3–0.4 mm

**shape:** linear-lanceolate, unistratose, the tips rolling up when dry

**tip:** acute to acuminate

**vaginant laminae:** up to 0.7 of the leaf length, half-open to closed

**base:** dorsal lamina reaching the leaf insertion

**costa:** failing below the apex

**border:** not differentiated

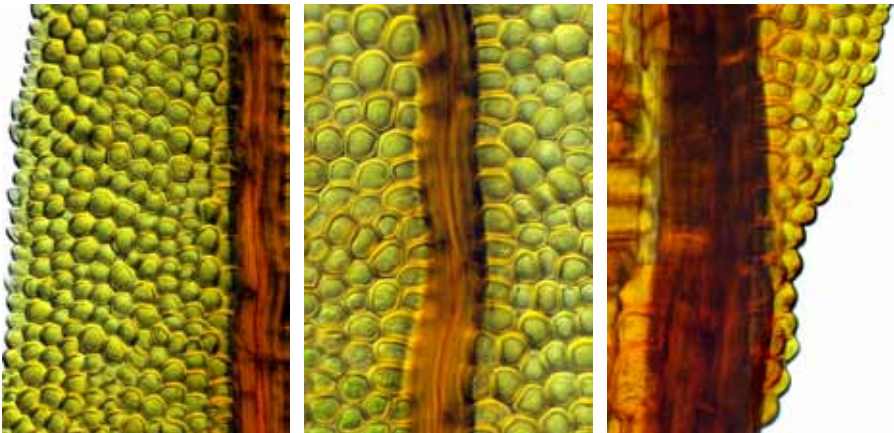
**margin:** serrulate-crenulate throughout, plane

**cells:** 7–12  $\mu\text{m}$ , irregularly hexagonal, firm-walled, smooth, mammillose

**capsule:** 0.5–1.0 mm, asymmetric, horizontal, exserted, brown; seta 4–5 mm, tortuose when dry, light brown; calyptra smooth, mitrate; spores 9.0–13.5  $\mu\text{m}$  in diam.

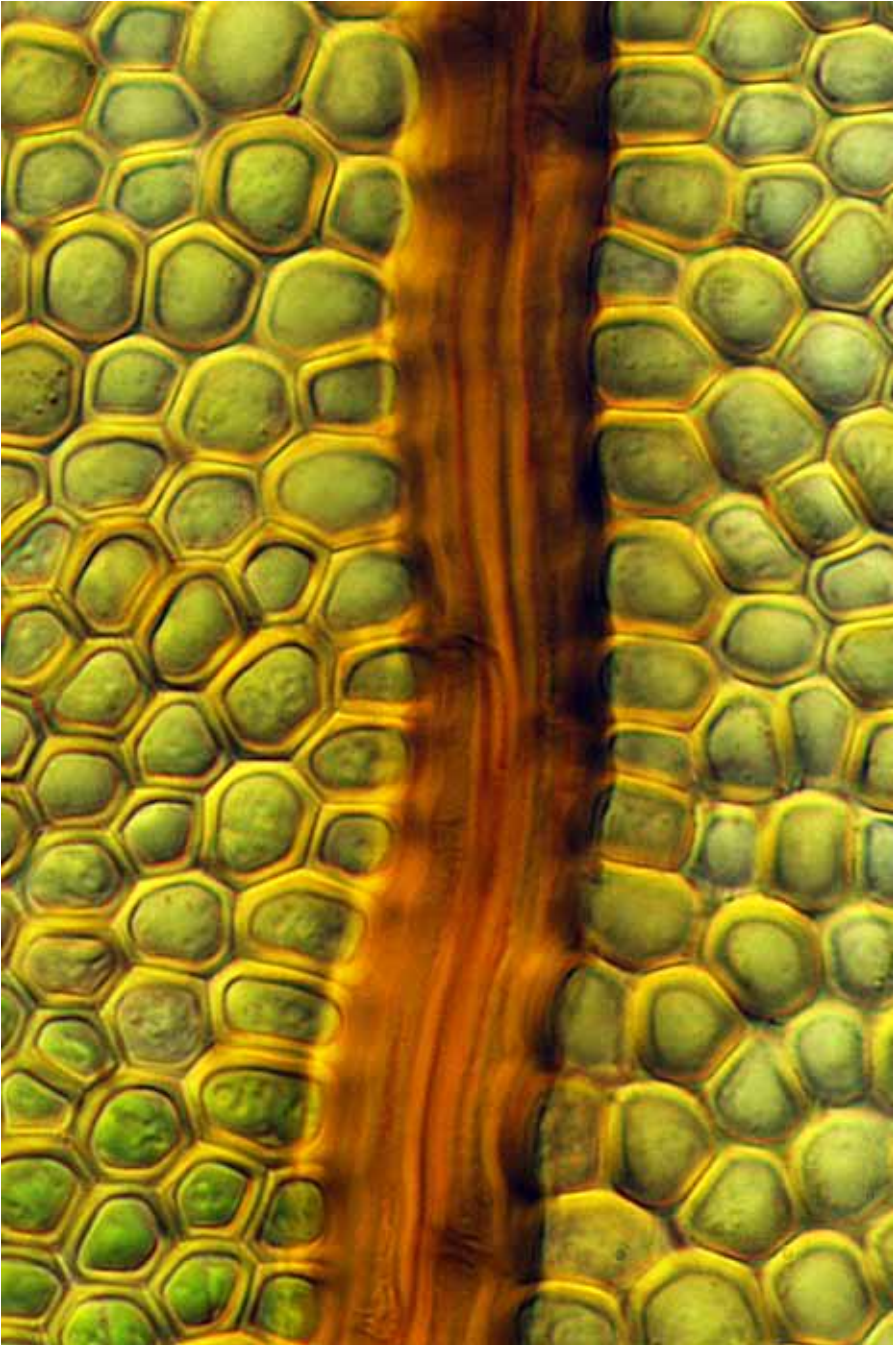


vegetative frond (dry), leaf outline, leaf apex, junction of apical and vaginant laminae  
 1 mm, 1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



margin of upper leaf, costa in upper leaf, and base of dorsal lamina  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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*Fissidens capitatus* costa upper leaf  
10  $\mu\text{m}$

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**Fissidens crispulus** var. **robinsonii** (Broth.) Z.Iwats. & Z.-H.Li

**form:** densely tufted, erect branches from creeping stems

**habitat:** soil or rock, known from only Raoul Island

**leaf:** size: 1.4–1.8 × 0.18–0.24 mm, in 20–35 pairs per stem, overlapping from mid-stem upwards, the lower leaves much smaller than the upper leaves

**shape:** narrowly lanceolate, asymmetric

**tip:** acute

**vaginant laminae:** 0.5–0.7 of the leaf length, almost closed

**base:** dorsal lamina variable

**costa:** per- to excurrent

**border:** not differentiated

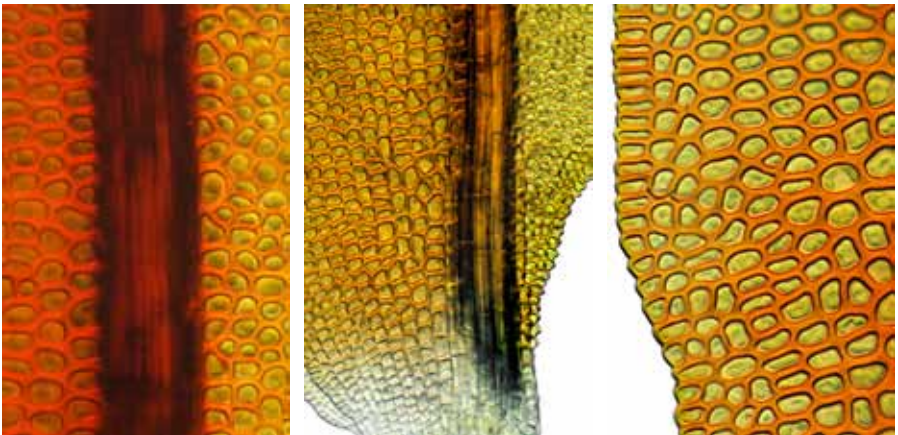
**margin:** finely serrulate, plane

**cells:** 6–8 μm, rounded-quadrate, thick-walled, mammillose, smooth

**capsule:** not seen in New Zealand collections; about 1 mm, urceolate, erect to inclined, exserted, brown; seta 3–4 mm; peristome dicranoid, red

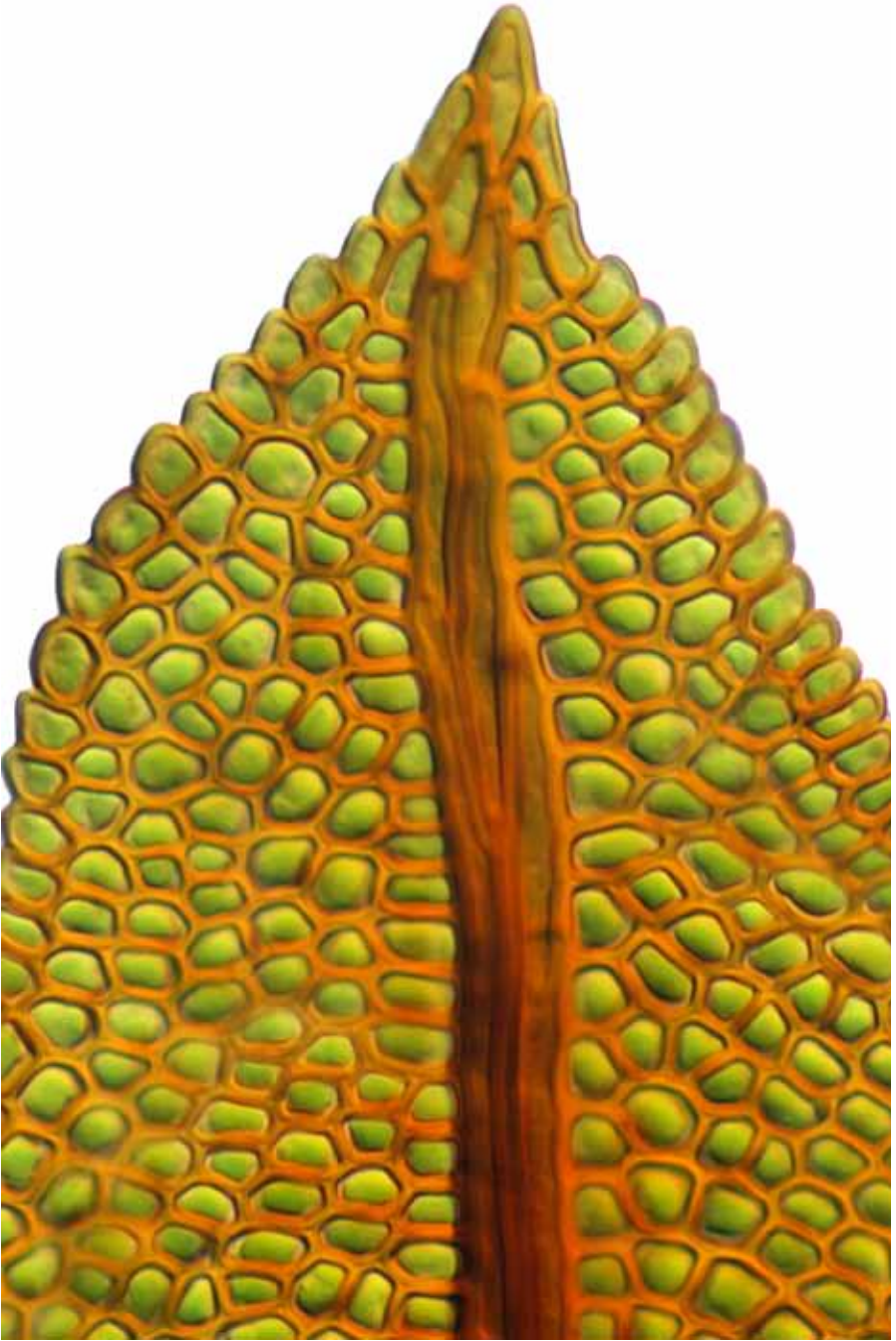


vegetative shoot (moist and dry), leaf outline, leaf apex, and apical/vaginant junction  
 1 mm, 1 mm, 0.1 mm, 50 μm, 50 μm



costa near leaf base, leaf base, and vaginant lamina near base  
 10 μm, 50 μm, 50 μm

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*Fissidens crispulus* var. *robinsonii* leaf tip  
10  $\mu$ m

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**Fissidens curvatus** Hornsch. var. **curvatus**

**form:** gregarious, unbranched stems, with leaves in 3–8(–15) pairs, pale to dark green, radiculose below, 1.5–5(–8) mm tall

**habitat:** soil in indigenous and exotic forest, throughout, to 1000 m elevation

**leaf:** size: 0.5–1.0 × 0.1–0.25 mm

**shape:** oblong-lanceolate to linear-lanceolate, unistratose, crisped when dry

**tip:** acute to acuminate, usually cuspidate

**vaginant laminae:** up to 0.7 of the leaf length, closed, deeply indented

**base:** dorsal lamina reaching the leaf insertion or nearly

**costa:** subpercurrent to long-excurrent

**border:** pluristratose on all laminae, ± fusing with the costa at the leaf apex

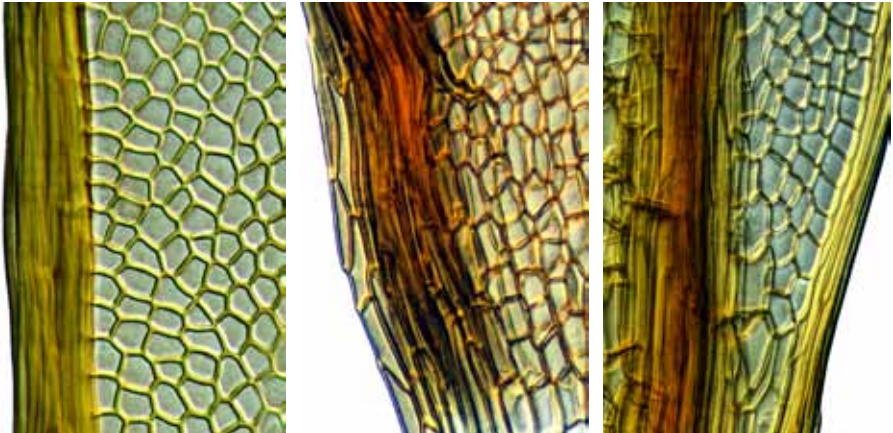
**margin:** entire, plane

**cells:** 6–14 μm, irregularly quadrate or hexagonal, firm-walled, smooth

**capsule:** 0.5–1.0 mm, erect to horizontal, symmetric to arcuate, exserted, brown; seta 2.5–12 mm, yellow to orange-brown; operculum beaked; calyptra smooth, cucullate; spores 12–21 μm in diam.



vegetative frond, leaf outline, leaf apex, and junction of apical and vaginant laminae  
 0.5 mm, 0.1 mm, 50 μm, 50 μm



margin upper leaf, base of vaginant lamina, and near base of dorsal lamina  
 10 μm, 10 μm, 10 μm

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**Fissidens curvatus** var. **inclinabilis** (Dixon) J.E.Beever

**form:** gregarious, unbranched stems, radiculose below, with leaves in 3–8(–15) pairs, not overlapping in mid-stem, pale to dark green, 1.5–5(–8) mm long

**habitat:** soil, from sea level to 200 m

**leaf:** size: 1.5–2.5 × 0.3–0.7 mm

**shape:** oblong- to linear-lanceolate, unistratose, crisped when dry

**tip:** acute to acuminate

**vaginant laminae:** up to 0.7 of the leaf, the minor lamina indented near its apex

**base:** dorsal lamina tapered, reaching the leaf insertion or failing just above

**costa:** subpercurrent to long-excurrent

**border:** 1–5 rows of elongate cells on the vaginant laminae, rarely other laminae

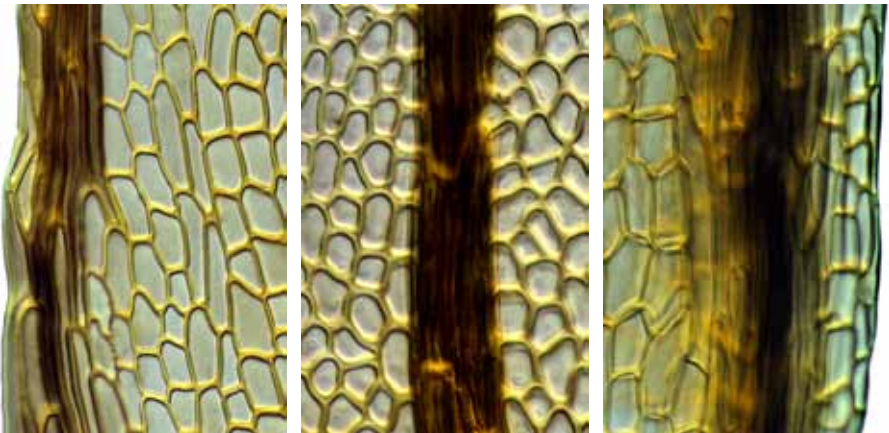
**margin:** entire, plane

**cells:** 7–12  $\mu\text{m}$ , irregularly quadrate to hexagonal, thin-walled, smooth

**capsule:** 0.5–1.0 mm, asymmetric, arcuate, inclined to horizontal, exserted, brown; seta 4–15 mm, yellow to orange-brown; operculum beaked; calyptra smooth, cucullate; spores 12–21  $\mu\text{m}$  in diam.



fronds (moist) (2), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$



vaginant lamina margin, costa upper leaf, and near base of dorsal lamina  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Fissidens curvatus* var. *inclinabilis* vaginant lamina margin (detail)  
10  $\mu$ m

continued next page

**Fissidens dealbatus** Hook.f. & Wilson

**form:** scattered to gregarious, erect, unbranched, delicate stems, radiculose below, leaves in 4–8 pairs, not overlapping in mid-stem, 5–8 mm tall

**habitat:** damp shaded mineral soil in forest along streambanks, to 800 m

**leaf:** size: 1.5–2.5 × 0.3–0.7 mm

*shape:* lanceolate, ± curved

*tip:* acute

*vaginant laminae:* up to 0.7 of the leaf, closed or nearly so

*base:* dorsal lamina reaching the leaf insertion, tapered below, decurrent

*costa:* not differentiated; the only other ecostate NZ *Fissidens* is *F. hylogenes*

*border:* pluristratose, 1–3 rows of elongate, thick-walled cells

*margin:* entire below, ± toothed near the apex, plane

*cells:* 40–80 × 20–40 μm, elongate-hexagonal, thin-walled, smooth

**capsule:** 0.6–1.0 mm, cylindric-ovoid, erect, exserted; seta 3–4 mm, fleshy; operculum rostrate; spores 12–17 μm in diam.



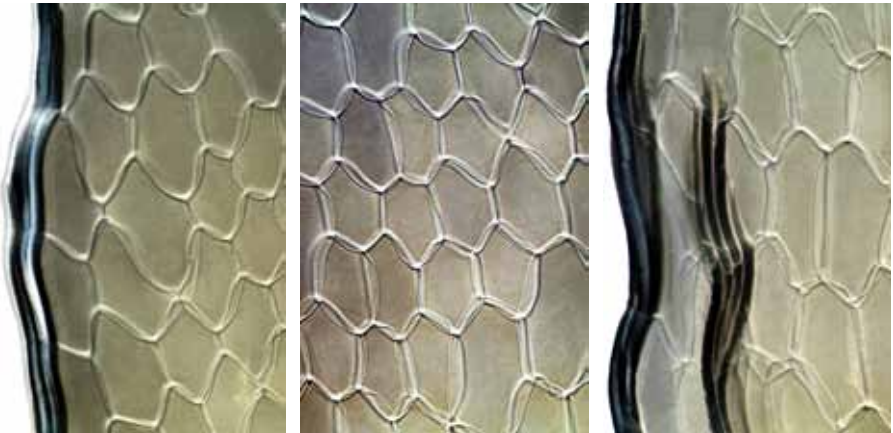
vegetative shoot, mature capsule, leaf outlines (2), and leaf apex

1 mm,

1 mm,

0.5 mm (2),

50 μm



margin midleaf, cells midleaf, and junction of apical and vaginant laminae

50 μm,

50 μm,

50 μm

continued next page



*Fissidens dealbatus* margin midleaf  
50  $\mu$ m

continued next page



*Fissidens dealbatus* leaf apex

50  $\mu$ m

continued next page

**Fissidens dietrichiae** Müll.Hal.

**form:** densely gregarious, erect, sparingly branched stems, pale to dark green, leaves in 10–40(–50) pairs, not overlapping in mid-stem, to 35 mm tall

**habitat:** on soil and rock near springs and in ravines; from Raoul Island only

**leaf:** size: 1.6–2.1 × 0.7–0.8 mm

*shape:* oblong-ovate

*tip:* acute, occasionally mucronate

*vaginant laminae:* about half the leaf length, closed

*base:* basal juxtacostal dorsal lamina cells rectangular, to 38 μm long

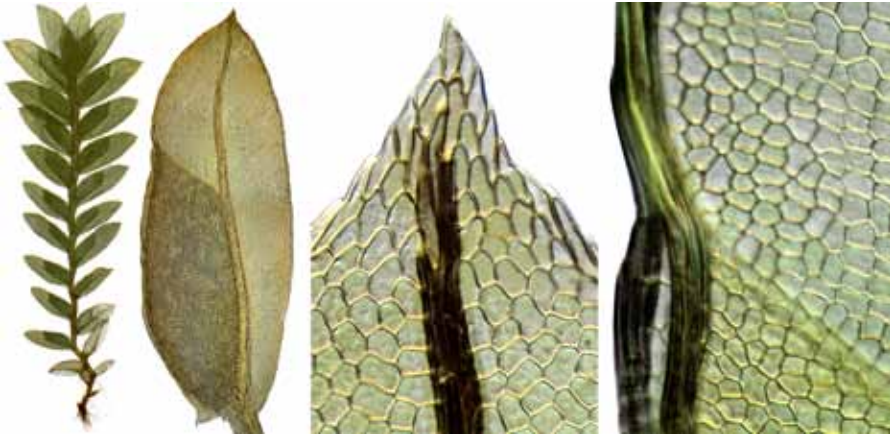
*costa:* prominent, reaching the apex or nearly, reddish brown

*border:* 1–3 rows of thin-walled linear cells 60 × 2 μm, to near the apex

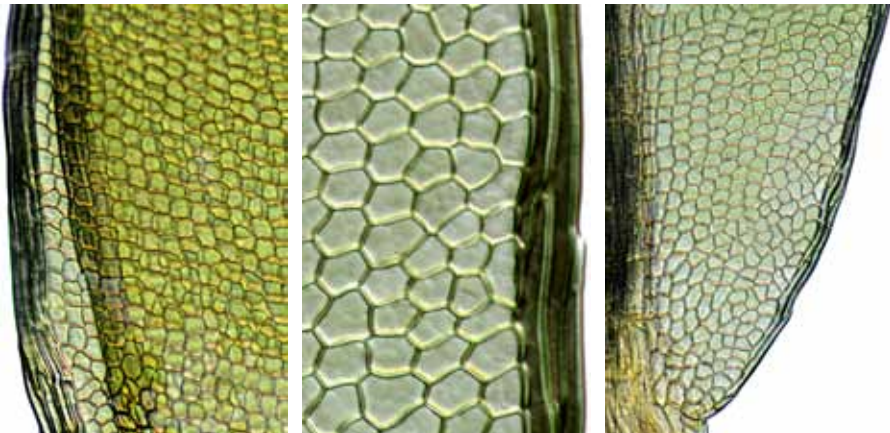
*margin:* mostly entire, weakly serrulate near the apex; plane

*cells:* 12–14 μm, larger near the costa, hexagonal, thin-walled, smooth

**capsule:** 0.8–1.4 mm, oblong, inclined, asymmetric, exserted, brown; seta 5–7 mm, light brown, matt; operculum acute-conic; exostome teeth dark red, to 300 μm, papillose; spores 18–25 μm in diam.



vegetative shoot (moist), leaf, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 10 μm, 10 μm



vaginant laminae borders, border of dorsal lamina, base of dorsal lamina  
 50 μm, 10 μm, 50 μm

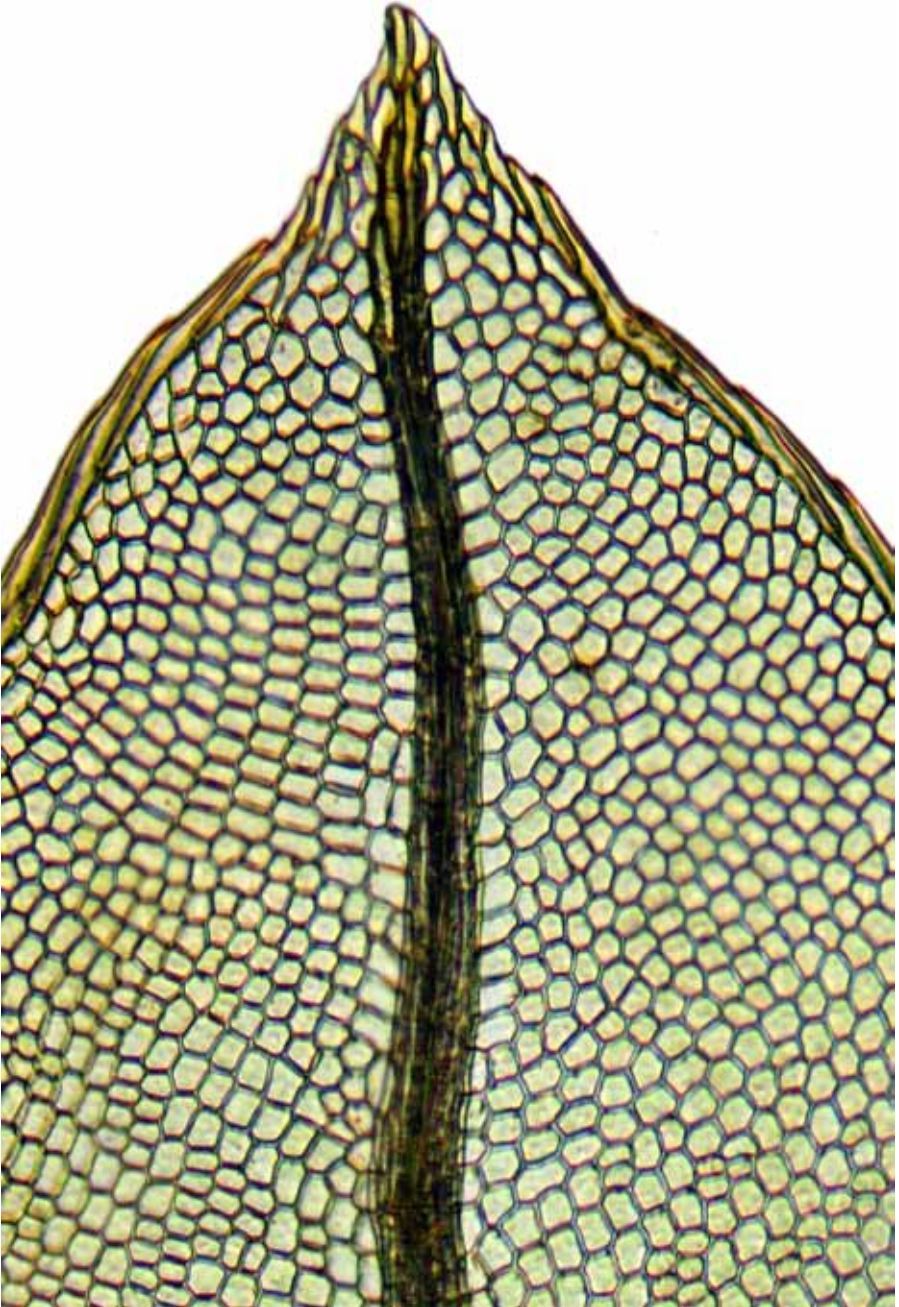
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*Fissidens dietrichiae* frond (dry on right)  
1 mm

continued next page





*Fissidens dietrichiae* leaf apex  
50  $\mu\text{m}$

continued next page

**Fissidens dubius** P.Beauv.

**form:** gregarious, branched stems, leaves in up to 35 pairs, overlapping in mid-stem, yellow-green, ± ragged and radiculose below, to 25 mm tall

**habitat:** on calcareous rock

**leaf:** size: 3.0–3.2 × 0.8–0.9 mm

**shape:** ovate-lanceolate, ± falcate, pluristratose in small irregular patches, little altered when dry

**tip:** acute

**vaginant laminae:** up to 0.7 of the leaf length, nearly closed

**base:** dorsal lamina reaching the leaf insertion, rounded, not decurrent

**costa:** failing 3–4 cells below the apex

**margin:** coarsely and irregularly serrate, plane, with several rows of thicker-walled cells forming a pale band

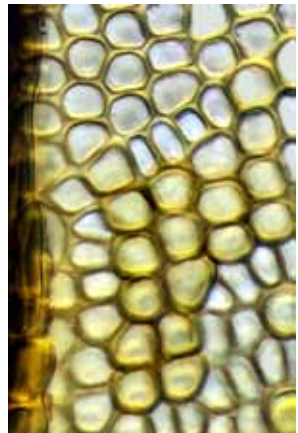
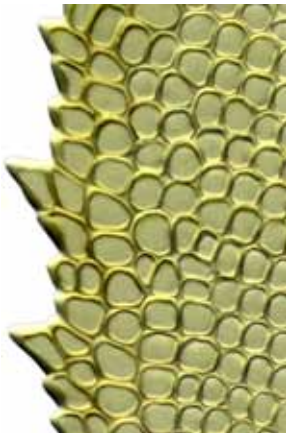
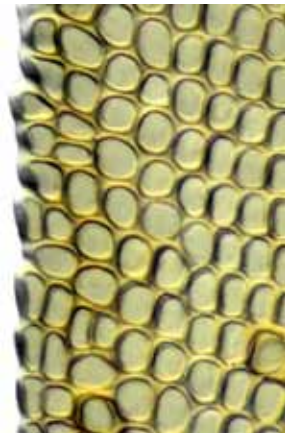
**cells:** 7–12 μm, quadrate to hexagonal, firm-walled, mammillose, smooth

**capsule:** capsules not seen in New Zealand

**notes:** probably introduced; known from only two Hawke's Bay collections

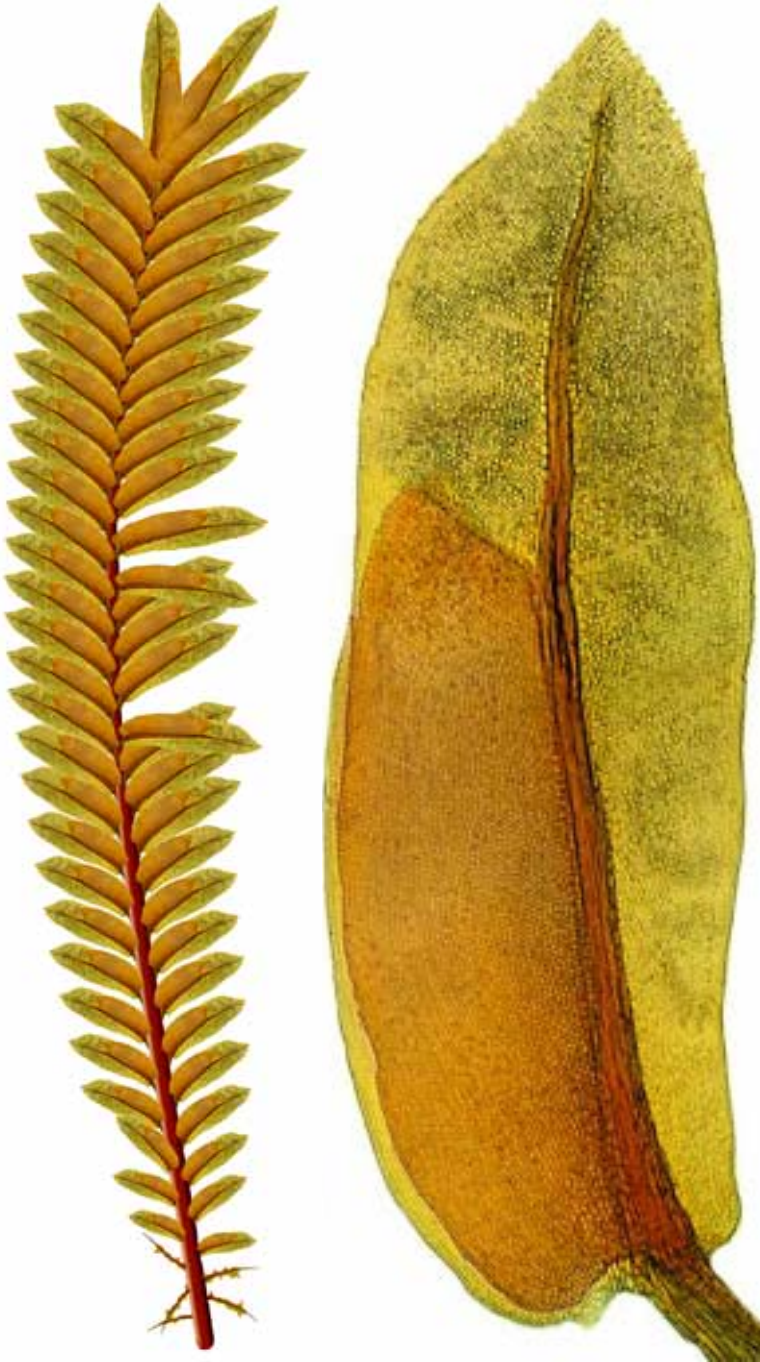


frond (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 5 mm, 1 mm, 50 μm, 100 μm



margin upper leaf, margin near leaf base, and bistratose patch of lamina near costa  
 10 μm, 10 μm, 10 μm

continued next page



*Fissidens dubius* vegetative frond (e- painting) and leaf whole-mount  
1 mm, 0.1 mm

continued next page

**Fissidens exilis** Hedw.

**form:** scattered fertile shoots on protonema, 2–3 leaf-pairs, to 2 mm tall  
**habitat:** soil in shaded, disturbed sites

**leaf:** size: 1.0–1.8 × 0.3–0.6 mm

*shape:* oblong-lanceolate, unistratose, little altered when dry

*tip:* acute

*vaginant laminae:* up to 0.7 of the leaf length, open

*base:* dorsal lamina tapered, failing above the leaf insertion

*costa:* percurrent

*border:* weak intramarginal border on the proximal vaginant laminae

*margin:* crenulate to serrulate; plane

*cells:* 9–16 μm, quadrate to hexagonal, firm-walled, slightly bulging, smooth

**capsule:** 0.5–0.8 mm, symmetric, erect, exserted, brown; seta 2–5 mm, yellow to light brown; operculum long-conic; calyptra smooth to slightly scabrous, mitrate; spores 9.0–13.5 μm in diam.

**note:** probably introduced



fertile shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 1 mm, 0.1 mm, 50 μm, 50 μm



margin upper leaf, margin of minor vaginant lamina, and near base of dorsal lamina  
 10 μm, 10 μm, 10 μm

continued next page



*Fissidens exilis* fertile bud-like shoot (partly diagrammatic)  
— 0.1 mm

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**Fissidens hylogenes** Dixon

**form:** small, scattered, unbranched stems with 3–8 pairs of leaves, to 3 mm tall

**habitat:** on rotting tree-ferns or wood (rarely soil or rock) in shade, to 700 m

**leaf:** size: 0.8–1.5 × 0.2–0.3 mm

*shape:* oblong-spathulate, unistratose

*tip:* broadly acute to obtuse

*vaginant laminae:* up to 0.7 the leaf length, half open

*base:* dorsal lamina decurrent down the stem

*costa:* not differentiated

*margin:* entire below, serrulate to serrate in the upper half, plane, with 1–2 rows of cells smaller than the other laminal cells

*cells:* 20–50 × 15–25 μm, irregularly hexagonal, thin-walled, smooth

**capsule:** 0.4–0.6 mm, ovoid, erect, exerted, brown; seta 1.5–2.0 mm, fleshy, colourless; operculum long-beaked; calyptra smooth, mitrate; spores 10–13 μm in diam.

**note:** endemic



vegetative shoots (moist), bifurcate peristome teeth, leaf outline, and leaf apex  
 1 mm (2), 50 μm, 0.1 mm, 50 μm



margin upper leaf, cells in upper leaf, and junction of apical and vaginant laminae  
 50 μm, 50 μm, 50 μm

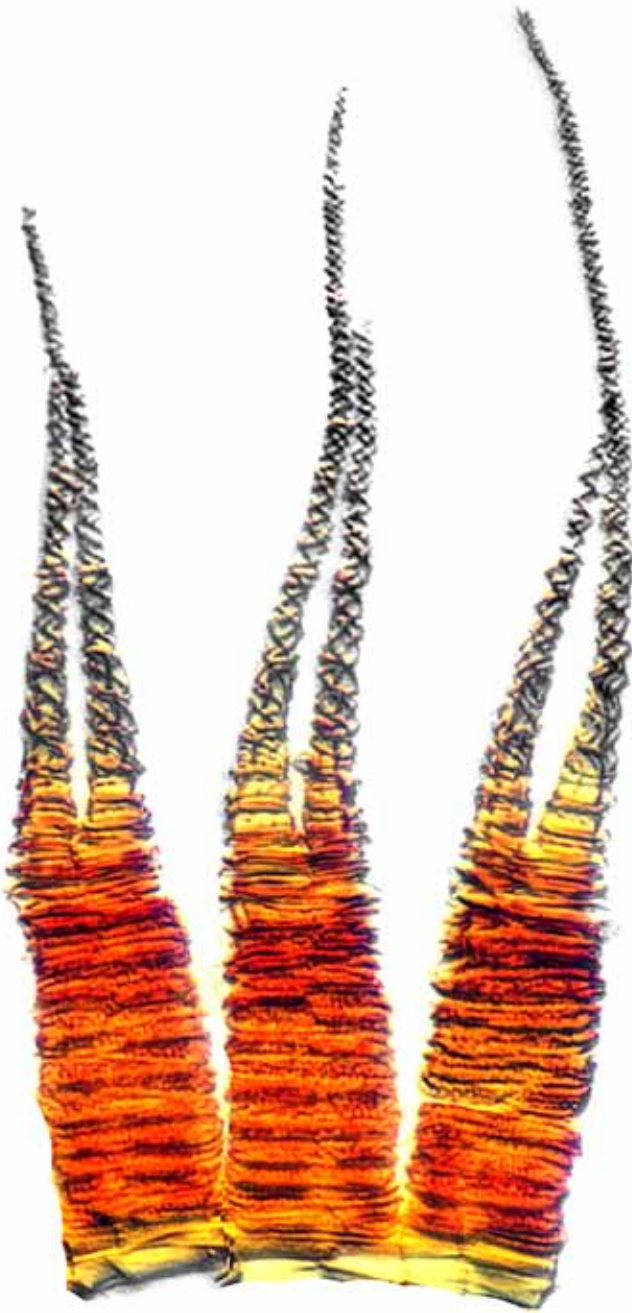
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*Fissidens hylogenes* fertile shoots (moist)

1 mm

continued next page



*Fissidens hylogenes* bifurcate peristome teeth  
50  $\mu\text{m}$

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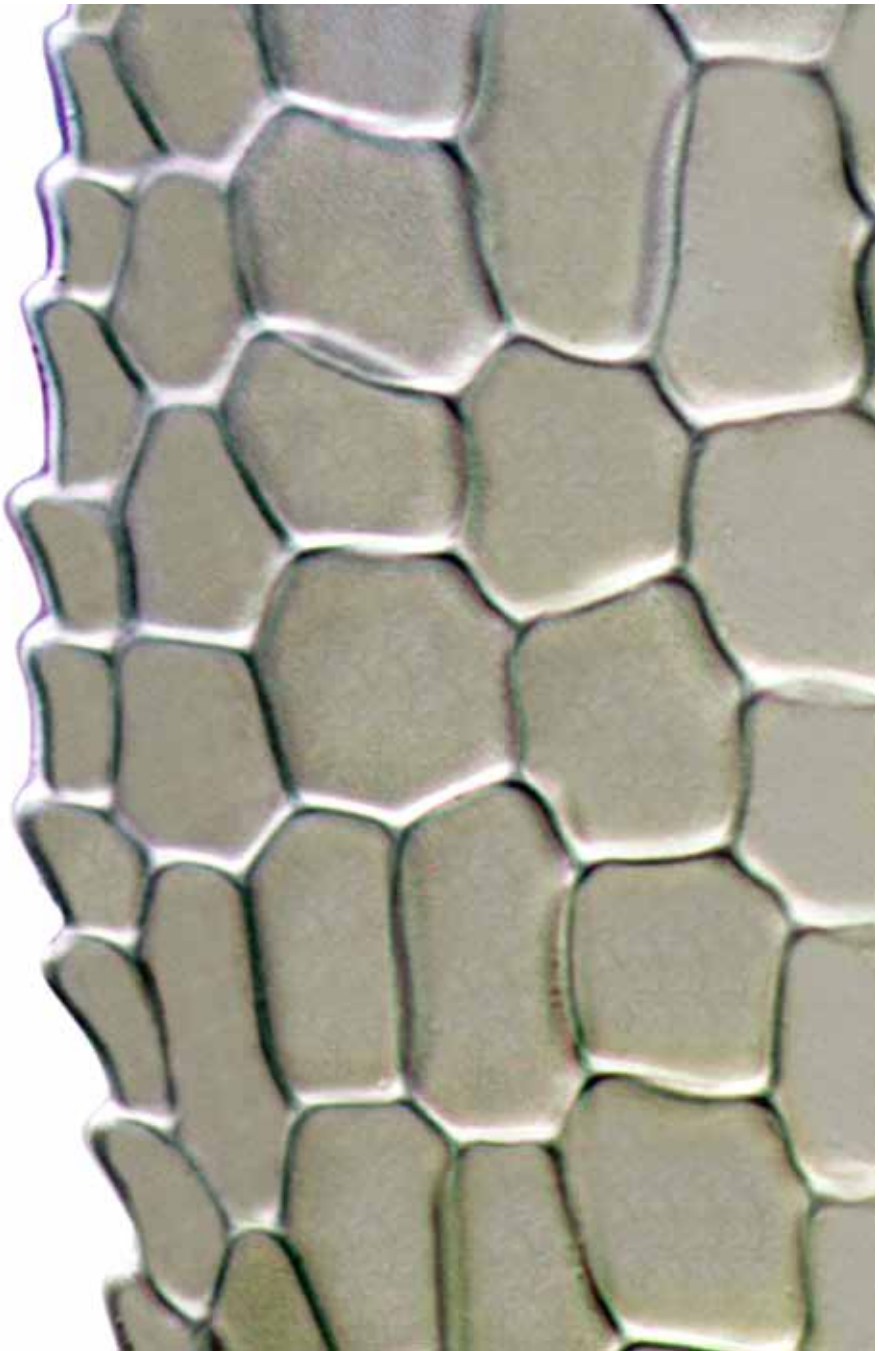




*Fissidens hylogenes* leaf apex

50  $\mu$ m

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*Fissidens hylogenes* margin upper leaf  
10  $\mu\text{m}$

continued next page



*Fissidens hylogenes* leaf cells (moist)  
10  $\mu$ m

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**Fissidens hyophilus** Mitt.

**form:** scattered to gregarious, branched stems, leaves in 10–16 pairs, overlapping in mid-stem, green to dark green, radiculose, 4–10 mm tall

**habitat:** smooth bark and exposed roots (rarely rock)

**leaf:** size: 1.5–2.5 × 0.3–0.4 mm

*shape:* lingulate, unistratose, the tips rolling upwards when dry

*tip:* obtuse to abruptly acute, often asymmetric

*vaginant laminae:* up to 0.5 of the leaf length, half-open to closed

*base:* dorsal lamina usually reaching the leaf insertion

*costa:* failing below the leaf apex

*border:* not differentiated

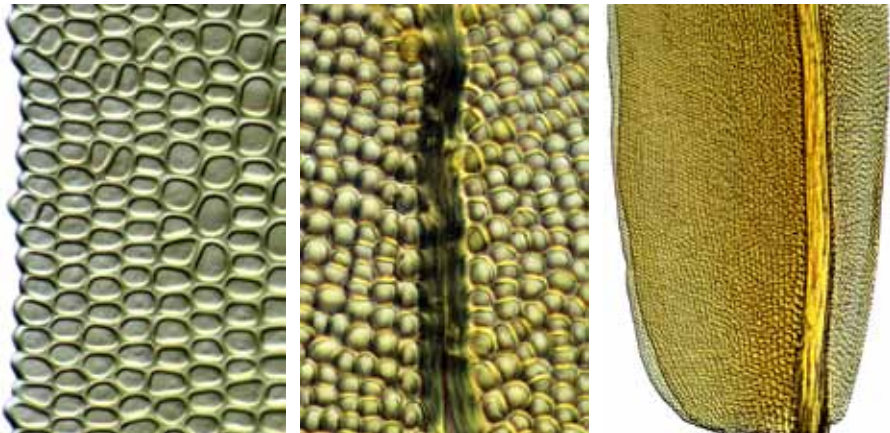
*margin:* serrulate-crenate throughout, plane

*cells:* 6–10 μm, irregularly hexagonal, firm-walled, mammillose, smooth

**capsule:** 0.5–0.8 mm, slightly asymmetric, inclined to erect, exerted, brown; seta 2.5–3.5 mm, strongly twisted when dry; calyptra smooth, mitrate; spores 10.0–13.5 μm in diam.



fronds (dry) (2), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 1 mm, 0.1 mm, 50 μm, 50 μm



margin of vaginant lamina, costa in upper leaf, and leaf base  
 50 μm, 50 μm, 100 μm

continued next page



*Fissidens hyophilus* leaf apex showing costa terminus  
10  $\mu\text{m}$

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**Fissidens integerrimus** Mitt.

**form:** gregarious or matted, branched stems, with leaves in 10–45 pairs, overlapping in the upper stem, 5–15 mm tall; branches easily detached

**habitat:** aquatic, on rock in streams and waterfalls, to 300 m elevation

**leaf:** size: 1.3–2.0 × 0.3–0.4 mm

*shape:* oblong-lanceolate, unistratose, little altered when dry

*tip:* acute to obtuse

*vaginant laminae:* up to 0.7 of the leaf length, half-open to closed

*base:* dorsal lamina tapering to the leaf insertion

*costa:* failing 2–5 cells below the apex

*border:* only 1–3 rows of intramarginal cells of the lower vaginant lamina

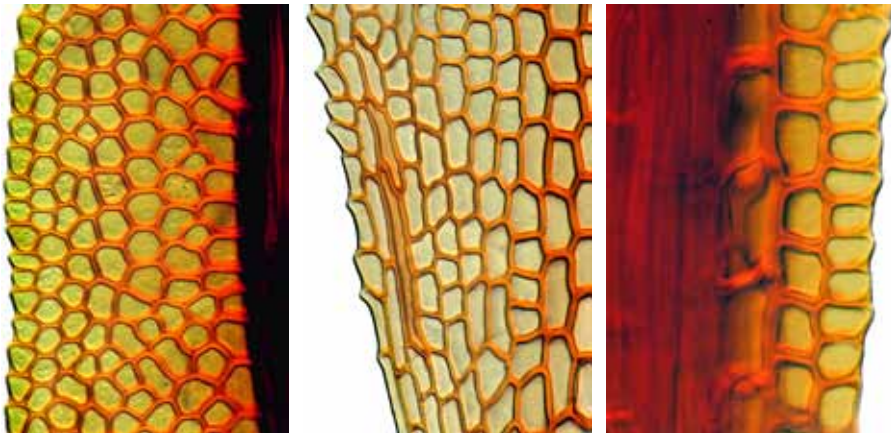
*margin:* serrulate throughout, plane

*cells:* 10–18 μm, quadrate to hexagonal, firm-walled, smooth

**capsule:** 0.4–0.6 mm, symmetric, inclined, exserted, brown; seta 2.5–3.5 mm, straw-coloured, stiff; operculum long-beaked; calyptra slightly scabrous at the apex, mitrate; spores 13–20 μm in diam.

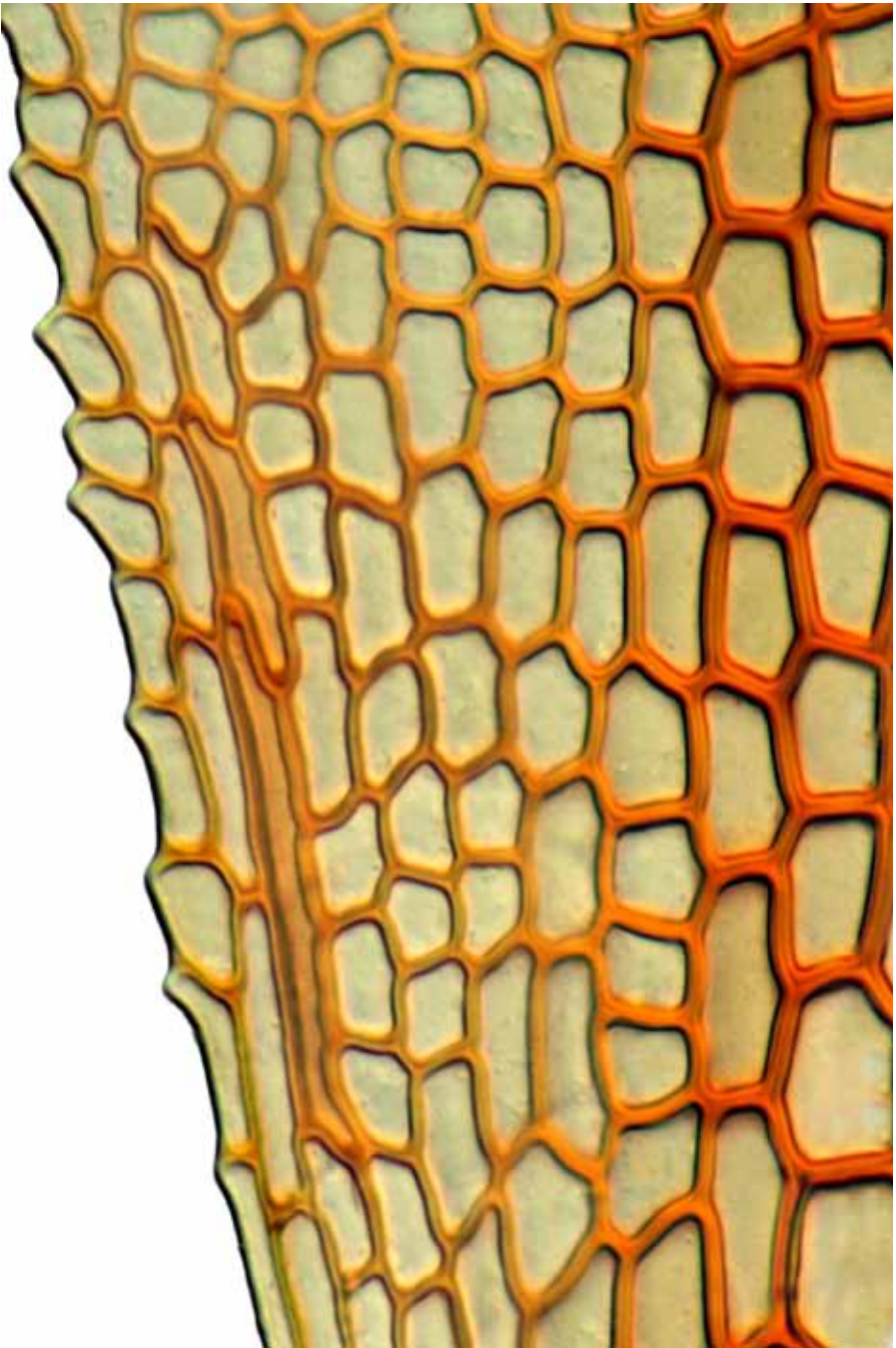


frond (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 50 μm



margin of upper leaf, vaginant intramarginal border, and near base of dorsal lamina  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Fissidens integerrimus* intramarginal border of vaginant lamina  
10  $\mu\text{m}$

continued next page

**Fissidens leptocladus** Rodway

**form:** densely gregarious, sparsely branched, yellow- to dark green, radiculose below, variable, leaves in 4–30(–45) pairs, 3–15 mm tall

**habitat:** soil or rock in diverse vegetation types, from sea level to 1650 m

**leaf:** size: 1.0–1.6 × 0.2–0.4 mm

**shape:** linear-lanceolate to oblong-ovate, ± curved, unistratose

**tip:** acute

**vaginant laminae:** up to 0.7 of the leaf length, closed

**base:** dorsal lamina often reaching the leaf insertion

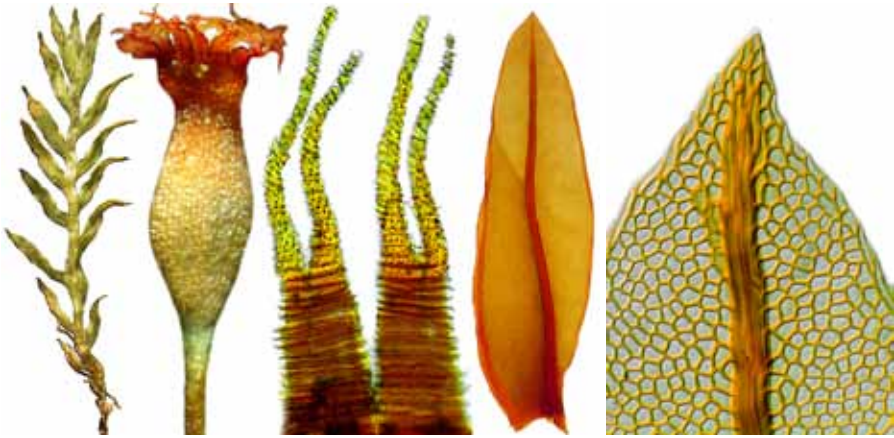
**costa:** failing within a few cells of the apex

**border:** one to several rows of thick-walled, elongate cells on all laminae

**margin:** entire, plane

**cells:** 6–9 × 5–8 μm, quadrate to hexagonal, firm-walled, smooth, ± bulging

**capsule:** 0.6–1.0 mm, ovoid, inclined, exserted, orange-brown; seta 3–4 mm; calyptra cucullate, smooth; operculum obliquely rostrate; spores 11–19 μm in diam.



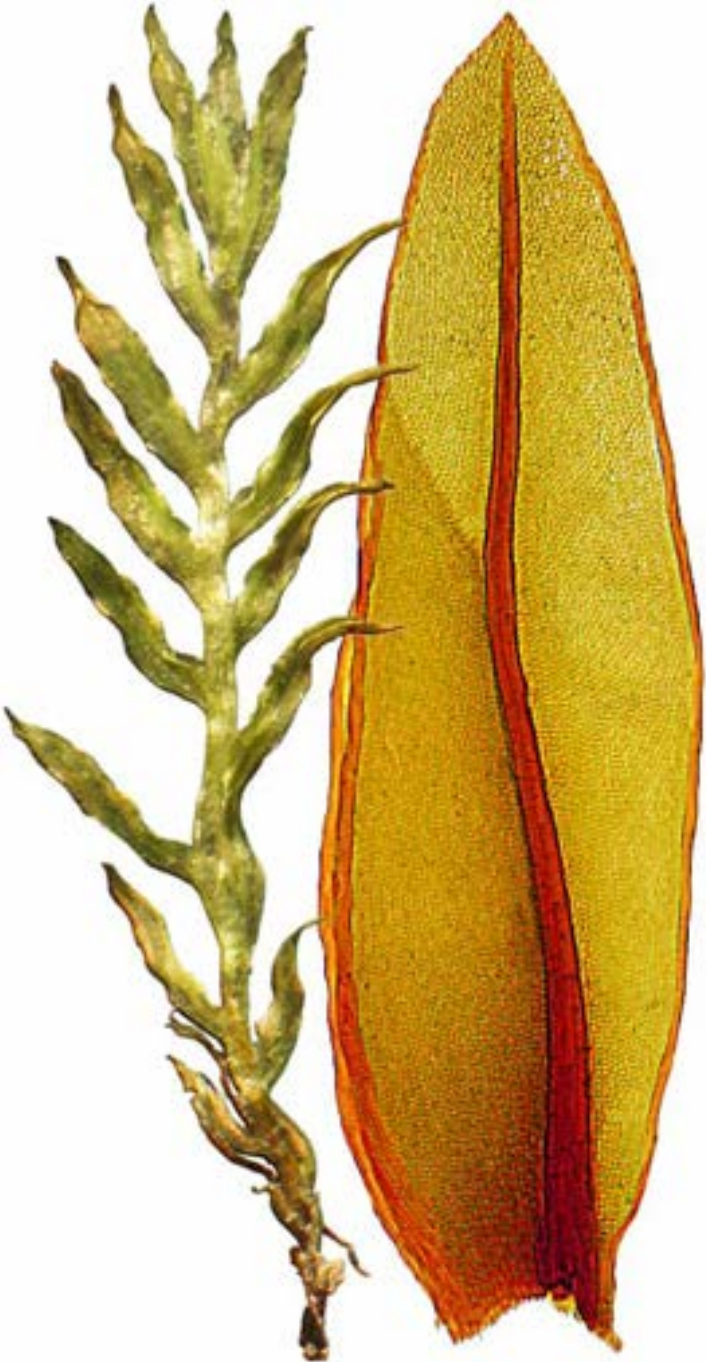
vegetative shoot (dry), mature capsule, peristome teeth (2), leaf outline, and leaf apex  
 1 mm, 0.1 mm, 10 μm (2), 0.1 mm, 50 μm



vaginant lamina apex, margin midleaf, and costa midleaf  
 50 μm, 50 μm, 50 μm

continued next page





*Fissidens leptocladus* frond (dry) and leaf whole-mount  
0.5 mm, 50  $\mu$ m

continued next page

**Fissidens linearis** var. **angustifolius** (Dixon) I.G.Stone

**form:** densely gregarious, ± branched stems, leaves in 3–16 pairs, overlapping in mid-stem, dull green, radiculose below or where contacting soil, 1.5–5 mm tall

**habitat:** soil, especially eroding banks, in shaded indigenous forest, to 450 m

**leaf:** size: 0.8–1.4 × 0.1–0.2 mm

*shape:* linear, unistratose, the apices decurved when dry

*tip:* narrowly acute and often asymmetric

*vaginant laminae:* half or less of the leaf length, half-open

*base:* dorsal lamina tapered, reaching the leaf insertion or failing just above

*costa:* subpercurrent to percurrent

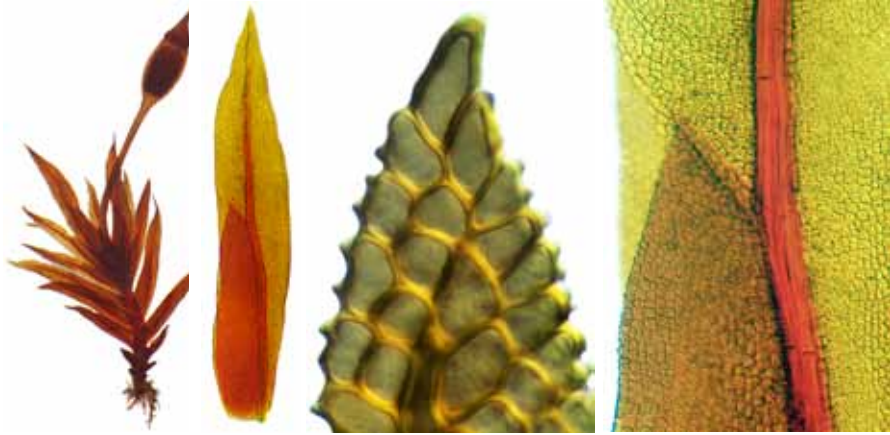
*border:* not differentiated

*margin:* crenulate and papillose, plane

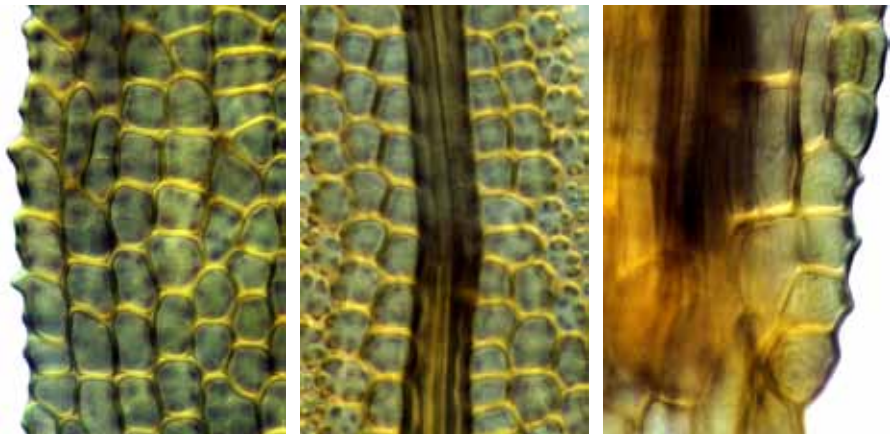
*cells:* 6–10 μm, quadrate to hexagonal, firm-walled, multipapillose

**capsule:** 0.5–0.7 mm, symmetric, erect, exserted, brown; seta 1.0–2.5 mm, yellow to light brown, stiff; operculum long-rostrate; spores 8–11 μm in diam.

**note:** endemic



fertile shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 10 μm, 100 μm



margin of vaginant lamina, costa in upper leaf, and base of dorsal lamina  
 10 μm, 10 μm, 10 μm

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*Fissidens linearis* var. *angustifolius* leaf apex and costa terminus  
10  $\mu\text{m}$

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**Fissidens linearis** Brid. var. **linearis**

**form:** densely gregarious, ± branched stems, leaves in 3–16 pairs, overlapping in mid-stem, dull green, radiculose below or with soil contact, 1.5–5 mm tall

**habitat:** soil or rock in shaded indigenous forest and coastal scrub, to 500 m

**leaf:** size: 0.8–1.4 × 0.2–0.3 mm

**shape:** oblong-lanceolate, unistratose, the apices decurved when dry

**tip:** acute

**vaginant laminae:** half or more of the leaf length, half-open

**base:** dorsal lamina tapered, reaching the leaf insertion or failing just above

**costa:** subpercurrent to percurrent

**border:** not differentiated

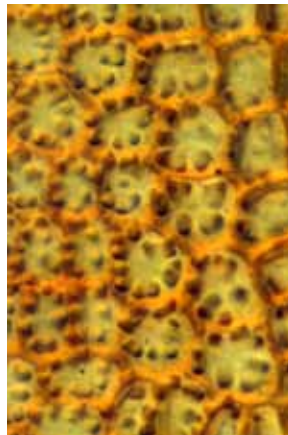
**margin:** crenulate and papillose, plane

**cells:** 6–10 μm, quadrate to hexagonal, firm-walled, multipapillose

**capsule:** 0.5–0.7 mm, symmetric, erect, exserted, brown; seta 1.0–2.5 mm, yellow to light brown, stiff; operculum long-rostrate; calyptra smooth to scabrous, cucullate; spores 8–18 μm in diam.



frond (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 50 μm, 100 μm



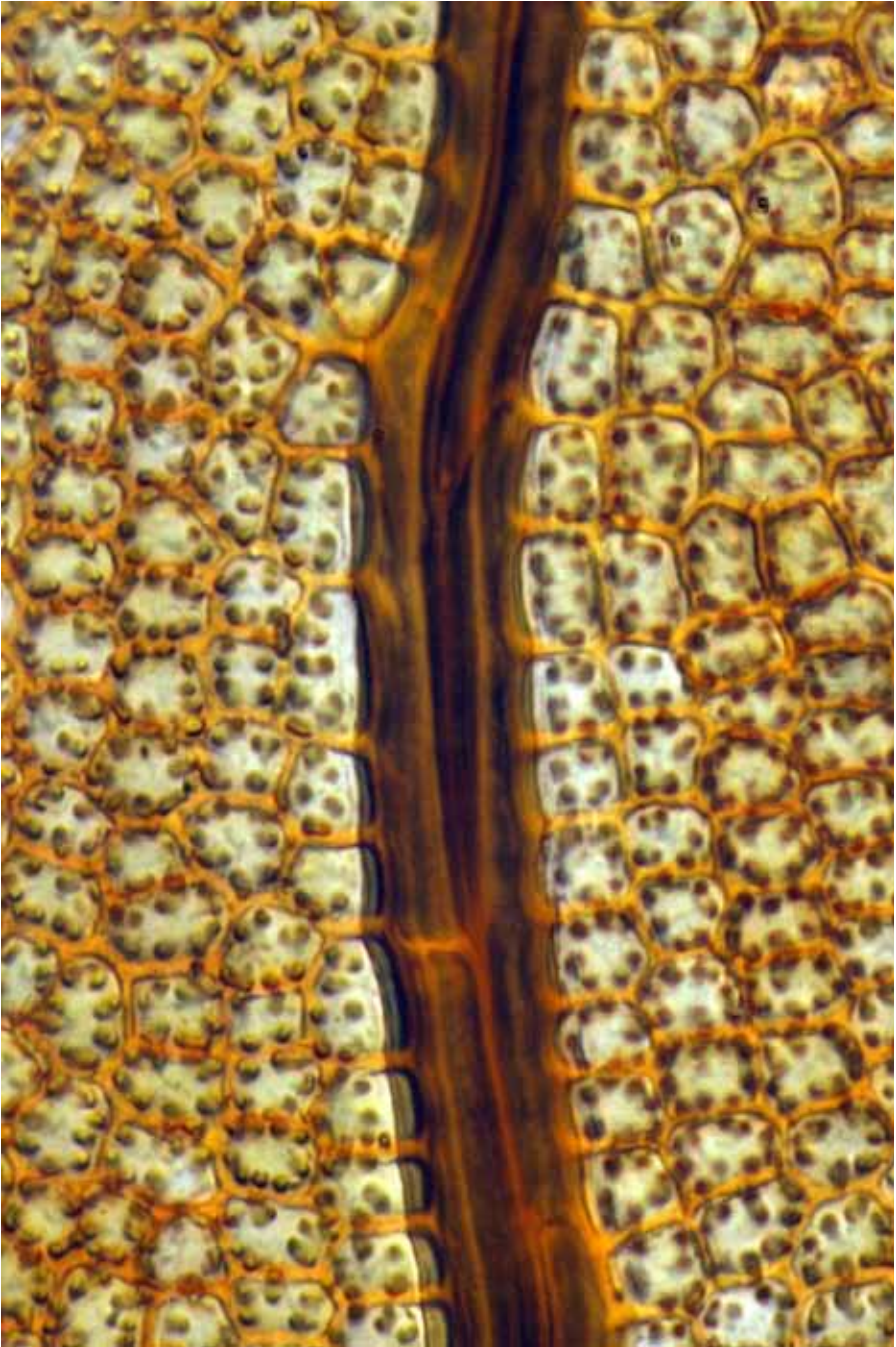
margin of upper leaf, lamina surface papillae, near base of dorsal lamina  
 10 μm, 10 μm, 10 μm

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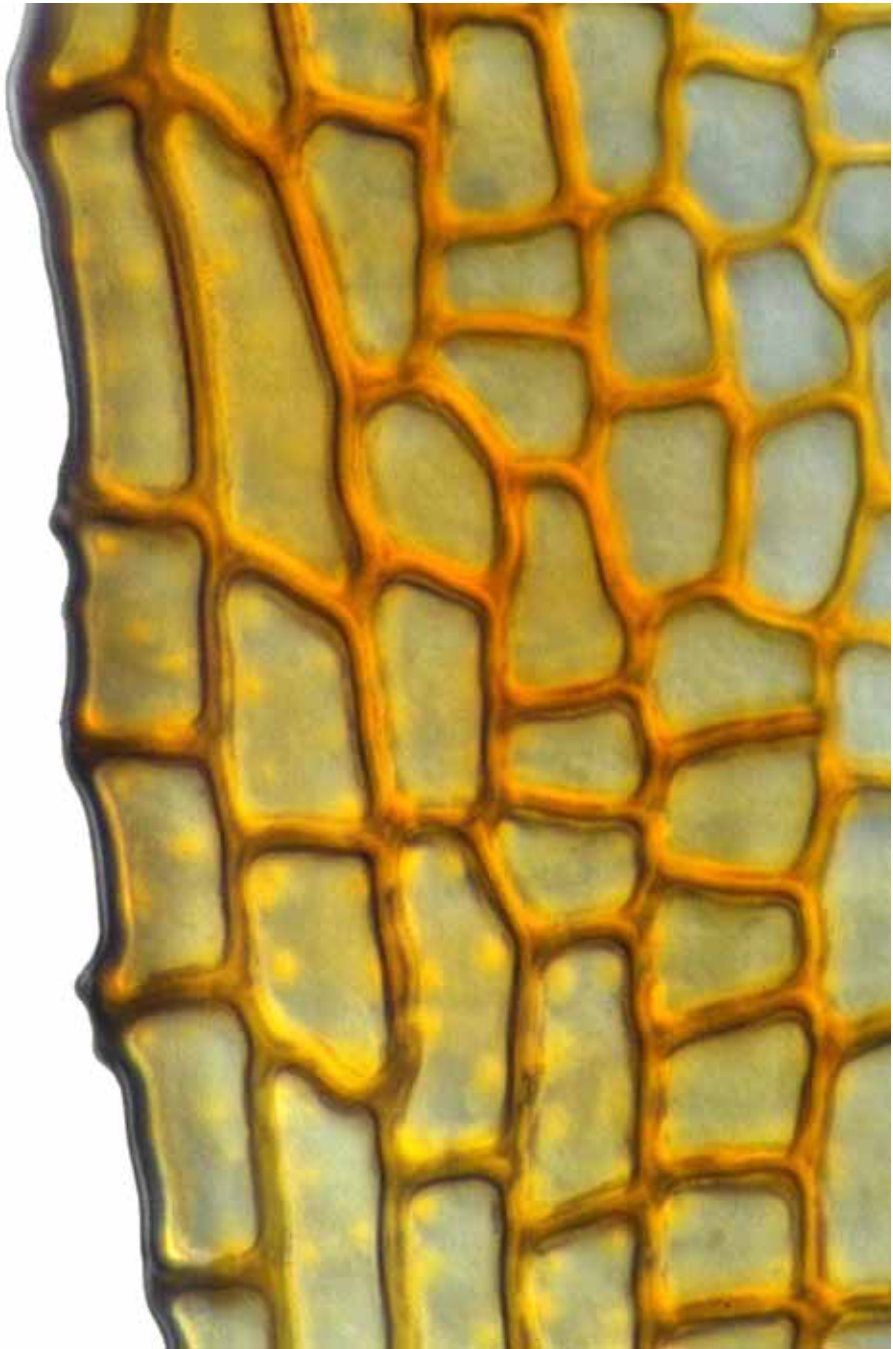
*Fissidens linearis* var. *linearis* frond (re-wetted dried specimen) and leaf whole-mount  
0.5 mm, 0.1 mm

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*Fissidens linearis* var. *linearis* costa and papillae midleaf  
10  $\mu$ m

continued next page



*Fissidens linearis* var. *linearis* minor vaginant lamina margin near leaf base  
10  $\mu$ m

continued next page

**Fissidens megalotis** Müll.Hal. subsp. **megalotis**

**form:** densely gregarious, yellow- to brown-green, radiculose only at the base, sparsely branched, 6–15 leaf pairs, 4–6 mm tall

**habitat:** soil or rock in exposed sites, sea level to 600 m altitude, more common in the drier eastern halves of both major islands

**leaf:** size: 1.0–1.6 × 0.3–0.5 mm

*shape:* ovate-oblong, typically curled under toward the tip

*tip:* obtuse and apiculate

*vaginant laminae:* up to 0.8 of the leaf length, open and often gaping

*base:* not differentiated

*costa:* percurrent

*border:* most conspicuous on the vaginant laminae, intramarginal at base

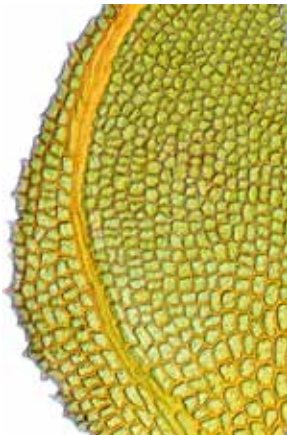
*margin:* occasionally irregularly serrate at base of vaginant laminae, plane

*cells:* 5–8 μm, pentagonal to hexagonal, firm-walled, bulging, smooth to weakly uni- to pluripapillose

**capsule:** capsules not found in New Zealand



habit, vegetative shoot (moist), leaf outline, and leaf apex  
 1 mm, 1 mm, 0.1 mm, 50 μm



vaginant intramarginal border, costa midleaf, junction of apical and vaginant laminae  
 50 μm, 50 μm, 50 μm

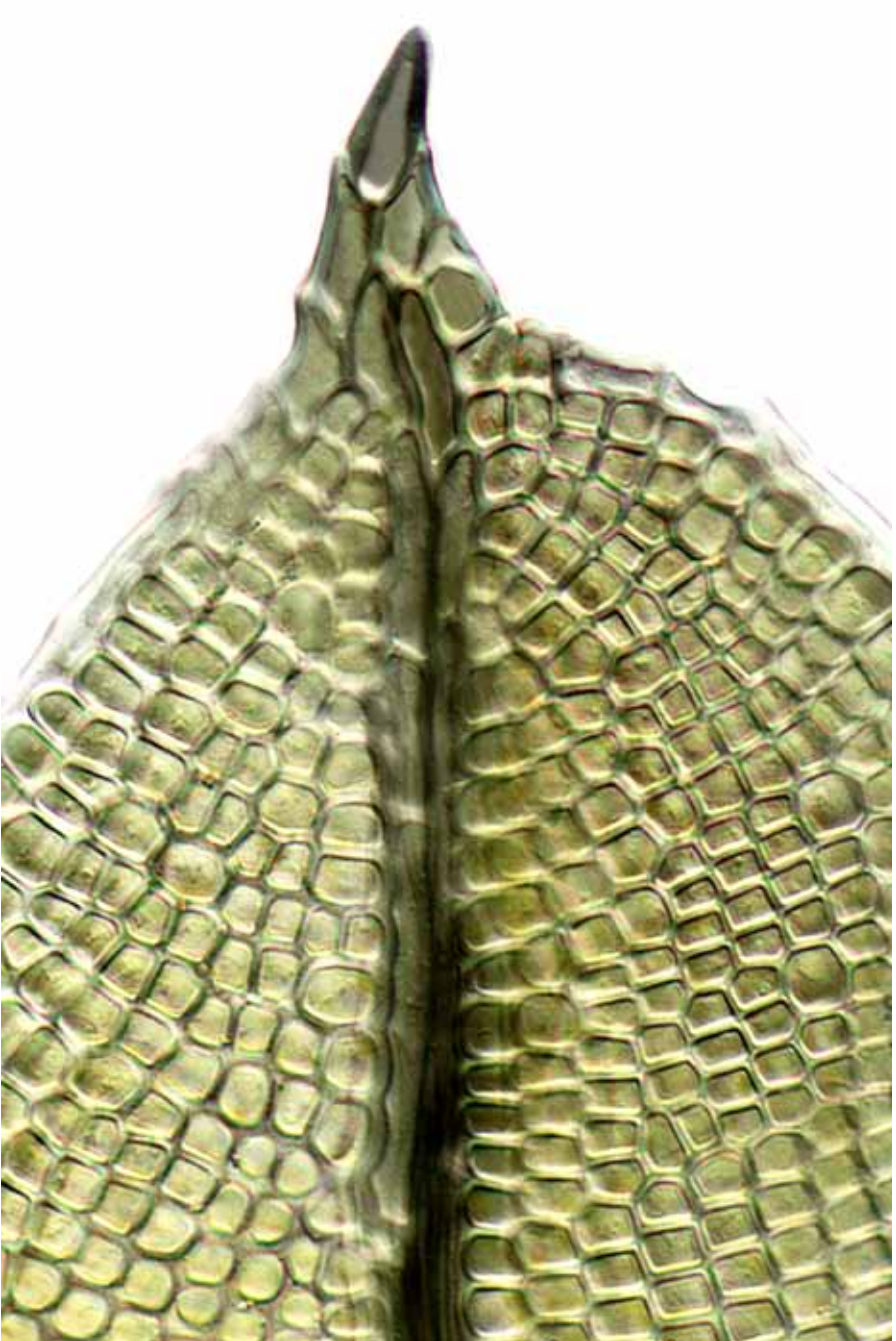
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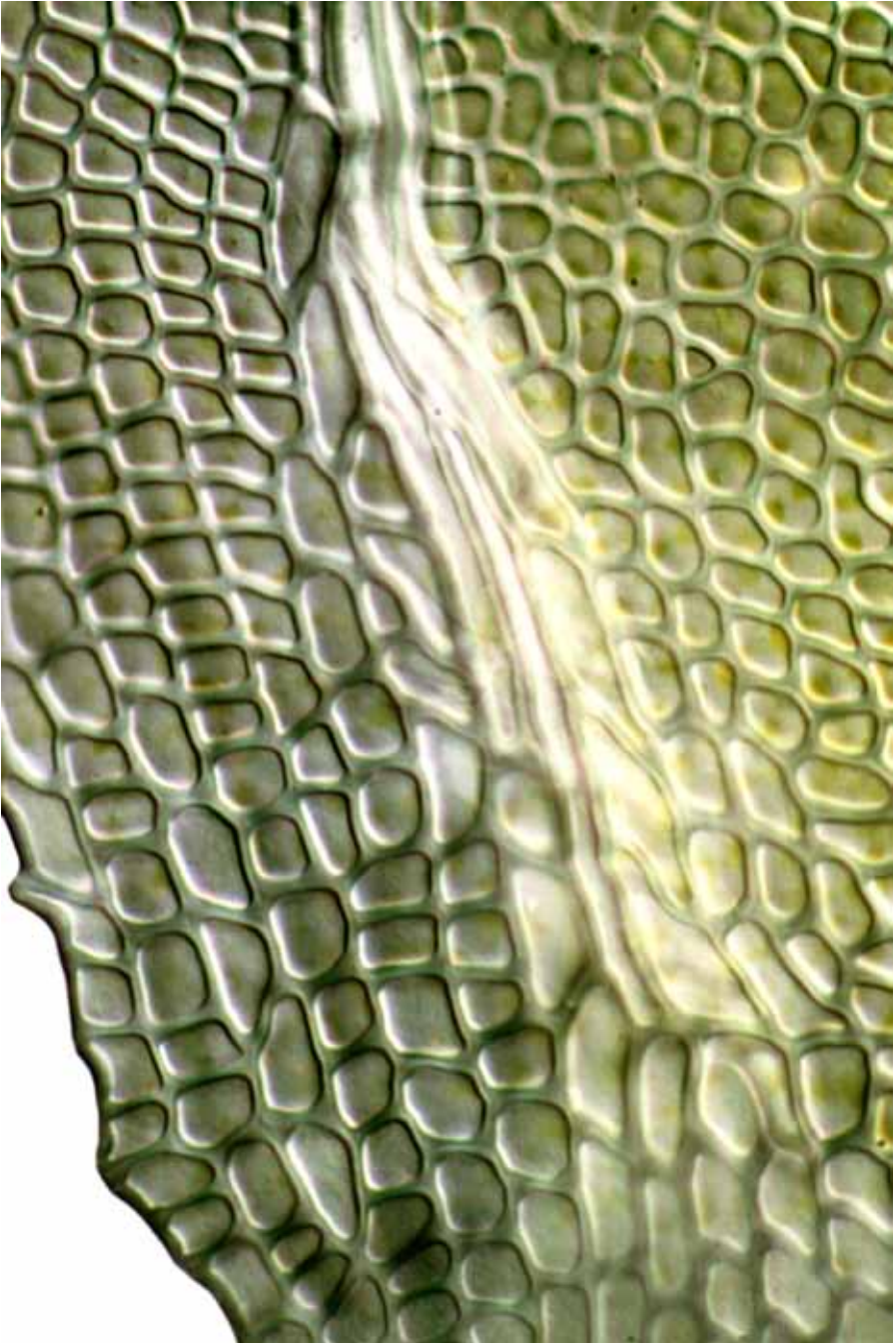
*Fissidens megalotis* subsp. *megalotis* habit  
1 mm

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*Fissidens megalotis* subsp. *megalotis* leaf apex showing costa and apiculus  
10  $\mu\text{m}$

continued next page



*Fissidens megalotis* subsp. *megalotis* intramarginal border of the minor vaginant lamina  
10  $\mu$ m

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**Fissidens oblongifolius** Hook.f. & Wilson

**form:** loosely gregarious, branched stems, with leaves in 15–30(–40) pairs, overlapping in mid-stem, dark below, radiculose at base only, 5–25 mm tall  
**habitat:** usually on rock, on dripping rock faces or in lava crevices, e.g. on the bare lava fields of Rangitoto Island, to 200 m elevation

**leaf:** size: 1.7–3.0 × 0.3–0.4 mm

*shape:* ligulate, unistratose, the tips loosely rolling up when dry

*tip:* broadly acute

*vaginant laminae:* up to 0.7 of the leaf length, half-open to closed

*base:* dorsal lamina failing above the leaf insertion

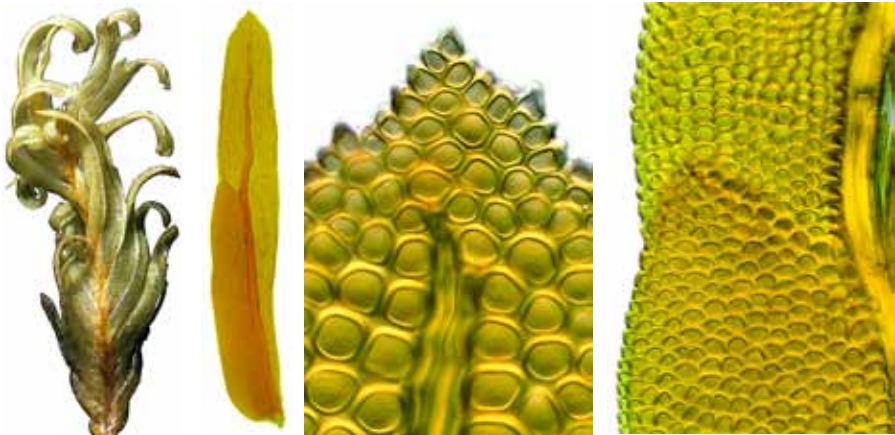
*costa:* failing below the leaf apex

*border:* not differentiated

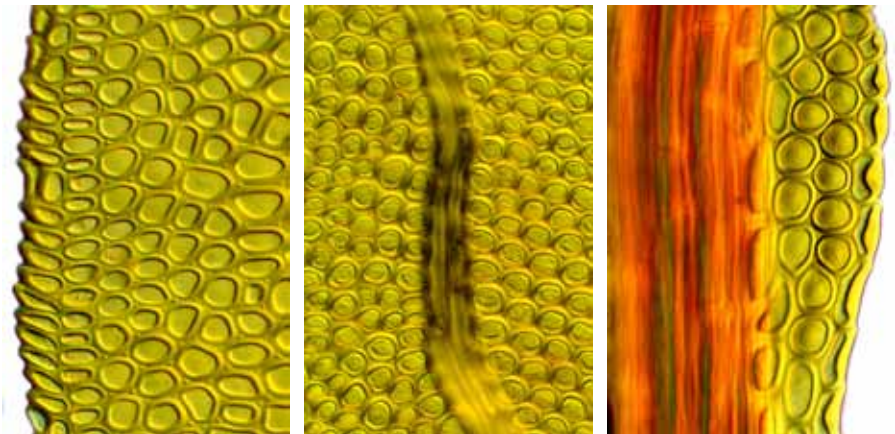
*margin:* serrulate-crenate throughout, plane

*cells:* 7–12  $\mu\text{m}$ , irregularly hexagonal, firm-walled, smooth, mammillose

**capsule:** 0.5–1.0 mm,  $\pm$  asymmetric, inclined to horizontal, exserted, brown; seta 5–10 mm, tortuose when dry; calyptra and mature spores not seen in NZ



vegetative frond (dry), leaf, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 50  $\mu\text{m}$



margin of upper leaf, costa in upper leaf, near base of dorsal lamina  
 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Fissidens oblongifolius* vegetative frond (dry), and leaf whole-mount  
1 mm, 0.1 mm

continued next page

**Fissidens pallidus** Hook.f. & Wilson

**form:** tufted to densely gregarious, unbranched, with leaves in 5–10(–17) pairs, overlapping in mid-stem, 3–15(–35) mm tall

**habitat:** soil in shady forests, an early colonizer of disturbed sites, to 600 m

**leaf:** size: 2.5–3.5 × 0.3–0.7 mm

*shape:* linear-lanceolate, unistratose, little altered when dry

*tip:* acute to acuminate

*vaginant laminae:* up to 0.7 of the leaf length, half-open

*base:* dorsal lamina tapered, reaching the leaf insertion

*costa:* failing 3–6 cells below the apex

*border:* not differentiated

*margin:* entire to minutely serrulate, ± sinuose above, plane

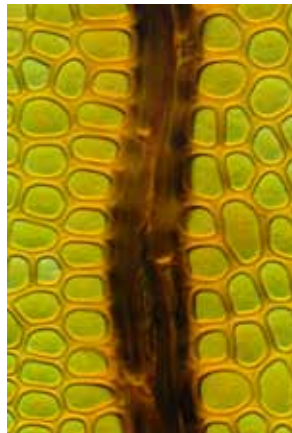
*cells:* 10–15 μm, irregularly rounded-hexagonal, firm-walled, smooth

**capsule:** 1.0–1.3 mm, ± urceolate, arcuate, horizontal; seta 3–8 mm, orange-brown, tortuose when dry; operculum long-beaked; calyptra smooth, mitrate; spores 9–12 μm in diam.



vegetative habit, shoot, leaf outline, and leaf apex

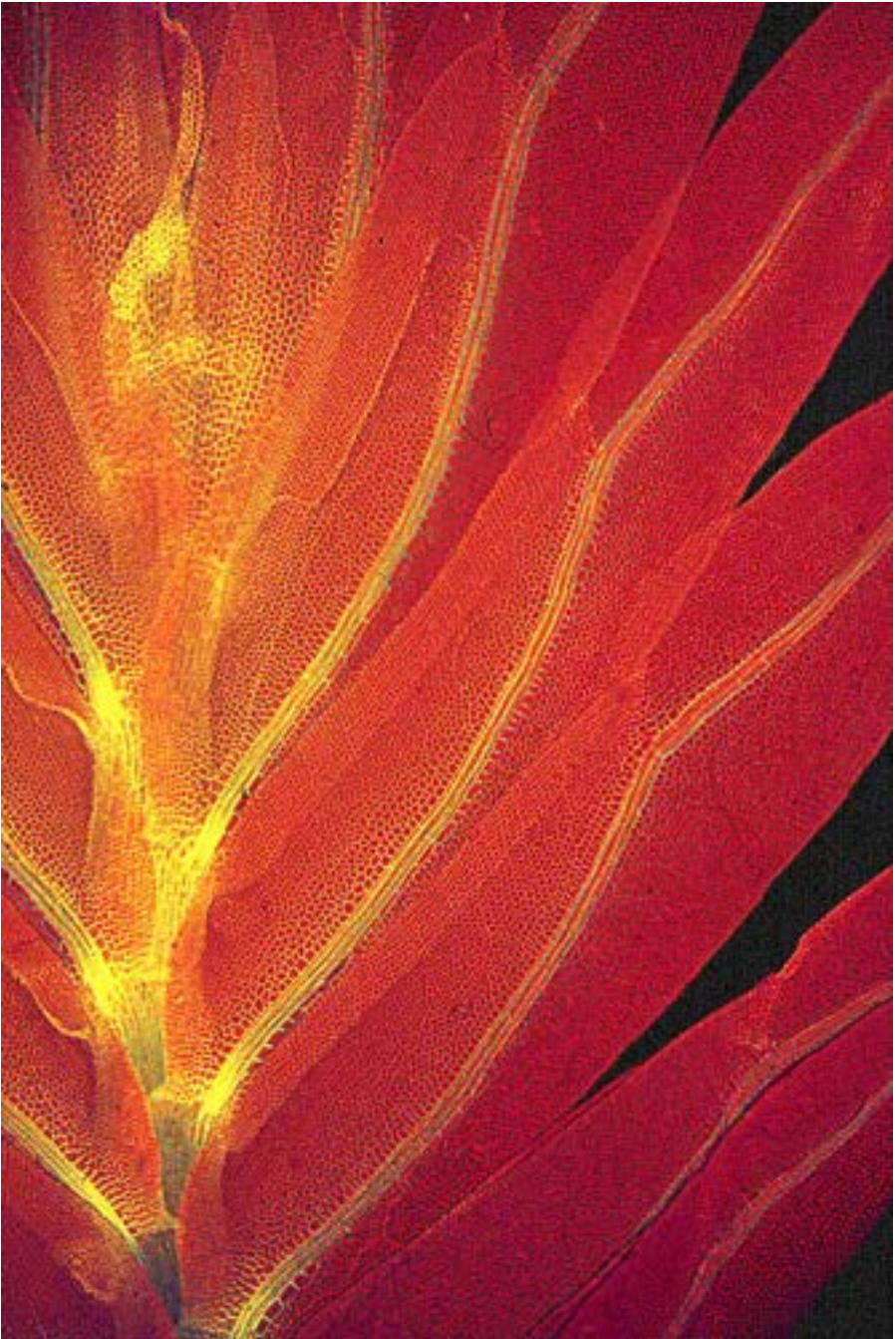
5 mm, 1 mm, 0.5 mm, 10 μm



margin of dorsal lamina, costa midleaf, and junction of apical and vaginant laminae

10 μm, 10 μm, 10 μm

continued next page



*Fissidens pallidus* vegetative shoot (detail) (UV microscope image)  
50  $\mu\text{m}$

continued next page



*Fissidens pallidus* mature capsule  
1 mm

continued next page



**Fissidens perangustus** Broth.

**form:** densely gregarious, unbranched stems, with leaves in 8–12 distant pairs, yellow-green, radiculose below, to 4 mm tall

**habitat:** on exposed, periodically inundated sandstone in indigenous forest

**leaf:** size: 0.6–0.8 × 0.2 mm

*shape:* lanceolate, unistratose, slightly falcate when moist, ± twisted when dry

*tip:* acute

*vaginant laminae:* up to 0.7 the leaf length, closed, the minor indented near apex

*base:* dorsal lamina tapered, its border adhering to the costa near the leaf base

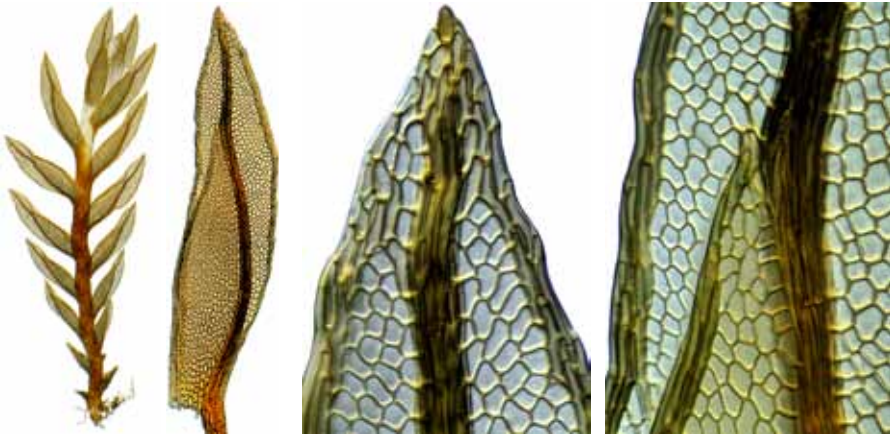
*costa:* subpercurrent, sometimes reddening with age

*border:* 2–4 rows of narrow, thick-walled cells on all laminae, to just below apex

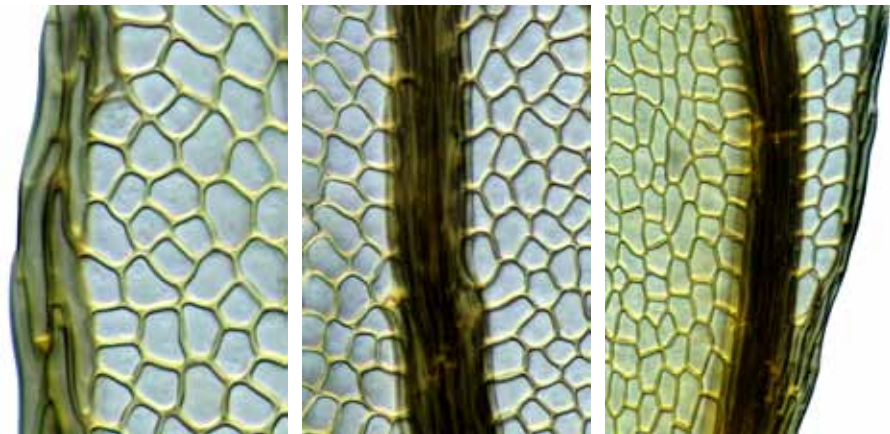
*margin:* entire, plane

*cells:* 7–14 μm, quadrate to irregularly hexagonal, thin-walled, smooth

**capsule:** 0.5–0.8 mm, ± asymmetric, erect to inclined, exserted; seta 2–3 mm, straw-coloured to orange-brown, stiff; operculum rostellate from a conic base; spores 19–25 μm in diam.



shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 50 μm, 50 μm



margin of upper leaf, costa in upper leaf, and base of dorsal lamina  
 10 μm, 10 μm, 10 μm



*Fissidens perangustus* base of dorsal lamina  
10  $\mu$ m

continued next page

**Fissidens rigidulus** var. **pseudostrictus** J.E.Beever in Beever & Stone

**form:** densely gregarious, ± branched stems, with leaves in 10–50 pairs, slightly overlapping above, dark green to black, eroded and debris-covered below

**habitat:** rock in fast-flowing streams in indigenous forest, to 250 m elevation

**leaf:** size: 1.5–3.0 × 0.3–0.8 mm

**shape:** broadly lanceolate, variably uni- to pluristratose, little altered when dry

**tip:** acute

**vaginant laminae:** up to 0.7 of the leaf length, two-thirds to fully closed

**base:** dorsal lamina reaching the leaf insertion or shortly decurrent onto stem

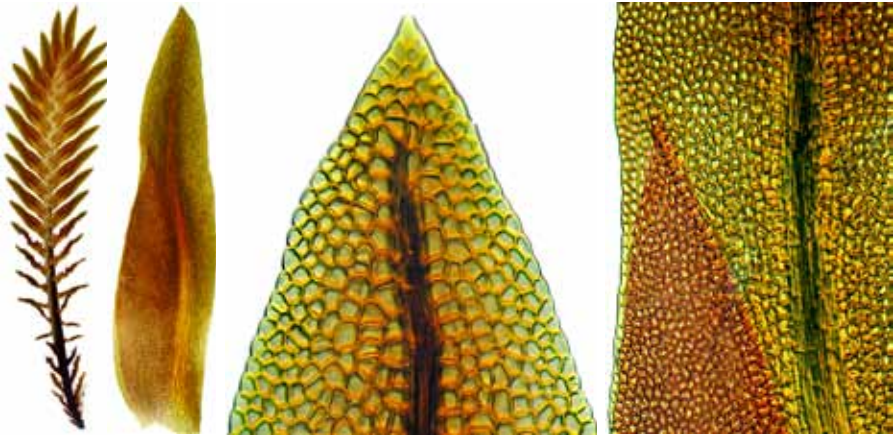
**costa:** subpercurrent

**border:** not differentiated

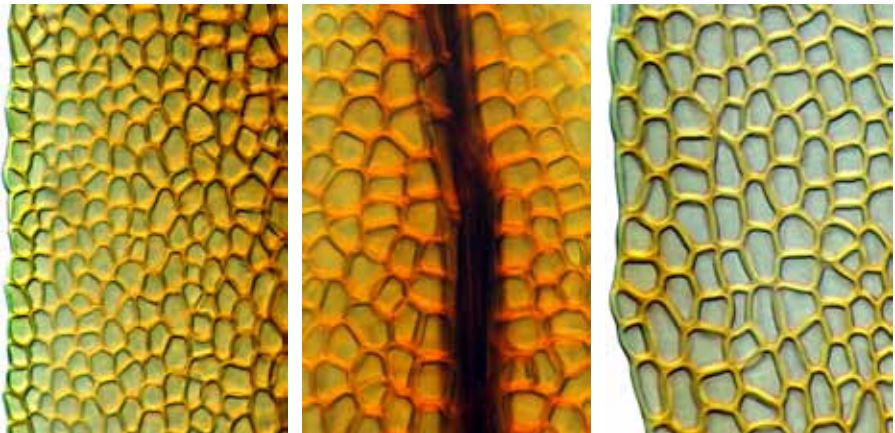
**margin:** entire to weakly crenulate, plane

**cells:** 7–17 μm, quadrate to irregularly hexagonal, firm-walled, smooth

**capsule:** capsules unknown



shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 5 mm, 0.5 mm, 50 μm, 100 μm



margin of upper leaf, costa in upper leaf, and margin of vaginant lamina  
 50 μm, 10 μm, 10 μm

continued next page



*Fissidens rigidulus* var. *pseudostrictus* frond and whole leaf  
1 mm, 0.1 mm

continued next page



*Fissidens rigidulus* var. *pseudostrictus* leaf apex, showing costa terminus  
10  $\mu\text{m}$

continued next page



*Fissidens rigidulus* var. *pseudostrictus* margin of vaginant lamina  
10  $\mu$ m

continued next page

**Fissidens rigidulus** Hook.f. & Wilson in Wilson var. **rigidulus**

**form:** densely gregarious, sparingly branched, green to black, with 10–80 leaf pairs,  $\pm$  overlapping in mid-stem, 10–80(–120) mm long

**habitat:** aquatic, rock in seeps, waterfalls, or submerged in lakes or fast streams

**leaf:** size: 1.5–3  $\times$  0.3–0.8 mm

**shape:** lanceolate to oblong-lanceolate, bi- to pluristratose near the costa

**tip:** acute

**vaginant laminae:** to 0.7 the leaf length, two-thirds to fully closed

**base:** dorsal lamina reaching the leaf insertion

**costa:** failing below the apex

**border:** usually several rows of thick-walled, prosenchymatous cells, occasionally rudimentary

**margin:** entire, plane

**cells:** 7.5–10.5  $\mu\text{m}$ , quadrate to  $\pm$  hexagonal, thick-walled, smooth

**capsule:** 0.8–1.0 mm, ovate-oblong, inclined,  $\pm$  asymmetric; seta 4–7 mm, orange-brown, wiry; peristome teeth bright red



vegetative habit (moist) (2), shoot (moist), and leaf outline

5 mm,

5 mm,

1 mm,

1 mm



leaf apex, junction of apical and vaginant laminae, and border of vaginant lamina base

50  $\mu\text{m}$ ,

50  $\mu\text{m}$ ,

10  $\mu\text{m}$

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*Fissidens rigidulus* var. *rigidulus* capsules  
0.5 mm

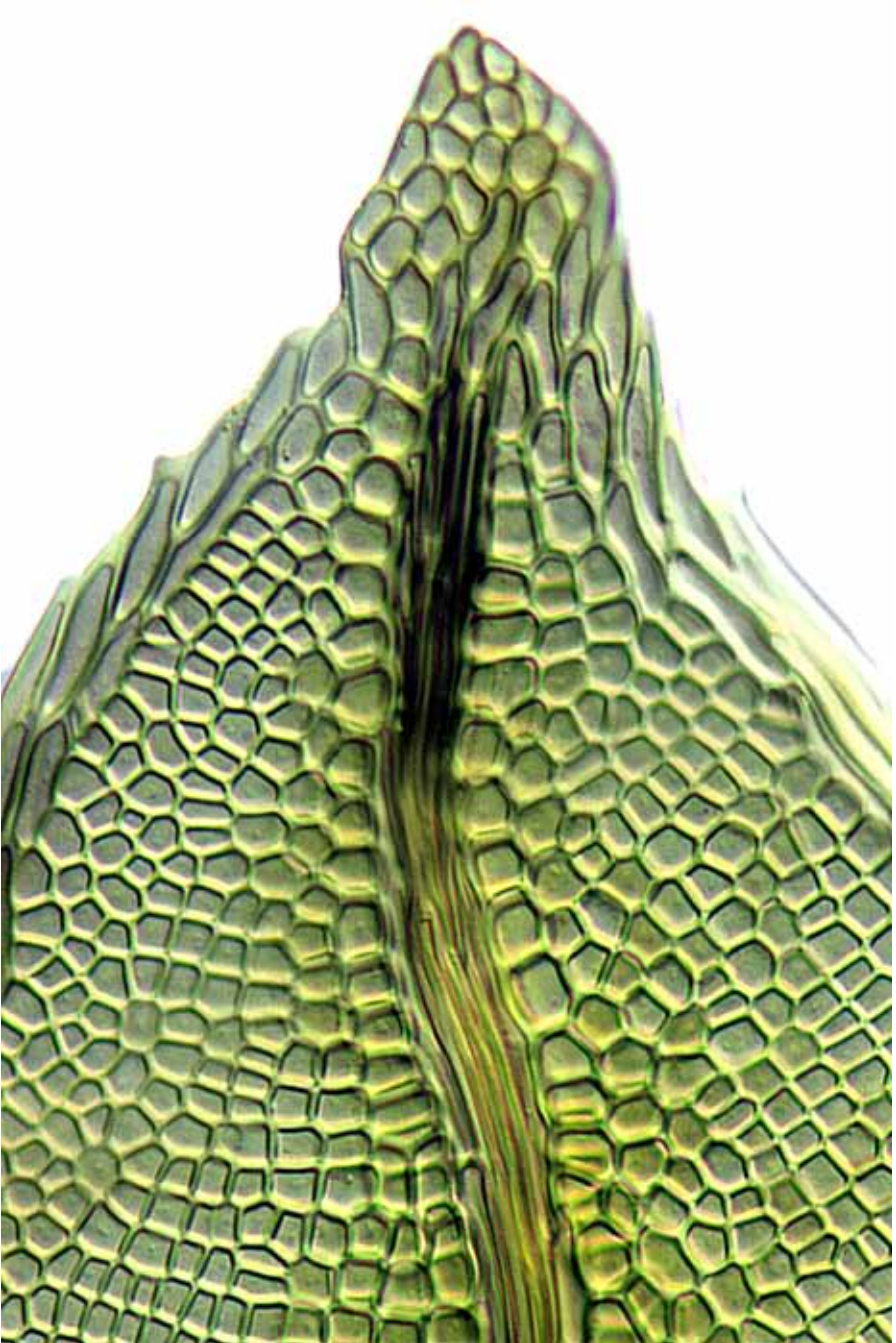
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*Fissidens rigidulus* var. *rigidulus* habit  
1 mm

continued next page



*Fissidens rigidulus* var. *rigidulus* leaf apex showing costa terminus  
10  $\mu\text{m}$

continued next page

**Fissidens strictus** Hook.f. & Wilson

**form:** tufted or matted, ± branched stems, leaves in 15–40 pairs, overlapping in mid-stem, the lowest leaves eroded and encrusted with epiphytes and detritus, 6–15 mm tall

**habitat:** rock, submerged or near to fast-flowing streams in indigenous forest, sea level to 320 m elevation

**leaf:** size: 1.5–2.0 × 0.2–0.3 mm

*shape:* linear; all laminae unistratose at the margin, bi- to pluristratose near costa

*tip:* acute to obtuse, occasionally asymmetric

*vaginant laminae:* half the leaf length, half-open

*base:* dorsal lamina reaching the leaf insertion and decurrent down the stem

*costa:* failing 5–10 cells below the apex

*border:* not differentiated

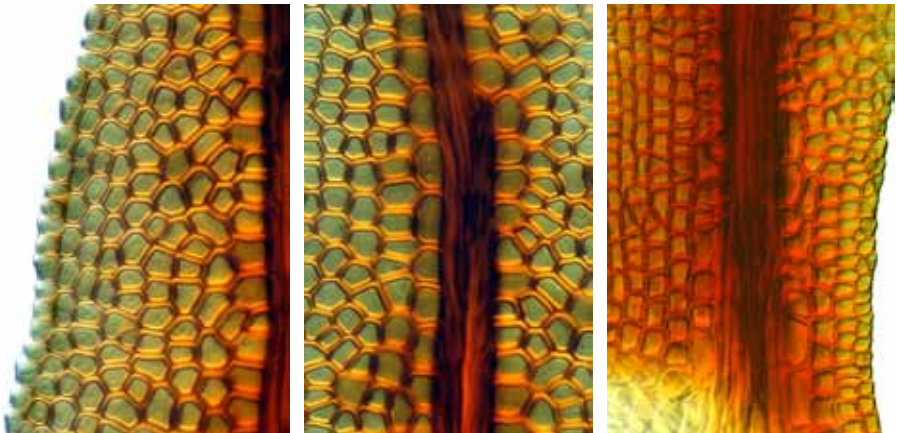
*margin:* crenulate, plane

*cells:* 9–14 μm, quadrate to irregularly hexagonal, firm-walled, smooth

**capsule:** mature capsules not seen in New Zealand



vegetative frond (2), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 1 mm, 0.1 mm, 10 μm, 50 μm



margin midleaf, costa in upper leaf, and near base of dorsal lamina  
 10 μm, 10 μm, 50 μm

continued next page



*Fissidens strictus* margin of upper leaf  
10  $\mu\text{m}$

continued next page

**Fissidens taxifolius** Hedw.

**form:** tufted to densely gregarious, yellow-green, branched at the base,  
10–15 leaf pairs, overlapping in mid-stem, 5–10 mm tall

**habitat:** soil in moderate shade, mostly urban parks and gardens, to 400 m

**leaf:** size: 1.4–2.4 × 0.4–0.8 mm, in 10–15 pairs on the stem

*shape:* oblong-lanceolate; bistratose patches distally

*tip:* acute to broadly acute, mucronate to cuspidate on some leaves

*vaginant laminae:* 0.5–0.7 of the leaf length, almost closed

*base:* dorsal lamina reaching the leaf insertion, often undulate there

*costa:* percurrent to excurrent in a mucro or cusp

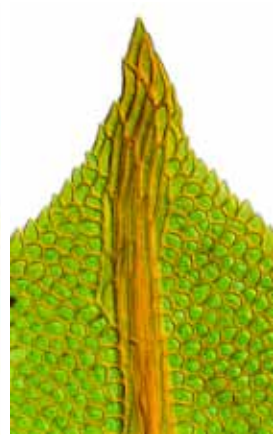
*border:* not differentiated

*margin:* serrulate, plane

*cells:* 8–10 μm, quadrate to hexagonal, firm-walled, bulging, smooth

**capsule:** capsules not found in New Zealand

**notes:** adventive and invasive, nearly cosmopolitan but not recorded yet from Australia



habit, vegetative shoot (dry), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm



junction of apical and vaginant laminae, costa in midleaf, and undulate leaf base

■ 50 μm, ■ 50 μm, ■ 50 μm

continued next page



*Fissidens taxifolius* vegetative habit  
1 mm

continued next page



*Fissidens taxifolius* leaf whole-mount  
— 0.1 mm

*Fissidens taylorii* var. *epiphytus* (Allison) I.G.Stone & J.E.Beever

**form:** scattered, ± branched stems, with leaves in 15–25 pairs, yellow-green to green, radiculose below, 2–10 mm tall

**habitat:** soil, sea level to 300 m elevation

**leaf:** size: 0.5–1.0 × 0.2–0.3 mm

**shape:** oblong to lanceolate, unistratose, little altered when dry

**tip:** acute to obtuse

**vaginant laminae:** to 0.8 of the leaf length, half to nearly fully closed

**base:** dorsal lamina narrow, failing above the leaf insertion

**costa:** percurrent to excurrent

**border:** 2–5 rows of narrow, thick-walled cells on only the vaginant laminae

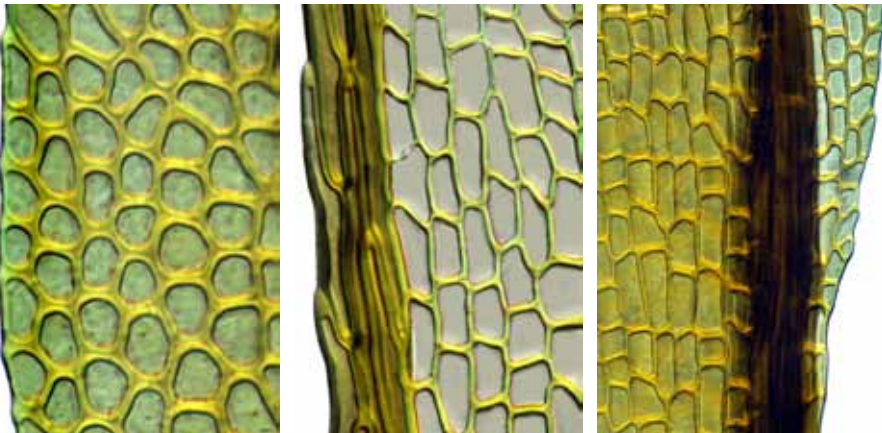
**margin:** entire to minutely serrulate, plane

**cells:** 8–16 μm, quadrate to irregularly hexagonal, firm-walled, smooth

**capsule:** 0.5–0.8 mm, symmetric to arcuate, erect to inclined, exserted, brown; seta 2–6 mm; operculum short-beaked; spores 25–36 μm in diam.



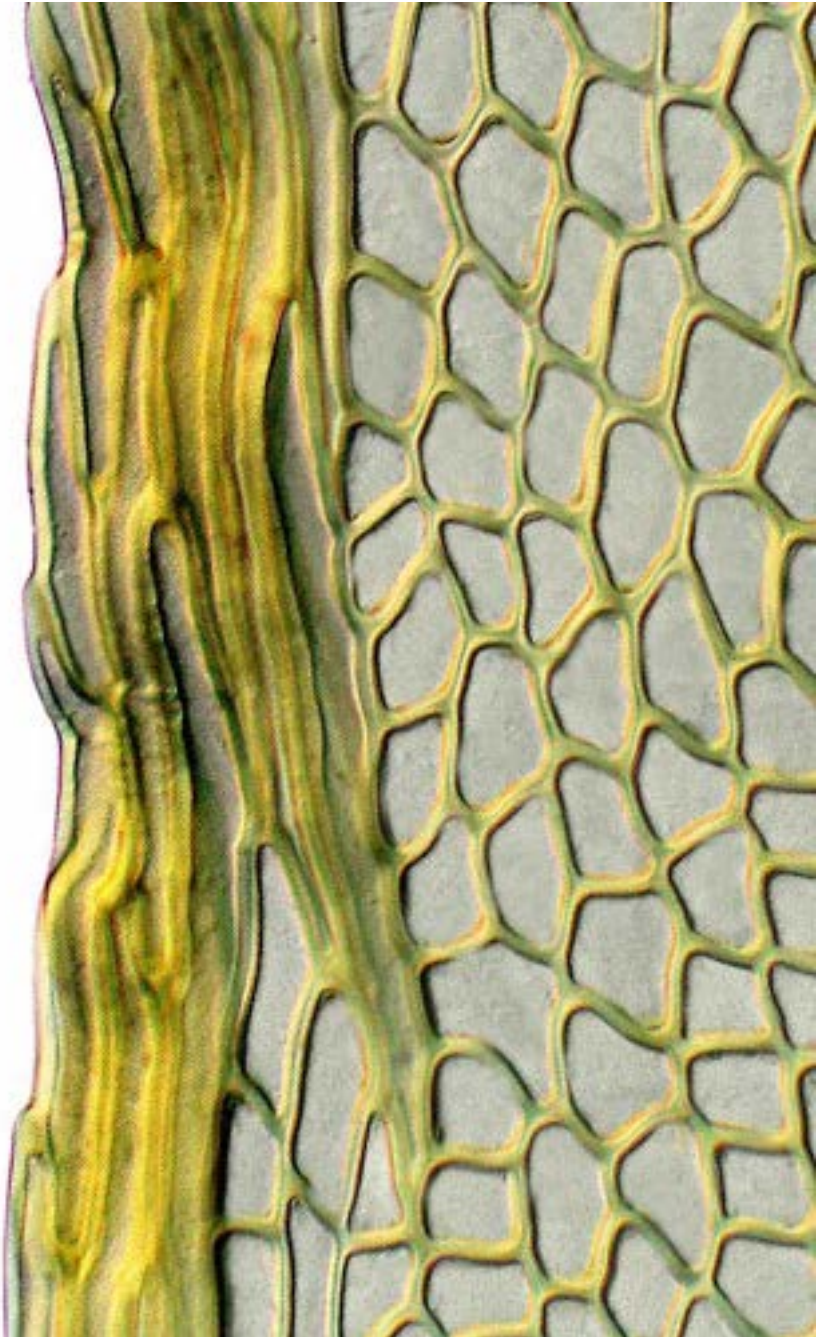
vegetative shoot (moist), leaf, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.5 mm, 0.1 mm, 50 μm, 10 μm



margin of upper leaf, border of vaginant lamina, and base of dorsal lamina  
 10 μm, 10 μm, 10 μm

continued next page





*Fissidens taylorii* var. *epiphytus* spurred border of vaginant lamina  
10  $\mu$ m

continued next page



*Fissidens taylorii* var. *epiphytus* leaf apex, showing costa terminus  
10  $\mu$ m

continued next page

**Fissidens taylorii** var. **sainsburyanus** Allison

**form:** scattered, ± branched stems, with leaves in 8–12 pairs, yellow-green to green, radiculose at base of both main and branch shoots, 2–10 mm tall

**habitat:** soil, in lawns and other modified sites, mostly dry-eastern, to 250 m

**leaf:** size: 0.4–0.7 × 0.2 mm

**shape:** oblong to lanceolate, unistratose, little altered when dry

**tip:** obtuse to acute

**vaginant laminae:** up to 0.8 of the leaf length, half-open to almost closed

**base:** dorsal lamina narrow, failing above the leaf insertion

**costa:** subpercurrent to percurrent

**border:** vaginant laminae ± bordered

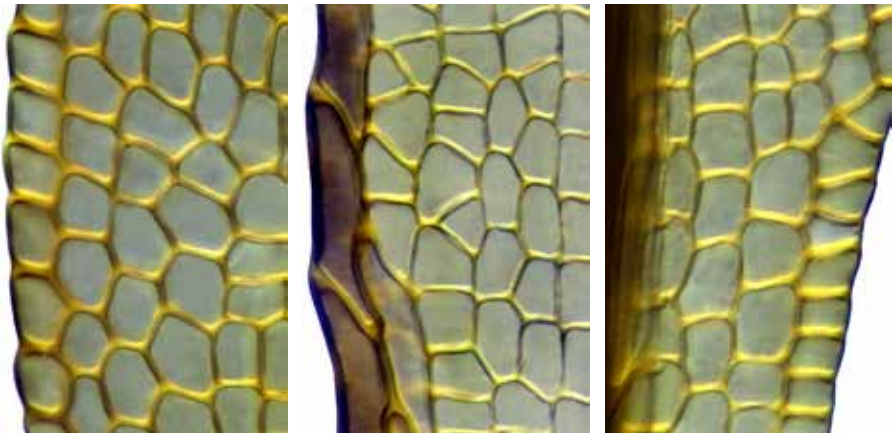
**margin:** entire to minutely serrulate, plane

**cells:** 7–14 μm, quadrate to irregularly hexagonal, firm-walled, smooth

**capsule:** 0.5–0.8 mm, erect to inclined, exserted, brown; seta 2–6 mm; operculum beaked; calyptra smooth, cucullate; peristome teeth erect, not split (= *sainsburia*-type peristome), spores 15–25 μm in diam.

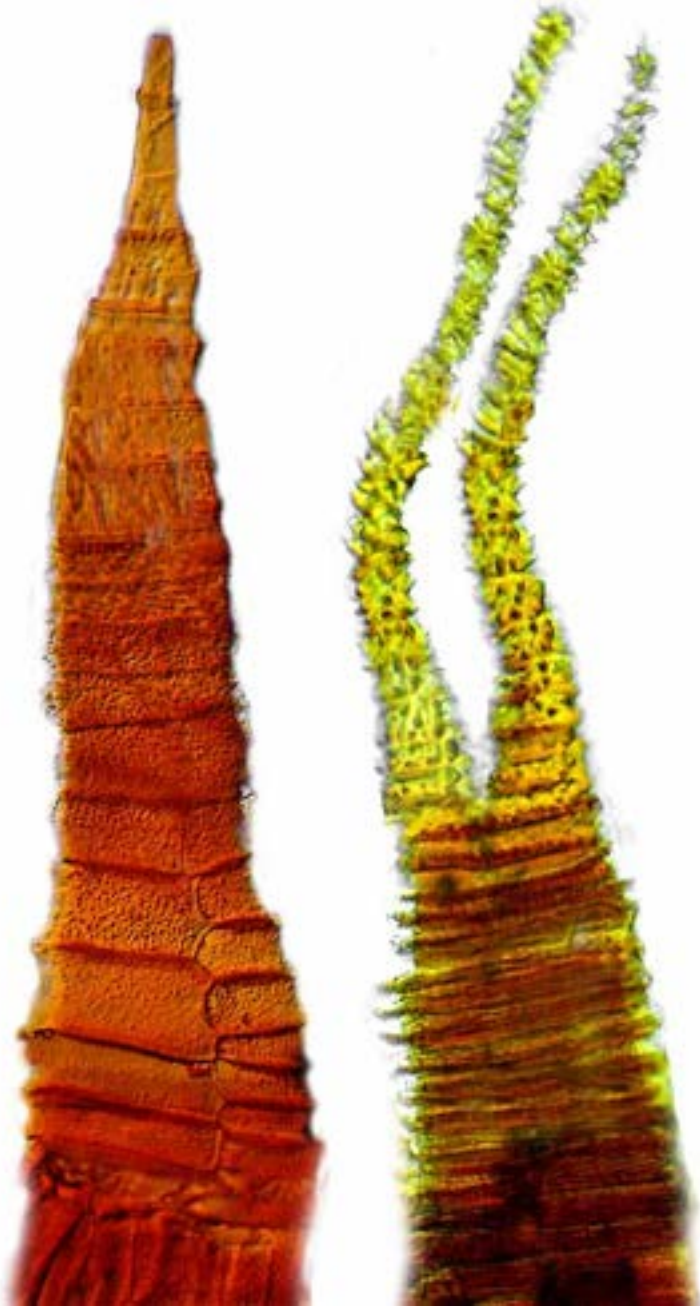


vegetative shoot (moist), leaf, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 10 μm, 10 μm



margin of upper leaf, margin of minor vaginant lamina, and margin of dorsal lamina  
 10 μm, 10 μm, 10 μm

continued next page



Left — an undivided peristome tooth (exostome) of *Fissidens taylorii* var. *sainsburyanus*.  
Right — a deeply divided tooth of *Fissidens leptocladus*, a peristome type that's found in most *Fissidens* species.

50  $\mu$ m

continued next page

**Fissidens taylorii** Müll.Hal. var. **taylorii**

**form:** scattered, ± branched stems, with leaves in 8–12 pairs, overlapping in only the upper stem, yellow-green to green, radiculose below, 2–10 mm tall  
**habitat:** soil, mostly dry sites east of the ranges, to 250 m elevation

**leaf:** size: 0.3–0.9 × 0.1–0.2 mm

**shape:** oblong to lanceolate, unistratose, little altered when dry

**tip:** obtuse to acute

**vaginant laminae:** up to 0.8 of the leaf length, half to nearly closed

**base:** dorsal lamina narrow, usually failing above the leaf insertion

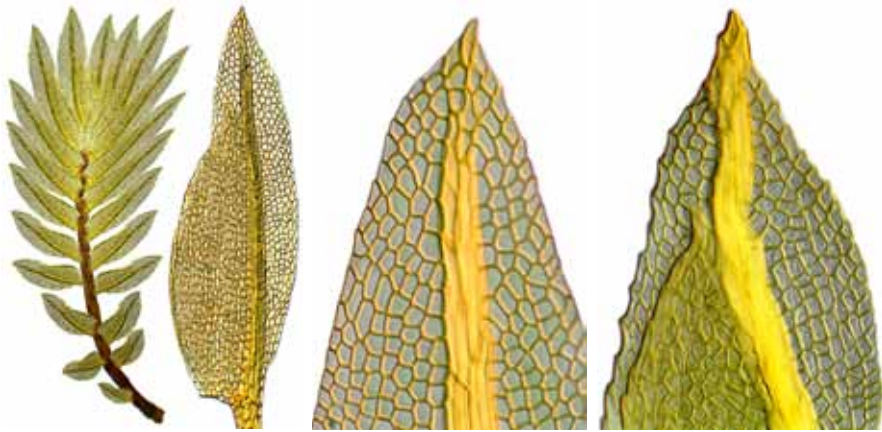
**costa:** subpercurrent to percurrent

**border:** on vaginant laminae only, sometimes 1–3 rows of elongate cells

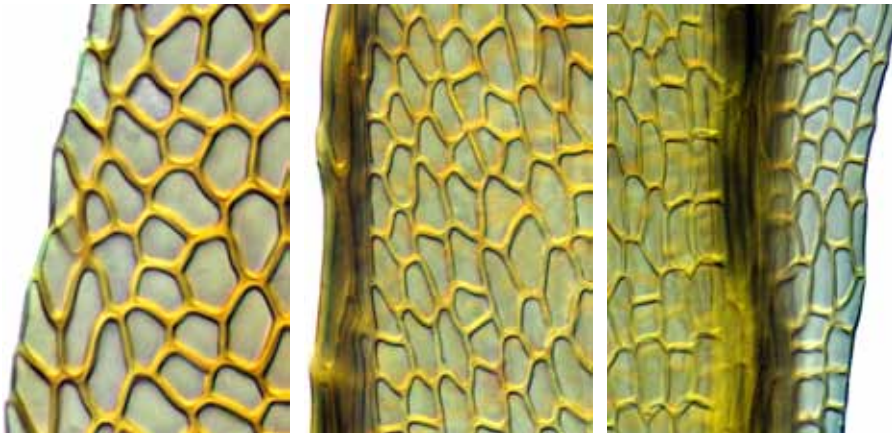
**margin:** entire to minutely serrulate, plane

**cells:** 7–20 μm, quadrate to irregularly hexagonal, firm-walled, smooth

**capsule:** 0.5–0.8 mm, symmetric, erect to inclined, exserted, brown; seta 2–6 mm; operculum beaked; calyptra smooth, cucullate; spores 15–35 μm in diam.

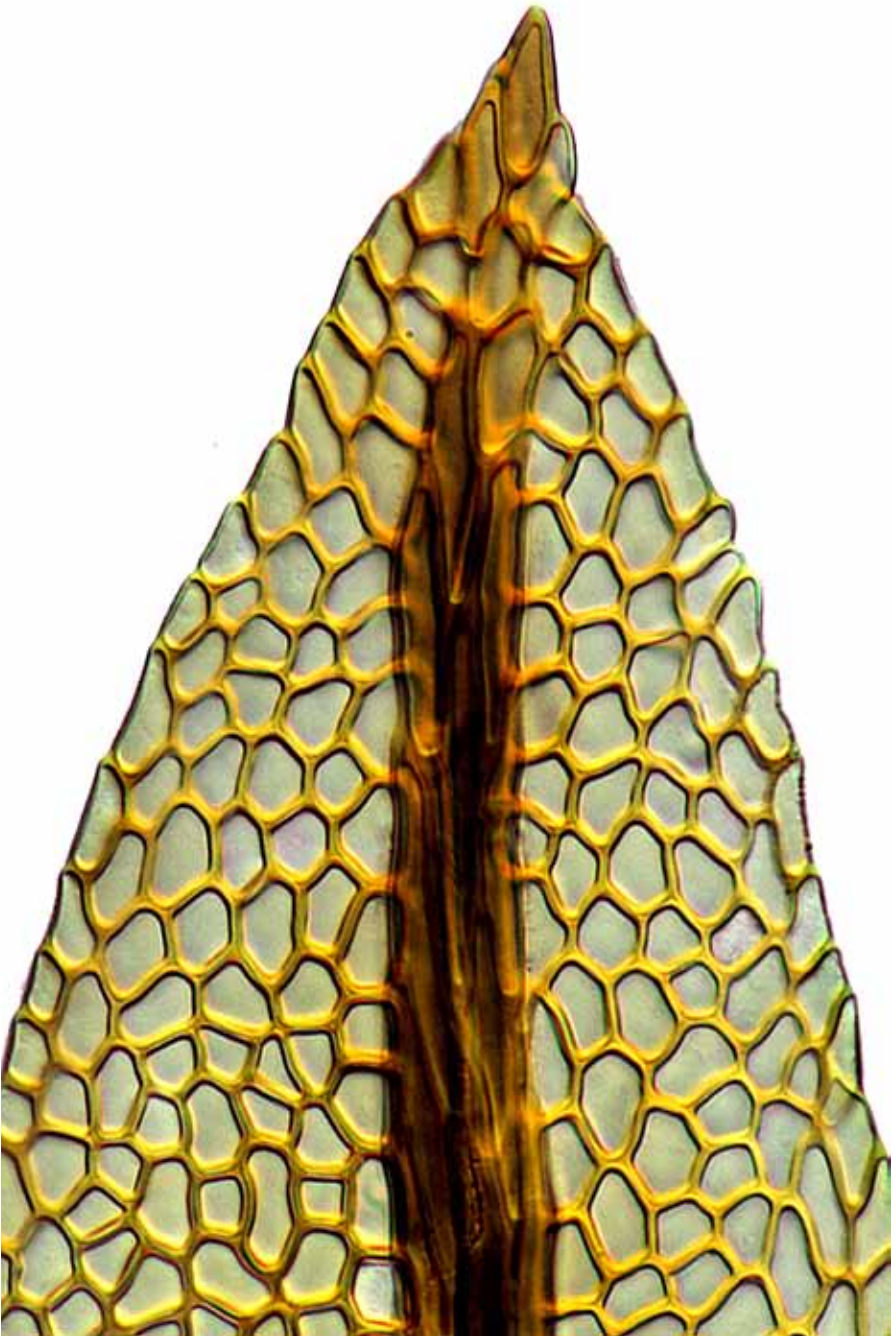


vegetative shoot (moist), leaf, leaf apex, and junction of apical and vaginant laminae  
 0.5 mm, 0.1 mm, 10 μm, 10 μm



margin of upper leaf, margin of vaginant lamina, and near base of dorsal lamina  
 10 μm, 10 μm, 10 μm

continued next page



*Fissidens taylorii* var. *taylorii* leaf apex showing end of costa  
10  $\mu$ m

continued next page

**Fissidens tenellus** var. **australiensis** (A.Jaeger) J.E.Beever & I.G.Stone

**form:** gregarious, ± branched stems, with leaves in 3–6(–14) pairs, overlapping in mid-stem, yellow- to dark green, radiculose below, 1–3 mm long

**habitat:** bark, rotting wood or bone, *Astelia* bases, rarely soil or rock, to 440 m

**leaf:** size: 0.8–1.3 × 0.1–0.2 mm

**shape:** lanceolate, ± falcate, unistratose, little altered when dry

**tip:** acute

**vaginant laminae:** about half the leaf length, ± open

**base:** dorsal lamina tapered, reaching the leaf insertion or failing just above

**costa:** failing 3–4 cells below the apex

**border:** not differentiated

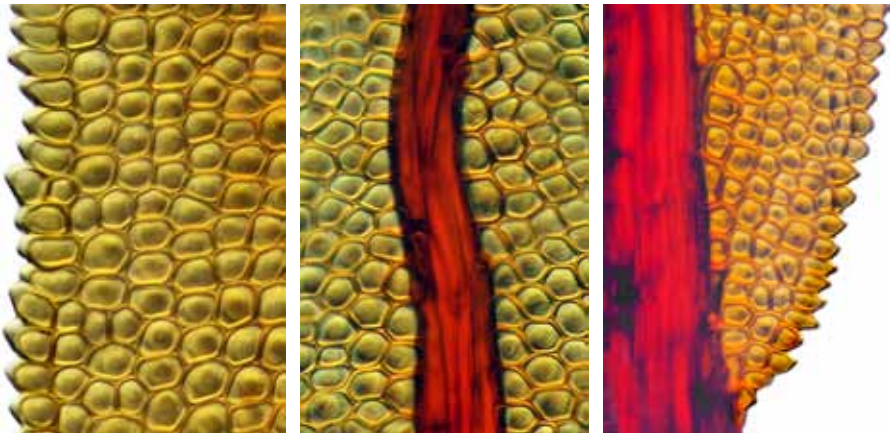
**margin:** denticulate throughout, plane

**cells:** 6–11 μm, quadrate to irregularly hexagonal, firm-walled, ± unipapillose

**capsule:** 0.5–0.8 mm, symmetric, erect, exserted, brown; seta 1.8–3.0 mm, light brown; operculum beaked; calyptra smooth to slightly scabrous, cucullate; spores 10–14 μm in diam.

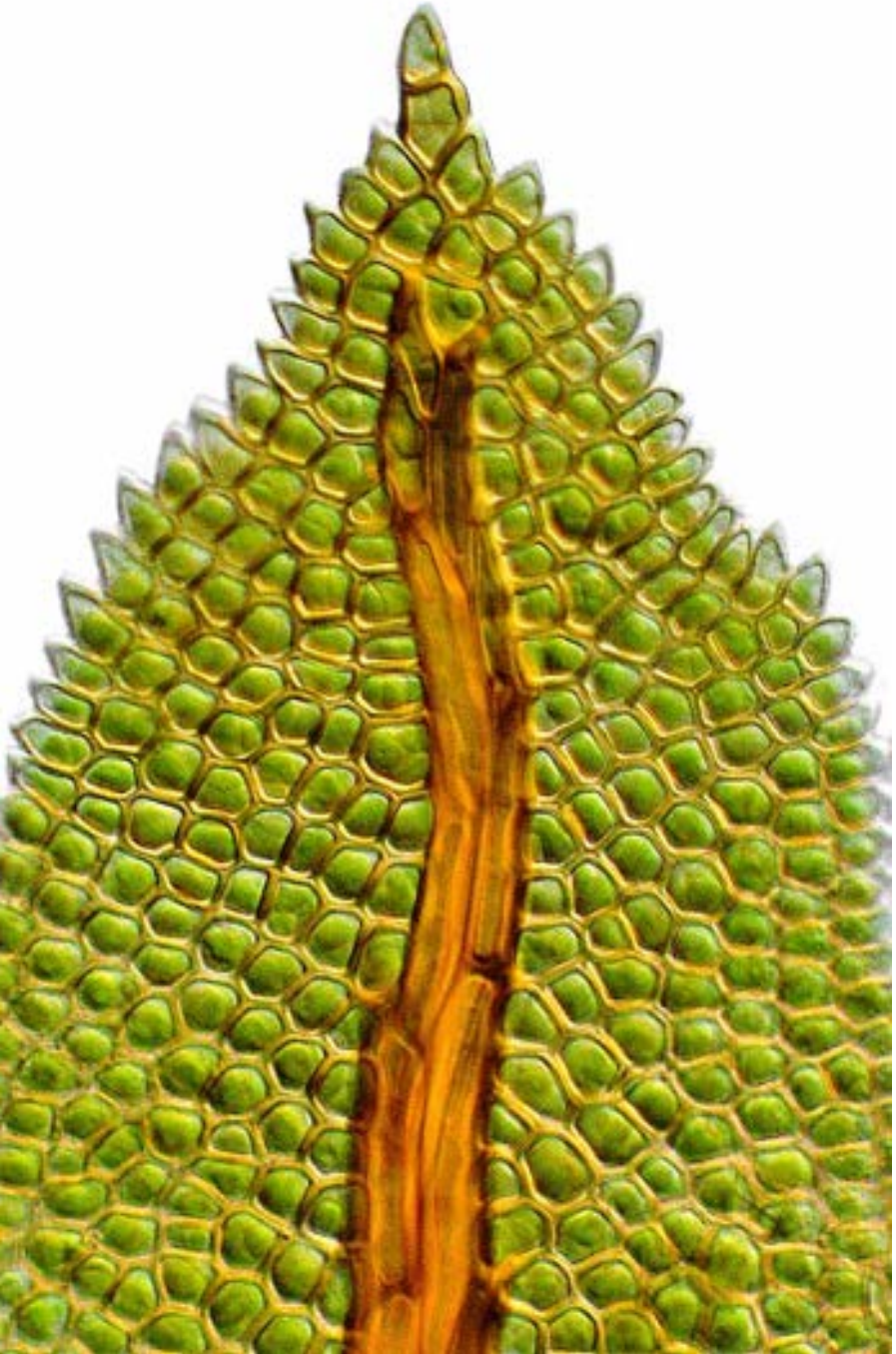


shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 1 mm, 0.1 mm, 50 μm, 50 μm



margin of upper leaf, costa in upper leaf, and base of dorsal lamina  
 10 μm, 10 μm, 50 μm

continued next page



*Fissidens tenellus* var. *australiensis* leaf apex and costa terminus  
10  $\mu\text{m}$

continued next page



**Fissidens tenellus** Hook.f. & Wilson var. **tenellus**

**form:** gregarious, ± branched stems, with leaves in 3–6(–14) pairs, overlapping in mid-stem, yellow- to dark green, radiculose below, 1–3 mm tall

**habitat:** soil or rarely rock, often on eroding banks in indigenous forest, to 950 m

**leaf:** size: 0.8–1.3 × 0.1–0.2 mm

**shape:** linear-lanceolate, ± falcate, unistratose, little altered when dry

**tip:** acute to acuminate

**vaginant laminae:** about half the leaf length, half to fully open

**base:** dorsal lamina tapered, reaching the leaf insertion or failing just above

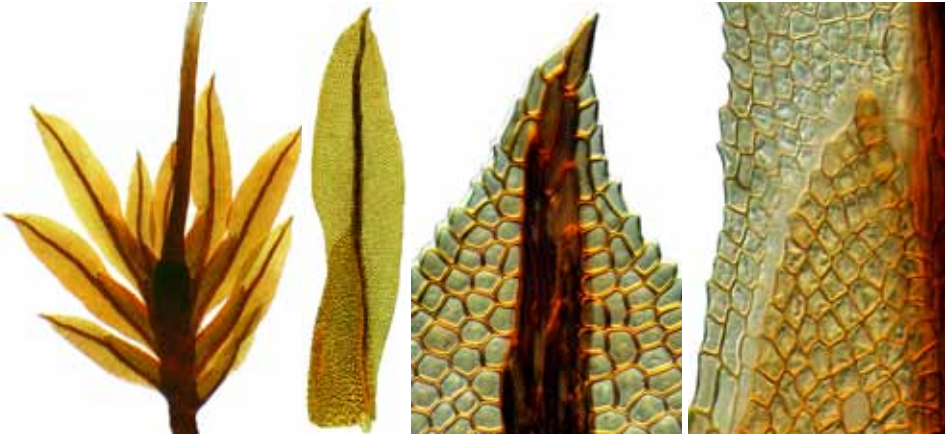
**costa:** percurrent to shortly excurrent

**border:** ± intramarginal on the vaginant laminae

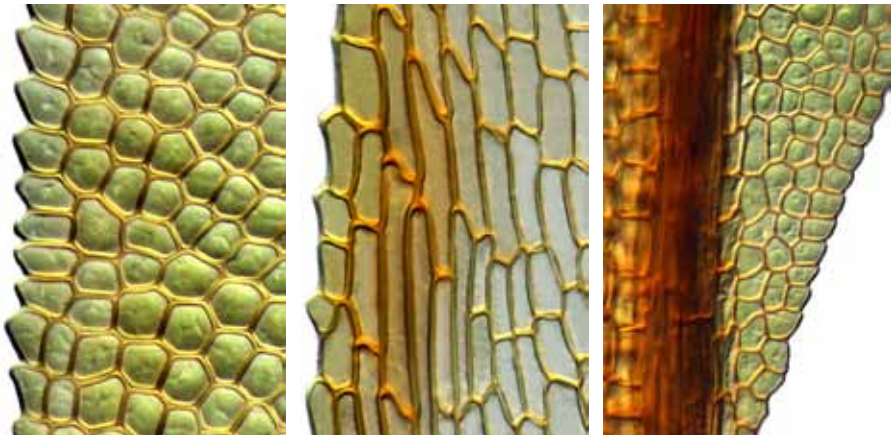
**margin:** crenulate to denticulate, plane

**cells:** 6–11 μm, quadrate to irregularly hexagonal, firm-walled, ± unipapillose

**capsule:** 0.4–0.7 mm, symmetric, erect, exserted, brown; seta 2–5(–10) mm, light brown; operculum beaked; calyptra scabrous, cucullate; spores 7.5–12 μm in diam.



fertile shoot (moist), leaf outline, leaf apex, and junction of apical and vaginant laminae  
 0.5 mm, 0.1 mm, 50 μm, 50 μm



margin of upper leaf, margin of minor vaginant lamina, and base of dorsal lamina  
 10 μm, 50 μm, 50 μm

continued next page



*Fissidens tenellus* var. *tenellus* leaf apex and failing costa  
10  $\mu$ m

continued next page

**Fissidens waiensis** J.E.Beever

**form:** ± gregarious, branched stems, leaves in 10–25(–60) pairs, not overlapping in mid-stem, yellow- to dark green, rhizoids basal, axillary, 10–20(–50) mm tall  
**habitat:** ± submerged rock (andesite, basalt, greywacke), in shade or exposed, indigenous or exotic forest, to 600 m elevation

**leaf:** size: 1.2–2.0 × 0.3–0.5 mm

**shape:** lanceolate, ± falcate, bistratose in patches and near costa, ± crisped dry

**tip:** acute

**vaginant laminae:** up to half the leaf length, closed or nearly so

**base:** dorsal lamina reaching to the leaf insertion

**costa:** failing 3–5 cells below the leaf apex

**border:** weak, a few rows of marginal cells in the vaginant laminae

**margin:** entire, plane

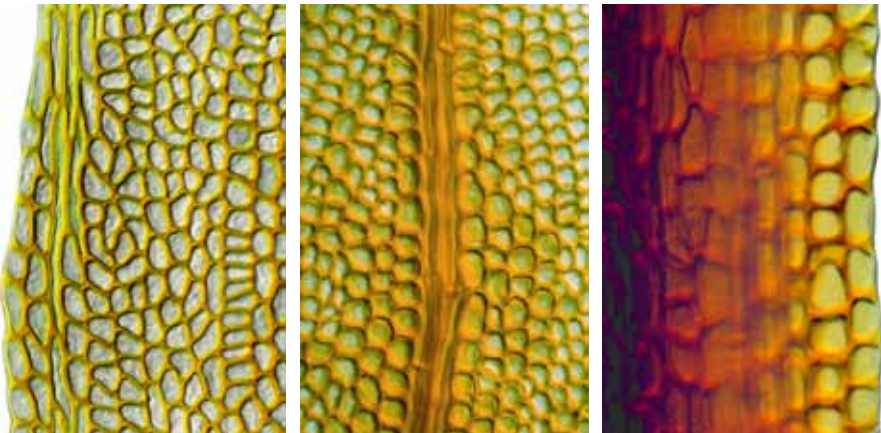
**cells:** 5–13 μm, quadrate to irregularly hexagonal, firm-walled, smooth

**capsule:** sporophytes not known

**note:** endemic



vegetative frond (moist), leaf, leaf apex, and junction of apical and vaginant laminae  
 ■ 1 mm, ■ 0.1 mm, ■ 50 μm, ■ 50 μm



margin of vaginant lamina, costa in upper leaf, and near base of dorsal lamina  
 ■ 50 μm, ■ 50 μm, ■ 10 μm

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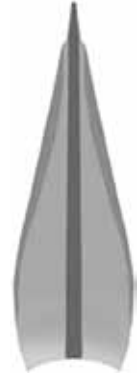
*Fissidens waiensis* vegetative frond (re-wetted specimen), and leaf whole-mount  
1 mm, 0.1 mm

**Ceratodon purpureus** subsp. **convolutus** (Reichardt) Burley**form:** dense tufts, dull, the stems often forked**habitat:** soil, rock, or sometimes wood in dry, open, or disturbed sites**leaf:** *size:* 1–2 × 0.3–0.7 mm*shape:* ovate-lanceolate to oblong-lanceolate, keeled, contorted when dry*tip:* acute to ± awned, lamina-costa junction oblique*base:* undifferentiated; basal cells short-rectangular*costa:* percurrent to shortly excurrent, prominent, terminal cell ± oblique*border:* not differentiated*margin:* entire below, a few blunt teeth above; revolute to near the apex*cells:* 8.5–12 μm, quadrate, thick-walled, collenchymatous, smooth**capsule:** 1–2.5 mm, oblong, strumose at the base, 4–6-angled, sulcate, more

so when dry, annulus large and revolute; seta 10–30 mm, purplish red,

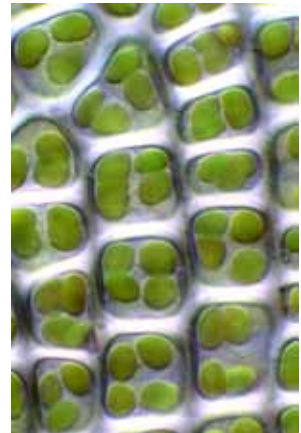
smooth; peristome single, of 16 teeth split nearly to the base, bordered

and papillose

**note:** a cosmopolitan “bryo-weed”, common in disturbed sites

habit (cutaway cushion), immature and mature capsules, leaf outline, and leaf apex

10 mm, 0.5 mm, 1 mm, 0.1 mm, 50 μm



leaf subapex, recurved leaf margins, and cells midleaf

50 μm, 50 μm, 10 μm



*Ceratodon purpureus* vegetative shoot (moist), and immature capsules  
1 mm

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*Ceratodon purpureus* massed mature capsules, three with calyptrae  
1 mm

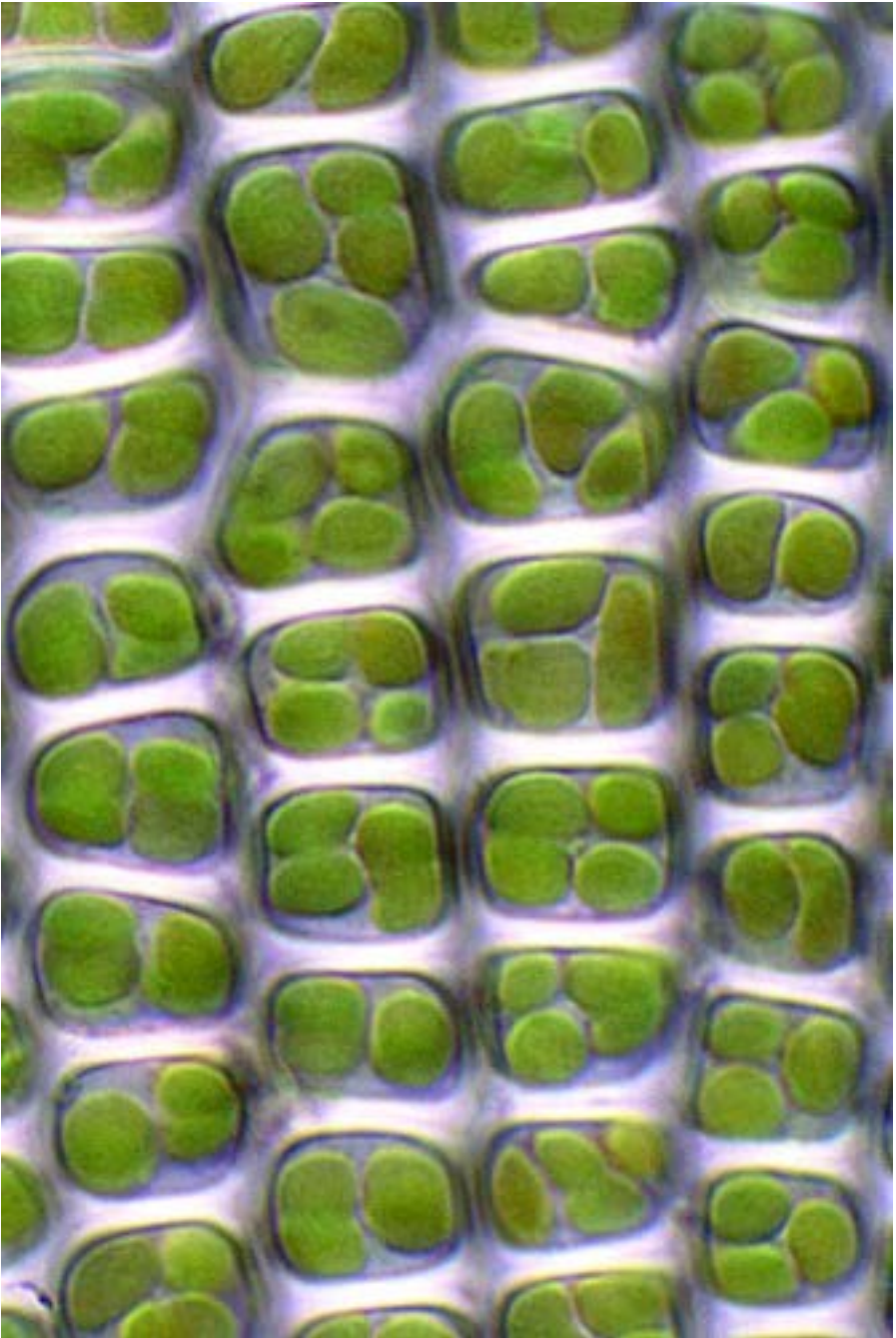
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*Ceratodon purpureus* peristome teeth and annulus  
50  $\mu\text{m}$

continued next page





*Ceratodon purpureus* cells midleaf  
10  $\mu\text{m}$

**Chrysoblastella chilensis** (Mont.) Reim.

**form:** loose tufts, yellow to yellow-green, simple or branched, 10–20 mm tall  
**habitat:** damp soil, often in sites disturbed naturally or by man

**leaf:** size: 2–3 × 0.5–0.8 mm

*shape:* oval-lanceolate to oblong-lanceolate; lamina bistratose throughout

*tip:* obtuse

*base:* basal cells oblong and smooth

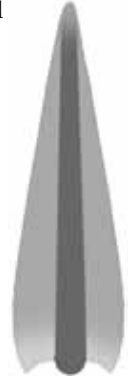
*costa:* percurrent, yellow, papillose at the back

*border:* absent

*margin:* entire, plane or partly recurved

*cells:* 10 × 7 μm, quadrate or short-rectangular, thick-walled, papillose

**capsule:** 2–3 mm, cylindric, slightly curved, pale brown; seta 10–20 mm, yellowish, ± flexuose when dry; annulus absent; calyptra cucullate; operculum rostrate to half the length of the capsule; peristome of 16 teeth, joined below into a cylinder, divided above into two filiform segments, papillose throughout; spores 15–18 μm in diam.



vegetative shoots (dry second from left), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 μm



margin midleaf, leaf cell papillae, and recurved lower leaf margin  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Chrysoblastella chilensis* habit  
1 mm

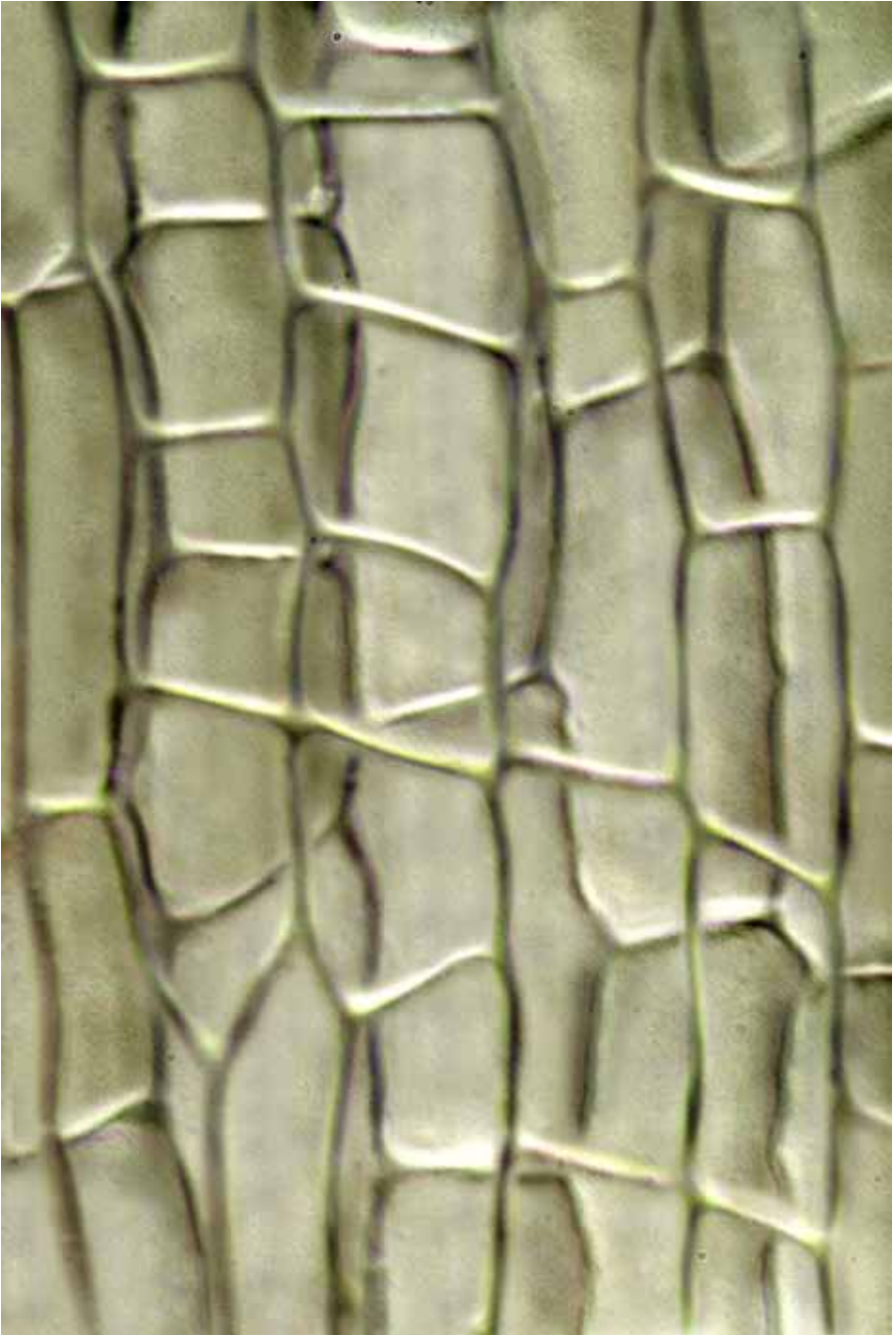
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*Chrysoblastella chilensis* vegetative shoot (dry on right)

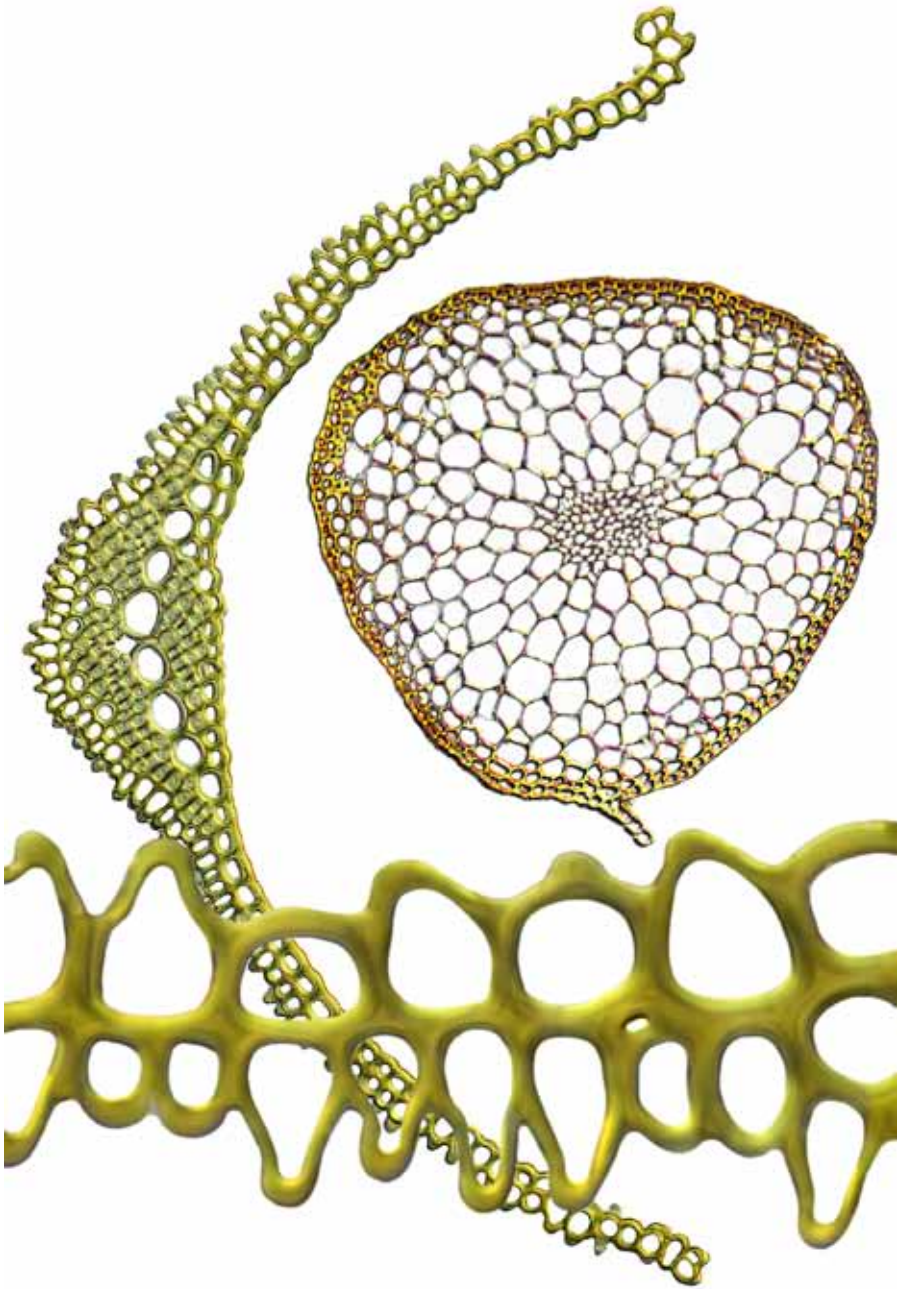
1 mm

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*Chrysoblastella chilensis* bistratose leaf, surface view  
10  $\mu\text{m}$

continued next page



*Chrysoblastella chilensis* leaf (bistratose) and stem cross-sections

50  $\mu\text{m}$  (left),

50  $\mu\text{m}$  (right),

10  $\mu\text{m}$  (below)

continued next page

**Distichium capillaceum** (Hedw.) Bruch & Schimp.

**form:** dense silky tufts, pale, simple or branched, slender, tomentose  
**habitat:** exposed moist soil or calcareous rock

**leaf:** *size:* 2.5–4.5 × 0.4–0.7 mm

*shape:* distichous, subulate, flexuose, reflexed, narrowing from an oblong-oval sheathing base

*tip:* linear-acuminate

*base:* basal cells linear-oblong, 85–140 × 4–5 μm, firm-walled

*costa:* excurrent, filling the subula, papillose on the back

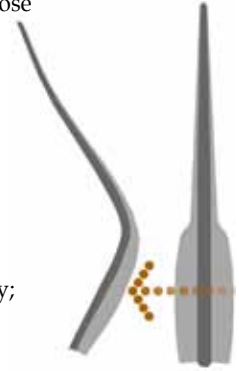
*border:* not differentiated

*margin:* entire, plane

*cells:* subula cells 15–20 μm, subquadrate, firm-walled, smooth

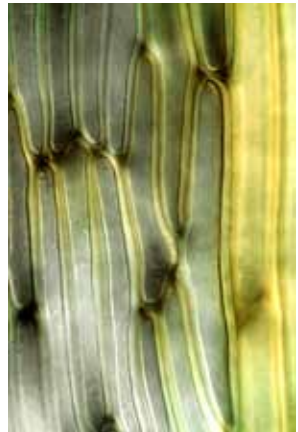
**capsule:** 1–2 mm, ovate-oblong to cylindric, ± erect, brown, glossy;  
 seta 8–18 mm, slender, flexuose; peristome of 16 short reddish  
 teeth inserted below the rim

**note:** cosmopolitan



habit, vegetative shoot, leaf outline, and mature capsule

5 mm, 1 mm, 0.5 mm, 0.5 mm, 0.5 mm



margin mid-subula, lower leaf cells, and leaf base cells

10 μm, 10 μm, 10 μm



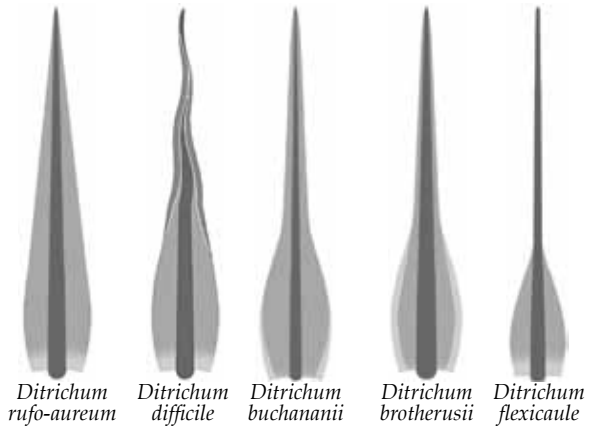
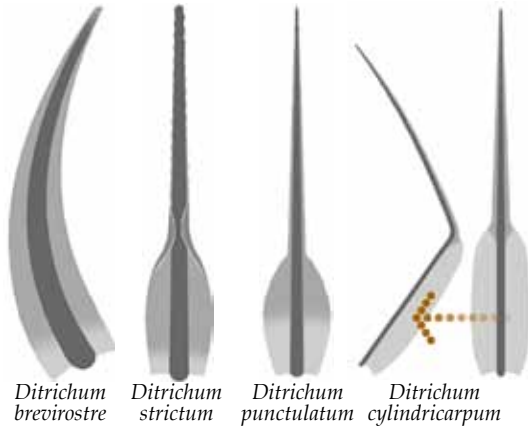
*Distichium capillaceum* cells lower leaf  
10  $\mu\text{m}$



**Key\* to New Zealand species of *Ditrichum* (9)**

- 1 Leaves with a hyaline margin at the base; peristome teeth entire or perforate..... 2  
 1: Leaves without a hyaline margin at the base; peristome teeth divided to the base..... 3
- 2(1) Leaves contorted when dry, costa 100–150  $\mu\text{m}$  wide near its base; spores 10–12  $\mu\text{m}$  in diam..... ● ***Ditrichum buchananii***  
 2: Leaves unaltered when dry; costa 150–200  $\mu\text{m}$  wide near base; spores 65–70  $\mu\text{m}$  long, (multicellular)..... ● ***Ditrichum brotherusii***
- 3(1): Leaves strongly falcate-secund..... ● ***Ditrichum brevirostre***  
 3: Leaves not falcate-secund ..... 4
- 4(3): Upper cells subquadrate or rounded and isodiametric..... 5  
 4: Upper cells elongate, linear ..... 8
- 5(4) Leaf base oblong, abruptly contracted to the subula ..... 6  
 5: Leaf base oval, gradually narrowed to the subula ..... 7
- 6(5) Capsule brown, elliptic, tapered toward the mouth .... ● ***Ditrichum punctulatum***  
 6: Capsule pale, long-cylindric, not tapered toward the mouth ..... ● ***Ditrichum cylindricarpum***
- 7(5): Leaf apex wide-obtuse, denticulate, never hyaline-tipped .. ● ***Ditrichum strictum***  
 7: Leaf apex narrow, entire, sometimes hyaline-tipped..... ● ***Ditrichum flexicaule***
- 8(4): Leaves 3–5 mm long, silky; plants lowland to montane; capsule ovate, flattened when dry ..... ● ***Ditrichum difficile***  
 8: Leaves 2.0–2.5 mm long, stiff; plants alpine; capsule cylindric, not flattened when dry ..... ***Ditrichum rufo-aureum***

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 73, 81 plus Scott, GAM; Stone, IG; Rosser, C (1976): *The Mosses of Southern Australia*. Academic Press, London. 111.



**Ditrichum brevirostre** (R.Br.ter) Broth.

**form:** loosely tufted, erect, slender stems, simple or sparsely branched  
**habitat:** soil or rock in exposed, disturbed sites

**leaf:** size: 1–2 mm

*shape:* long-subulate from an ovate-elliptic base, falcate-secund

*tip:* bluntly acute

*base:* sheathing

*costa:* 1/3 the width of the leaf base, filling most of the subula

*border:* not differentiated

*margin:* entire below, weakly denticulate near the apex, plane

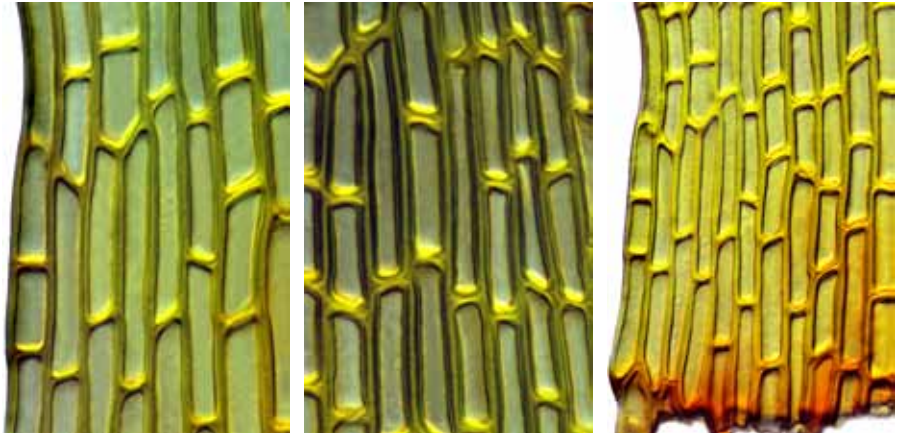
*cells:* subula cells 12–20 × 5–8 μm, rectangular, firm-walled, smooth

**capsule:** 1–1.5 mm, cylindrical, erect, exserted, reddish brown; seta 10–30 mm, ± flexuose, smooth; peristome single, the teeth filiform, papillose, split nearly to the base; operculum short-rostrate; calyptra cucullate, smooth, naked



vegetative shoots (dry), capsule (dry), leaf outline, leaf apex, and leaf subapex

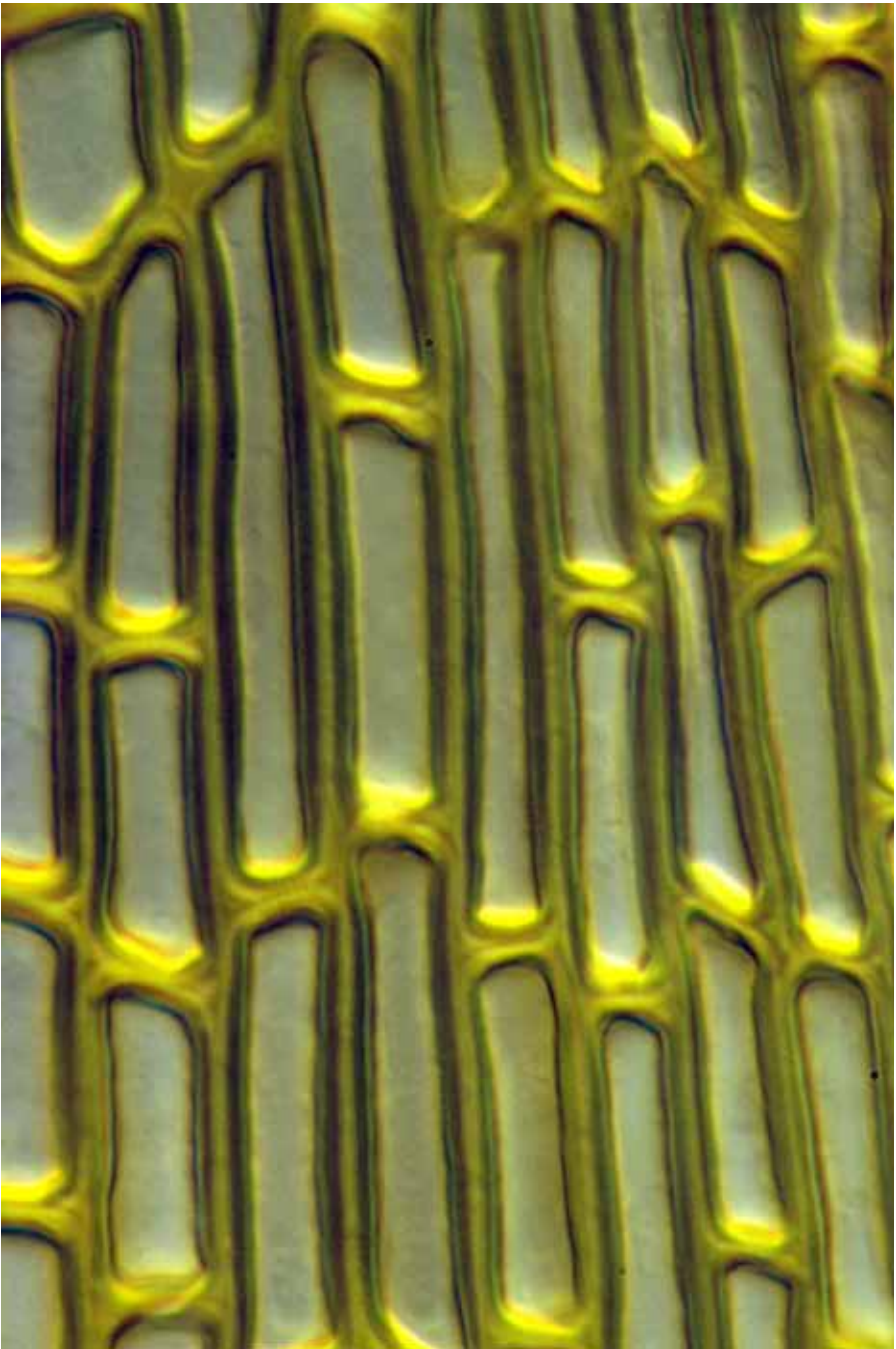
1 mm, 1 mm, 0.5 mm, 0.1 mm, 50 μm, 50 μm



margin lower leaf, cells near leaf base, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page



*Ditrichum brevirostre* cells near leaf base  
10  $\mu\text{m}$

continued next page

**Ditrichum brotherusii** (R.Br.bis) Seppelt

**form:** densely tufted, branched, glossy, yellowish stems, dark below  
**habitat:** soil

**leaf:** size: to 3 mm

*shape:* oval base contracting to a subula

*tip:* long-subulate

*base:* hyaline-bordered, basal cells short-rectangular, thin-walled

*costa:* 150–200  $\mu\text{m}$  wide at its base

*border:* not differentiated

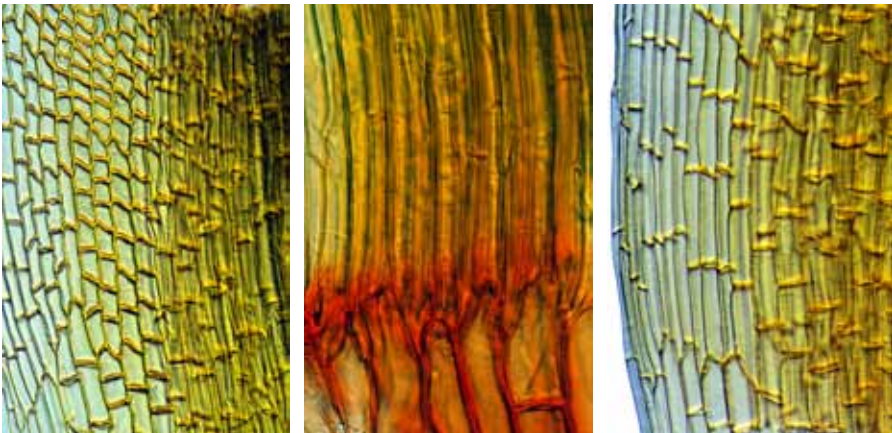
*margin:* entire below, denticulate at the apex, plane

*cells:* 10–20  $\times$  7–10  $\mu\text{m}$ , oval, firm-walled, smooth

**capsule:** 1–1.5 mm, elliptic, inclined to horizontal, long-exserted, brown; seta 10–20 mm, slender, flexuose; operculum subulate; annulus present; peristome single, exostome teeth 16, short, orange, inserted below the rim; spores 65–70  $\mu\text{m}$  in diam., multicellular



vegetative shoot (dry) (2), leaf outline, leaf apex, and margin midleaf  
 1 mm, 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



cells below shoulder, leaf insertion, and leaf basal angle  
 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

**Ditrichum buchananii** (R.Br.bis) Broth.

**form:** densely tufted, erect,  $\pm$  branched, yellowish stems, not glossy  
**habitat:** soil in exposed tussockland and river flats

**leaf:** size: 2–3 mm

*shape:* ovate or oblong base tapering gradually to an acute point

*tip:* long-tapering, denticulate at the tip

*base:* basal cells rectangular to linear

*costa:* strong, 100–150  $\mu\text{m}$  wide at the leaf base, percurrent

*border:* several rows of narrow, thin-walled, hyaline cells at leaf base

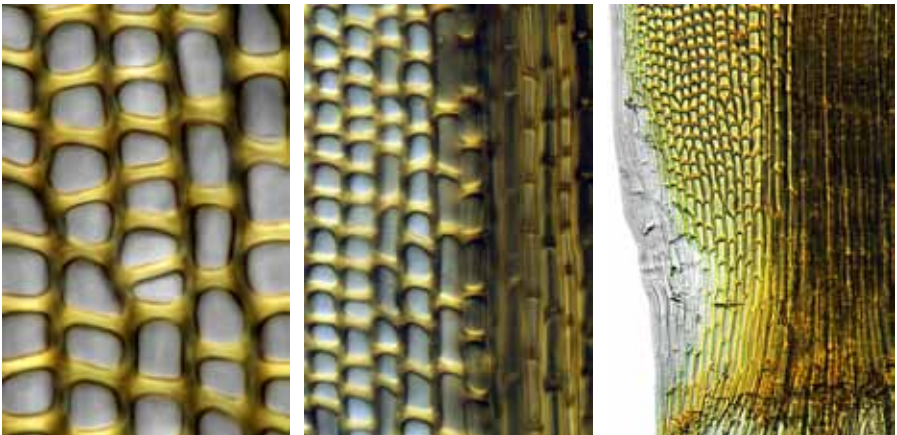
*margin:* entire below, denticulate near apex; broadly incurved

*cells:* 7–10  $\mu\text{m}$ , quadrate to oval, thick-walled, smooth

**capsule:** 1–1.5 mm, oblong to ovate-oblong,  $\pm$  erect, long-exserted, brown; seta to 10 mm, slender, flexuose; operculum short-beaked; peristome single, of 16 short, papillose teeth inserted below the rim, not split or perforate; spores 10–12  $\mu\text{m}$  in diam.



fertile and vegetative shoots (dry), capsule (dry), leaf outline, leaf apex, margin midleaf  
 1 mm, 1 mm, 0.5 mm, 0.5 mm, 10  $\mu\text{m}$ , 50  $\mu\text{m}$



lamina cells midleaf, juxtacostal cells midleaf, and hyaline border at leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

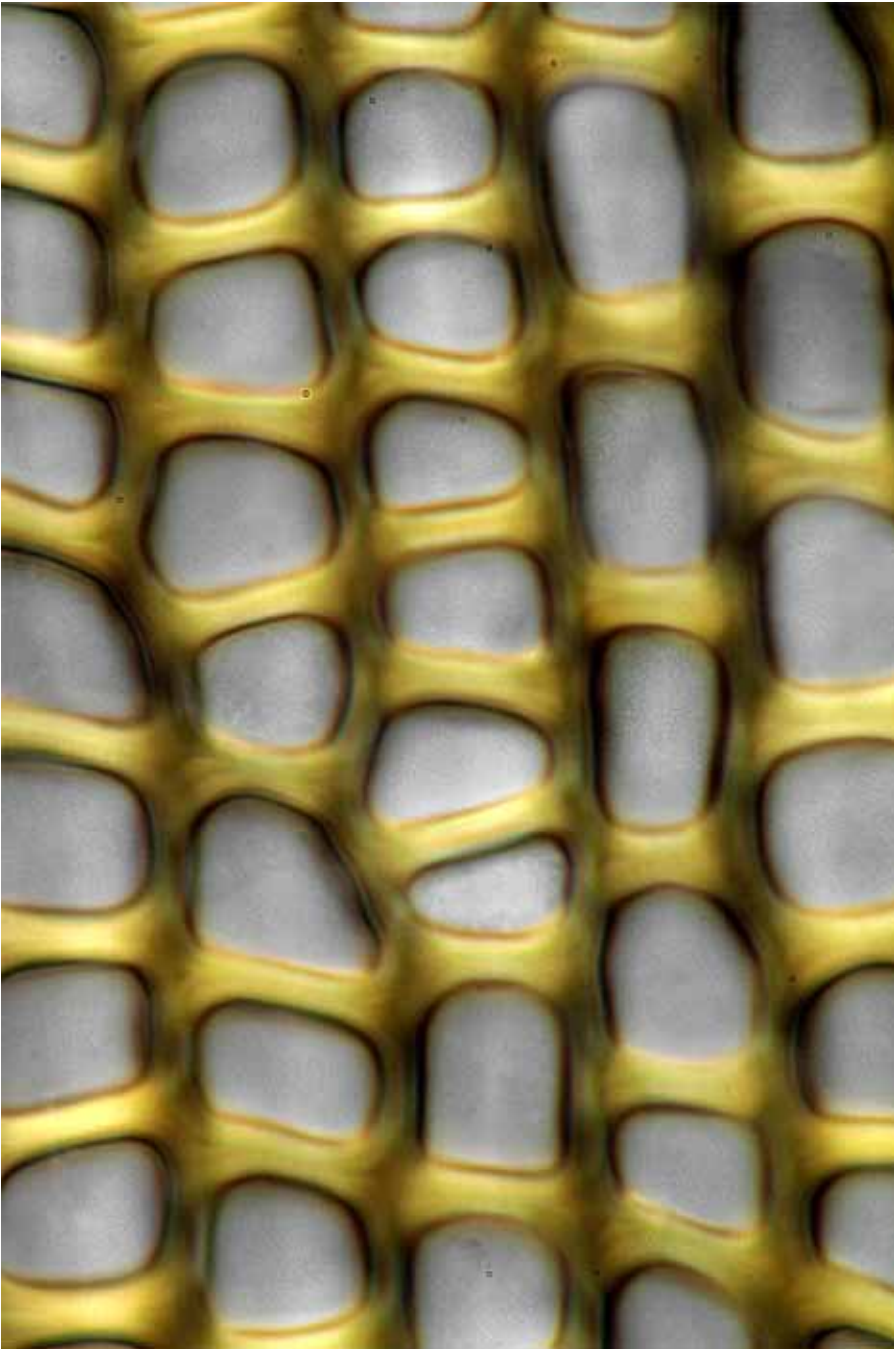
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*Ditrichum buchananii* vegetative shoots (dry)

1 mm

continued next page



*Ditrichum buchananii* cells midleaf  
10  $\mu\text{m}$

continued next page



***Ditrichum cylindricarpum*** (Müll.Hal.) Müll.Hal.

**form:** loosely tufted, simple or forked, dull yellow, brown, or green  
**habitat:** soil and occasionally rock

**leaf:** size: 3–6 × 0.5–1.0 mm

**shape:** subulate, reflexed, ± flexuose, suddenly contracted from an oblong, concave base

**tip:** acute

**base:** basal cells elongate, thick-walled near the costa

**costa:** filling the upper subula, excurrent, denticulate at the apex

**border:** in the sheath, a few rows of narrow, thin-walled, hyaline cells

**margin:** entire, plane

**cells:** subula cells 15 × 5 μm, short-rectangular, incrassate, smooth

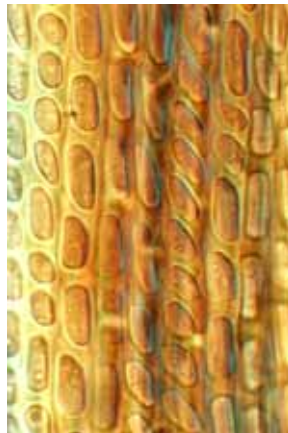
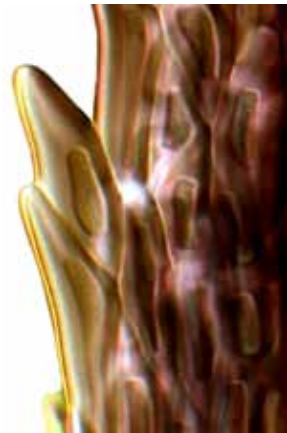
**capsule:** 2.5–4 mm, narrowly cylindrical, symmetrical, erect to inclined, pale brown; seta 10–30 mm, slender, reddish below

**notes:** differs from *Ditrichum punctulatum* in having a more narrowly cylindrical capsule with a dark mouth and neck



habit, mature capsules (dry) (2), leaf outlines (3), and leaf apex (2)

■ 1 mm, ■ 1 mm (2), ■ 0.5 mm (3), ■ 10 μm, ■ 10 μm



margin mid-subula, costa mid-subula, and basal costa and lamina cells

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page

**Ditrichum difficile** (Duby) M.Fleisch.

**form:** densely gregarious, sparingly branched, erect, silky, green to yellow-green  
**habitat:** soil, especially track cuttings, lowland to montane

**leaf:** size: 3–5 mm

*shape:* oval or oblong base narrowed to a subula

*tip:* long, channelled, flexuose subula

*base:* alar cells not differentiated

*costa:* flattened, pale, excurrent, filling the upper subula

*border:* not differentiated

*margin:* entire below, ± denticulate at the extreme tip, plane

*cells:* 40–90 × 4–8 μm, rectangular above, linear below, firm-walled, smooth

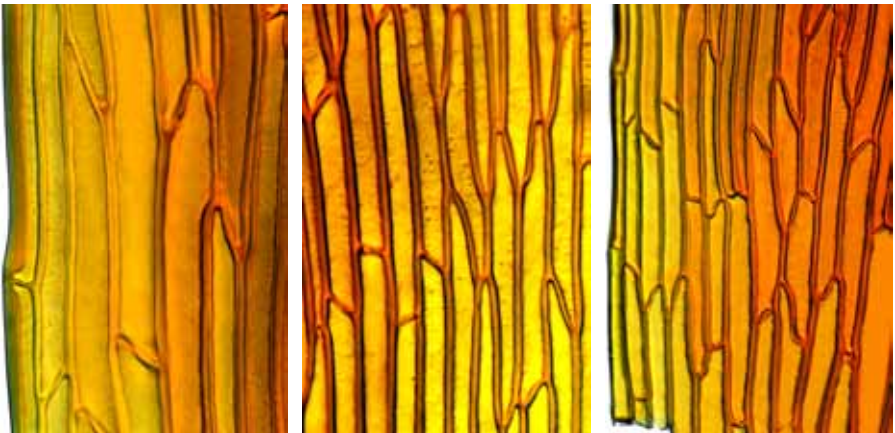
**capsule:** 2–3 mm, ovate-cylindric, inclined, long-exserted, flattened when dry, ± asymmetric, orange-brown; seta 20–30 mm, thin, flexuose, yellow or reddish; peristome teeth cleft to the base into two filiform, papillose segments; operculum beaked; calyptra cucullate, naked

**note:** common and widespread



vegetative shoot (dry), capsules (2), leaf outline, leaf apex, and midleaf margin

5 mm, 1 mm (2), 0.5 mm, 0.5 mm, 10 μm, 10 μm



margin near base, cells near leaf base, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page



*Ditrichum difficile* vegetative shoot (dry)

1 mm

continued next page

**Ditrichum flexicaule** (Schwägr.) Hampe

**form:** tufted, silky, yellowish, flexuose, fragile, branched stems, radiculose below, 10–50 mm tall

**habitat:** calcareous soil or rock

**leaf:** size: 3–3.5 mm

*shape:* lanceolate base narrowing to a subula

*tip:* bluntly acute to subobtuse on a long subula, sometimes hyaline-tipped

*base:* basal cells  $\pm$  rectangular, thin-walled

*costa:* wide, obscure, disappearing in the subula

*border:* 1–2 rows of narrow, hyaline cells in lower leaf

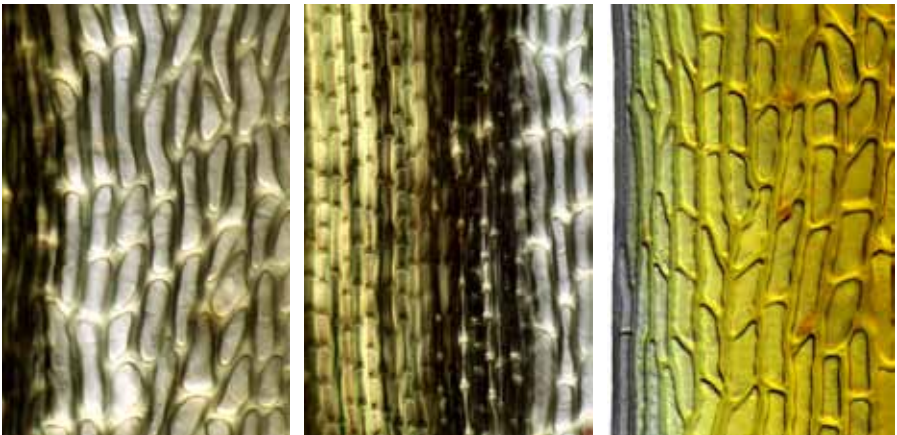
*margin:* entire, plane

*cells:* subula cells 8–10  $\mu\text{m}$ , isodiametric to oval, sheath cells 20–60  $\times$  5–20  $\mu\text{m}$ , linear to rhombic and irregular,  $\pm$  porose, firm- to thick-walled, smooth

**capsule:** capsules unknown



vegetative shoots (dry) (2), leaf outline, apex, subapex, and margin of upper shoulder  
 5 mm, 5 mm, 1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



juxtacostal cells midsheath, costa cells midsheath, and margin near leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

**Ditrichum punctulatum** Mitt.

**form:** tufts of erect, sparsely branched stems, dull, green to brown, the leaves glossy, spirally twisted along their length when dry, 10–30 mm tall

**habitat:** soil or rock

**leaf:** size: 3–4 mm

*shape:* from an oblong, concave base abruptly contracted to a narrow subula

*tip:* denticulate

*base:* basal leaves long-rectangular

*costa:* wide below, excurrent and filling the subula above

*border:* not differentiated

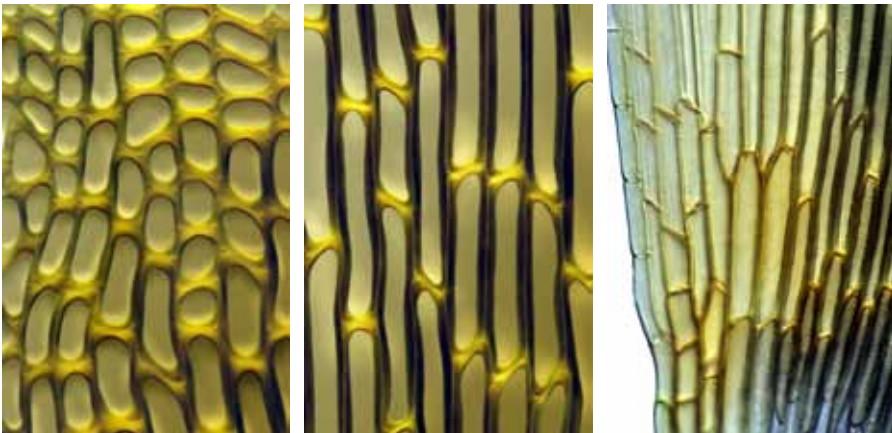
*margin:* entire below, denticulate toward the tip, plane

*cells:* 10–60 × 10 μm, rounded-quadrate at the shoulder and above, ± rectangular below, thick-walled, smooth

**capsule:** 1–2 mm, ellipsoid to oblong, symmetric, erect, exserted, brown; seta 10–13 mm, flexuose, reddish below, yellow above; operculum rostrate; peristome single, the teeth 16, deeply split into two densely papillose filaments

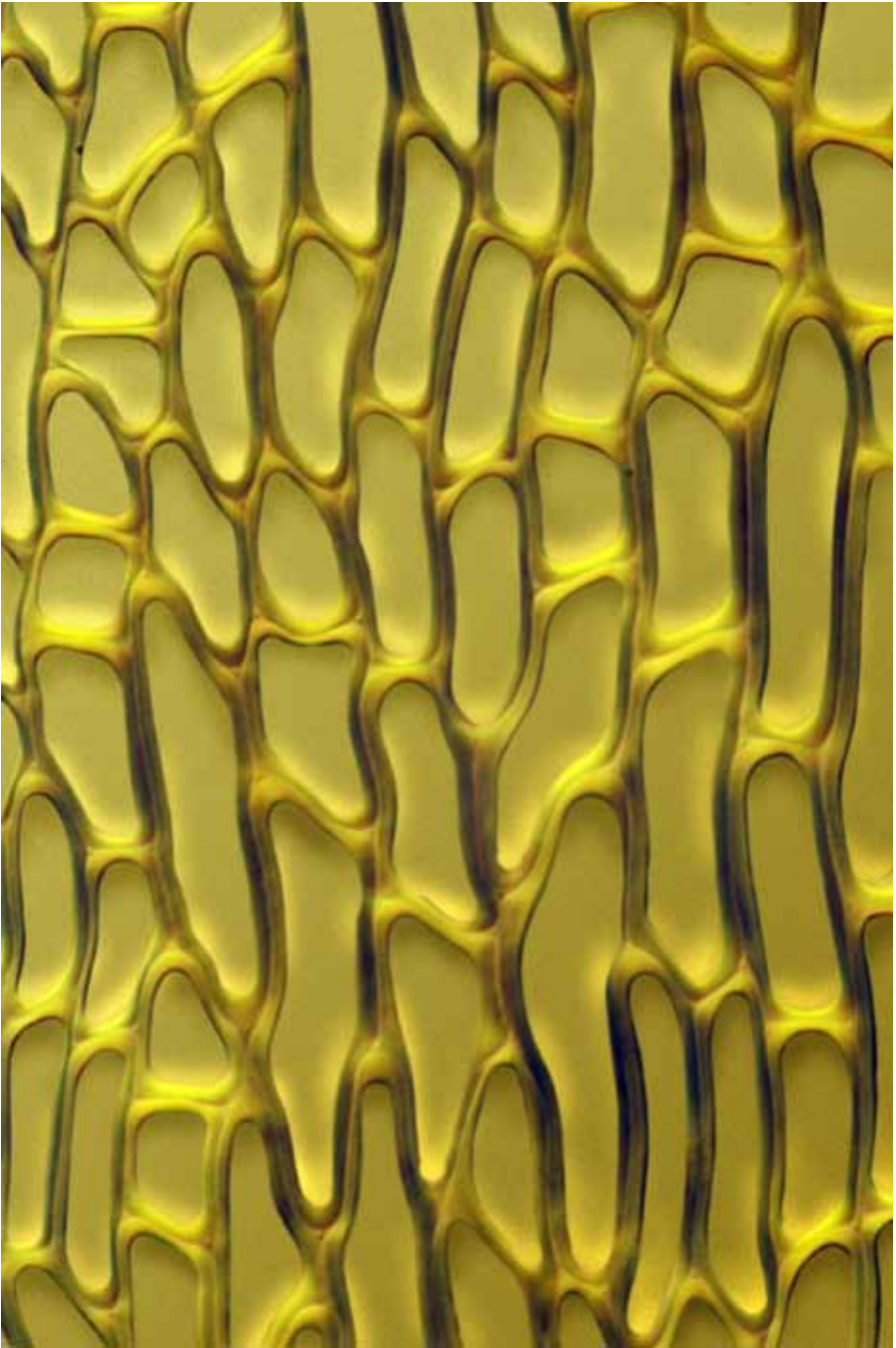


vegetative shoot (dry) (2), capsule (2), leaf outline, leaf apex, and margin of upper subula  
 1 mm, 1 mm, 0.5 mm, 0.1 mm, 0.1 mm, 10 μm, 10 μm



leaf shoulder cells, cells near leaf base, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page



*Ditrichum punctulatum* leaf shoulder cells  
10  $\mu$ m

continued next page

**Ditrichum strictum** (Hook.f. & Wilson) Hampe

**form:** tufted, sparsely branched, erect stems, dark below, 10–40 mm tall  
**habitat:** soil

**leaf:** size: 5–8 mm

*shape:* oblong-lanceolate base abruptly tapering to a narrow rigid subula

*tip:* ± serrulate, blunt, sometimes subspathulate

*base:* basal cells ± linear, firm-walled, pigmented

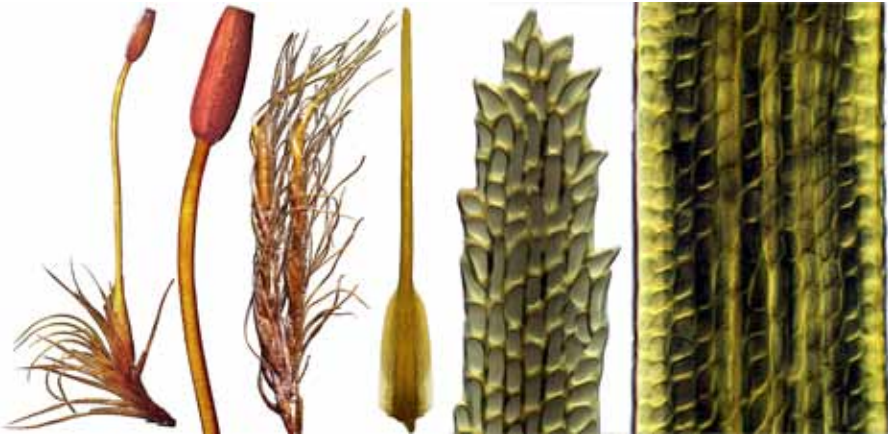
*costa:* strong below, almost filling the subula, failing at the apex

*border:* weak and partial, 1–4 rows of narrow, hyaline cells near the base

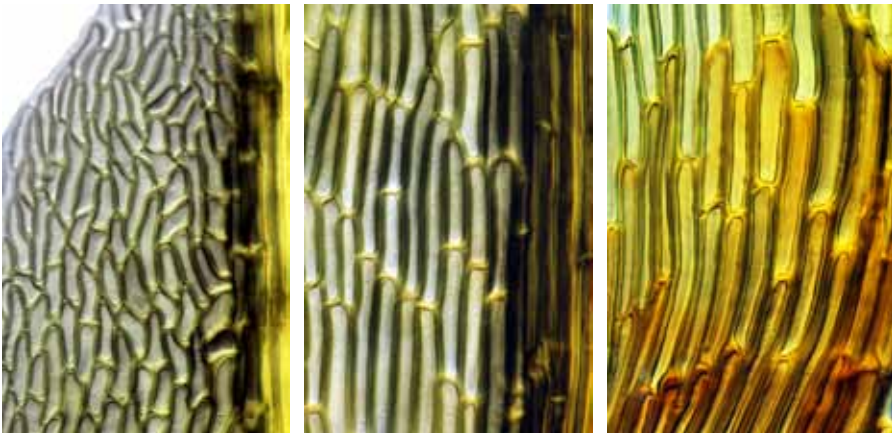
*margin:* entire below, ± denticulate near the apex, plane

*cells:* subula cells rounded-isodiametric, 8–10 μm, thick-walled, smooth; sheath cells 80–100 × 8–10 μm, rectangular to linear, firm-walled, smooth

**capsule:** 1.3–1.8 mm, ovate-oblong, erect, long-exserted, glossy, dark brown; seta 10–15 mm, orange, flexuose; peristome single, 16 teeth inserted below the capsule rim, undivided, coarsely papillose; operculum beak oblique, as long as the urn



fertile shoot, capsule, vegetative shoot (dry), leaf outline, leaf apex, and leaf subapex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm



irregular cells at shoulder, juxtacostal cells mid-sheath, and coloured cells near leaf base  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

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*Ditrichum strictum* juxtacostal cells mid-sheath  
10  $\mu\text{m}$

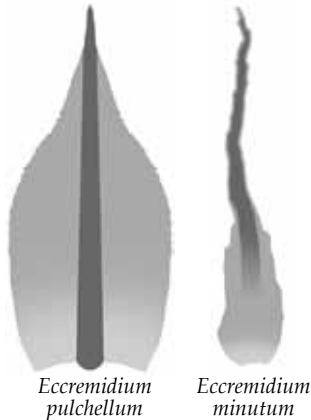
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**Key\* to the New Zealand species of *Eccremidium* (2)**

- 1 Leaves lanceolate, tapering to a subula; costa thin, occupying the larger part of the leaf in the upper half; seta straight, capsule erect..... ● ***Eccremidium minutum***  
 1: Leaves broadly ovate, bluntly apiculate or rounded; costa strong above but absent below; seta arcuate, capsule pendent..... ● ***Eccremidium pulchellum***

\* based partly on Catcheside, DG (1980): *Mosses of South Australia*. Government Printer, Adelaide. 95.



**Eccremidium minutum** (Mitt.) I.G.Stone & G.A.M.Scott

**form:** scattered or in turfs, erect, yellowish, radiculose below, to 2 mm tall  
**habitat:** soil

**leaf:** size: 1.0–1.5 × 0.2–0.3 mm

*shape:* subulate, ± flexuose, tapering from an oblong base

*tip:* acute

*base:* lower leaf cells long-rectangular, 85–110 × 15–20 μm, thin-walled

*costa:* ± filling the upper half of the leaf

*border:* not differentiated

*margin:* entire below, serrulate above, plane

*cells:* 60–80 × 8–12 μm, long-rectangular, thin-walled, smooth

**capsule:** 0.3 mm in diam., spherical, emergent, pendent, cleistocarpous, reddish;  
 seta 0.2 mm, curved at the apex; calyptra conic-mitrate, acuminate and darkened toward the apex; operculum and peristome absent



shoots (dry on far left), immature capsule, leaf outline, leaf apex, and leaf subapex

1 mm, 1 mm, 0.1 mm, 0.1 mm, 10 μm, 10 μm



subula near its base, margin lower leaf, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page

**Eccremidium pulchellum** (Hook.f. & Wilson) Müll.Hal.

**form:** gregarious, erect, ± branched stems, up to 5 mm tall

**habitat:** soil in exposed sites

**leaf:** size: 1.2–2.5 mm

*shape:* ± triangular to lanceolate and ovate

*tip:* bluntly apiculate to cuspidate or subulate

*base:* basal cells short-rectangular to subquadrate, thin-walled

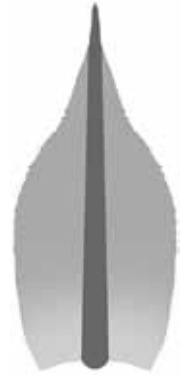
*costa:* excurrent, ± filling the cusp or subula

*border:* not differentiated

*margin:* entire to serrulate, adjacent cell ends projecting in pairs, plane

*cells:* 20–50 × 10–15 μm, irregularly rhombic, firm- to thick-walled, smooth

**capsule:** 0.3 mm, spherical, erect, emergent, brown, cleistocarpous, dehiscent at about mid-capsule; seta 0.2 mm; calyptra dark yellow, conic-mitrate, acuminate, blackish above, not flared below; spores 60–80 μm in diam.



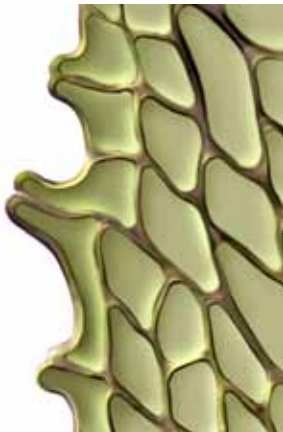
vegetative shoots (dry) (2), leaf outline, and leaf apex (2)

1 mm (2),

0.5 mm,

50 μm,

50 μm



margin upper leaf, justacostal cells midleaf, and leaf basal angle

10 μm,

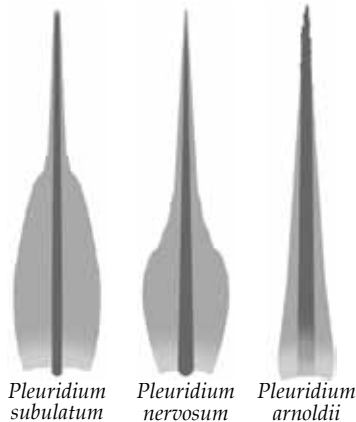
10 μm,

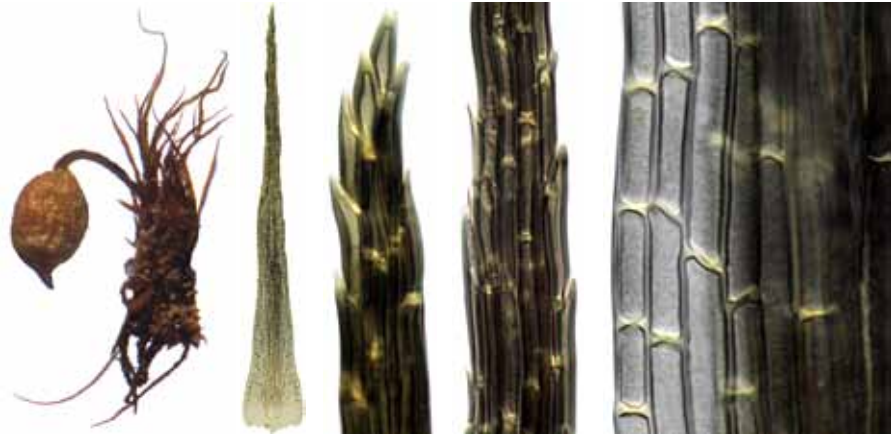
50 μm

**Key\* to the New Zealand species of *Pleuridium* (3)**

- 1 Seta curved..... ● ***Pleuridium arnoldii***  
 1: Seta straight or nearly so..... 2
- 2(1): Capsule long-beaked..... ● ***Pleuridium subulatum***  
 2: Capsule short-pointed..... ● ***Pleuridium nervosum***

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*. RSNZ Bull. 5, 69.



**Pleuridium arnoldii** (R.Br.bis) Paris**form:** tufted, minute, densely foliate, silky, branched stems, up to 2 mm tall**habitat:** exposed soil, especially disturbed sites in pastures or on cutbanks, from mid- to high-montane elevations**leaf:** size: to  $2 \times 0.3$  mm*shape:* lanceolate-subulate from a concave base*tip:* long-acuminate, ending in a bluntly acute tip*base:* undifferentiated*costa:* percurrent to excurrent, almost filling the subula*border:* not differentiated*margin:* entire below, denticulate in the subula, plane*cells:*  $20\text{--}50 \times 8\text{--}12$   $\mu\text{m}$ , narrowly oblong, firm-walled, smooth**capsule:** 0.5 mm in diam., nearly globose, apiculate, erect, protruding from among the leaves, cleistocarpous, long-beaked seta strongly arched; calyptra cucullate; operculum absent; peristome absent; spores 30  $\mu\text{m}$  in diam.

fertile shoot, leaf outline, leaf apex, leaf subapex, and margin midleaf

 0.5 mm, 0.1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 


cells midleaf, costa midleaf, and margin near leaf base

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 

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**Pleuroidium nervosum** (Hook.) Mitt.

**form:** loose to dense mats of small (3–5 mm tall), unbranched, comose stems  
**habitat:** bare exposed soil

**leaf:** size: 0.5–3 × 0.3–0.7 mm

**shape:** ± subulate from an ovate or ovate-lanceolate base

**tip:** acute to long-acuminate

**base:** undifferentiated

**costa:** percurrent to excurrent

**border:** not differentiated

**margin:** entire below, crenate to denticulate above, plane

**cells:** 20–50 × 10–12 μm, rectangular to rhombic, firm-walled, smooth

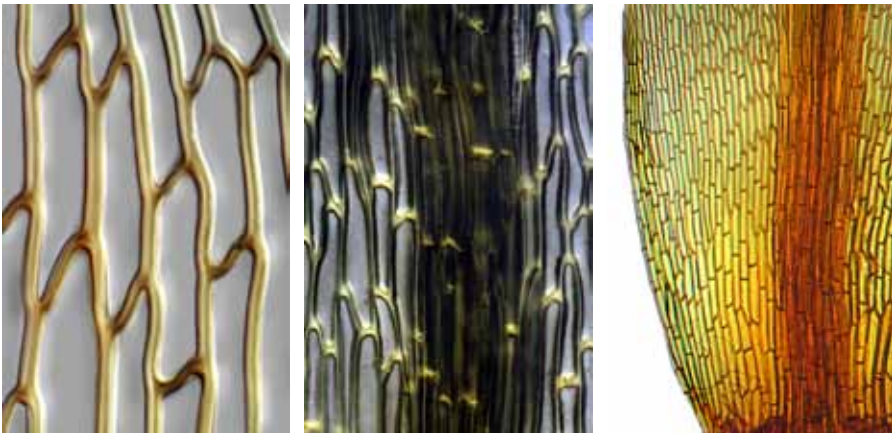
**capsule:** 1 mm in diam., ovoid to globose, erect, immersed, cleistocarpous, orange- to chestnut-coloured, apiculate; seta 1 mm long

**notes:** *Acaulon integrifolium* also has a reddish capsule, but differs in having wider leaves and leaf cells, and a capsule that's not apiculate



fertile shoots (2), capsule, leaf outline, leaf apex, and margin midleaf

1 mm, 1 mm, 0.5 mm, 0.5 mm, 30 μm, 10 μm



cells midleaf, costa midleaf, and leaf basal angle

10 μm, 50 μm, 50 μm

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*Pleuridium nervosum* costa midleaf  
10  $\mu\text{m}$

continued next page

**Pleuridium subulatum** (Hedw.) Rabenh.

**form:** gregarious to tufted, yellow-brown, erect, sparsely branched, to 3 mm tall  
**habitat:** exposed soil in lawns, old fields, pastures, cemeteries, and roadsides

**leaf:** size: to 1.5–4 mm, ± homomallous

*shape:* long-setaceous from an oblong or ovate sheathing base

*tip:* subulate

*base:* cells of sheathing base short-rectangular, thin-walled

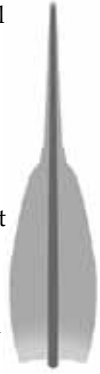
*costa:* stout, wide at the base, ± filling the subula

*border:* not differentiated

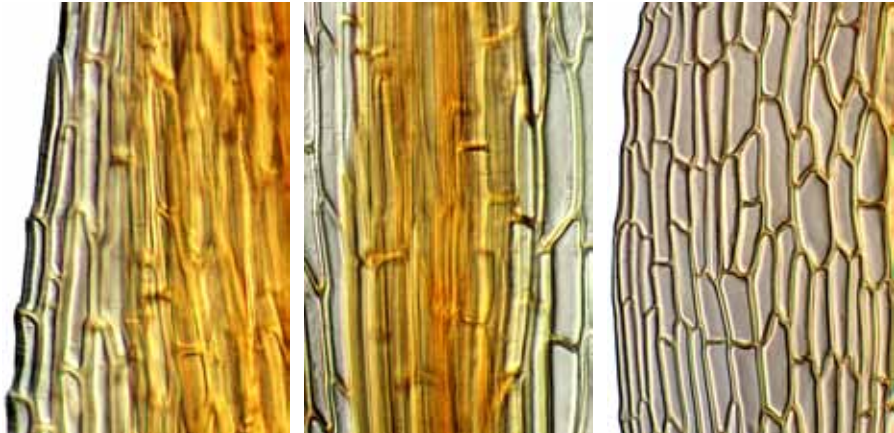
*margin:* serrulate above, the marginal wall thickened, tubulose above, sinuose at the shoulder, plane

*cells:* 20–70 × 5–8 μm, linear-flexuose, firm-walled, smooth

**capsule:** 0.6–0.8 mm, ovoid to subglobose, orange-brown, apiculate, cleistocarpous, stomatose throughout; seta 0.4–1 mm; calyptra cucullate; operculum absent; peristome absent; spores 24–41 μm in diam.



fertile shoots (dry) (4), leaf outline, subula, subapex, and thickened marginal cell walls  
 1 mm (2), 1 mm (2), 0.1 mm, 0.1 mm, 50 μm, 10 μm



margin midleaf, costa midleaf, and margin near leaf base  
 10 μm, 10 μm, 10 μm

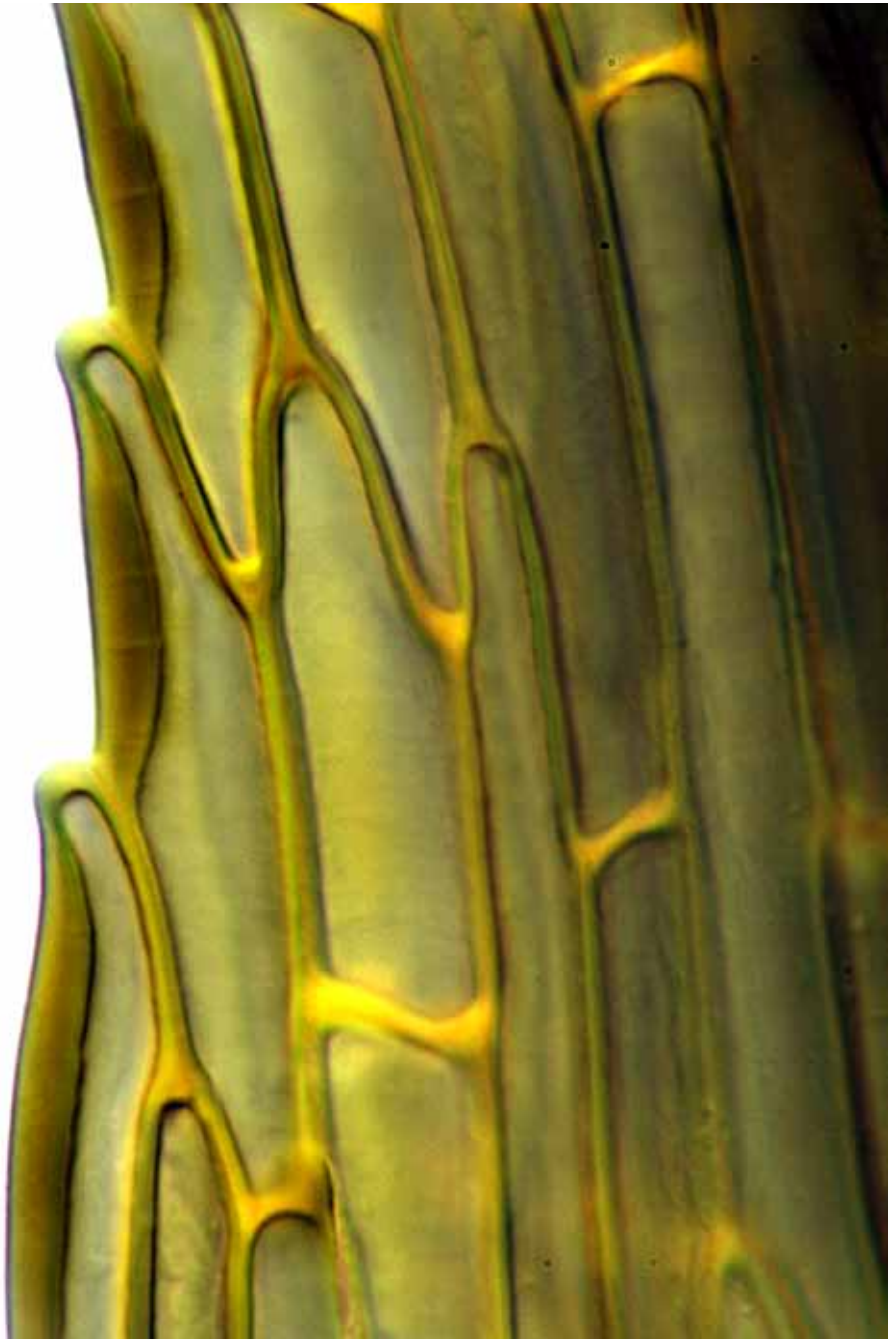
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*Pleuridium subulatum* fertile shoots (dry), apiculate cleistocarpous capsule, and calyptra  
1 mm, 0.1 mm (2)

continued next page



*Pleuridium subulatum* thickened marginal cell walls  
10  $\mu\text{m}$

continued next page

**Saelania glaucescens** (Hedw.) Broth. ex Bom. & Broth.

**form:** tufted, soft, glaucous blue-green, glossy, erect, freely branched stems, with hyaline radicles in the leaf axils, up to 10 mm tall

**habitat:** rock crevices or rarely bark

**leaf:** size: 2–2.5 mm

*shape:* narrowly ovate-lanceolate or oblong-lanceolate

*tip:* acute to acuminate

*base:* basal cells shorter and wider than the other blade cells

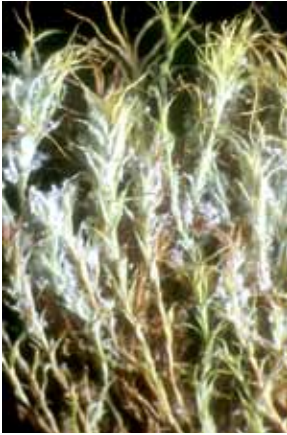
*costa:* strong, terete, percurrent

*border:* not differentiated

*margin:* irregularly serrate above, recurved

*cells:* 80–150 × 12–15 μm, linear-rhombic, thin-walled, smooth

**capsule:** 0.6–1 mm, oval or oblong-oval, suberect to horizontal, contracted below the mouth when dry, brown; seta to 10 mm, slender, reddish, flexuose; operculum conic; peristome teeth purple, densely papillose, split into two filiform segments; spores 15–18 μm in diam.



vegetative habit (dry) (2), leaf outline, and leaf apex

1 mm, 0.5 mm, 0.5 mm, 10 μm

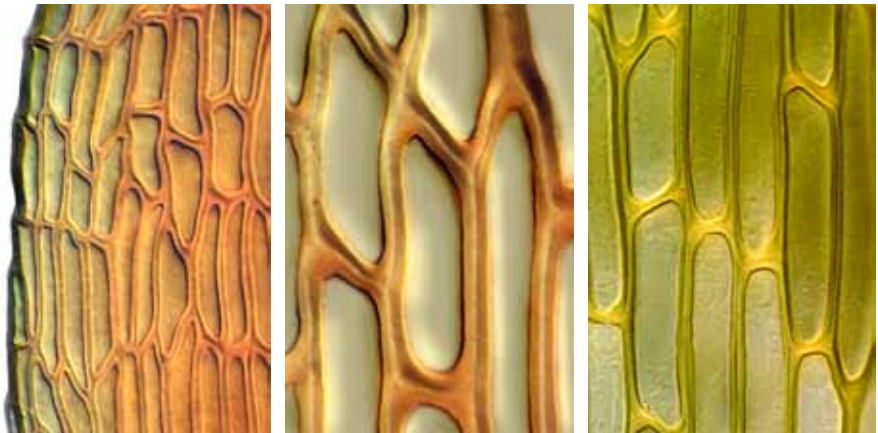


leaf subapex, margin midleaf, and leaf base cells

50 μm, 10 μm, 10 μm

**Trichodon cylindricus** (Hedw.) Schimp.**form:** tufted, erect, slender, yellowish, unbranched stems, to 6 mm tall**habitat:** on exposed, bare, acidic soil in  $\pm$  disturbed sites such as roadsides**leaf:** size: 1–3 mm*shape:* subulate from a broad sheathing base*tip:* subulate, tubulose*base:* basal cells larger than other cells in the blade*costa:* percurrent to excurrent, filling the distal subula, prorulose abaxially above*border:* not differentiated*margin:* serrulate above, plane*cells:* 17–40  $\times$  3–5  $\mu\text{m}$ , rectangular, firm-walled, prorulose distally**capsule:** 1.3–2 mm, narrowly cylindrical, exserted, suberect to inclined,  $\pm$  curved, smooth, pale brown; seta 5–25 mm, orange; operculum bluntly conic; peristome teeth 240–340  $\mu\text{m}$  tall; spores 11–13  $\mu\text{m}$  in diam.

vegetative shoot, capsule, leaf outline, leaf apices (2), and leaf shoulder margin  
 0.5 mm, 0.5 mm, 0.5 mm, 5  $\mu\text{m}$ , 5  $\mu\text{m}$ , 5  $\mu\text{m}$

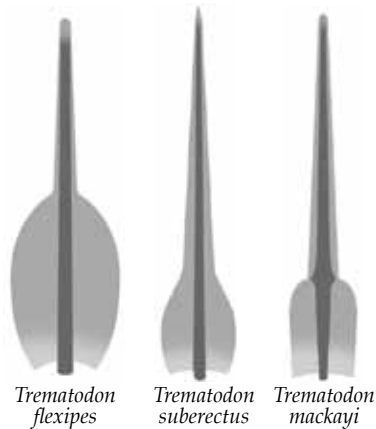


upper shoulder margin, upper shoulder cells, and leaf base cells  
 5  $\mu\text{m}$ , 5  $\mu\text{m}$ , 5  $\mu\text{m}$

**Key\* to the New Zealand species of *Trematodon* (3)**

- 1 Capsule gymnostomous; spores > 50  $\mu\text{m}$  in diam. .... ● ***Trematodon mackayi***  
 1: Capsule peristomate; spores < 40  $\mu\text{m}$  in diam. .... 2
- 2(1:) Capsule 1.5–2 mm; seta strongly flexuose; peristome teeth 120–180  $\mu\text{m}$ , reflexed when dry ..... ● ***Trematodon flexipes***  
 2: Capsule 3–6 mm; seta not flexuose; peristome teeth 300–500  $\mu\text{m}$ , erect when dry ..... ● ***Trematodon suberectus***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*. RSNZ Bull. 5, 94.



**Trematodon flexipes** Mitt.

**form:** gregarious, pale to yellowish, erect, unbranched stems, 2–5 mm tall  
**habitat:** exposed soil, gravel, or peat along streams or tarn margins, or along tracks or in other disturbed sites, from lowland to mid-montane elevations

**leaf:** size: 1.5–2.5 × 0.5–0.6 mm

**shape:** elliptic to oval sheathing base abruptly narrowed to a long subula

**tip:** acute

**base:** basal cells 70–110 × 12–20 μm, rectangular, thin-walled

**costa:** ± filling the upper subula

**border:** not differentiated

**margin:** entire, plane

**cells:** subula cells 20–50 × 10–15 μm, ± oblong, firm-walled, smooth

**capsule:** 1.5–2 mm, ovoid, long-necked, ± strumose, erect; seta 2–5 mm, slender, flexuose, pale; operculum rostrate as long as the capsule; calyptra cucullate; peristome teeth vertically striate; spores 30–35 μm in diam.

**note:** differs from *Trematodon mackayi* in having a peristome



fertile shoots (cleared) (2), leaf outline, leaf apex, and leaf subapex  
 ■ 1 mm (2), ■ 0.25 mm, ■ 50 μm, ■ 10 μm



shoulder margin, costa midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

continued next page

**Trematodon mackayi** (R.Br.bis) Broth.

**form:** densely gregarious, pale to yellowish, erect, rarely branched, 2–6 mm tall  
**habitat:** exposed soil, often in disturbed sites, from lowland to mid-montane

**leaf:** size: 1.5–2(–8) × 0.3–0.4 mm, contorted when dry

**shape:** subulate, contracting from an oblong, concave, strongly sheathing base

**tip:** abruptly tapered to a long, narrow subula

**base:** basal cells 70–110 × 12–20 μm, rectangular, thin-walled. smooth

**costa:** filling most of the subula, sometimes slightly excurrent

**border:** not differentiated

**margin:** entire below, denticulate above, plane

**cells:** subula cells 20–50 × 10–15 μm, ± oblong, firm-walled, smooth

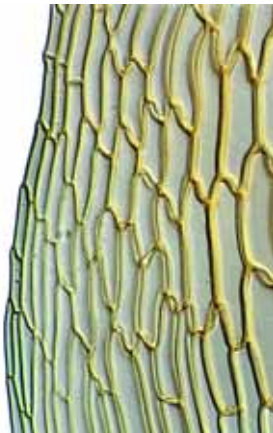
**capsule:** 4–5 mm, clavate, suberect, ± curved, long-necked, gymnostomous (peristome reduced to a short hyaline membrane); seta 10–20 mm, slender, weakly flexuose, pale; calyptra 2–4-lobed at the base; operculum finely long-rostrate; spores uncommonly large, 50–70 μm in diam.

**notes:** differs from *Trematodon flexipes* and *T. suberectus* in lacking a peristome



fertile and vegetative shoots, leaf outline, leaf apex, and subula

■ 1 mm, ■ 1 mm, ■ 0.25 mm, ■ 10 μm, ■ 10 μm



margin mid-sheath (2), and margin near leaf base

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page

**Trematodon suberectus** Mitt.

**form:** densely gregarious, erect, radiculose, sparsely branched stems, 3–6 mm tall  
**habitat:** exposed soil, sand, or gravel in disturbed sites, lowland to mid-montane

**leaf:** size: 2–2.5 mm, contorted when dry

*shape:* ovate-oblong, gradually narrowed to a flexuose subula

*tip:* acute

*base:* sheathing; basal cells  $70\text{--}120 \times 12\text{--}20 \mu\text{m}$

*costa:* reaching the subula apex

*border:* not differentiated

*margin:*  $\pm$  denticulate toward the apex, entire below, plane

*cells:* upper cells  $10\text{--}15 \mu\text{m}$ , oblong to quadrate, thin-walled, smooth

**capsule:** 3–6 mm, cylindric, long-necked, erect or nearly so, variably curved to arcuate; seta 7–15(–30) mm, thin, pale yellow,  $\pm$  flexuose; annulus present; calyptra cucullate; operculum finely long-rostrate; peristome teeth 16, erect, joined at the base to form a low membrane, narrowly lanceolate, unequally split, joined at the tips, vertically striolate; spores  $20\text{--}30 \mu\text{m}$  in diam.



vegetative habit (moist), immature capsules (2), peristome teeth, leaf outline, leaf apex  
 1 mm, 0.5 mm (2), 50  $\mu\text{m}$ , 0.25 mm, 50  $\mu\text{m}$



leaf base, costa in upper leaf, and costa near leaf base  
 100  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$



**Erpodium glaucum** (Wilson) I.G.Stone

**form:** matted, creeping, irregularly branched stems, radiculose below, to 10 mm long, the leaves 4-ranked, dimorphic, weakly complanate, glaucous

**habitat:** bark of tree trunks and exposed roots, or rotting logs and rock

**leaf:** size: 0.4–0.7 × 0.5 mm; ventral leaves smaller

**shape:** dimorphic; dorsolateral leaves ovate; ventral leaves lanceolate

**tip:** dorsolateral leaves acute, ± apiculate; ventral leaves ± acuminate

**base:** a few basal cells longer than the other blade cells

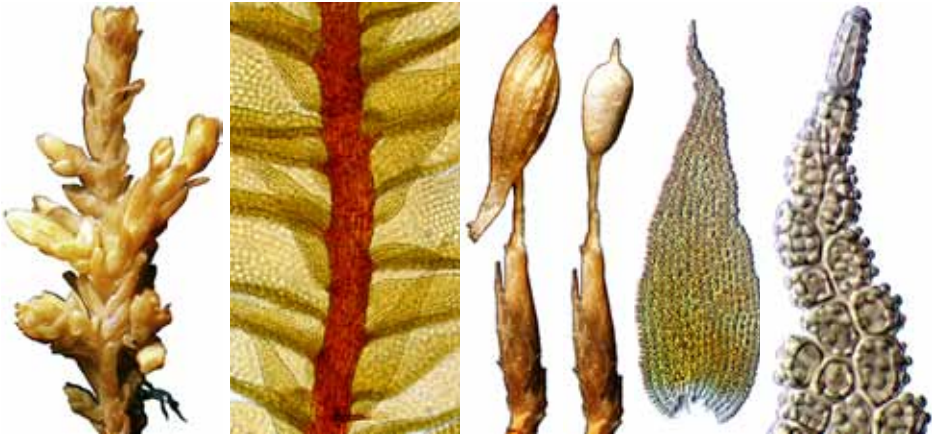
**costa:** none

**border:** not differentiated

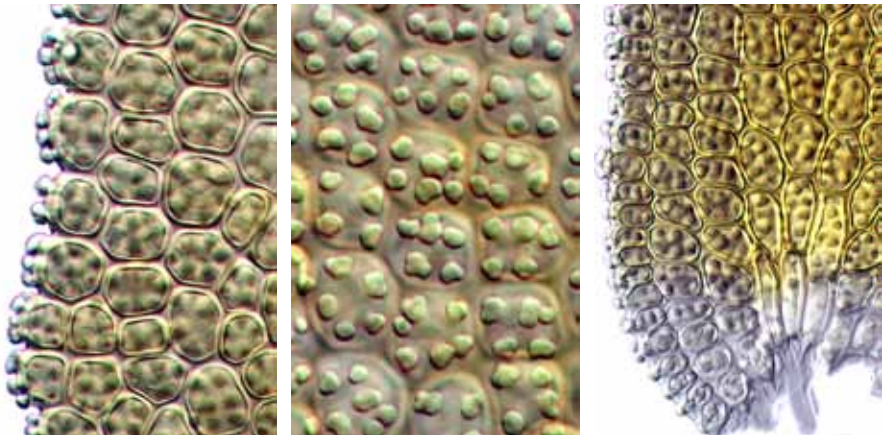
**margin:** crenulate-papillose, plane

**cells:** 20–30 μm, rounded-hexagonal, thin-walled, bulging, pluripapillose

**capsule:** 0.3 mm, ovoid, estomate, erect, emergent to exerted, annulus vestigial; seta 0.7–1 mm; calyptra cylindric, plicate, twisted, covering the entire capsule when immature, often clasping the seta below; operculum rostrate; peristome none; spores 32–36 μm in diam.



vegetative shoot (moist), dorsolateral leaves, calyptra, capsule, leaf outline, and leaf apex  
 1 mm, 0.1 mm, 1 mm, 1 mm, 0.1 mm, 10 μm

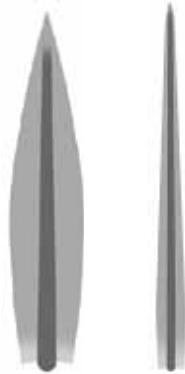


margin midleaf, lamina cell papillae, and leaf basal angle  
 10 μm, 10 μm, 10 μm

### Key to the New Zealand species of *Amphidium* (2)

- 1 Leaves oblong-lanceolate, 1.2–2.0 mm long ..... ● ***Amphidium lapponicum***  
 1: Leaves linear-lanceolate to ligulate, 2.0–3.8 mm long ... ● ***Amphidium cyathicarpum***

\* based partly on Beaver, J; Allison, KW; Child, J (1992): *The Mosses of New Zealand*. University of Otago Press, Dunedin.



*Amphidium  
lapponicum*

*Amphidium  
cyathicarpum*

**Amphidium cyathicarpum** (Mont.) Broth.**form:** densely tufted, soft, dull, yellowish, simple or branched, 10–30 mm tall**habitat:** damp, shaded, usually acidic rock walls near streams at high altitude**leaf:** size: 2.5–4.0 × 0.2 mm**shape:** linear-lanceolate to ligulate, carinate, crisped when dry**tip:** acute**base:** basal cells oblong, firm-walled, and hyaline; alar cells not differentiated**costa:** subpercurrent or disappearing in the apex, yellow**border:** not differentiated**margin:** irregularly denticulate above, plane or narrowly revolute below**cells:** 9–12 μm, subquadrate, incrassate, multi low-papillose**capsule:** 1–1.5 mm, oval to pyriform, emergent, deeply 8-grooved and wide-mouthed when empty; seta 1.0–2.0 mm, straight or flexuose; peristome none; spores 11–15 μm in diam.**note:** differs from species of *Anoetangium* and *Zygodon* in having deuters (guide cells) in the centre of its costa cross-section

fertile shoots (dry) (3), capsule (dry), leaf outline, and leaf apex

1 mm, 1 mm, 1 mm, 1 mm, 0.25 mm, 5 μm



margin midleaf, and lamina surface papillae (2)

10 μm, 10 μm, 10 μm

**Amphidium lapponicum** (Hedw.) Schimp.

**form:** densely tufted, erect, dark green or brown stems, the leaves curled and contorted when dry, to 15 mm

**habitat:** damp acidic rock, in crevices or below overhangs, to 1500 m

**leaf:** size: 2–3 mm

**shape:** narrowly oblong-lanceolate; crispate when dry

**tip:** acute

**base:** basal cells somewhat enlarged, firm-walled, hyaline or pale yellow

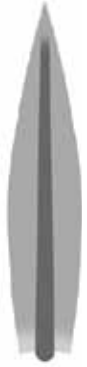
**costa:** subpercurrent

**border:** not differentiated

**margin:** entire, plane

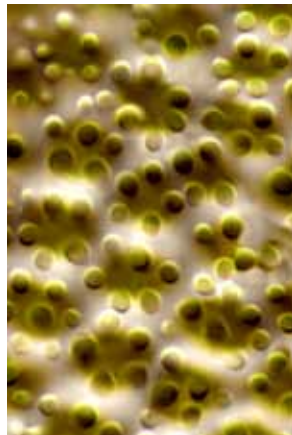
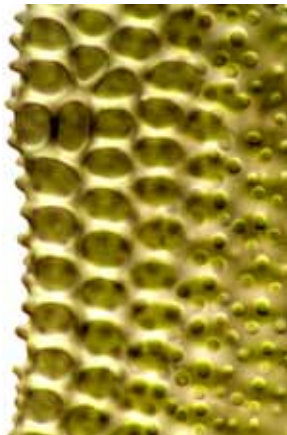
**cells:** 9–12  $\mu\text{m}$ , isodiametric, thick-walled, densely warty-papillose

**capsule:** 0.8–1.3 mm, oblong to pyriform, half-emergent, erect, 8-ribbed at maturity, the mouth flared when dry and empty; seta 1–1.5 mm; calyptra cucullate; operculum obliquely short-rostrate; peristome none; spores 12–15  $\mu\text{m}$  in diam.



vegetative and fertile shoots (3), leaf outline, and leaf apex

1 mm, 0.5 mm, 0.5 mm, 0.5 mm, 10  $\mu\text{m}$



margin midleaf, lamina papillae (detail), and leaf base

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Amphidium lapponicum* fertile shoot and immature capsule with calyptra

1 mm (left),

0.5 mm (right)

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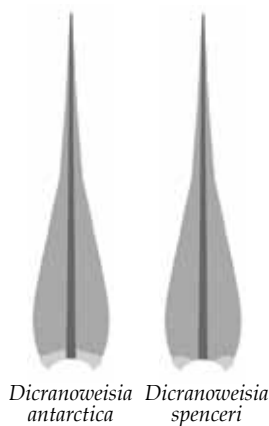
*Amphidium lapponicum* leaf apex showing papillae  
10  $\mu\text{m}$

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**Key\* to the New Zealand species of *Dicranoweisia* (2)**

- 1 Alar cells conspicuous; capsule exannulate and astomatose; peristome teeth entire and coarsely papillose ..... ● ***Dicranoweisia antarctica***  
 1: Alar cells only weakly developed; capsule annulate and stomatose; peristome teeth deeply bifid and finely papillose above, striolate below ..... ● ***Dicranoweisia spenceri***

\* based partly on Scott, GAM; Stone, IG; Rosser, C (1976): *The Mosses of Southern Australia*. Academic Press, London. 158.



**Dicranoweisia antarctica** (C.M.) Paris

**form:** dense cushions of simple or branched stems, not tomentose, yellowish above, brown below, 15–40 mm tall

**habitat:** on acidic rock or soil over rock, in exposed sites, to 2600 m

**leaf:** size: 2–4 × 0.4–1.0 mm

*shape:* flexuose subula from an ovate-lanceolate base, concave to tubulose

*tip:* acute, strongly crisped and corkscrewed when dry

*base:* alar cells numerous, coloured, inflated, weakly auriculate

*costa:* shortly excurrent in the subula

*border:* not differentiated

*margin:* entire, plane

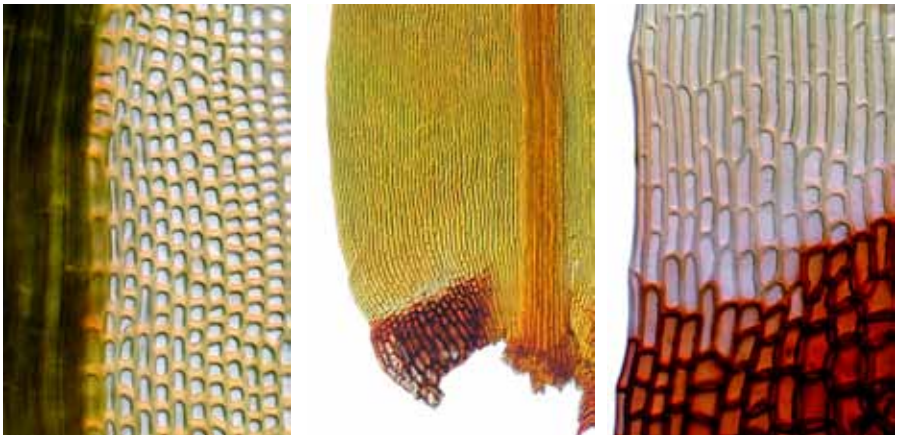
*cells:* 4–6  $\mu\text{m}$ ,  $\pm$  quadrate, incrassate, smooth

**capsule:** 1.0–1.8 mm, oval to elliptic, erect, symmetric; seta 5–22 mm, slender, yellow; calyptra cucullate; operculum long-rostrate; peristome dicranoid, the teeth lanceolate, orange, inserted below rim; spores 15–24  $\mu\text{m}$  in diam., green

**note:** widely distributed in high latitudes of both hemispheres



habit (dry), shoot (dry), capsule, leaf outline, leaf apex, and lower leaf margin  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



costa midleaf, leaf basal angle, and alar region detail  
 ■ 50  $\mu\text{m}$ , ■ 100  $\mu\text{m}$ , ■ 50  $\mu\text{m}$



**Dicranoweisia spenceri** Dixon & Sainsbury

**form:** densely tufted, yellow-green, erect, seldom-branched stems, to 10 mm tall  
**habitat:** bark and rotting wood in open montane *Nothofagus* forest

**leaf:** size: 2–5 mm

**shape:** ovate-lanceolate base gradually narrowing to a long flexuose subula

**tip:** acute

**base:** lower cells narrowly linear; alar cells rectangular, orange to red

**costa:** excurrent in the subula

**border:** not differentiated

**margin:** entire, plane

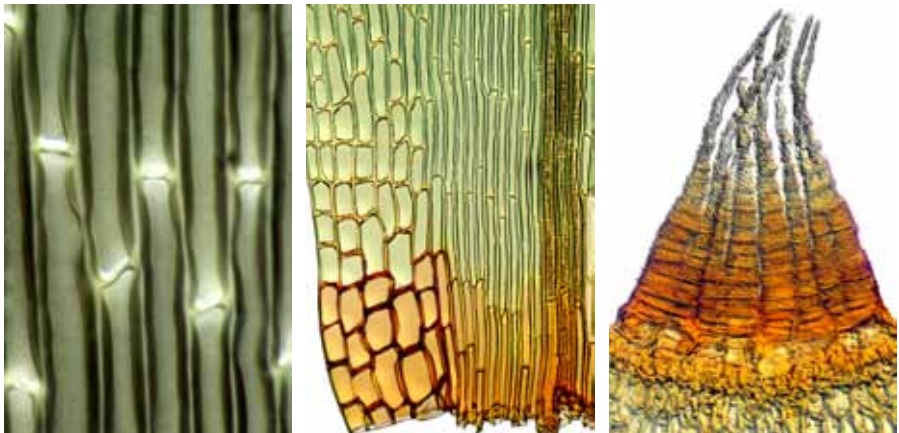
**cells:** 10–50 × 10 μm, oval to oblong, firm- to thick-walled, smooth

**capsule:** to 1.3 mm, oval to oblong, erect, exserted, light brown, red-rimmed;  
 seta to 10 mm, slender, yellow; operculum long-beaked; calyptra cucullate;  
 peristome teeth deeply bifid, striolate below

**notes:** known from only a few sites; collected recently from the Waihohonu Hut area of Tongariro National Park

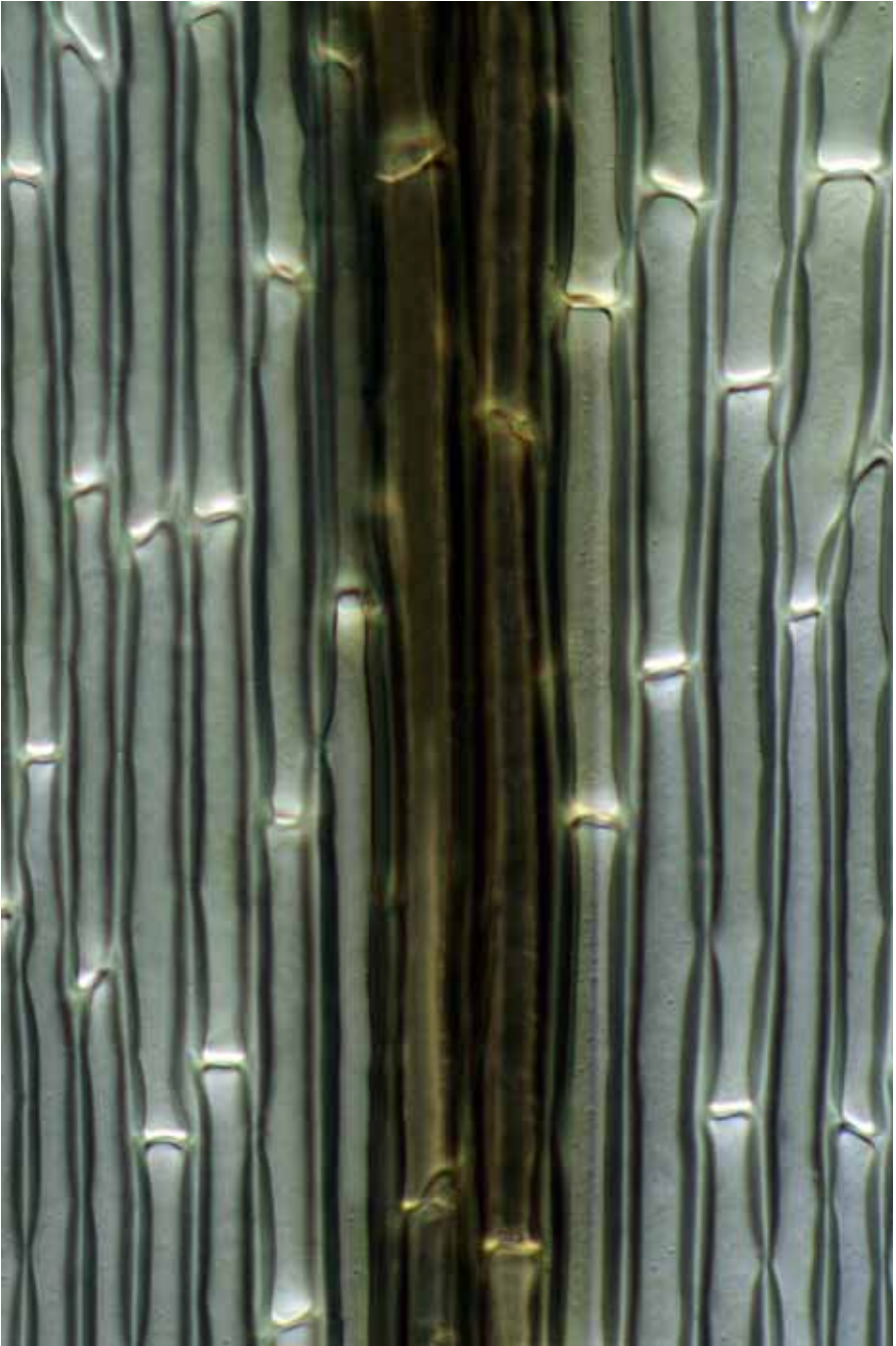


fertile shoot (dry), capsule, peristome, leaf outline, leaf apex, and margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



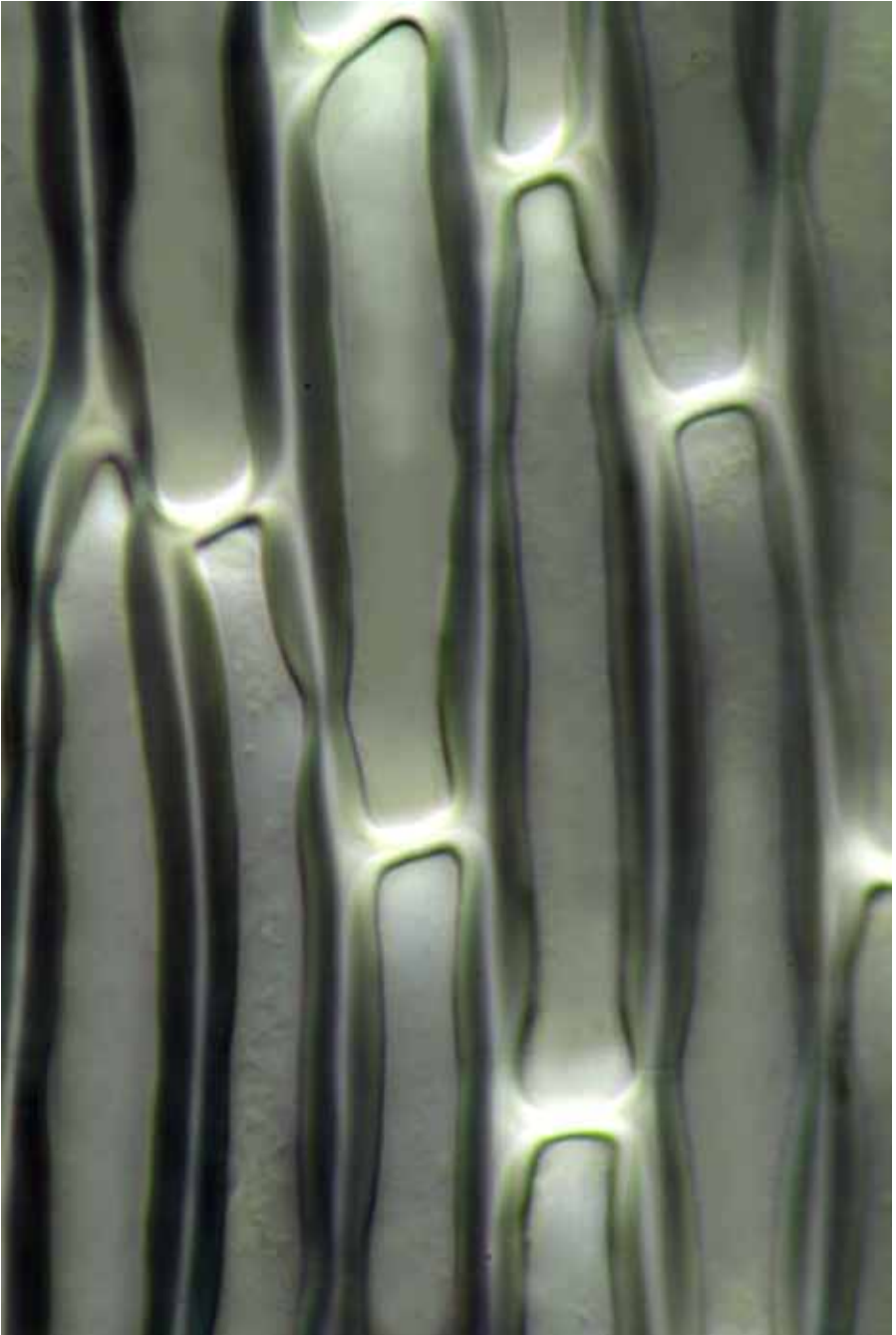
juxtacostal basal cells, leaf basal angle, and 4-tooth peristome fragment  
 ■ 10 μm, ■ 50 μm, ■ 50 μm

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*Dicranoweisia spenceri* costa lower leaf  
10  $\mu$ m

continued next page



*Dicranoweisia spenceri* juxtacostal basal cells  
10  $\mu\text{m}$

**Holodontium strictum** (Hook.f. & Wilson) Ochyra

**form:** loosely tufted, erect, dull, golden,  $\pm$  unbranched stems, 20–50 mm tall  
**habitat:** wet soil or rock, sometimes submerged

**leaf:** size: 5–7 mm

*shape:* subulate from an ovate-lanceolate base,  $\pm$  falcate-secund

*tip:* gradually narrowed to an acute acumen

*base:* alar cells inflated, coloured, in distinct auricles

*costa:* excurrent and filling the width of the upper subula

*border:* not differentiated

*margin:* entire to slightly dentate near the apex, plane

*cells:*  $50\text{--}90 \times 7\text{--}9 \mu\text{m}$ , linear, thick-walled, smooth

**capsule:** 2–3 mm, narrowly oblong, oval, or subcylindric, erect, sparsely stomatose; seta to 25 mm, red, flexuose; calyptra cucullate, smooth, entire below; operculum long-rostrate; spores papillose



vegetative habit, leaf outline, leaf apex, and margin midleaf  
 ■ 5 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



cells midleaf (2) and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Kiaeria pumila** (Mitt.) Ochyra

**form:** turves of slender, silky, dark yellow, glossy stems, simple or branched, not tomentose, 6–13 mm

**habitat:** acidic rock at high elevation, near late snow-melt beds, to 1900 m

**leaf:** size: 2.8–3.2 × 0.8–1.0 mm

**shape:** subulate-tubulose from a lanceolate base, falcate-secund

**tip:** subulate

**base:** alar cells rectangular to subquadrate, coloured

**costa:** poorly defined below, excurrent

**border:** not differentiated

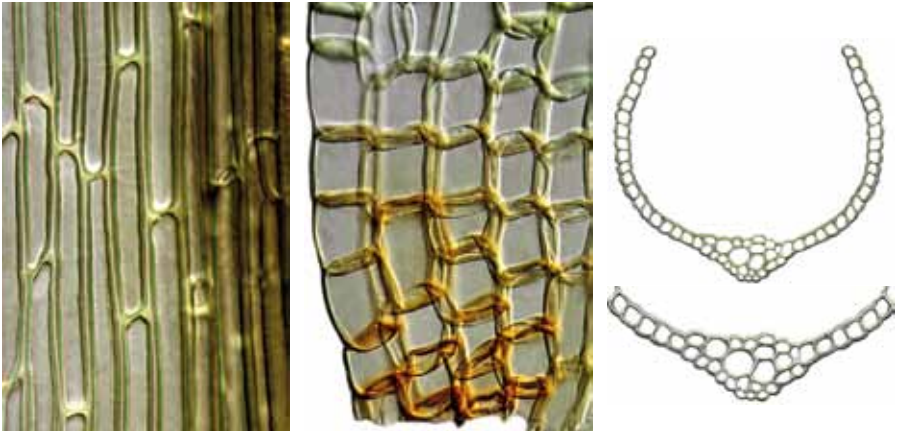
**margin:** entire, plane

**cells:** 25–60 × 4–7 μm, rectangular, firm-walled, smooth or mammillate

**capsule:** 1–1.5 mm, narrowly oblong-cylindric, erect, pale brown, red-mouthed, the neck tapered, annulus persistent; seta 6–11 mm, slender, yellow; operculum finely rostrate; peristome teeth red, vertically striate, split into two pale, papillose halves; spores 15–19 μm in diam.



fertile shoot and capsules (dry) (4), leaf outline, leaf apex (2), and margin midleaf  
 ■ 1 mm (2), ■ 1 mm (2), ■ 0.5 mm, ■ 50 μm, ■ 10 μm, ■ 10 μm



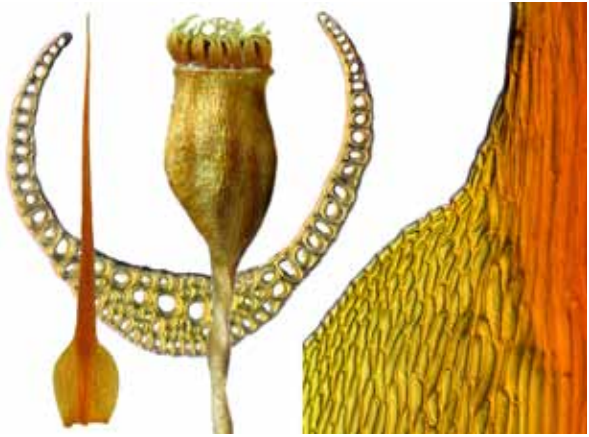
linear basal juxtacostal cells, leaf basal angle, and leaf and costa cross-sections  
 ■ 10 μm, ■ 10 μm, ■ 50 μm (upper), ■ 10 μm (lower)

**Key\* to the New Zealand species of *Campylopodium* (2)**

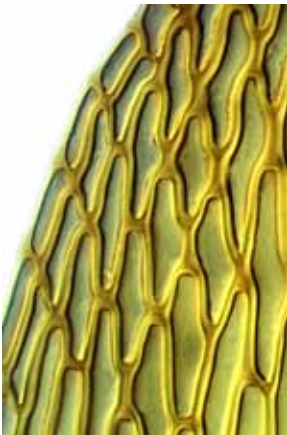
- 1 Leaf abruptly narrowed from a wide base; margin entire above.....  
 ..... ● ***Campylopodium capillaceum***
- 1: Leaf gradually narrowed from a lanceolate base; margin denticulate above.....  
 ..... ● ***Campylopodium lineare***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*. RSNZ Bull. 5, 98.



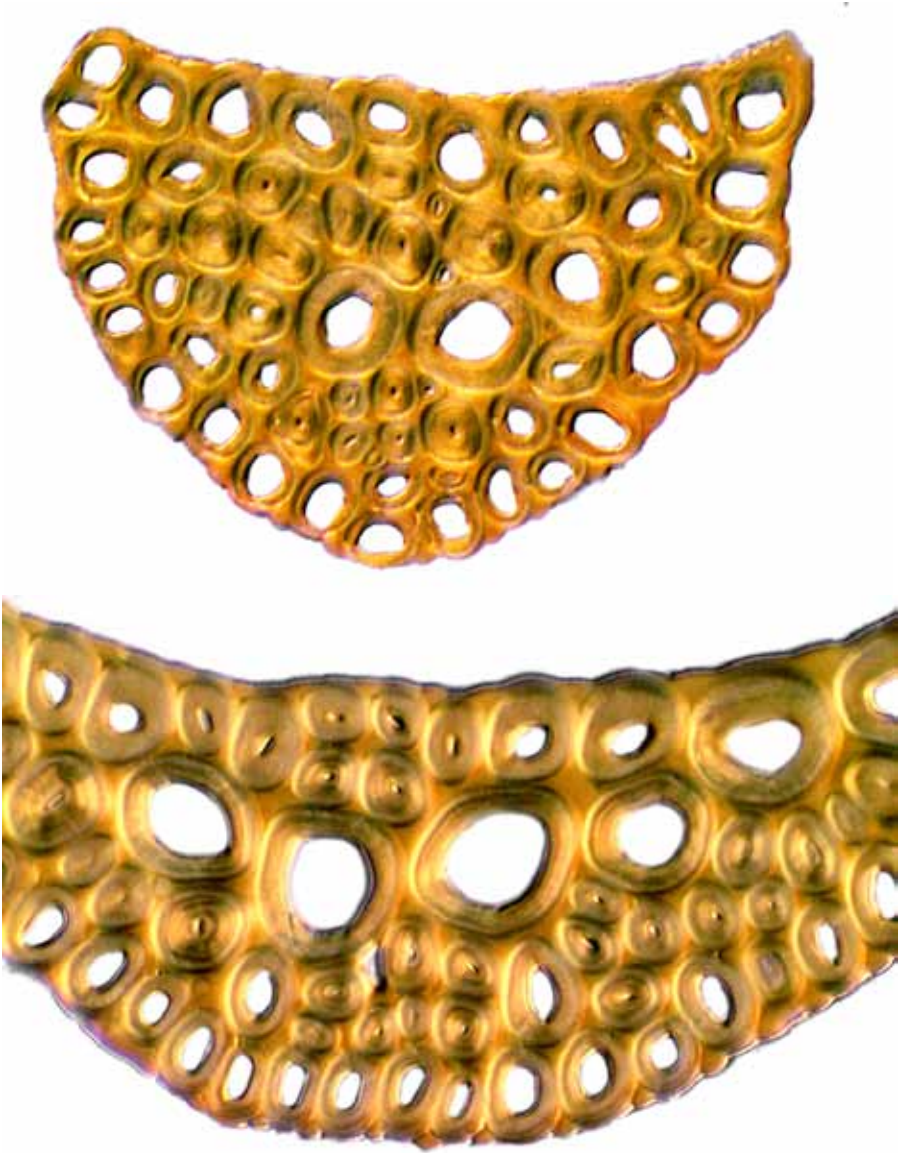
**Campylopodium capillaceum** (Hook.f. & Wilson) Fife**form:** dense tufts of silky, yellowish, ± branched stems, 5–40 mm, bright green**habitat:** soil, often clay, ditches, road cuttings, lake or stream margins, to 1400 m**leaf:** size: 3–6.5 × 0.5–0.9 mm, channelled below**shape:** long flexuose subula abruptly narrowed from an obovate, ± sheathing base**tip:** acuminate**base:** cells of the sheath 40–50 × 5–6.5 μm, firm-walled**costa:** narrowed at the leaf base, filling the subula above**border:** not differentiated**margin:** entire or ± finely denticulate, plane**cells:** upper cells 12–21 × 6 μm, rectangular to rhombic, firm-walled, smooth**capsule:** 0.8–1.5 mm, oval or wide-fusiform, ± strumose, emergent, sulcate when dry; stomata superficial; seta 3–6 mm, cygneous when moist, flexuose when dry; calyptra cucullate; operculum long-rostrate; peristome dicranoid, the teeth 16 in a single row, deeply forked, papillose above and vertically pitted-striolate below; spores 22–30 μm in diam.

fertile habit, leaf cross-section, leaf outline, capsule, and shoulder / subula junction  
 1 mm, 50 μm, 1 mm, 0.5 mm, 10 μm



shoulder margin, subula margin, and sheathing base cells  
 10 μm, 10 μm, 10 μm

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*Campylopodium capillaceum* cross-section through leaf subula (above) and sheath (below)  
10  $\mu\text{m}$ , 10  $\mu\text{m}$



**Campylopodium lineare** (Mitt.) Dixon**form:** tufts of branched stems, radicle below, 2–5 mm tall**habitat:** soil on tracks, roadsides, railway banks, or over rock, to 1200 m**leaf:** size: 1.5–2.5 × 0.5–0.8 mm**shape:** subulate, gradually narrowed from an ovate-lanceolate, non-sheathing base**tip:** acute**base:** cells of the sheath 40–80 × 8–10 μm, thin-walled; no distinct alar region**costa:** percurrent to excurrent, nearly filling the subula, spinulose abaxially**border:** not differentiated**margin:** entire or crenulate below, serrulate toward the apex, plane**cells:** upper cells 20–30 × 6–8 μm, rhombic, firm-walled, smooth**capsule:** 0.8–1.0 mm, ovoid, narrowed below the mouth, furrowed and urceolate when dry; seta 3–5 mm, cygneous when moist, flexuose when dry; operculum rostrate; peristome teeth split, striate below, hyaline above; spores 21–24 μm**notes:** differs from *Dicranella* in its cygneous seta, and from *Campylopus* in its narrow costa and long subulate leaves

fertile shoot (dry), mature capsule, leaf outline, and leaf apex (2)

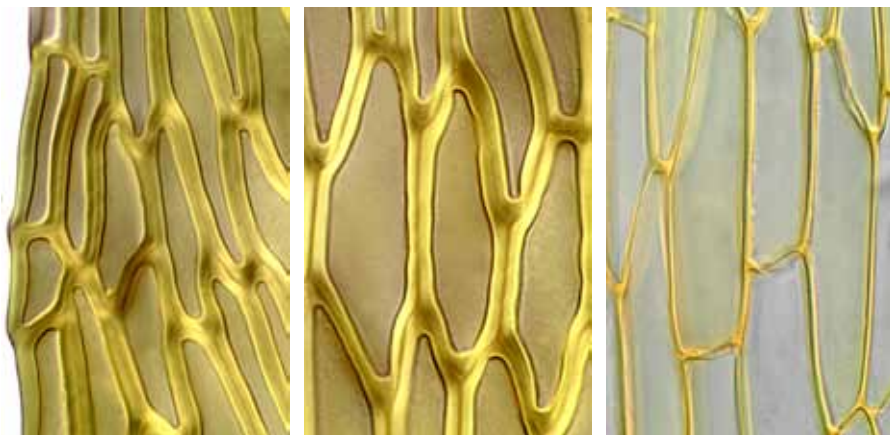
1 mm,

1 mm,

1 mm,

10 μm,

10 μm



shoulder margin, shoulder cells, and leaf base cells

10 μm,

10 μm,

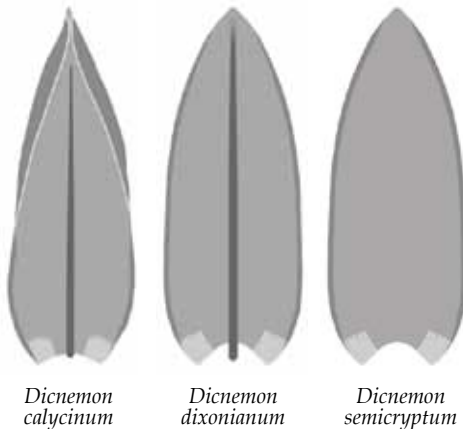
10 μm

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**Key\* to the New Zealand species of *Dicnemon* (3)**

- 1 Leaves ecostate, not rhizoidal at the base..... ● ***Dicnemon semicryptum***  
 1: Leaves costate, often rhizoidal at the base ..... 2
- 21(1:) Uppermost perichaetial bracts tapered, overtopping the capsule .....  
 ..... ● ***Dicnemon calycinum***  
 2: Uppermost perichaetial bracts blunt, not overtopping the capsule .....  
 ..... ● ***Dicnemon dixonianum***

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 136.



**Dicnemon calycinum** (Hook.) Schwägr.

**form:** densely tufted, golden green, creeping, branched stems, to 40 mm  
**habitat:** bark in montane *Nothofagus* forest

**leaf:** size: 2–2.5 × 0.5–0.6 mm

*shape:* oblong-lanceolate, concave below, with short rhizoid growths

*tip:* acute, cucullate at the apex; perichaetial leaf tips tapered

*base:* alar cells conspicuous, pigmented, subquadrate, incrassate

*costa:* failing below the apex

*border:* 1–3 rows of long, narrow, hyaline cells

*margin:* entire, plane below, incurved above

*cells:* 20–70 × 10–15 μm, irregular, incrassate, porose, smooth

**capsule:** 3 mm, calyptra side-split; subcylindric, curved, ± asymmetric, ± strumose, mouth oblique, immersed, erect to inclined; seta 4–5 mm; spores multicellular, to 250 μm long

**notes:** differs from *Dicnemon dixonianum* in having a cucullate calyptra, tapered perichaetial leaf tips, and ± immersed capsules



fertile habit, capsule, leaf outline with laminal rhizoids, and cucullate leaf apex  
 1 mm, 0.5 mm, 0.5 mm, 50 μm



border lower leaf, cells midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

continued next page



*Dicnemon calycinum* capsules with calyptrae  
1 mm

continued next page

**Dicnemon dixonianum** B.Allen

**form:** densely tufted, golden green, creeping, branched stems, to 40 mm  
**habitat:** bark in *Nothofagus* montane forest

**leaf:** *size:* 1.5–2 mm, short adventitious rhizoids near the base

*shape:* oblong to lanceolate

*tip:* acute, convolute; perichaetial leaf tips blunt

*base:* alar cells coloured, subquadrate, incrassate

*costa:* failing below the apex

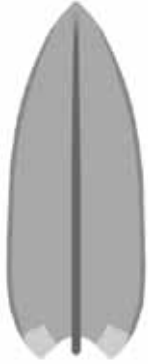
*border:* narrow, 1–2 rows of long hyaline cells

*margin:* entire, plane

*cells:* 30–40 × 10 μm, elongate, porose, smooth

**capsule:** 3 mm, subcylindric, curved, ± asymmetric, ± strumose, mouth oblique, emergent, erect to inclined; seta 4–5 mm; calyptra mitrate, scabrose

**notes:** differs from *Dicnemon calycina* in having a mitrate and scabrose calyptra, obtuse perichaetial leaf tips, and emergent capsules



fertile habit, capsules (2) and calyptra, perichaetial leaf apices, and leaf outline  
 1 mm, 1 mm (2), 0.5 mm, 0.5 mm



margin midleaf, cells midleaf, and basal leaf cells  
 10 μm, 10 μm, 10 μm

**Dicnemon semicryptum** C.Müll.

**form:** densely matted, creeping, tangled, branched stems, to 40 mm long  
**habitat:** bark in *Nothofagus* montane forest

**leaf:** size: 2 mm

**shape:** oblong-lanceolate, concave below

**tip:** acute, ± convolute at the apex

**base:** alar cells conspicuous, pigmented, subquadrate, large, thin-walled

**costa:** none

**border:** 1–3 rows of long, narrow, hyaline cells

**margin:** entire, plane below, convolute above

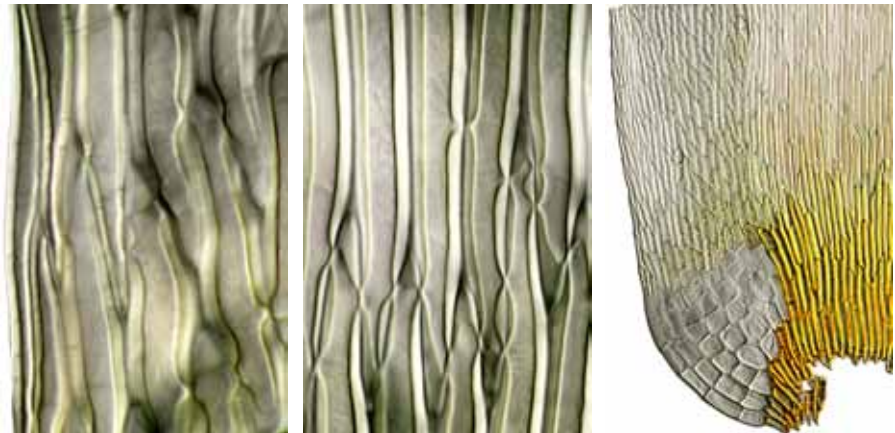
**cells:** 20–70 × 10–15 μm, irregular, incrassate, porose, smooth

**capsule:** to 3 mm; subcylindric, curved, ± asymmetric, not strumose, suberect; seta 4–5 mm; calyptra mitrate

**note:** differs from *Dicnemon calycinum* and *Dicnemon dixonianum* in lacking a costa and having rhizoidal growths on the leaf base



fertile shoot, capsule with calyptra, calyptra, leaf outline, and leaf apex  
 ■ 1 mm, ■ 0.5 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm



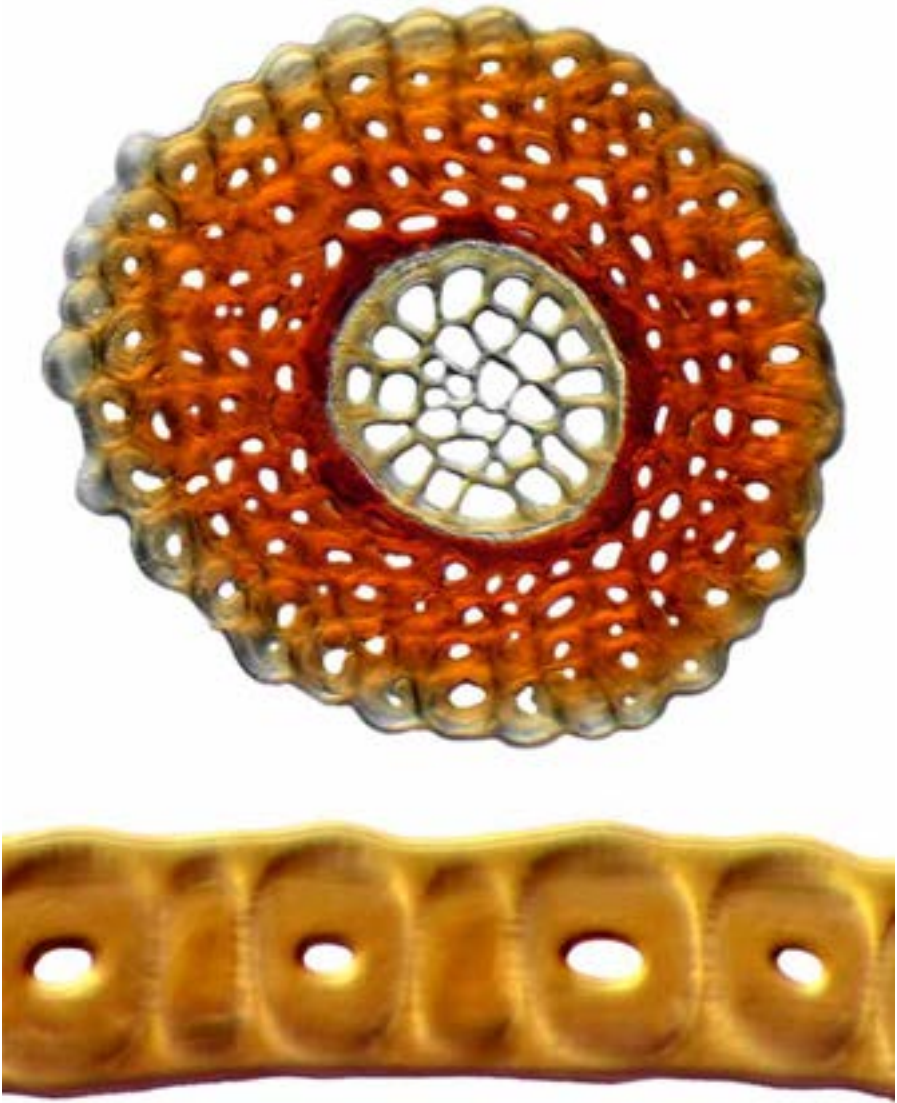
margin near leaf base, central cells just above leaf base, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

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*Dicnemon semicryptum* porose cells near lower leaf margin  
10  $\mu\text{m}$

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*Dicnemum semicryptum* calyptra and seta (above) and leaf (below) cross-sections  
10  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)



**Key\* to the New Zealand species of *Dicranella* (6)**

- 1 Base of upper leaves not sheathing ..... 2  
 1: Base of upper leaves distinctly sheathing ..... 3
- 2(1) Capsule 0.6–0.9 mm long, erect, symmetric ..... ● ***Dicranella gracillima***  
 2: Capsule 1.5 mm, inclined to horizontal, asymmetric ..... ● ***Dicranella heteromalla***
- 3(1:) Stems 5–10 mm tall ..... ***Dicranella schreberiana***  
 3: Stems 10–40 mm tall ..... 4
- 4(3:) Leaves 1–2 mm long ..... ● ***Dicranella cardotii***  
 4: Leaves 3–4 mm long ..... 5
- 5(4:) Plants on volcanically heated soil; peristome teeth smooth or slightly papillose above, vertically striolate below ..... ● ***Dicranella dietrichiae***  
 5: Plants not on volcanically heated soil; peristome teeth papillose throughout ..... ● ***Dicranella vaginata***

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 136.



*Dicranella gracillima*



*Dicranella cardotii*



*Dicranella schreberiana*



*Dicranella vaginata*



*Dicranella dietrichiae*



*Dicranella heteromalla*

**Dicranella cardotii** (R.Br.bis) Dixon

**form:** dense curves of  $\pm$  unbranched, erect, tomentose stems, 10–70 mm  
**habitat:** wet exposed soil along stream margins, to 1650 m

**leaf:** size: 1.1–3.5  $\times$  0.6–0.7 mm

**shape:** subulate from a wide-shouldered, strongly sheathing base

**tip:** acute to rounded

**base:** alar cells not differentiated

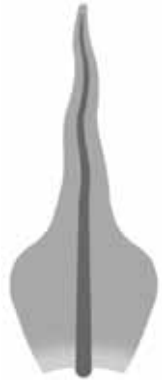
**costa:** failing just below the apex

**border:** not differentiated

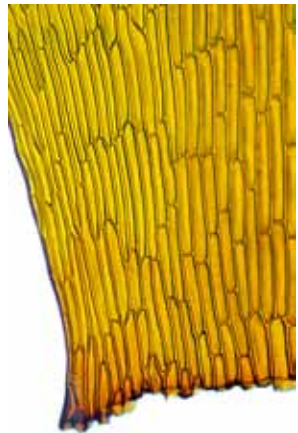
**margin:** entire to crenulate, plane

**cells:** subula cells 8–20  $\times$  7–12  $\mu\text{m}$ , quadrate to rectangular, firm-walled, smooth; sheath cells 40–80  $\times$  4–8  $\mu\text{m}$ , linear, firm-walled, mammillose

**capsule:** 1–1.3 mm, cylindric, erect, exserted, red-brown, wide-mouthed when dry; seta 5–20 mm, red, erect, flexuose; operculum long-rostrate; peristome dicranoid, the teeth deep red, perforate or split above; spores 21–36  $\mu\text{m}$  in diam., green



habit, vegetative shoot (moist), capsule (dry), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$



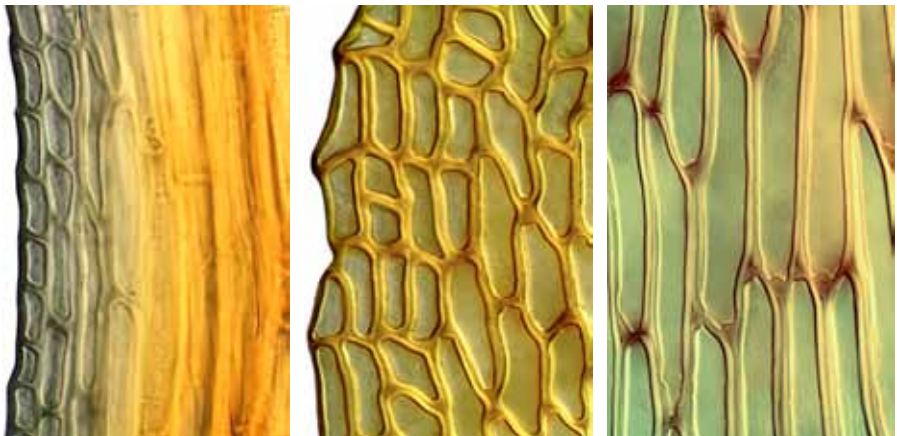
shoulder margin, sheath cells, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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**Dicranella dietrichiae** (Müll.Hal.) A.Jaeger**form:** curves of erect, unbranched, laxly foliate, yellow-brown stems, to 15 mm**habitat:** volcanically heated soil or open pasture**leaf:** size: 2.0–2.5 × 0.4–0.5 mm*shape:* oblong-ovovate base abruptly contracted to a narrow, flexuose subula*tip:* subulate*base:* sheathing; the sheath cells oblong-rectangular, 15–50 × 6–9 μm, smooth*costa:* weak below, failing below the apex*border:* not differentiated*margin:* crenulate above, entire below, plane above, reflexed at shoulders*cells:* subula cells 20 × 10 μm, short-rectangular, firm-walled, smooth**capsule:** 1.0–1.2 mm, ovate-cylindric, erect, symmetric, pale, sulcate when dry; seta 5–10 mm, slender, pale, flexuose; calyptra cucullate, smooth, naked, the base entire; operculum long-rostrate; peristome dicranoid, the teeth split to the middle, papillose above, vertically striolate below; spores 21–27 μm in diam.

shoot (dry), shoot (cleared), leaf outline, leaf apex, and lower subula margin

1 mm, 0.5 mm, 0.5 mm, 10 μm, 10 μm



upper subula margin, shoulder of sheathing base, and lower sheath cells

10 μm, 10 μm, 10 μm

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**Dicranella gracillima** (Beckett) Paris**form:** loose tufts of erect, mostly simple stems, 4–8 mm, the leaves secund**habitat:** clay, silt, or sand along exposed stream or ditch margins, to 800 m**leaf:** size: 1–1.5 mm*shape:* lanceolate to lanceolate-subulate, sometimes slightly curved*tip:* acute*base:* not sheathing; basal cells longer and wider than the other lamina cells*costa:* narrow, percurrent*border:* not differentiated*margin:* entire, plane*cells:* 45–75 × 6–9 μm, ± rectangular, firm-walled, smooth**capsule:** 0.5–1.0 mm, cylindric, erect, symmetric, long-exserted, brown, wide-mouthed when dry; seta 4–8 mm, brown; operculum beaked, shorter than the capsule; peristome single, teeth red, vertically striolate, partly cleft, the two segments papillose above and pale; spores 12–15 μm in diam.

vegetative shoots (dry) (4), leaf outline, and leaf apex (2)

1 mm (4), 0.1 mm, 50 μm, 50 μm



margin midleaf, costa upper leaf, and leaf basal angle

10 μm, 50 μm, 50 μm

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**Dicranella heteromalla** (Hedw.) Schimp.

**form:** tufts of ± forked stems, 4–7 mm, the leaves yellow to dark green, shiny, falcate-secund

**habitat:** soil of tracksides and roots of wind-felled trees in shady forest

**leaf:** size: 2–3 × 0.2 mm

**shape:** narrowly triangular, tapering to a slender subula ± filled with the costa

**tip:** bluntly acute

**base:** not sheathing, alar cells not differentiated

**costa:** filling a third of the leaf width at the base, excurrent, filling the subula

**border:** not differentiated

**margin:** entire below, faintly serrulate above, plane

**cells:** 15–40 × 6 μm, narrowly rectangular, firm-walled, smooth

**capsule:** 1–1.5 mm, curved, asymmetric, with a tapered neck, inclined to horizontal, exserted, reddish brown, furrowed and contracted below the mouth when dry; mouth distinctly oblique; seta 6 mm, yellowish; operculum beak long and curved; spores 14–18 μm in diam., minutely roughened



fertile shoot (dry and moist) (3), leaf outline, capsule with operculum, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 10 μm



margin midleaf, margin of shoulder, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

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**Dicranella vaginata** (Hook.) Cardot

**form:** dense tufts of erect, simple or branched stems, to 150 mm; leaves distant  
**habitat:** sand and rock (limestone, mudstone, or sandstone) along streambanks or in ditches, to 830 m

**leaf:** size: 1.0–3.5 × 0.5–0.7 mm

*shape:* subulate, narrowing from an oblong-obovate, pale, sheathing base

*tip:* obtuse, with several blunt irregular teeth

*base:* sheathing, shouldered, the sheath cells linear, 75–95 × 6–9 μm

*costa:* 70–100 μm wide, filling the subula, failing below the apex

*border:* not differentiated

*margin:* entire, plane

*cells:* 60–120 × 8–12 μm, linear, firm- to thick-walled, smooth

**capsule:** 1.3–1.8 mm, elliptic-ovate, erect, exserted, dark brown, glossy when dry; seta to 14 mm, reddish, slender, ± flexuose; operculum beak long and slanted; calyptra cucullate; peristome single, dicranoid, the teeth fused at the base, ± cracked, perforate, and papillose above; spores 21–30 μm in diam.



vegetative shoot (dry), leaf outline, leaf apex, leaf shoulder, and margin midleaf  
 1 mm, 0.5 mm, 50 μm, 50 μm, 50 μm



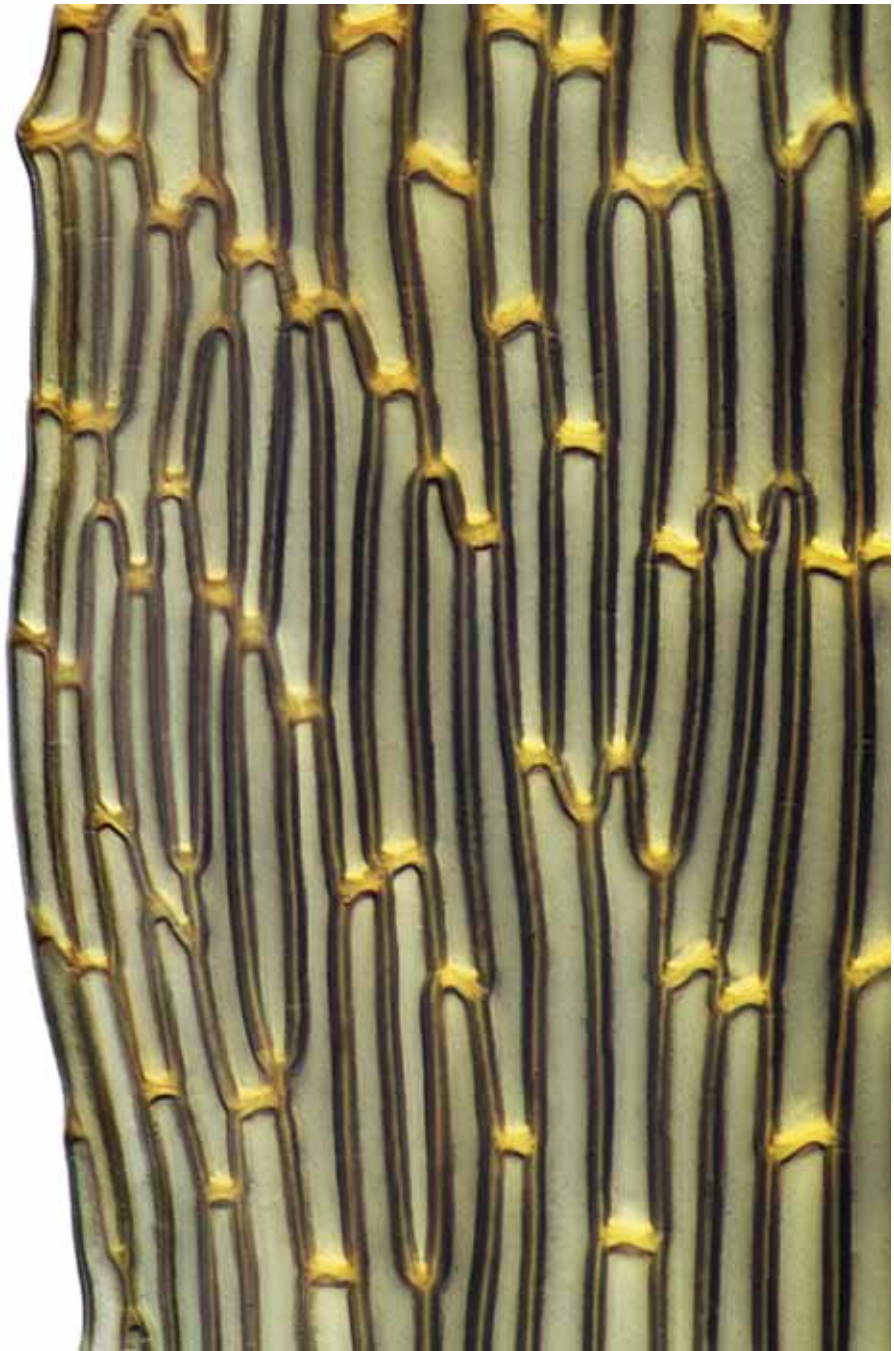
cells midleaf, juxtacostal cells midleaf, and margin near leaf base  
 50 μm, 50 μm, 50 μm

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*Dicranella vaginata* leaf subula apex and subapex  
10  $\mu$ m, 10  $\mu$ m

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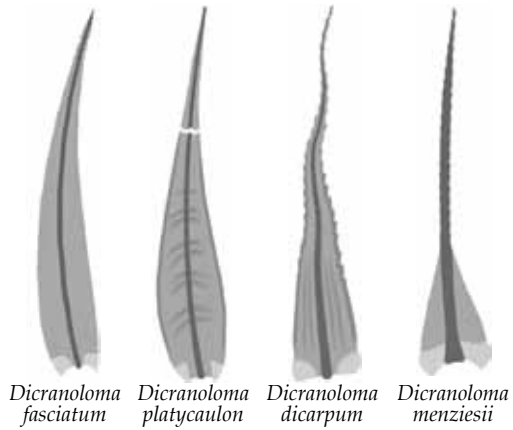
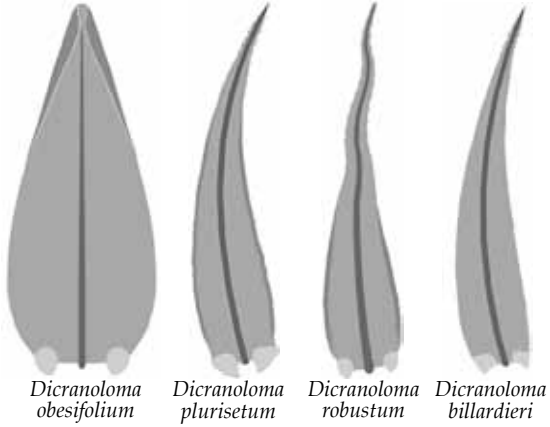
*Dicranella vaginata* margin midsheath  
10  $\mu\text{m}$



**Key\* to the New Zealand species of Dicranoloma (8)**

- 1 Leaf apex obtuse to rounded and  $\pm$  cucullate ..... ● **Dicranoloma obesifolium**  
 1: Leaf apex  $\pm$  subulate ..... 2
- 2(1:) Subula cells isodiametric ..... ● **Dicranoloma menziesii**  
 2: Subula cells  $\pm$  elongate ..... 3
- 3(2:) Juxtacostal cells of the subula markedly shorter than the marginal cells .....  
 ..... ● **Dicranoloma dicarpum**  
 3: Juxtacostal cells of the subula not much shorter than the marginal cells ..... 4
- 4(3:) Cells of subula  $3 \times 1$  or shorter; costa undulate on the back when dry .....  
 ..... ● **Dicranoloma platycaulon**  
 4: Cells of subula rarely shorter than  $4 \times 1$ ; costa not undulate on the back when dry ... 5
- 5(4:) Costa in lamina broad,  $> 60 \mu\text{m}$  (sometimes indistinct) ● **Dicranoloma plurisetum**  
 5: Costa in lamina narrow,  $< 50 \mu\text{m}$  and often much narrower ..... 6
- 6(5:) Costa in lamina thick ..... ● **Dicranoloma robustum**  
 6: Costa in lamina faint, often indistinct below ..... 7
- 7(6:) Leaf border distinct, hyaline; capsule immersed ..... ● **Dicranoloma fasciatum**  
 7: Leaf border narrow or indistinct; capsule exerted ..... ● **Dicranoloma billardieri**

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 126.



**Dicranoloma billardieri** (Brid.) Paris

**form:** cushions of erect, branched, glossy, yellowish to golden green stems, the leaves falcate and homomallous, radiculose in the axils, to 100 mm tall

**habitat:** soil, bark, tree trunks, or rock, in bogs, scrub, or beech forest, to 1250 m

**leaf:** size: 6–9 × 1.0–1.5 mm

**shape:** subulate, gradually tapering from an ovate-lanceolate base, falcate-second

**tip:** acuminate, often twisted

**base:** alar cells subquadrate, pigmented orange to brown, not inflated

**costa:** shortly excurrent, narrow and weak, 3–7 deuters in xs, dentate on the back

**border:** narrow and hyaline below

**margin:** entire below, ± serrate above, plane, ± channeled below

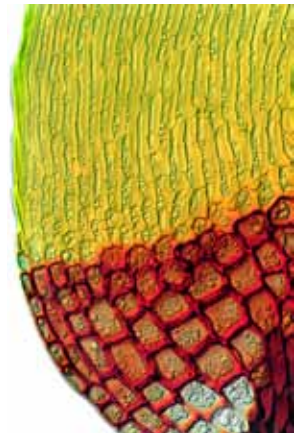
**cells:** mid lamina cells 40–75 × 4–6 μm, elongate, incrassate, porose, smooth

**capsule:** 2–3.5 mm, ± cylindrical, curved, horizontal, strumose below; seta 20–30 mm, straight or flexuose; operculum curved-rostrate; peristome dicranoid

**notes:** highly variable—the leaves can be curved to straight, and the margin entire to dentate



habit, leaf outline, leaf apex, capsule, and spears (calyptrae with persistent archegonia)  
 ■ 10 mm, ■ 1 mm, ■ 10 μm, ■ 1 mm, ■ 1 mm (2), ■ 1 mm (2)

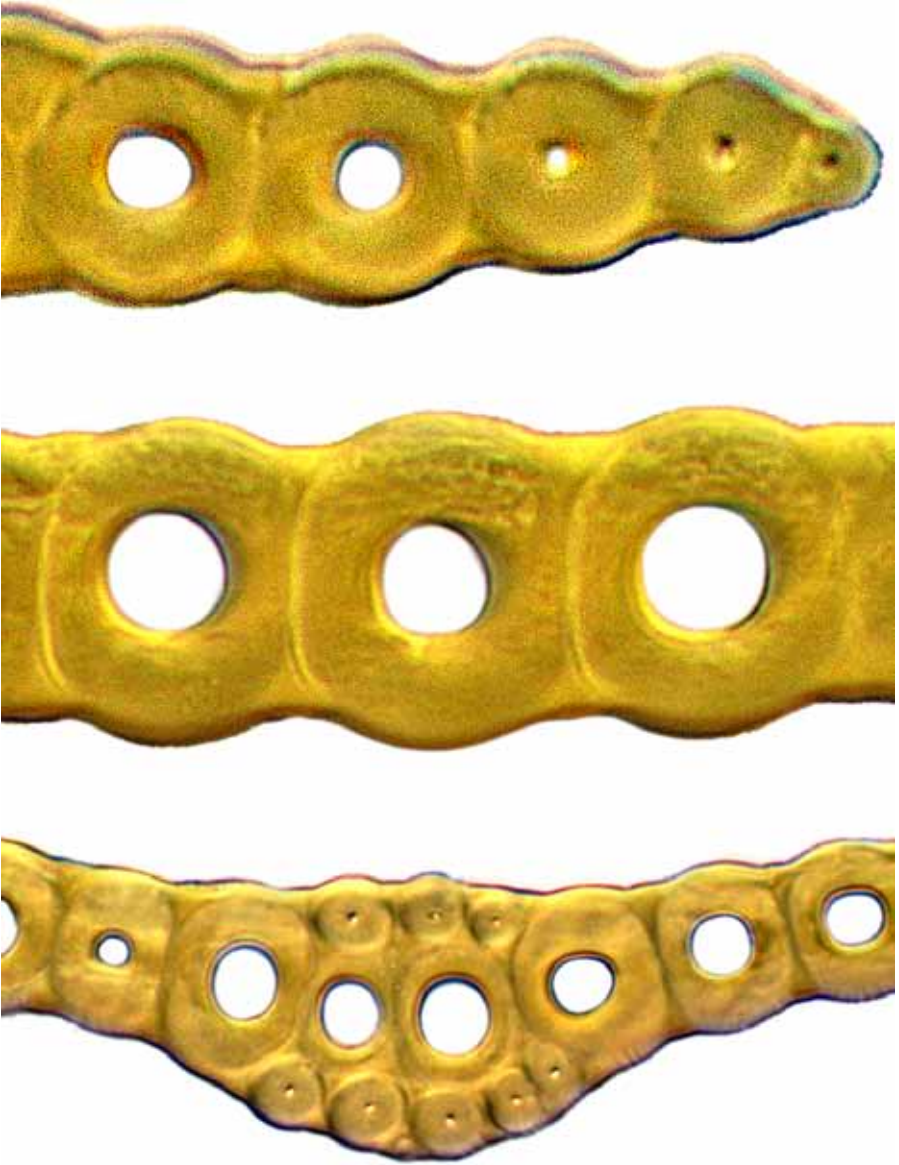


border lower leaf, cells midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm



*Dicranoloma billardieri* habit  
1 mm

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*Dicranoloma billardieri* leaf cross-sections: margin (top), lamina (middle), costa (bottom)

10  $\mu$ m,

10  $\mu$ m,

10  $\mu$ m

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**Dicranoloma dicarpum** (Nees) Par.

**form:** tufts or cushions of unbranched, flexuose stems, 35–90 mm tall, whitish tomentose below, leaves  $\pm$  falcate-secund

**habitat:** rotting logs or rarely tree trunks in dryish beech forest, to 1160 m

**leaf:** size: 6–10  $\times$  0.–1.0 mm

*shape:* oblong-lanceolate base gradually tapered above, keeled,  $\pm$  plicate, curved

*tip:* spinulose-dentate

*base:* alar cells pigmented, red in KOH, quadrate to short-rectangular, thin-walled

*costa:* narrow, spinulose on the back near the apex

*border:* 3–4 rows of linear, pale, thick-walled cells in lower leaf

*margin:* entire below, sharply spinose-serrate above, plane

*cells:* mid lamina cells 40–100  $\times$  6–10  $\mu$ m, 10–20  $\mu$ m near the costa, 40–100  $\mu$ m near the margin, smooth,  $\pm$  porose near the base

**capsule:** 2.5–3.5 mm, cylindric, erect to inclined, exserted, strumose, brown; seta 15–20 mm, up to 9 per perichaetium; peristome dicranoid; operculum long-beaked; calyptra cucullate, naked



vegetative shoot (dry) (2), leaf outline, leaf apex, and leaf subapex (abaxial surface)  
 5 mm, 5 mm, 1 mm, 50  $\mu$ m, 50  $\mu$ m



upper margin, leaf base, and leaf basal angle  
 50  $\mu$ m, 0.5 mm, 50  $\mu$ m

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*Dicranoloma dicarpum* vegetative shoot (dry)  
1 mm

continued next page



*Dicranoloma dicarpum* strumose capsule (dry)  
1 mm

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**Dicranoloma fasciatum** (Hedw.) Paris

**form:** cushions of branched, tomentose stems, 20–50 mm tall, the leaves pale green to yellowish, secund

**habitat:** bark, rotting logs, exposed roots, or rarely soil in cool to warm temperate rainforest, to 960 m

**leaf:** size: 4.0–6.5 × 0.8–1.0 mm

*shape:* ovate-lanceolate, secund, ± plicate

*tip:* gradually tapering to an acute, spinose tip

*base:* alar cells inflated, thin-walled, pigmented, to 75 × 40 μm

*costa:* ± percurrent, toothed in two rows abaxially above

*border:* 3–8 rows of linear, hyaline cells reaching the serrated portion

*margin:* spinose-serrate above, entire below, plane to ± tubulose

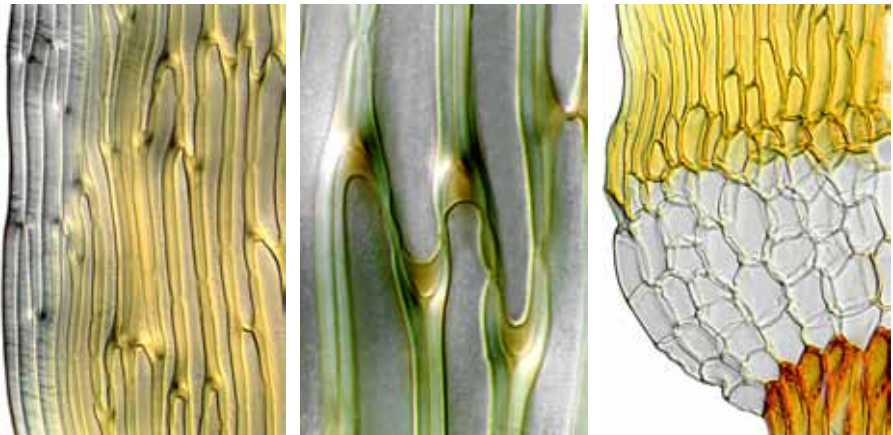
*cells:* 80–100 × 7–14 μm, elongate, thick-walled, porose, smooth

**capsule:** 1.8–3.0 mm, cylindric, curved, ± strumose, reached or overtopped by the sheathing perichaetial bracts; seta 8–10 mm, smooth; calyptra almost covering the capsule; operculum curved-rostrate; spores 15–18 μm in diam.



fertile shoots (dry) (2), leaf outline, leaf apex (2), and margin upper leaf

■ 5 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 μm, ■ 10 μm, ■ 10 μm



margin midleaf, cells midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

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*Dicranoloma fasciatum* spinose leaf tips  
10  $\mu\text{m}$  (left), 10  $\mu\text{m}$  (right)

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**Dicranoloma menziesii** (Hook.f. & Wilson) Paris

**form:** cushions or turves of branched,  $\pm$  curved, radiculose stems, 10–50 mm, the leaves yellow- to dark green,  $\pm$  secund

**habitat:** bark of exposed roots and trunks, rotting logs and stumps, rarely rock in montane beech forest, to 1200 m

**leaf:** size: 9–14  $\times$  0.7–1.2 mm

*shape:* linear-lanceolate base tapering to a setaceous apex

*tip:* long-subulate

*base:* basal cells porose; alar cells numerous, sharply delimited, hyaline to yellow

*costa:* wide and strong below, filling the setaceous apex above

*border:* 1–3 rows of narrow, elongate cells

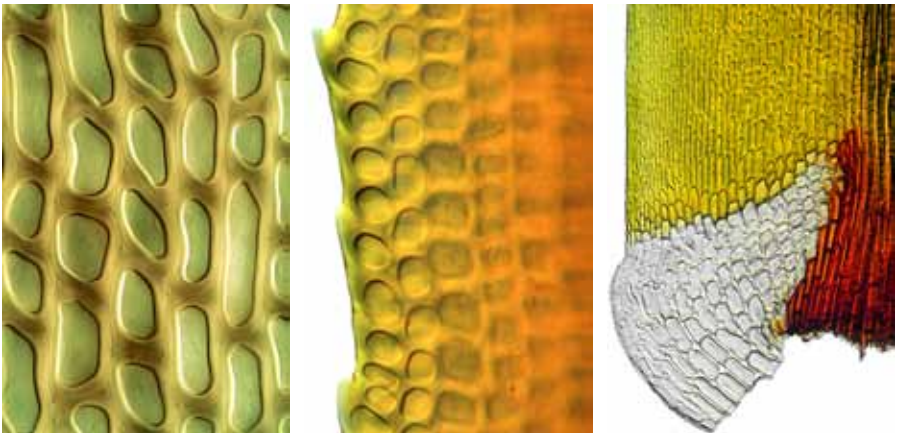
*margin:* entire below, weakly serrate above, plane

*cells:* cells 8–12  $\times$  6–8  $\mu\text{m}$ ,  $\pm$  isodiametric, incassate, smooth, not porose

**capsule:** 2.0–2.5 mm, cylindric, curved,  $\pm$  erect, exserted, strumose, striate; seta to 10 mm; operculum long-beaked; peristome teeth 16, red, vertically striolate on the outer face, split to halfway down, pale above; spores 15–18  $\mu\text{m}$  in diam.

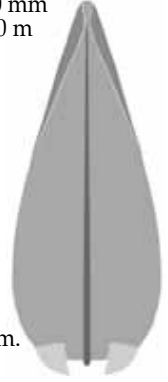


fertile shoot (dry), immature capsules (2), leaf outline, leaf apex, and margin lower leaf  
 5 mm, 1 mm (2), 1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



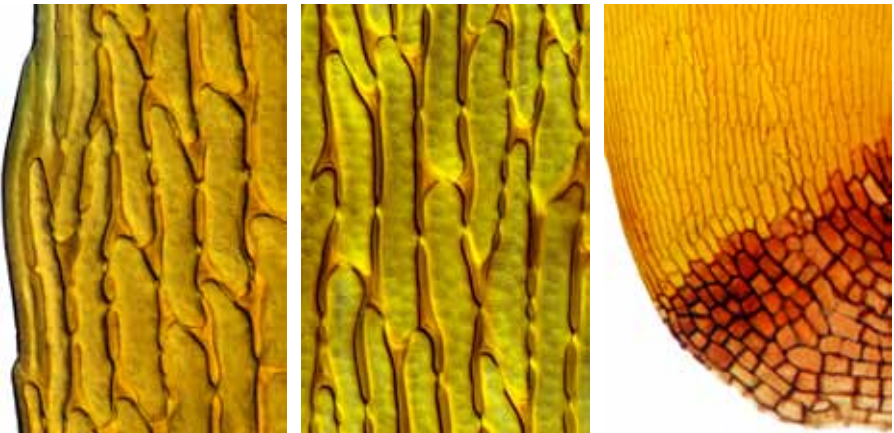
cells midleaf, subula margin, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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**Dicranoloma obesifolium** (R.Br.ter.) Broth.**form:** cushions of branched, erect stems, golden above, dark below, 30–120 mm**habitat:** soil or rock, in margins of bogs or tarns, or in beech forests, to 1650 m**leaf:** size: 4–8 × 1.5–3 mm*shape:* ovate, tubulose*tip:* rounded or obtuse, ± cucullate at the tip*base:* alar cells numerous, red-brown, quadrate, not inflated, auriculate*costa:* thin, narrow below, percurrent or failing at the apex*border:* weakly differentiated, 1–2 rows of elongate cells*margin:* entire, plane*cells:* 60–120 × 12–15 μm, irregularly rhombic to hexagonal with rounded ends, firm-walled, smooth, strongly porose throughout**capsule:** 3.0–3.5 mm, arcuate, strumose, cylindric, arcuate, strumose, exerted, brown; seta to 30 mm, red, flexuose; peristome teeth 16, red below, vertically striolate, cleft to about halfway; spores 18–21 μm in diam.**note:** endemic; our only species of *Dicranoloma* with an obtuse leaf apex

vegetative shoots (dry) (2), leaf outline, and leaf apex

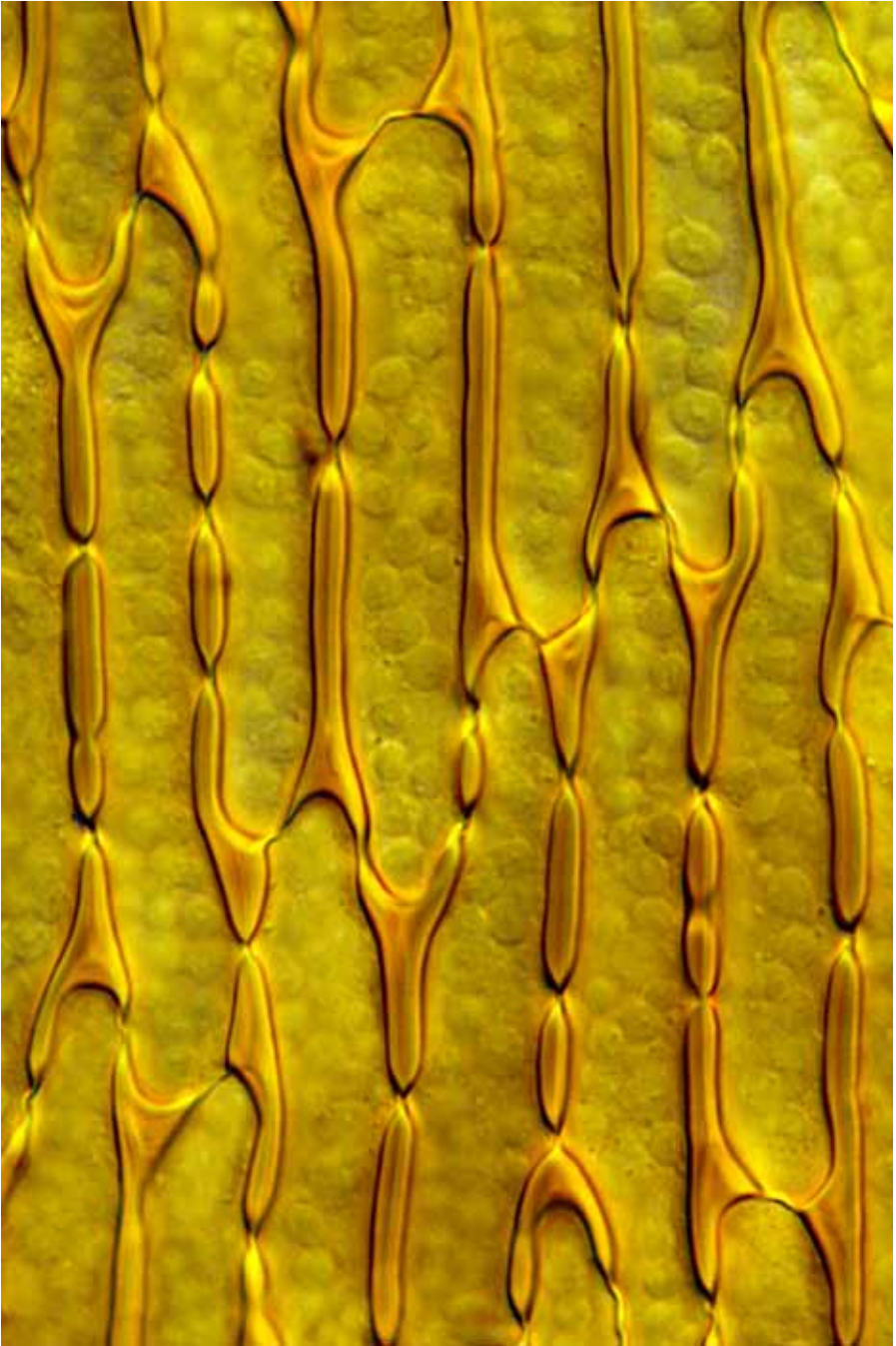
■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm



margin midleaf, cells midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

continued next page



*Dicranoloma obesifolium* cells midleaf  
10  $\mu\text{m}$

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**Dicranoloma platycaulon** Dixon

**form:** cushions of robust, tufted, tomentose, subflorally branched, glossy stems, 35–75 mm, the leaves  $\pm$  golden

**habitat:** duff, soil, rock, and bark, to 1350 m

**leaf:** size: 8–11  $\times$  1.4–1.5 mm

**shape:** ovate-lanceolate, undulate below,  $\pm$  tubulose, falcate-secund

**tip:** gradually long-acuminate with a blunt, toothed, fragile tip

**base:** lower cells porose, incrassate; alar cells  $\pm$  quadrate, inflated, thin-walled

**costa:** excurrent, with two rows of teeth abaxially above

**border:** 6–16 rows of elongate, hyaline cells reaching to the serrate portion

**margin:** entire below, serrate in about the upper half, plane

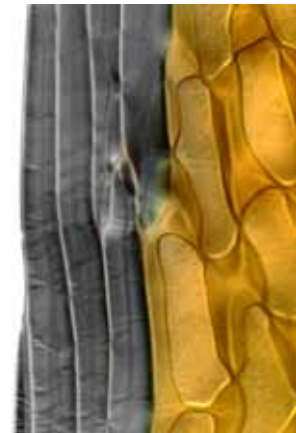
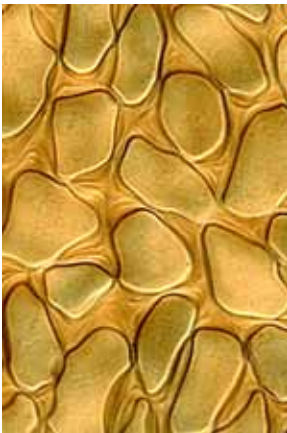
**cells:** upper cells 10–65  $\times$  6–15  $\mu$ m, irregular, variably thickened, smooth

**capsule:** 3–4  $\times$  0.7–0.8 mm, cylindric,  $\pm$  curved,  $\pm$  strumose, sulcate dry, erect to inclined; seta 11–14 mm, to 3 per perichaetium; spores 18–22  $\mu$ m in diam.

**notes:** differs from other species of Australasian *Dicranoloma* in having larger and paler leaves that are undulate along the costa when dry



fertile habit, leaf outline, leaf apex, and margin upper leaf  
 10 mm, 1 mm, 10  $\mu$ m, 10  $\mu$ m



cells midleaf, margin lower leaf, and leaf basal angle  
 10  $\mu$ m, 10  $\mu$ m, 50  $\mu$ m

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**Dicranoloma plurisetum** Dixon

**form:** cushions of ± branched stems, 30–100 mm, the leaves falcate-secund, plicate, golden to pale yellow-green

**habitat:** soil or the bark of exposed roots in montane beech forest, to 1300 m

**leaf:** size: 7–9 mm

*shape:* ovate-lanceolate base tapering to the apex, keeled

*tip:* acuminate

*base:* clasping; basal cells incrassate and porose; alar cells in large inflated auricles

*costa:* narrow (about 60 μm), spinose in two rows on the back above, excurrent

*border:* up to 8 rows of elongate, incrassate, hyaline cells

*margin:* entire below, sharply spinose-serrate above, plane

*cells:* 50–120 × 8–15 μm, elongate to irregular, incrassate, porose, smooth

**capsule:** 2–3 mm, cylindric, inclined, curved, exserted, reddish brown; seta 8–15 mm, up to 9 per perichaetium; operculum long-rostrate; peristome dicranoid; spores 16–19 μm in diam.



fertile shoot (dry), capsule, leaf outline, leaf apex, spinose costa, and subula margin  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm, ■ 10 μm



margin lower leaf, cells midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

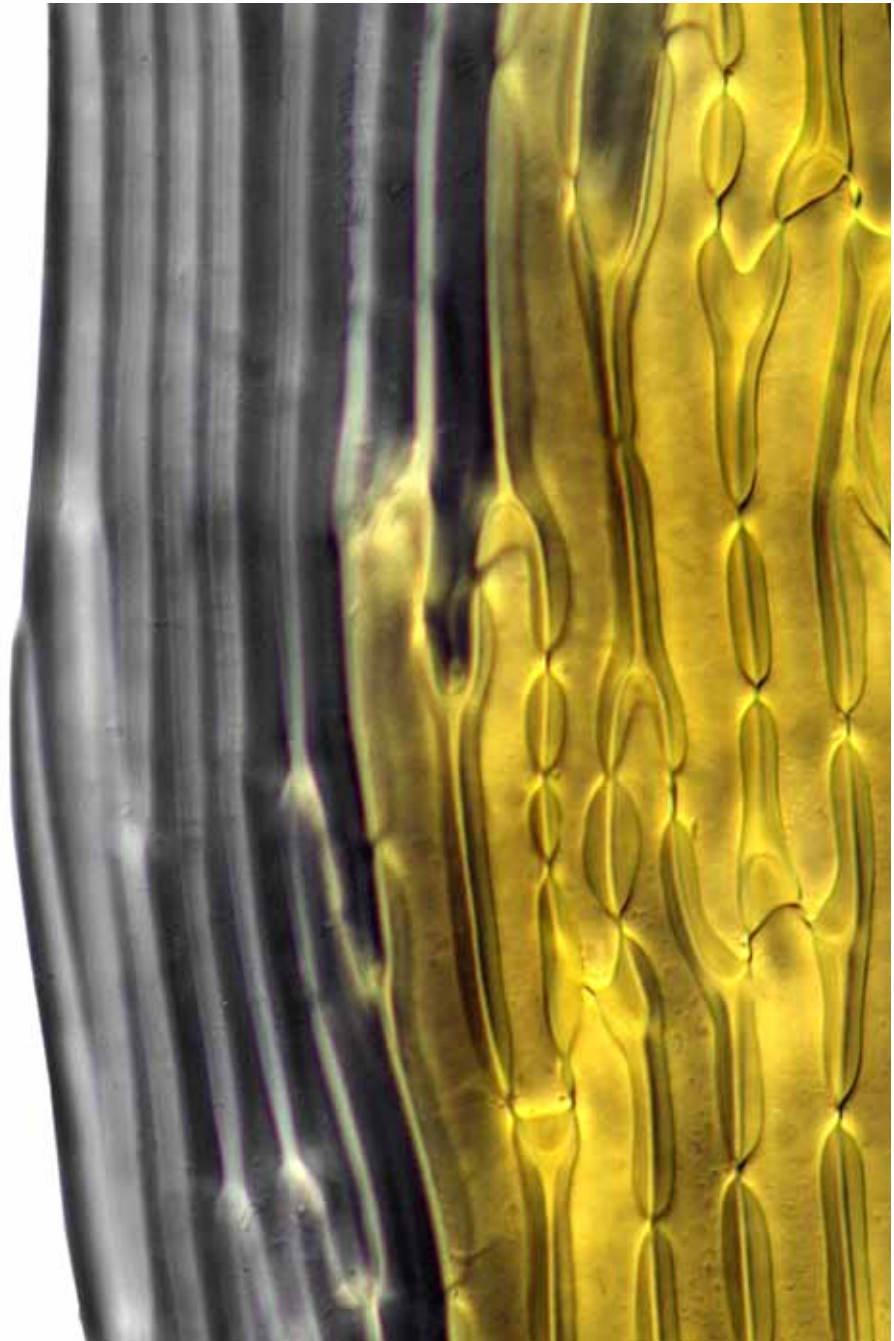
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*Dicranoloma plurisetum* multiple sporophytes  
1 mm, 1 mm

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*Dicranoloma plurisetum* leaf border, porose lamina cells  
10  $\mu\text{m}$

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**Dicranoloma robustum** (Hook.f. & Wilson) Paris

**form:** cushions of ± branched stems, 20–120 mm tall, the leaves golden, glossy, falcate-secund

**habitat:** soil, rotting logs, and tree trunks in shady, subalpine beech forest

**leaf:** size: 10–22 × 5 mm

**shape:** lanceolate base, long-tapered, ± falcate and secund

**tip:** long, fine capillary subula

**base:** clasping, auriculate; alar cells numerous, coloured

**costa:** strong, variably denticulate at the back, excurrent

**border:** 2–4 rows of elongate, incrassate cells in lower leaf

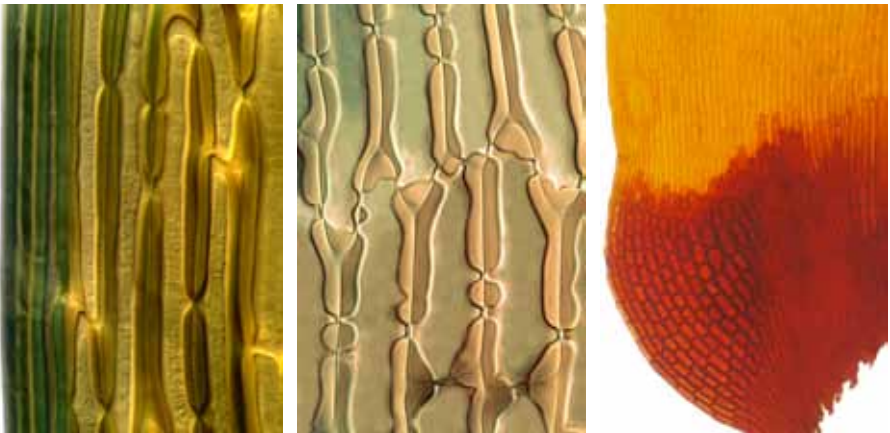
**margin:** entire below, weakly toothed above, plane

**cells:** 45–120 × 9–12 μm, linear, incrassate, porose, smooth

**capsule:** 2.3–3.5 mm, ovoid-cylindric, ± erect, exserted, ± curved, ± strumose; seta 10–30 mm, reddish, flexuose; operculum curved-rostrate; peristome dicranoid, teeth 16, red, vertically striolate below, split halfway down; spores 16–21 μm in diam.

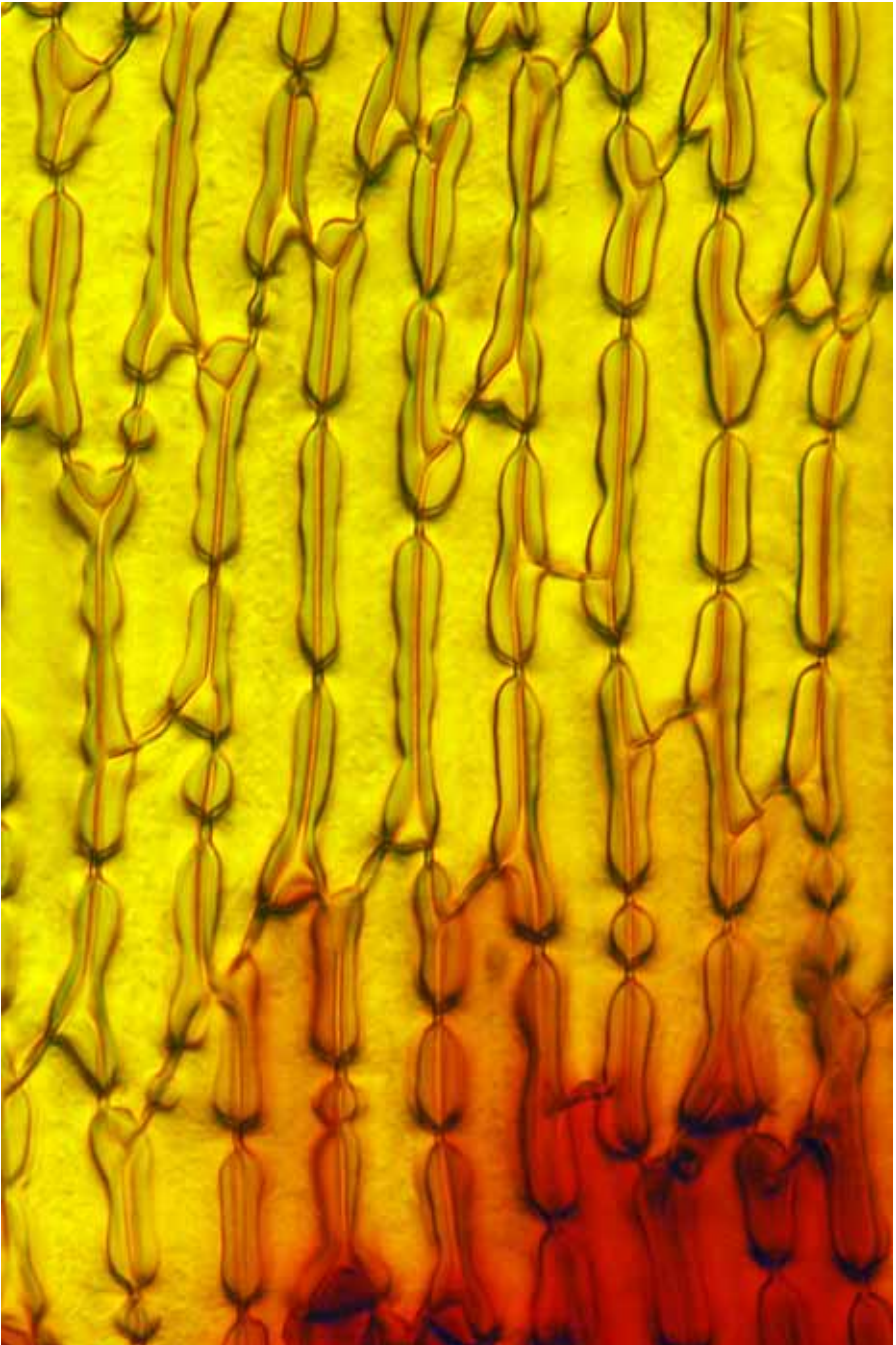


vegetative shoot (dry), mature capsule, leaf outline, leaf apex, and margin midleaf  
 10 mm, 1 mm, 1 mm, 10 μm, 10 μm



margin lower leaf, porose cells of lower leaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

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*Dicranoloma robustum* porose cells near leaf base  
10  $\mu\text{m}$

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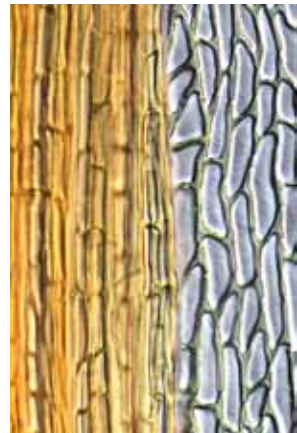
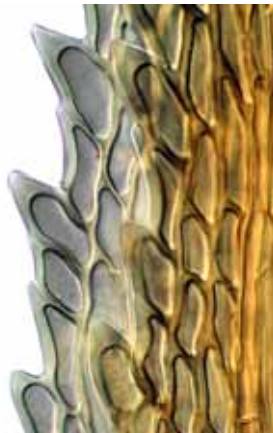


*Dicranoloma robustum* leaf and costa cross-sections  
10  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)

**Dicranum leioneuron** Kindb.**form:** cushions of erect, tomentose, branched stems, to 80 mm, leaves yellow-green**habitat:** acidic or leached soil, logs, bark, rock, mostly dunes and marshes, to 1700 m**leaf:** *size:* 2.6–3.5 × 1.1–3.3 mm*shape:* ovate-lanceolate, tubulose above, secund, arcuate, little changed when dry*tip:* bluntly acute, densely toothed*base:* alar cells ± bistratose, orange*costa:* narrow, percurrent, toothed above*border:* not differentiated*margin:* entire below, strongly dentate in the upper half, incurved below*cells:* midleaf 50–80 × 7–12 μm, rectangular-vermiculate, thick-walled, ± porose**capsule:** not found in New Zealand; 3–4 mm (excluding operculum), cylindric, curved, exserted, suberect, exannulate; seta 18–35 mm, red with age; calyptra cucullate, smooth, entire; operculum long-rostrate; peristome dicranoid, teeth split into 2(–3), vertically striolate; spores 16–24 μm in diam., finely papillose

habit (dry), shoot whole-mount, leaf outline, and leaf apex

1 mm, 1 mm, 10 μm, 10 μm



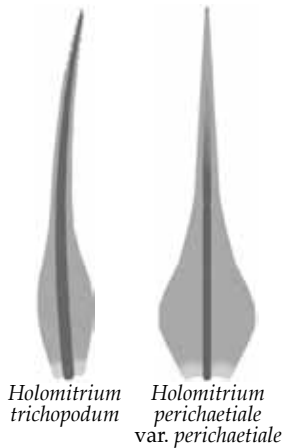
dentate subula (2) and costa midleaf

100 μm, 50 μm, 50 μm

**Key\* to the New Zealand species of *Holomitrium* (2)**

- 1 Leaves falcate-secund, little changed when dry; peristome teeth split right to the base ..... ● ***Holomitrium trichopodum***  
 1: Leaves ± straight, strongly crisped when dry; peristome teeth irregularly split or with only median perforations ..... ● ***Holomitrium perichaetiale* var. *perichaetiale***

\* based on Klazenga, N (2006): *Holomitrium trichopodum* (Bryophyta, Dicranaceae), a *Holomitrium* with split peristome teeth from Australia and New Zealand. *Journal of the Hattori Botanical Laboratory* **100**, 293–303.



**Holomitrium perichaetiale** (Hook.) Brid. var. **perichaetiale**

**form:** cushions of branched, tomentose stems, 10–35 mm, microphyllous shoots in leaf axils

**habitat:** bark or rotting logs, rarely rock, to 1300 m

**leaf:** size: 3.0–4.5 × 0.8–1.0 mm, glossy when dry

**shape:** channeled, subulate, narrowing from an obovate-elliptic base

**tip:** acuminate

**base:** weakly sheathing; alar cells enlarged, pigmented, extending up margin

**costa:** strong but narrow, percurrent, sometimes hyaline-tipped

**border:** not differentiated

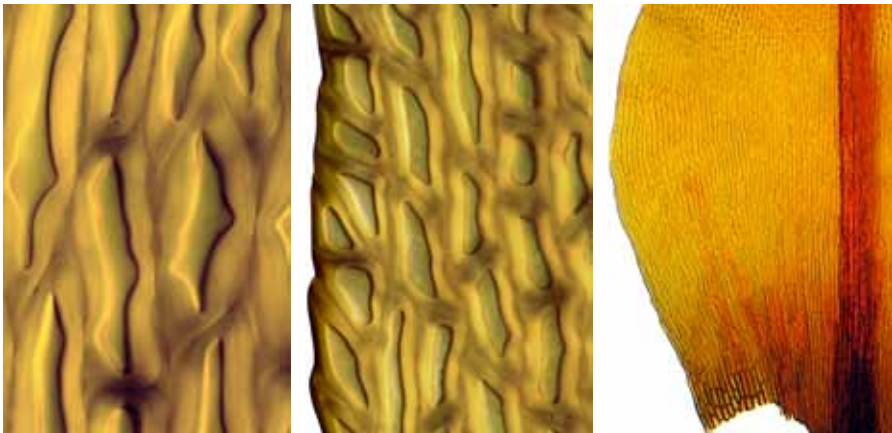
**margin:** entire, plane, bistratose in upper leaf

**cells:** mid lamina cells 5–12 × 0.5–0.8 μm, isodiametric, incrassate, smooth; sheath cells elongate, incrassate, ± porose

**capsule:** 2–2.6 mm, oblong-cylindric, ± curved, erect; seta 15–40 mm, flexuose, yellow; calyptra 5 mm, clasping at base; operculum long-rostrate; peristome dicranoid, teeth 16, ± divided into two papillose filaments; spores 14–21 μm



vegetative shoots (moist, dry), leaf outline, leaf apex, and upper sheath margin  
 5 mm (2), 0.5 mm, 10 μm, 10 μm



cells mid-sheath, margin mid-sheath, and leaf basal angle  
 10 μm, 10 μm, 100 μm

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*Holomitrium perichaetiale* fertile shoots (dry) and mature capsule  
1 mm (2), 1 mm

continued next page



**Holomitrium trichopodum** (Mitt.) Klazenga

**form:** cushions of sparsely branched tomentose stems, 10–50 mm, the leaves glossy, light green when fresh

**habitat:** bark of branches and trunks, rarely rock, in wet areas, to 1400 m

**leaf:** size: 3–10 × 0.4–0.7 mm

*shape:* ovate-lanceolate base tapering to a long, flexuose subula, ± falcate

*tip:* tapered to subulate, tubulose acumen

*base:* weakly sheathing; alar cells inflated, coloured, forming a conspicuous group

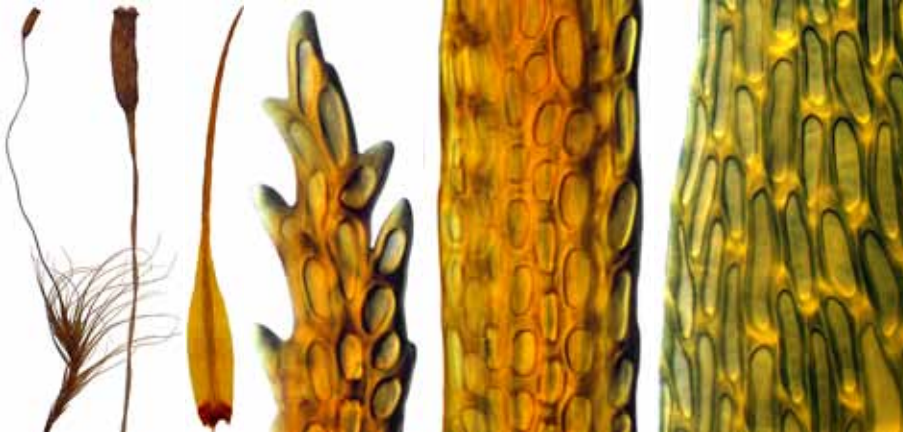
*costa:* excurrent into the subula, in xs with guide cells and two stereid bands

*border:* 1–4 rows of narrow, hyaline cells

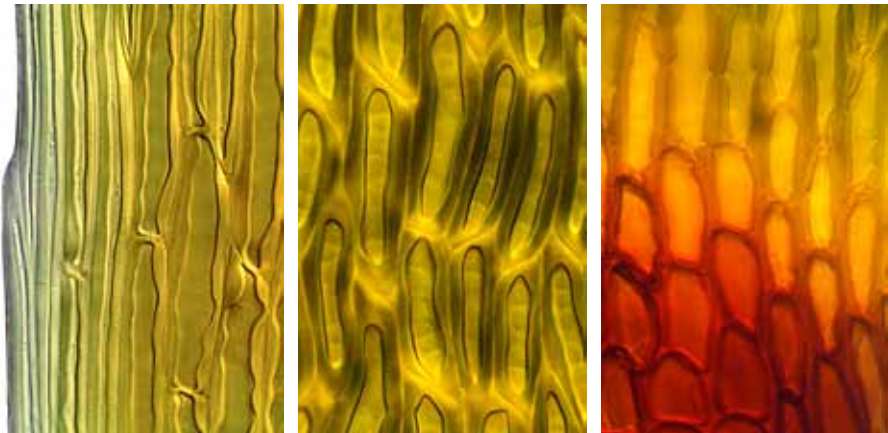
*margin:* entire to denticulate below, ± spinose-toothed near the apex, plane

*cells:* mid lamina cells 8–15 × 4–6 μm, rounded-oblong, incrassate, porose, smooth; basal cells 20–80 × 10–20 μm, linear, incrassate, porose, smooth

**capsule:** 2–3 mm, ± cylindrical; symmetric; seta 17–50 mm, yellow, slender, flexuose; operculum long-rostrate; peristome dicranoid, the teeth long, papillose, and split to their bases; spores 18 μm in diam., smooth



fertile shoot (dry), capsule, leaf outline, leaf apex, subula, and margin of upper sheath  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm, ■ 10 μm



margin lower sheath, sheath cells, and pigmented cells near leaf base  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Holomitrium trichopodum* sheath cells  
10  $\mu$ m

**Mesotus celatus** Mitt.

**form:** patchy, creeping, erect, tomentose, brownish,  $\pm$  branched stems, in top view resembling pinwheels when moist, 30–100 mm

**habitat:** bark or rarely rock in damp lowland to montane forest, to 1200 m

**leaf:** size: stem: 1.7–2.8  $\times$  0.9 to 1.2 mm; branch: 4.0–6.5  $\times$  1.0–1.3 mm

**shape:** stem leaves with ovate base; branch leaves with oblong base,  $\pm$  sigmoid tip; acuminate

**base:** sheathing; alar cells numerous, oblong, pigmented, extending up margin

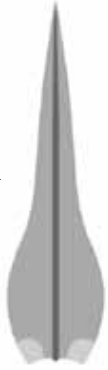
**costa:** failing below the apex or shortly excurrent

**border:** 2–3 rows of narrowly linear, hyaline, incrassate cells

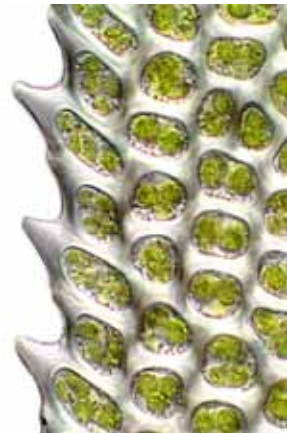
**margin:** undulate, spinulose-serrulate above, plane

**cells:** 9–11  $\mu$ m in diam., subquadrate, incrassate, papillose

**capsule:** 2 mm, seta very short; oval, erect, completely immersed; calyptra mitriform, lobed, covering only the operculum; operculum short-rostrate; peristome teeth inserted below the capsule rim, the teeth lanceolate, blunt, split and perforate; spores multicellular, dimorphic, 75–135  $\mu$ m long

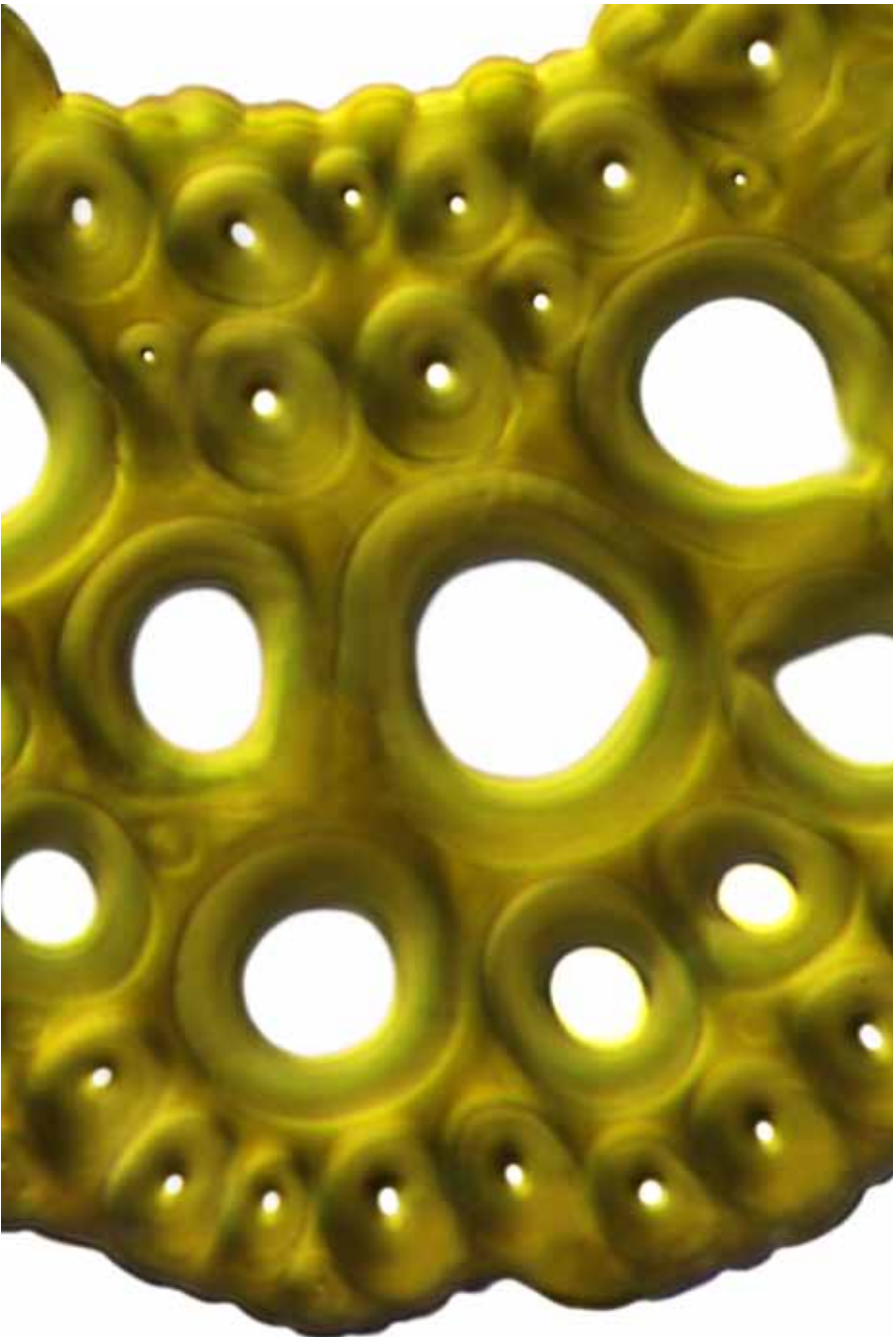


habit (top view, moist), fertile shoot (dry), capsule and calyptra, leaf outline, leaf apex  
 5 mm, 5 mm, 0.5 mm, 0.5 mm, 10  $\mu$ m



margin midleaf, margin lower leaf, and leaf basal angle  
 10  $\mu$ m, 10  $\mu$ m, 50  $\mu$ m

continued next page



*Mesotus celatus* costa cross-section  
10  $\mu$ m

continued next page



*Mesotus celatus* leaf cross-section, margin detail  
10  $\mu$ m

**Pseudephemerum nitidum** (Hedw.) Reimers

**form:** loosely tufted, slender, pale, simple or branched stems, to 5 mm tall  
**habitat:** soil, in open ground among rushes in swampy sites

**leaf:** size:  $2 \times 0.7$  mm

*shape:* narrowly triangular to lanceolate

*tip:* acuminate

*base:* basal cells wider and more rectangular than the blade cells

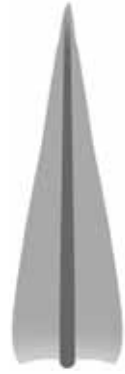
*costa:* weak, thin, failing below the apex

*border:* not differentiated

*margin:*  $\pm$  denticulate at the apex, plane

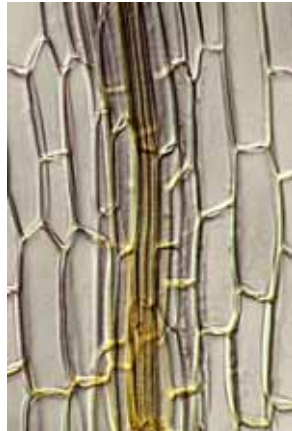
*cells:*  $50\text{--}70 \times 8\text{--}15 \mu\text{m}$ , rhombic, thin-walled, unipapillose at the lower end

**capsule:** 0.7–0.9 mm, cylindric, immersed, short-apiculate, cleistocarpous;  
 seta 0.5 mm, often more than one per stem; calyptra cucullate; spores  $30\text{--}45 \mu\text{m}$  in diam., globose, papillose



habit, leaf outline, leaf apex (2), and margin midleaf

5 mm, 0.5 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



cells midleaf, costa midleaf, and leaf base

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

**Sclerodontium pallidum** (Hook.) Schwaegr.

**form:** mats of creeping, branched, wiry, radiculose stems, dull olive-green, to 25 mm, the branches in fascicles, erect

**habitat:** rock (mostly non-calcareous) or soil, to 600 m

**leaf:** size: 2.3–2.8 × 0.5–0.7 mm

*shape:* ovate-lanceolate, concave below, tubulose above

*tip:* acuminate, ± falcate, sometimes with a smooth, hyaline hair-point

*base:* alar cells numerous, quadrate, reddish brown, in triangular groups

*costa:* thin, failing below the apex

*border:* 2–4 rows of elongate cells extending almost to the apex

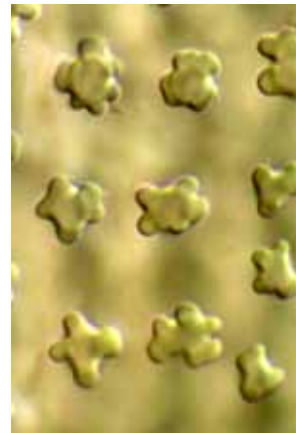
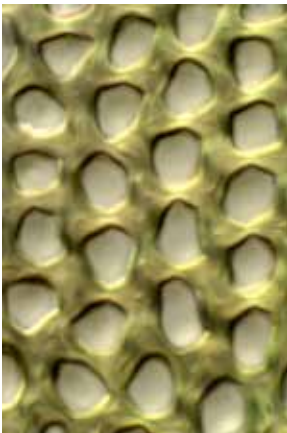
*margin:* entire below, weakly toothed at apex, plane

*cells:* 8–15 × 7–8 μm, isodiametric, irregular, incrassate, unipapillose (branched)

**capsule:** 1.0–1.8 mm, oblong-cylindric, ± inclined, symmetric, curved when dry; seta 7–14 mm, slender, red; operculum long-rostrate; peristome split to about the middle; spores 25–39 μm in diam., green



vegetative habit, leaf outline, leaf apex, and margin of lower leaf  
 5 mm, 0.5 mm, 10 μm, 10 μm



cells midleaf, lamina cell papillae, and alar cells  
 10 μm, 10 μm, 10 μm

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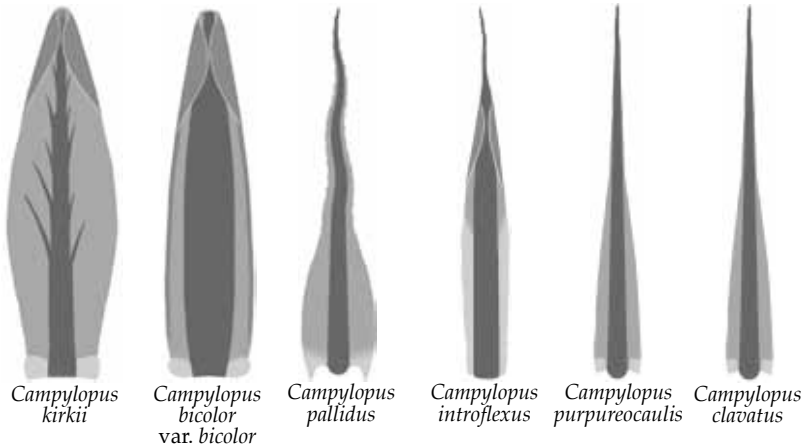
*Sclerodontium pallidum* habit (Rangitoto Island)  
10 mm



**Key\* to the New Zealand species and varieties of *Campylopus* (6)**

- 1 Shoot tips readily deciduous; upper lamina cells oval..... ● ***Campylopus clavatus***  
 1: Shoot tips not deciduous; upper lamina cells rhombic, quadrate, or rectangular ..... 2
- 2(1): Leaves ending in hyaline hair-points formed by the excurrent costa ..... 3  
 2: Leaves not ending in hyaline hair-points ..... 4
- 3(2) Hair-points abruptly reflexed at a 90° angle when dry ● ***Campylopus introflexus***  
 3: Hair-points not reflexed when dry ..... ● ***Campylopus purpureocaulis***
- 4(2): Leaf tips cucullate..... 5  
 4: Leaf tips not cucullate..... ● ***Campylopus pallidus***
- 5(4) Costa filling 2/3 of leaf width at the widest part, without side nerves (spurs) .....  
 ..... ● ***Campylopus bicolor* var. *bicolor***  
 5: Costa filling only 1/3 of leaf width at the widest part, with side nerves (spurs).....  
 ..... ● ***Campylopus kirkii***

\* based on Frahm, J-P; Malcolm, W (2005): *The Moss Family Dicranaceae in New Zealand, an Illustrated Key*. Micro-Optics Press, Nelson. 26.



**Campylopus bicolor** (Müll.Hal.) Wilson var. **bicolor**

**form:** dense tufts of erect, unbranched stems, to 50 mm tall, the leaves yellow-brown to dark green above, darker below, not glossy

**habitat:** wet peat, soil, or rock in acidic sites in montane forest, to 1230 m

**leaf:** size: 3.0–6.5 × 1.0 mm

*shape:* linear-lanceolate, ± tubulose, lamina unistratose, little altered when dry

*tip:* obtuse to rounded, abruptly cucullate, rarely with a hyaline hair-point

*base:* alar cells hyaline, thin-walled, not in groups

*costa:* wide throughout, filling half the width at the base, not spurred

*border:* weak, 1–3 rows of cells narrower than the other lamina cells

*margin:* entire below, ± denticulate at the tip, plane

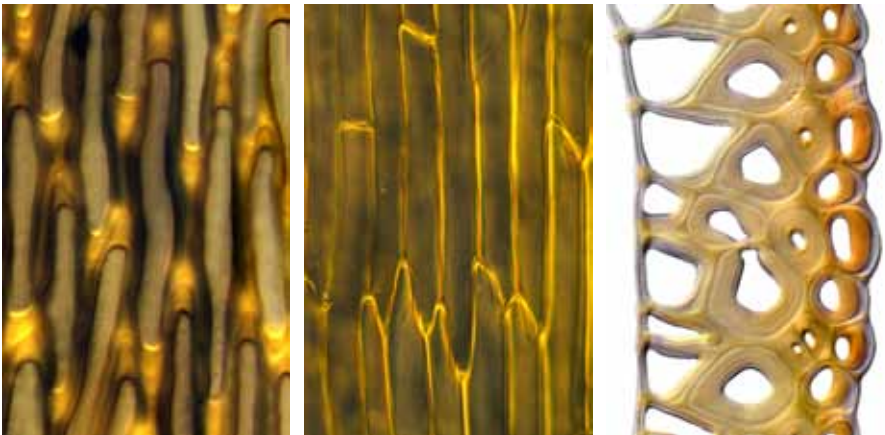
*cells:* 30–60 × 4–5 μm, linear-rhombic to vermicular, thick-walled, ± porose

**capsule:** 1–1.3 mm, oblong-ovoid, ± plicate when dry, erect, exserted, brown; seta to 8 mm, cygneous when moist, flexuose when dry; peristome dicranoid; spores 18–21 μm in diam.



vegetative shoots (dry), leaf outline, cucullate leaf apex, and margin midleaf

■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm



lamina cells midleaf, adaxial costa cells midleaf, and costa cross-section

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Campylopus bicolor* var. *bicolor* costa cross-sections — the leaf's large, thin-walled adaxial cells conserve water by spindling the leaf when they lose volume from desiccation and then collapse

10  $\mu$ m

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**Campylopus clavatus** (R.Br.) Hook.f. & Wilson

**form:** curves of tomentose, glossy, green-bronze stems, the tips readily deciduous

**habitat:** soil or rock, especially exposed road-cuttings, clay banks, and bare ground from sea level to the subalpine zone, to 1550 m

**leaf:** size: 4–6–6.0 × 0.6–0.7 mm

*shape:* lanceolate-subulate from an oblong base, ± tubular above

*tip:* toothed, bluntly acute, sometimes with a hyaline hair-point

*base:* alar cells rectangular, inflated, and pigmented, ± in auricles

*costa:* to half the leaf width below, excurrent in a ± denticulate subula, not spurred

*border:* weak, 1–3 rows of linear cells

*margin:* entire below, denticulate above, plane below, tubulose above

*cells:* 20–90 × 10–20 μm, obliquely rhombic, thick-walled, smooth, porose

**capsule:** 1.5–1.8 mm, elliptic to subcylindric, symmetric, erect, smooth, pale brown;

seta to 10 mm, cygneous when young; peristome teeth 16 but cleft to the base

into 32 filiform, densely papillose segments; spores 9–15 μm in diam.

**note:** highly variable, particularly the alar cells



habit, massed deciduous brood bodies, leaf outline, leaf apex, and brood body

10 cm, 5 mm, 0.5 mm, 10 μm, 0.5 mm



margin midleaf, leaf basal angle, peristome, and upper leaf cross-section

10 μm, 50 μm, 0.5 mm, 10 μm

continued next page

**Campylopus introflexus** (Hedw.) Brid.

**form:** curves of simple or branched, erect, ± comose stems, 10–60 mm tall

**habitat:** soil, sand, or peaty banks, less often on rotting or burnt wood, to 1530 m

**leaf:** size: 3.5–5.0 × 0.5–0.8 mm

**shape:** lanceolate-subulate from an oblong, concave base

**tip:** acute to acuminate

**base:** alar cells indistinct; basal cells rectangular, thin-walled, and hyaline

**costa:** broad, excurrent in a hyaline point, ridged abaxially, reflexed 90° when dry

**border:** weak, 1–2 rows of linear cells

**margin:** ± denticulate, incurved, and tubular above, entire and plane below

**cells:** upper cells 12–24 × 6–12 μm, rhombic, incrassate, and smooth, lower cells

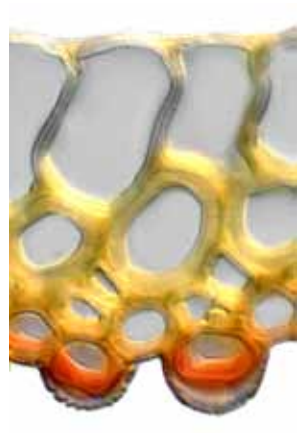
40–55 × 8–10 μm, rectangular, thin-walled, smooth, and hyaline

**capsule:** 1.8 mm, narrowly oblong to elliptic, curved when dry, horizontal to nodding; seta up to 8 mm, cygneous when dry; calyptra fimbriate

**note:** introduced into Britain about 1940, and now spreading rapidly throughout Europe, sometimes displacing the native *Campylopus pilifer*



vegetative habit, dry shoot with hair-points reflexed 90°, leaf outline, and hair-point  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm



margin midleaf, fringed calyptra, peristome, and abaxially ridged costa cross-section  
 ■ 10 μm, ■ 0.1 mm, ■ 0.1 mm, ■ 10 μm

continued next page

**Campylopus kirkii** Beckett

**form:** tufts of comose, ± unbranched stems, golden above, 20–50 mm

**habitat:** soil in bogs and other perpetually wet habitats, to 1030 m

**leaf:** size: 3.8–6.0 × 0.5–1.3 mm

*shape:* broadly lanceolate, concave, narrowed to the insertion

*tip:* obtuse, ± cucullate; no hair-point

*base:* basal cells thin-walled; alar cells inflated, pigmented or not, auriculate

*costa:* broad at the base, with side-nerves (spurs), percurrent

*border:* 1–2 rows of narrowed cells

*margin:* entire below, weakly toothed above, plane

*cells:* 40–75 × 6–9 μm, vermiform, incrassate, porose, smooth

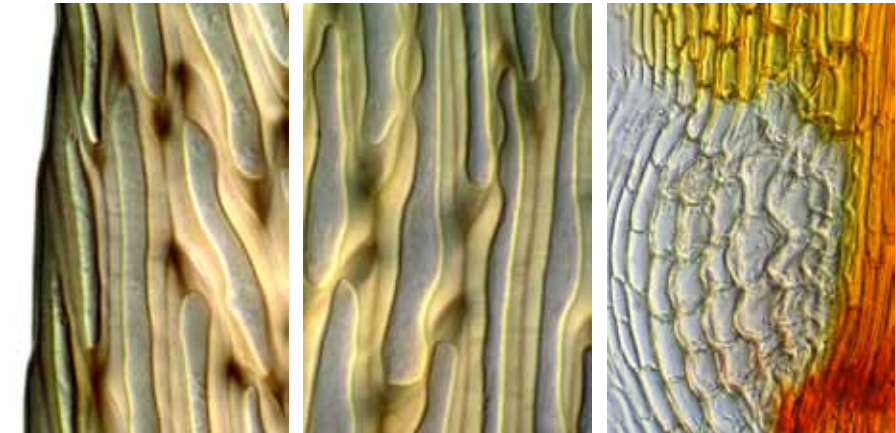
**capsule:** 2 mm, ovoid, furrowed; seta to 10 mm; calyptra cucullate, fringed at the base; operculum short-rostrate; peristome dicranoid; spores 15–18 μm in diam.

**note:** differs from var. *acuminatus* in having obtuse and cucullate rather than piliferous leaf tips, and a heavily spurred costa



vegetative shoot (dry), leaf outline, costa side-nerves, and leaf apex

1 mm, 1 mm, 100 μm, 10 μm



margin midleaf, cells midleaf, and alar region

10 μm, 10 μm, 10 μm

continued next page



*Campylopus kirkii* leaf cross-section showing adaxial hyalocysts  
10  $\mu\text{m}$

continued next page

**Campylopus pallidus** Hook.f. & Wilson

**form:** dense curves of red-tomentose stems, 5–50 mm, the leaves pale green, slender, silky, falcate

**habitat:** soil, logs, fumaroles, boggy or swampy ground or forests, to 1300 m

**leaf:** size: 3–7.5 × 0.5–0.7 mm

**shape:** lanceolate from an oblong, base, ± tubulose, tapering to a long subula

**tip:** slender, flexuose, sometimes hyaline subula

**base:** alar cells none or only weakly developed

**costa:** filling the upper subula, excurrent, not spurred

**border:** a few rows of narrow, hyaline cells in the lower leaf

**margin:** entire below, serrulate above, plane

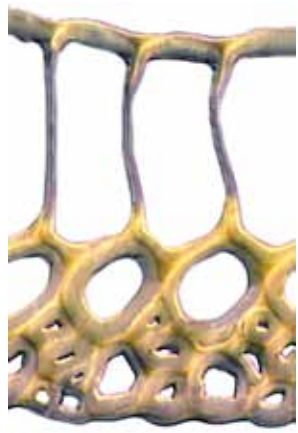
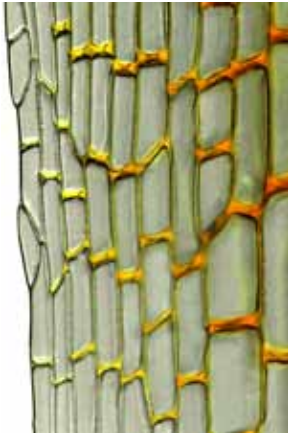
**cells:** 9–30 × 6–9 μm, quadrate to short-rectangular, firm-walled, smooth

**capsule:** 1.0–1.5 mm, ± cygneous; ovoid, erect, exserted, sulcate when dry, brown; seta 7–9 mm; calyptra fringed; operculum ± curved-rostrate, about half the length of the urn; operculum reddish, rostrate; peristome dicranoid, the teeth 16, cleft to the middle, vertical-striolate; spores 12–14 μm in diam.



vegetative shoot (dry), capsule, leaf outline, leaf apex (2), and mid-subula

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm, ■ 10 μm, ■ 50 μm

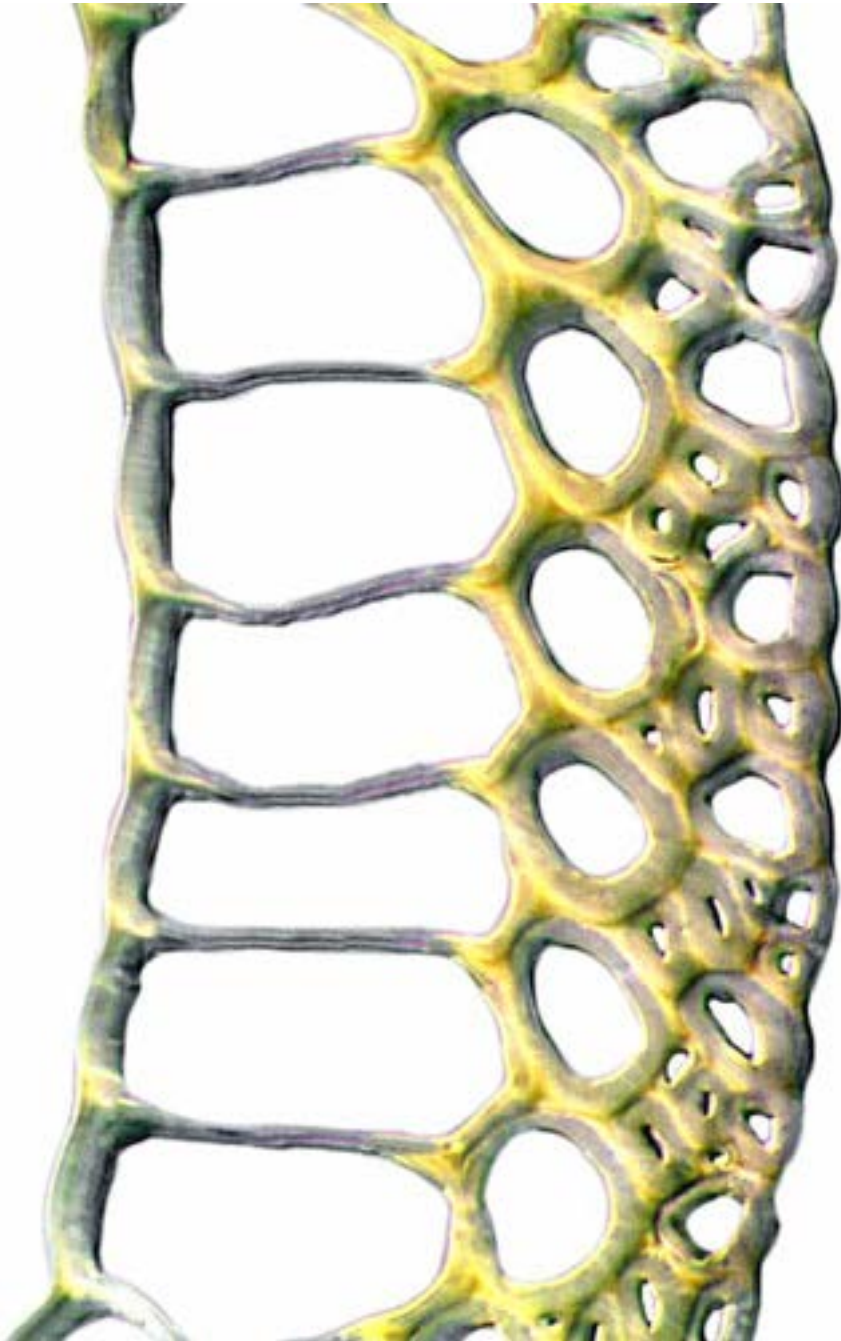


margin midleaf, margin near leaf base, and leaf cross-section

■ 10 μm, ■ 10 μm, ■ 10 μm

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*Campylopus pallidus* leaf cross-section showing adaxial hyalocysts  
10  $\mu\text{m}$

continued next page

**Campylopus purpureocaulis** Dusén

**form:** tufts of erect, branched stems, red-tomentose, to 50 mm, with brood bodies  
**habitat:** rotting logs in forest clearings at high elevation, to 1300 m

**leaf:** size: to  $2-6 \times 0.5-0.7$  mm

*shape:* lanceolate base narrowing to a long subula

*tip:*  $\pm$  serrate hair-point

*base:* alar cells inflated, pigmented, not in auricles

*costa:* excurrent in the hair-point, in section with dorsal and ventral stereid bands

*border:* weak, 1-5 rows of linear cells in lower leaf

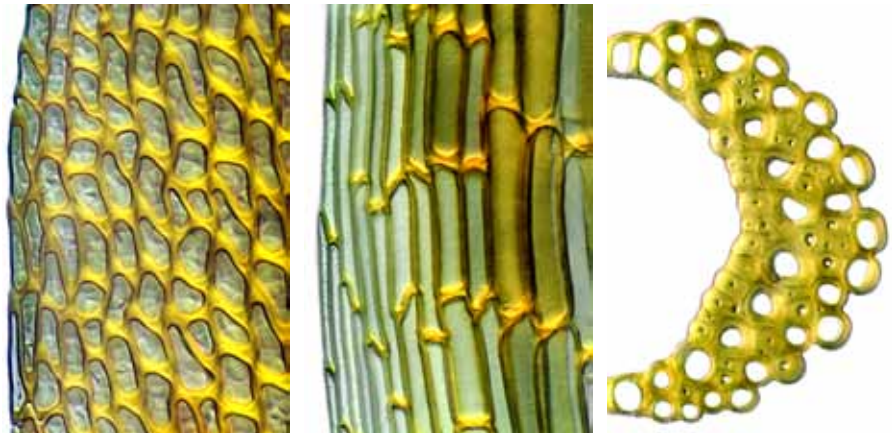
*margin:* entire, plane below,  $\pm$  tubular above

*cells:* upper lamina cells  $6-21 \times 6-12 \mu\text{m}$ , rhombic, thick-walled, smooth

**capsule:** 1.5 mm, ovoid,  $\pm$  strumose, symmetric, erect, smooth, pale brown; seta 8 mm, often aggregated; calyptra cucullate, fimbriate at the base; operculum rostrate, the beak erect and half the length of the urn; peristome dicranoid, the teeth 16, cleft to about the middle, lanceolate, reddish, hyaline and papillose above and vertically-striolate below



vegetative shoot (dry), leaf outline, mature capsule, leaf apices (2), and leaf subapex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10  $\mu\text{m}$  (2), ■ 10  $\mu\text{m}$



margin midleaf, margin lower leaf, and costa cross-section  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Campylopus purpureocaulis* leaf cross-section  
10  $\mu\text{m}$

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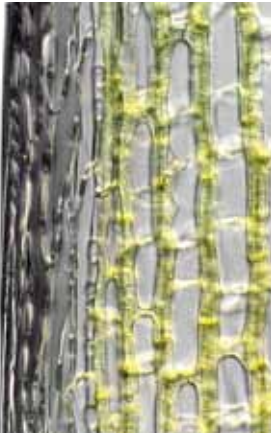


*Campylopus purpureocaulis* stem cross-section  
10  $\mu\text{m}$

**Leucobryum javense** (Brid.) Mitt.**form:** erect, forked, brittle, whitish stems in dense cushions, 10–80 mm tall**habitat:** soil, rotting logs, tree stumps, and exposed roots in forest**leaf:** size: 2–7 × 0.5–1.8 mm*shape:* lanceolate, falcate-secund, spindled into a conic tube*tip:* cucullate, denticulate subula narrowed from an oblong base*base:* undifferentiated*costa:* filling most of the leaf, which consists of a row of chlorocysts enclosed above and below by 2–6 layers of hyalocysts*border:* not differentiated*margin:* the true lamina, entire and plane, 4–6 rows of narrow, hyaline cells*cells:* hyalocysts 40 μm wide, rectangular, firm-walled, pored, smooth**capsule:** 1–1.5 mm, oblong, inclined, asymmetric, strumose, curved, 8-ribbed when dry; seta 13–20 mm, terminal or lateral, slender, red; calyptra cucullate; operculum long-rostrate; peristome dicranoid, the teeth 16, lanceolate, cleft to the middle, vertically pitted-striolate below

vegetative habit, fertile shoot, capsules (mature and immature), and leaf outline

10 mm, 1 mm, 0.5 mm (4), 1 mm



margin midleaf and leaf base (2)

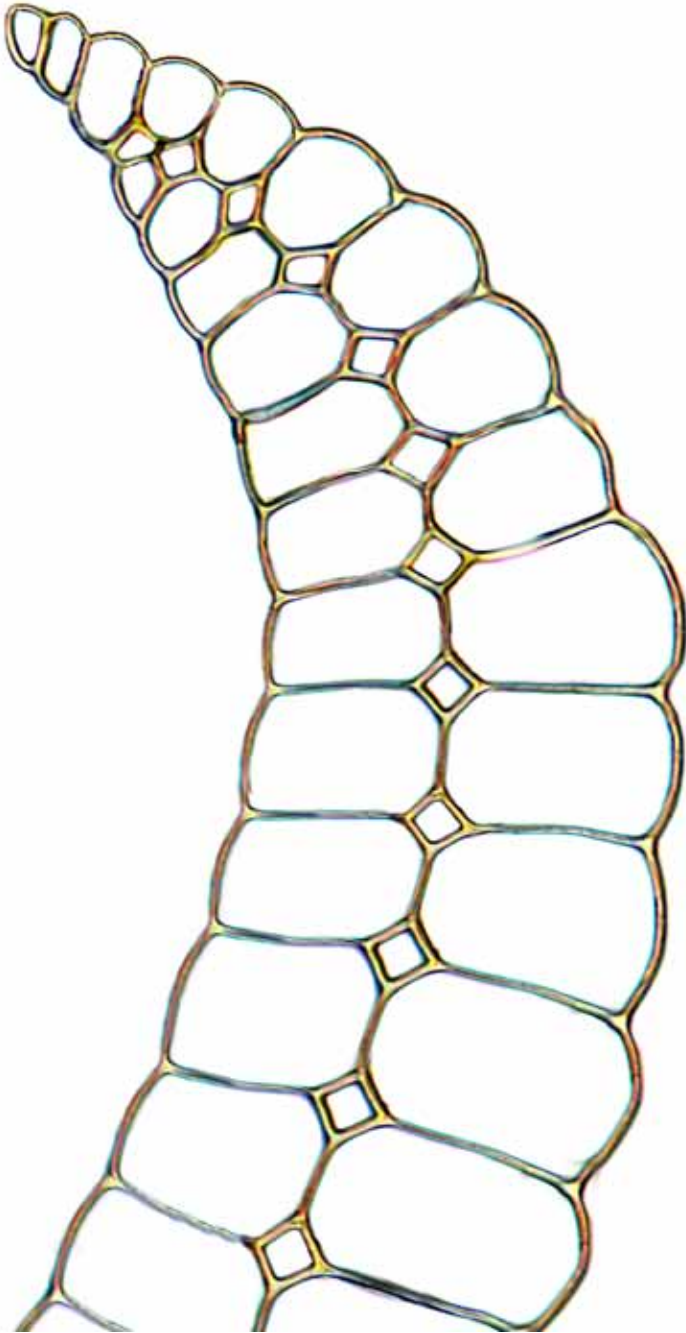
50 μm, 100 μm, 50 μm

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*Leucobryum javense* immature capsules  
0.5 mm

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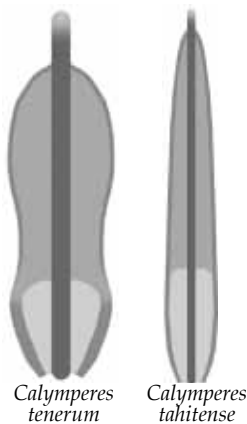


*Leucobryum javense* leaf cross-section  
50  $\mu\text{m}$

**Key\* to the New Zealand species of Calymperes (2)**

- 1 Leaves linear-lanceolate, 5–7 mm; costa percurrent, bearing gemmae in a cluster on only its adaxial surface; cells of the distal end of the cancellinae arranged in finger-like rows ..... ● **Calymperes tahitense**
- 1: Leaves panduriform, 1.5–2 mm; costa excurrent, bearing gemmae in a sphere around its entire circumference; cells of the distal end of the cancellinae not arranged in finger-like rows ..... ● **Calymperes tenerum**

\* based partly on Reese, WD; Stone, IG (1995): The Calymperaceae of Australia. *Journal of the Hattori Botanical Laboratory* 78, 1–40.





**Calymperes tahitense** (Sull.) Mitt.

**form:** tufts or cushions of stems, often forked, dark green, 10–40 mm tall, rhizoidal below

**habitat:** bark and rock in humid and shaded lowland forest near streams

**leaf:** size: 5–7 × 1 mm

*shape:* linear-lanceolate, tubulose

*tip:* obtuse, tipped with a stout excurrent costa (proboscis)

*base:* sheathing, cancellinae on both sides, interfingered distally among lamina cells

*costa:* stout, excurrent, gemmiferous on its distal adaxial surface

*border:* strongly intramarginal below, nearly marginal above

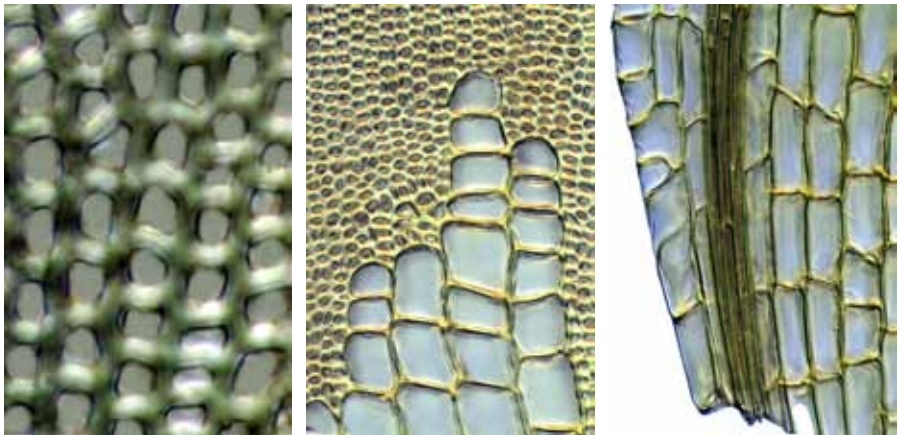
*margin:* minutely toothed below, coarsely toothed near apex, ± revolute

*cells:* lamina cells 3–5  $\mu\text{m}$ , isodiametric, thick-walled, bulging on adaxial surface, smooth; cancellinae cells rectangular, thin-walled, smooth, 40–90 × 25  $\mu\text{m}$

**capsule:** not seen in New Zealand



vegetative shoots (dry), leaf outline, excurrent costa (naked), basal intramarginal border  
 ─── 5 mm, ─── 5 mm, ─── 1 mm, ─── 0.1 mm, ─── 10  $\mu\text{m}$



cells midleaf, uppermost cancellinae cells, and leaf basal angle  
 ─── 5  $\mu\text{m}$ , ─── 10  $\mu\text{m}$ , ─── 10  $\mu\text{m}$

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**Calymperes tenerum** Müll.Hal.

**form:** scattered tufts or cushions of erect, sparsely forked stems, up to 10 mm  
**habitat:** bark, less often logs, rocks, or soil, in shady, damp forests

**leaf:** size: 1.5–2.7 × 0.6 mm

*shape:* panduriform from a sheathing cancellinate base, bistratose above

*tip:* excurrent costa bearing green propagules (gemmae)

*base:* sheathing, paired cancellinae of hyaline, thin-walled, ± rectangular cells

*costa:* stout, excurrent, bearing globose cluster of green, fusiform propagules (gemmae), 6–9-celled, 150–200 μm long

*border:* weak to absent, at most several rows of linear cells, not intramarginal

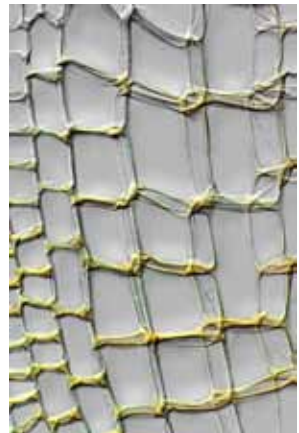
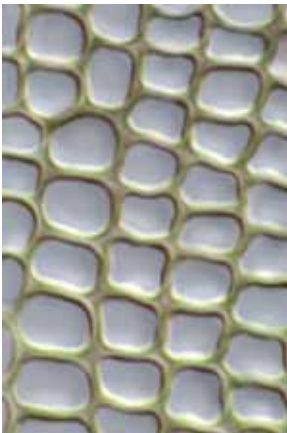
*margin:* ± entire, plane

*cells:* upper lamina cells 5–8 μm, isodiametric, firm-walled, smooth, strongly bulging adaxially in xs; cancellinae cells 60–75 × 30 μm, thin-walled, smooth

**capsule:** capsules not seen in NZ; 1.5–3 mm, cylindrical, emergent, erect; seta 1.5–2 mm, orange; calyptra persistent, covering the capsule; peristome none

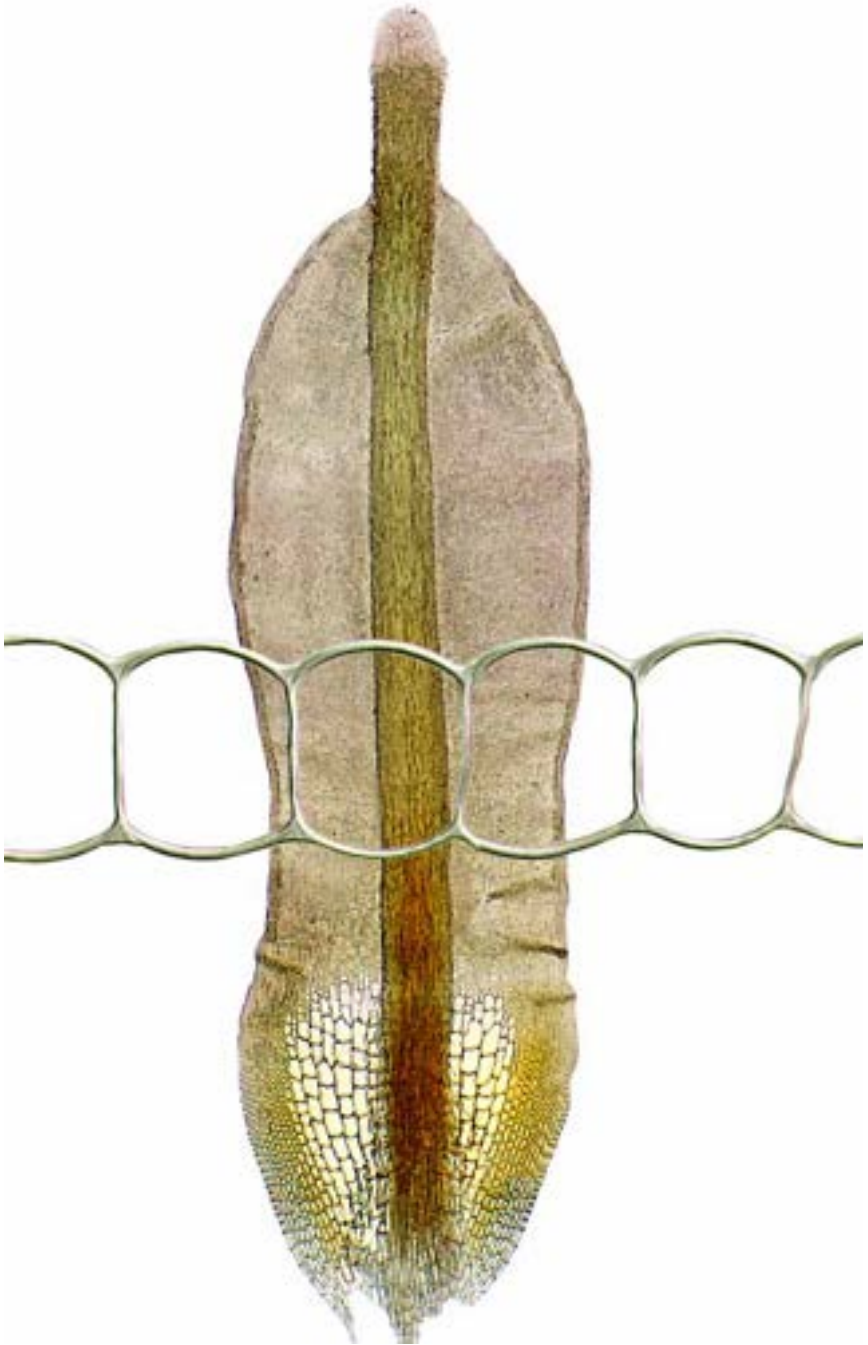


habit, vegetative shoot (dry), leaf outline, propagule, excurrent costa (naked)  
 ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 100 μm



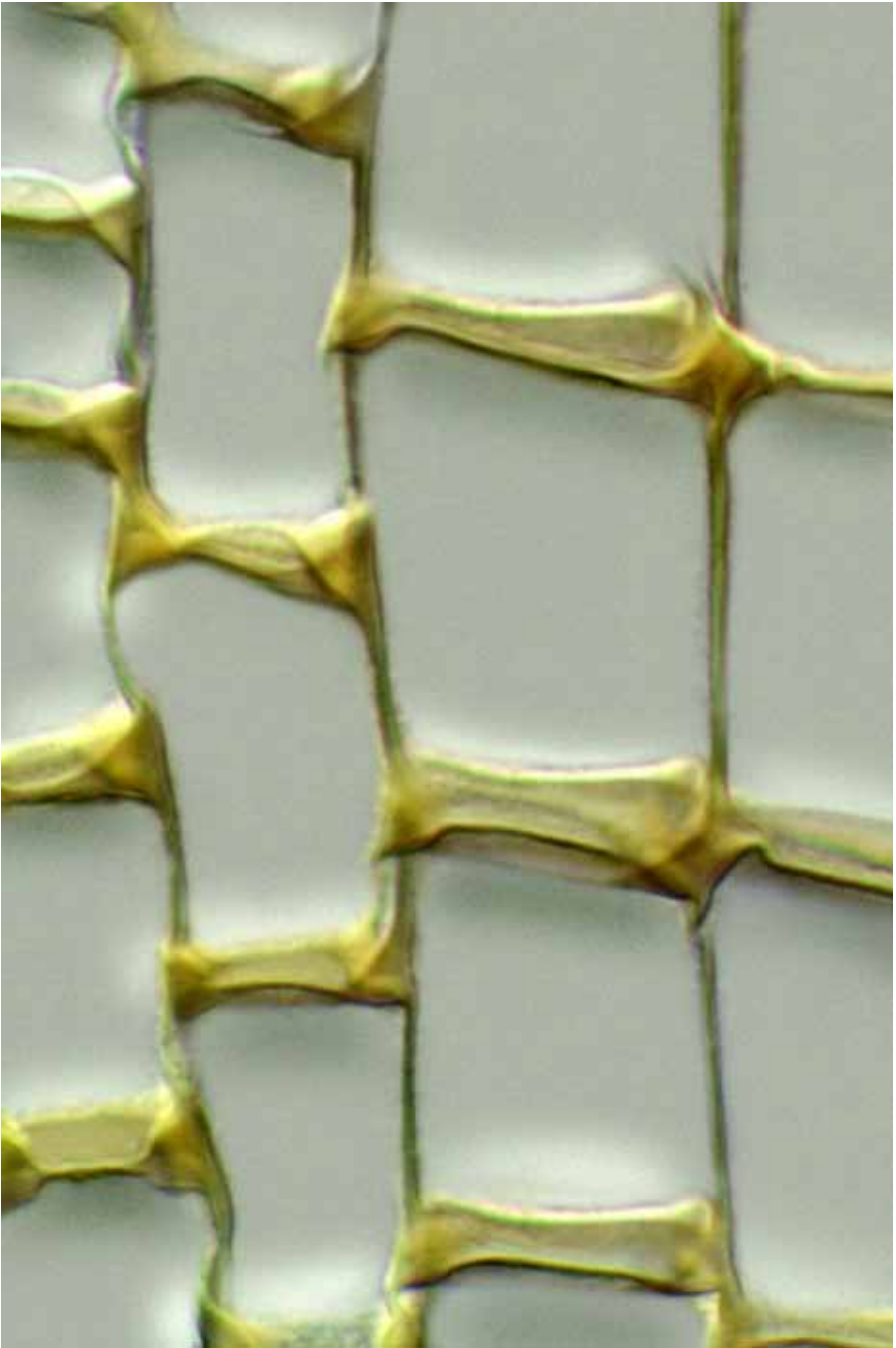
cells midleaf, costa and cancellinae at leaf base, and cancellinae  
 ■ 10 μm, ■ 50 μm, ■ 10 μm

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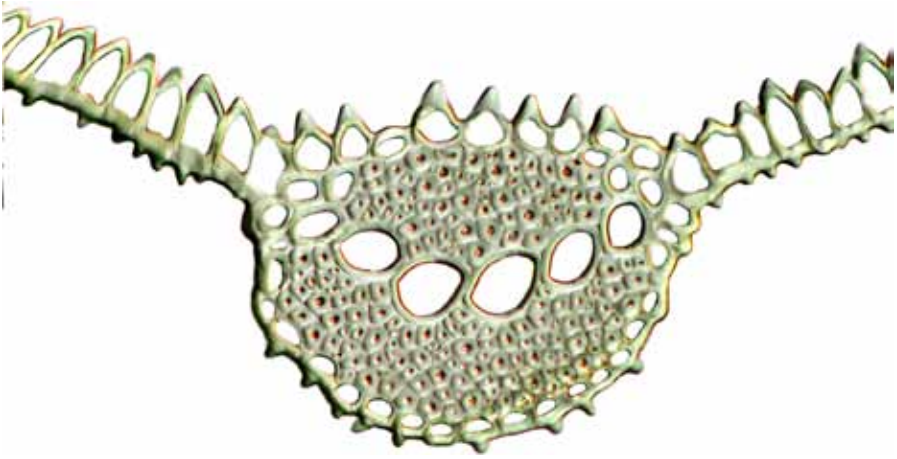
*Calymperes tenerum* leaf whole-mount and cross-section of cancellina cells  
0.1 mm (leaf), 10  $\mu$ m (cancellina cells)

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*Calymperes tenerum* cancellina cells  
10  $\mu\text{m}$

continued next page



*Calymperes tenerum* cross-section of costa (top), lamina at midleaf (middle), and margin (bottom), all showing leaf cells with adaxial bulge and papillae on underside  
 ■ 10  $\mu\text{m}$  (top), ■ 10  $\mu\text{m}$  (middle), ■ 10  $\mu\text{m}$  (bottom)

**Syrhophodon armatus** Mitt.

**form:** tufts or turves of erect, sparsely forked stems, with red papillose rhizoids, to 10 mm tall, the leaves often appearing glaucous

**habitat:** bark, soil, rotting logs, stumps, and rock, to 1800 m

**leaf:** size: 2.5–3.0 × 0.3–0.4 mm

**shape:** ligulate-linear from a slightly broader sheathing base

**tip:** mucronate; adaxial surface with a low dense pad of cylindric-clavate gemmae, 4–6-celled, 75 × 25 μm

**base:** cancellinae abruptly delimited about 1/3 up lamina

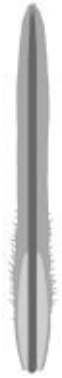
**costa:** subpercurrent, spinose-papillose abaxially

**border:** narrow, hyaline

**margin:** entire above, hyaline, toothed-ciliate below, the cilia ± retrorse, plane

**cells:** 10–15 μm, rounded-isodiametric, firm-walled, unipapillose on both surfaces

**capsule:** not known in New Zealand, 1–2.5 mm, cylindric, erect, exserted; seta 10–20 mm; calyptra cucullate, deciduous; operculum rostrate; peristome single, the teeth 16



vegetative shoot (moist on left) (2), leaf outline, and leaf apex  
 1 mm, 1 mm, 1 mm, 10 μm



armed costa, midleaf, lower margin showing cancellinae, and spinose lower margin  
 10 μm, 10 μm, 10 μm

***Acaulon integrifolium* C.Müll.**

**form:** gregarious, bulbiform, brownish, unbranched stems, 1–2 mm tall  
**habitat:** bare exposed soil in semi-arid sites at low elevation

**leaf:** size: 0.5–1.0 × 0.3–0.5 mm

**shape:** ovate to obovate or elliptic

**tip:** shortly acute to acuminate

**base:** basal cells rectangular, hyaline, thin-walled

**costa:** excurrent in a mucro or arista

**border:** not differentiated

**margin:** entire or irregularly denticulate above, plane

**cells:** 20 × 10 μm, irregularly hexagonal, incrassate, smooth

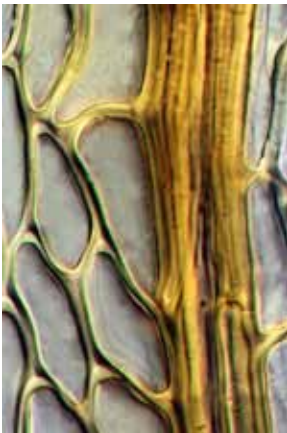
**capsule:** 0.7 mm in diam., globose, erect, immersed, cleistocarpous, orange to chestnut; seta 0.2 mm long; calyptra small; spores 36–38 μm in diam.

**note:** *Pleuridium nervosum* too has a reddish capsule, but differs in having narrower leaves and leaf cells



fertile habit, leaf outline, leaf apex, and margin midleaf

1 mm, 0.1 mm, 10 μm, 10 μm



costa midleaf, cells midleaf, and margin near leaf base

10 μm, 10 μm, 10 μm

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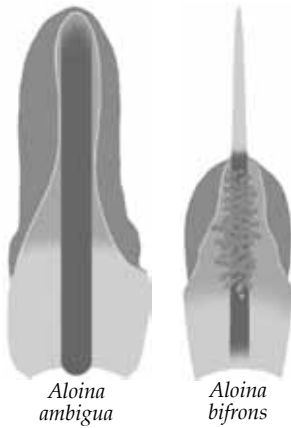
*Acaulon integrifolium* fertile habit  
1 mm



**Key\* to the New Zealand species of *Aloina* (2)**

- 1 Leaf apex muticous; costa percurrent to subpercurrent..... ● ***Aloina ambigua***  
 1: Leaf apex piliferous; costa indistinct in upper leaf ..... ● ***Aloina bifrons***

\* based on Delgadillo M, C (2007): *Aloina*. *Flora of North America* 27, 615.



***Aloina ambigua*** (Bruch & W.P.Schimper) Limpricht

**form:** rosettes of infolded leaves enclosing dense adaxial filaments

**habitat:** calcareous gravel and clayey soils

**leaf:** size: 1–3 × 0.3–0.7 mm

**shape:** lingulate from a slightly wider base

**tip:** obtuse (can be pointed when the leaf margins are spread), cucullate

**base:** basal cells rectangular with thick hourglass-shaped transverse walls

**costa:** ± reaching the apex; dense adaxial cushion of filaments 3–6 cells tall, the terminal cell apically thickened

**border:** not differentiated

**margin:** entire, deeply infolded

**cells:** 15–20 μm, quadrate to oblong, thick-walled, smooth

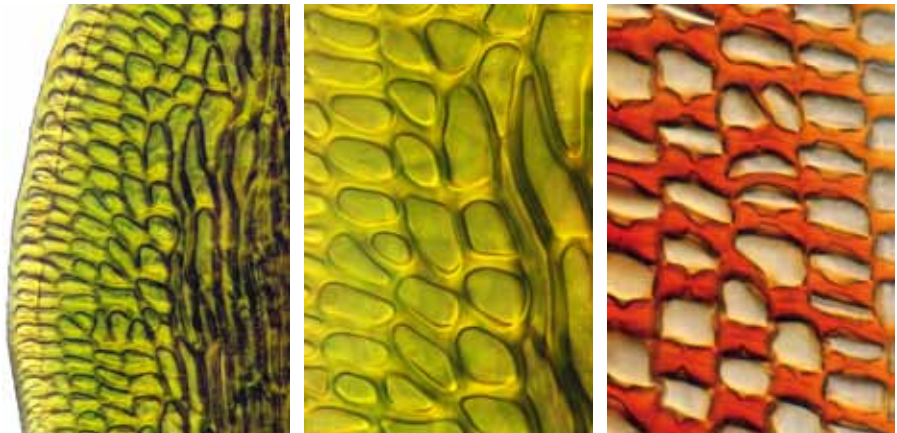
**capsule:** to 2.5 mm, narrowly cylindrical, straight, erect; seta 6–12 mm;

**peristome** teeth filiform, twisted

**note:** the rosette resembles an *Agave* plant in miniature



fertile shoot, capsule and peristome, rosette, leaf outline, leaf apex, and costal filaments  
 ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



margin midleaf, cells in upper leaf, and cells near leaf base  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

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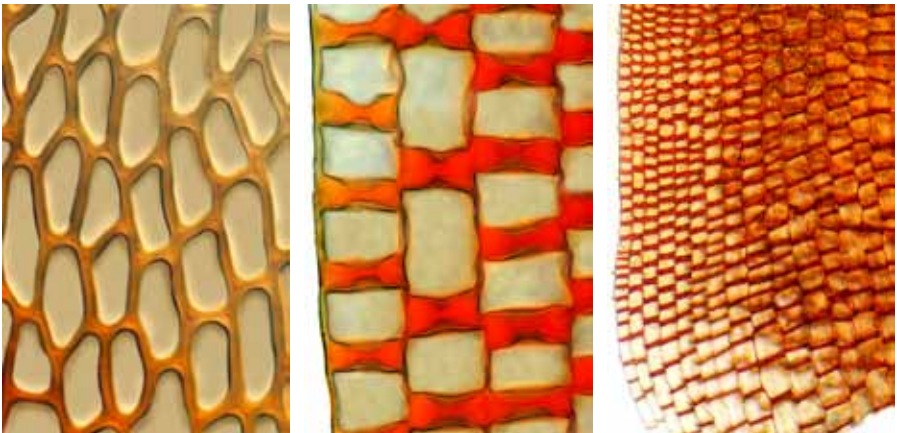


*Aloina ambigua* filamentous peristome  
0.1 mm

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***Aloina bifrons*** (De Not.) Delgad.**form:** gregarious to loosely tufted, erect, simple stems, 2–6 mm tall**habitat:** limestone or calcareous soil in semi-arid sites to high elevations**leaf:** *size:* to 2 mm including arista*shape:* widely elliptic; KOH reaction red*tip:* subacute, cucullate*base:* sheath cells pellucid and their transverse walls strongly thickened*costa:* broad, indistinct, excurrent in a cusp or a smooth, hyaline arista*border:* not differentiated*margin:* entire, strongly involute above*cells:* 15  $\mu\text{m}$ ,  $\pm$  isodiametric, thick-walled, smooth**capsule:** 3–3.5 mm, narrowly cylindrical, erect, brown; seta 10–40 mm, flexuose; peristome teeth 32, filamentous, arising from a low cylinder; operculum narrowly conic, about 1/3 the length of the capsule**note:** on the adaxial costa and lamina is a dense mat of filamentous propagules

fertile shoot (dry), operculum, capsule, peristome, leaf outline, propagules, base of arista  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



cells of sheathing leaf base, margin of lower leaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

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*Aloina bifrons* margin near leaf base  
10  $\mu\text{m}$

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*Aloina bifrons* margin of upper sheath  
10  $\mu\text{m}$

**Anoetangium aestivum** (Hedw.) Mitt.

**form:** dull, matted tufts of sparsely branched, tomentose stems, 15–40 mm tall  
**habitat:** damp rock, often calcareous, near water sources to high elevations

**leaf:** size: 1–1.5 × 0.2–0.3 mm

**shape:** linear-lanceolate, carinate, appressed and twisted when dry

**tip:** acuminate

**base:** cells at the base rectangular and smooth

**costa:** failing or shortly excurrent, papillose at the back

**border:** not differentiated

**margin:** entire, plane

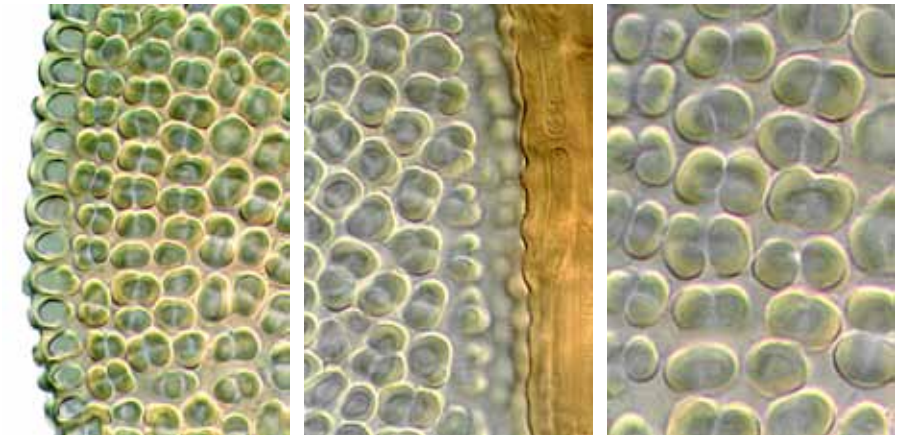
**cells:** 10 μm diam., subquadrate, thick-walled, papillose, rectangular below

**capsule:** 0.8–1.5 mm, oval to oblong with a tapered neck, erect, symmetrical; seta 10 mm, slender, lateral; operculum finely long-rostrate; peristome absent

**note:** *Amphidium cyathicarpum* differs in having a smooth costa and leaves that are crisped when dry



vegetative shoots (dry), leaf outline, leaf apex, and margin upper leaf  
 1 mm, 0.5 mm, 10 μm, 10 μm



margin midleaf, cells near costa, and surface papillae  
 10 μm, 10 μm, 10 μm

**Ardeuma recurvirostrum** (Hedw.) R.H.Zander & Hedd.  
(formerly *Hymenostylium recurvirostrum*)

**form:** densely tufted, tomentose, erect, yellow-green stems, 5–40 mm tall

**habitat:** moist rock or soil over rock, especially limestone

**leaf:** size: 0.8–1.8 mm

**shape:** narrowly lanceolate

**tip:** acuminate

**base:** basal cells larger than the other blade cells, smooth, hyaline

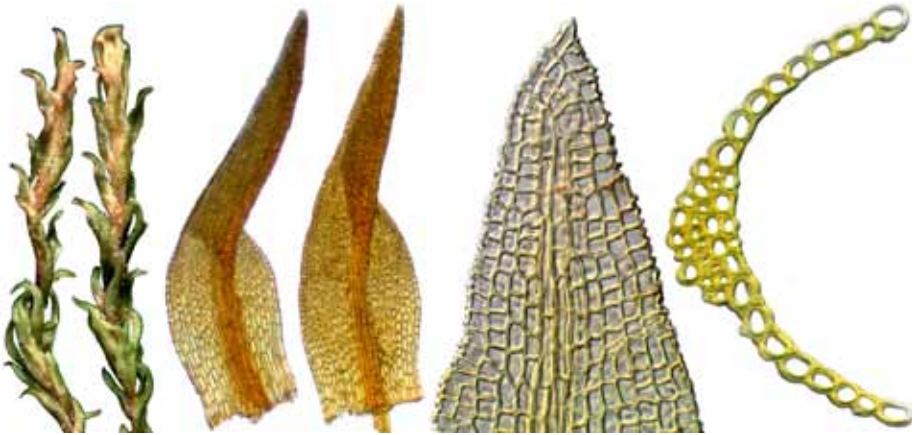
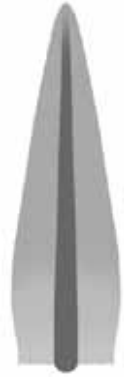
**costa:** ending below the apex

**border:** not differentiated

**margin:** entire, recurved on one or both sides below

**cells:** 6–13  $\mu\text{m}$ , quadrate to rectangular, firm-walled, pluripapillose

**capsule:** 0.7–1.2 mm, operculum obliquely rostrate, often remaining attached to the columella after dehiscence, ovoid, erect, straight; seta 3–10 mm; calyptra cucullate, naked, smooth; peristome none; spores 14–20  $\mu\text{m}$ , weakly papillose



shoots (2) (dry), leaf outlines (2), leaf apex, and leaf cross-section  
 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



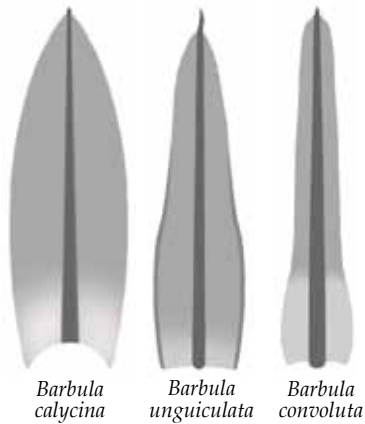
margin midleaf, costa midleaf, and margin near leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



**Key\* to the New Zealand species of *Barbula* (3)**

- 1 Margin plane or only slightly recurved or revolute; leaves flaccid or undulate ..... 2  
 1: Margin strongly recurved; leaves stiff ..... ● ***Barbula unguiculata***
- 2 Leaves broadly oblong-lanceolate; costa excurrent in a mucro ... ● ***Barbula calycina***  
 2: Leaves oblong-ligulate from a broader base; costa ending at or just below the apex....  
 ..... ● ***Barbula convoluta***

\* based partly on Catcheside, DG (1980): *Mosses of South Australia*. Government Printer, Adelaide. 177.



***Barbula calycina*** Schwäger.

**form:** tufted, yellow-green, unbranched stems, tomentose, 5–30 mm tall  
**habitat:** soil or rock in open dunes, forest, or scrub, to high elevations

**leaf:** size: 2–3 × 0.6–0.9 mm

**shape:** widely oblong-lanceolate, spirally contorted when dry

**tip:** acuminate with a mucro

**base:** basal cells rectangular, hyaline, smooth

**costa:** excurrent in a mucro

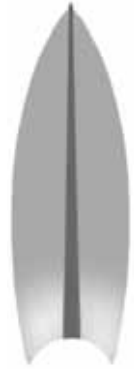
**border:** not differentiated

**margin:** entire, involute, variably undulate

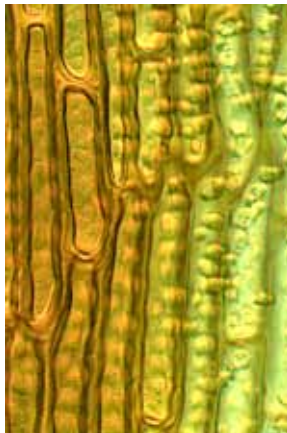
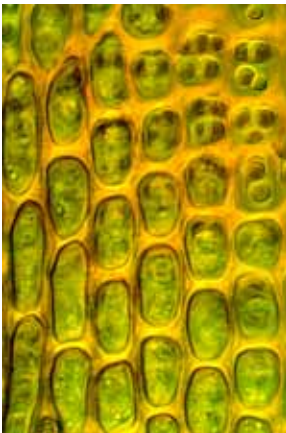
**cells:** 8–10 μm, isodiametric, thick-walled, densely papillose

**capsule:** 1.3–2 mm, elliptic or fusiform, slightly curved, erect or inclined;  
 seta 10–35 mm, slender, often flexuose; operculum finely long-rostrate;  
 peristome of 32 brown, papillose filaments; spores 8–10 μm in diam.

**note:** differs from *Tortella* in lacking a V-shaped base of hyaline cells



vegetative habit (moist), shoot (dry), leaf outline, and mucronate leaf apex  
 5 mm, 5 mm, 1 mm, 50 μm



cells midleaf, juxtacostal cells in lower leaf, and costa cross-section  
 10 μm, 10 μm, 10 μm

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*Barbula calycina* vegetative habit  
1 mm

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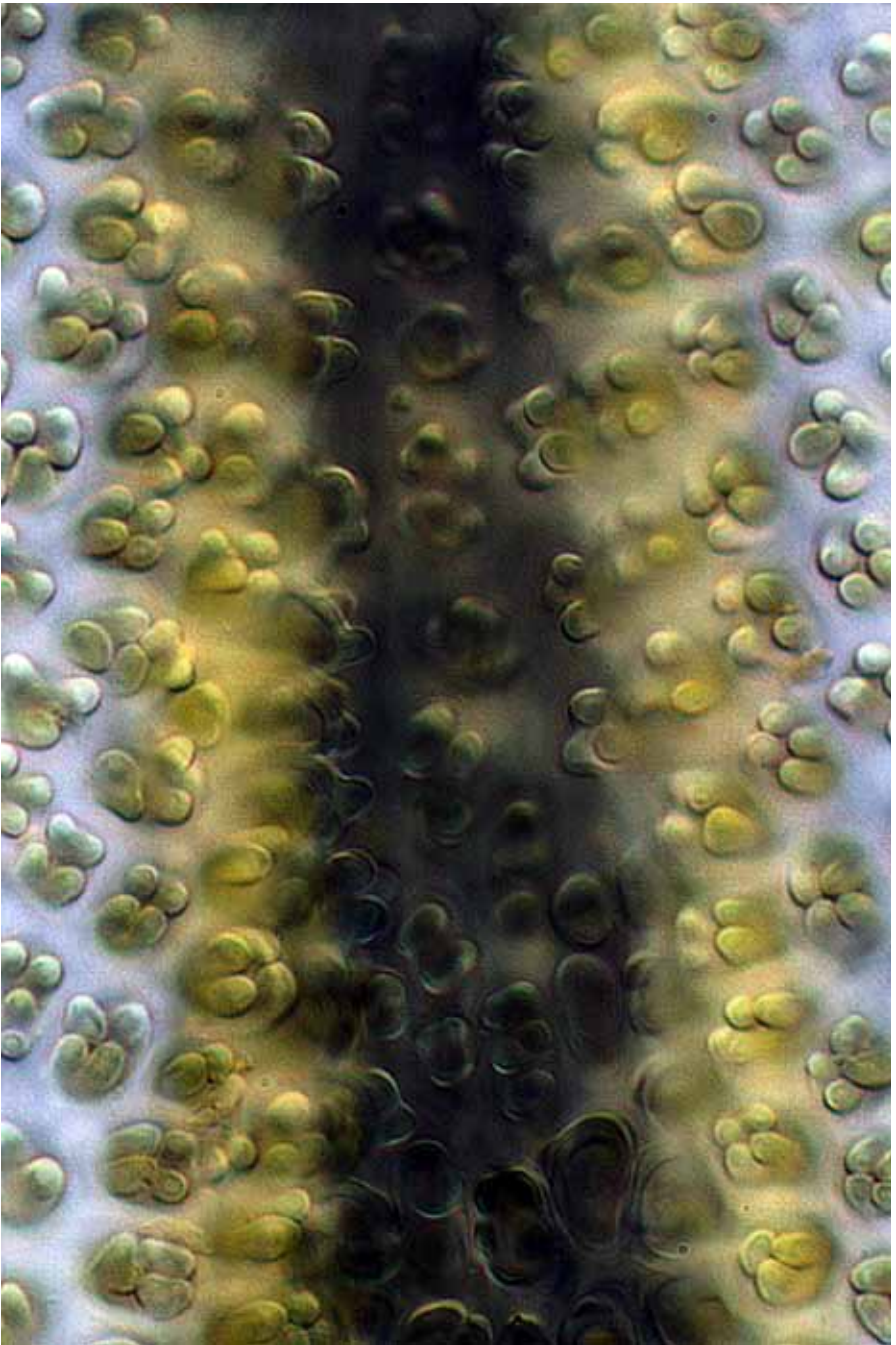
*Barbula calycina* vegetative habit  
1 mm, 1 mm

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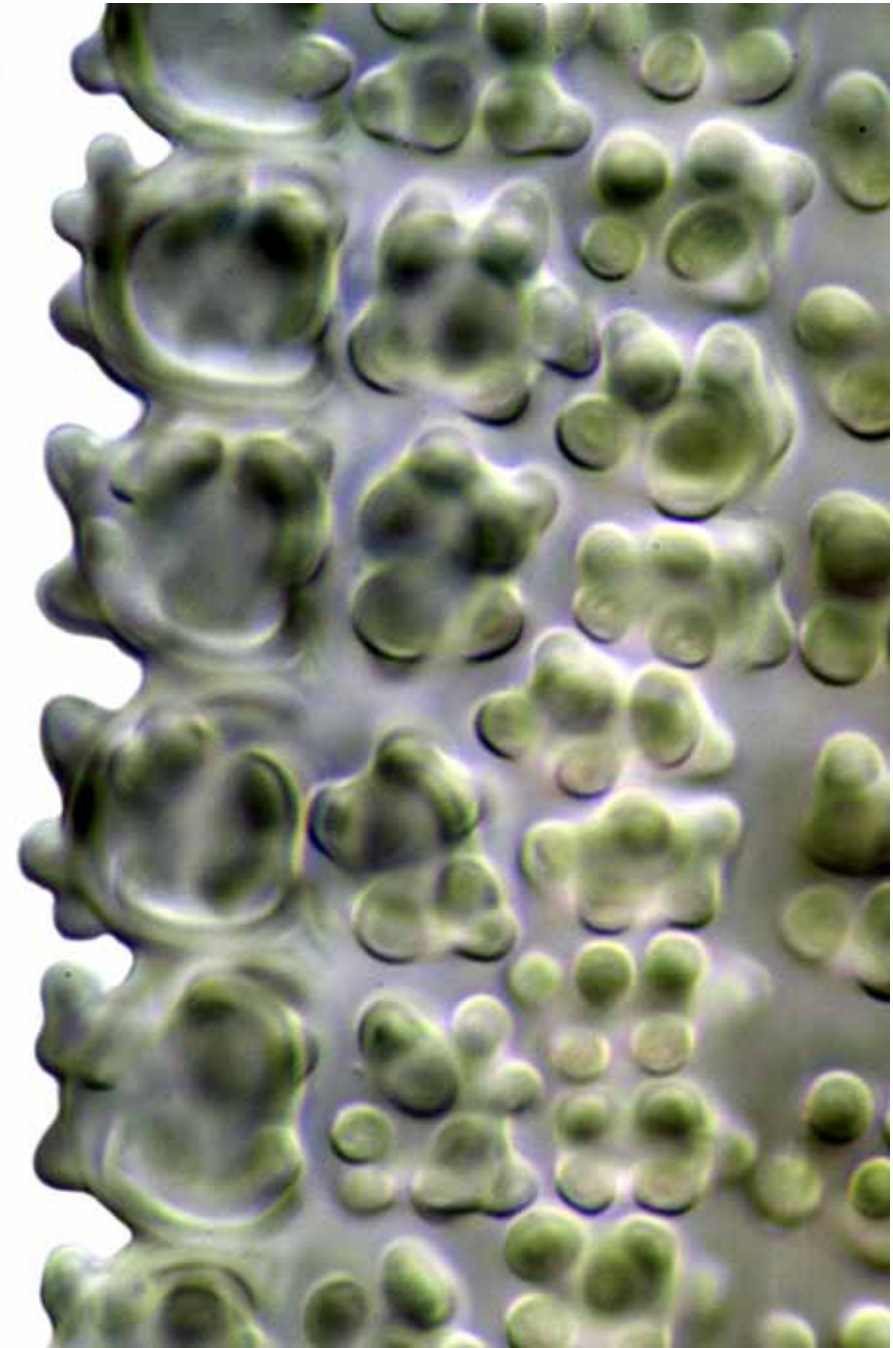
*Barbula calycina* fertile shoots, showing immature capsules and calyptrae  
 1 mm, 1 mm, 1 mm

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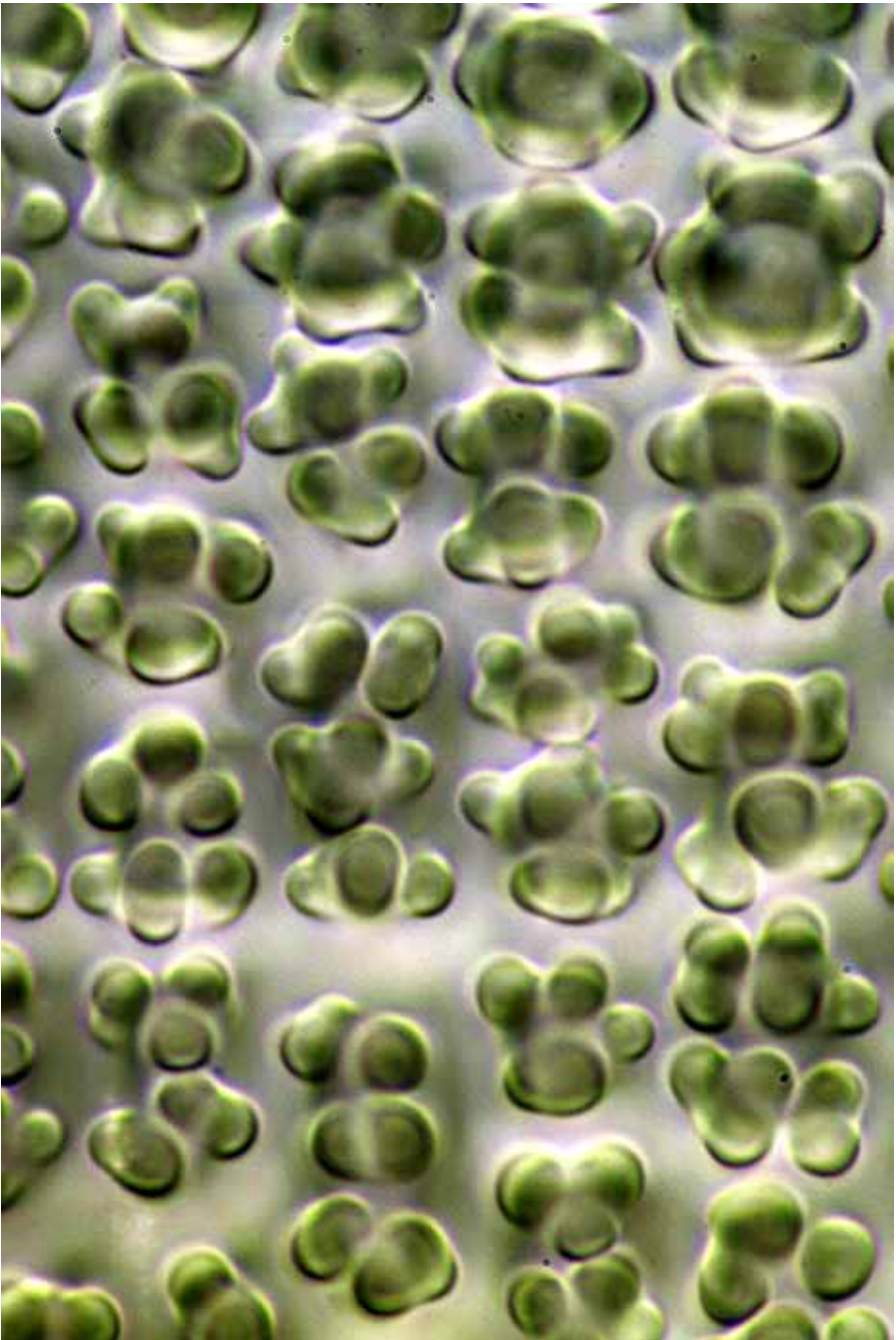
*Barbula calycina* leaf surface papillae above costa  
10  $\mu$ m

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*Barbula calycina* margin midleaf showing surface papillae  
10  $\mu$ m

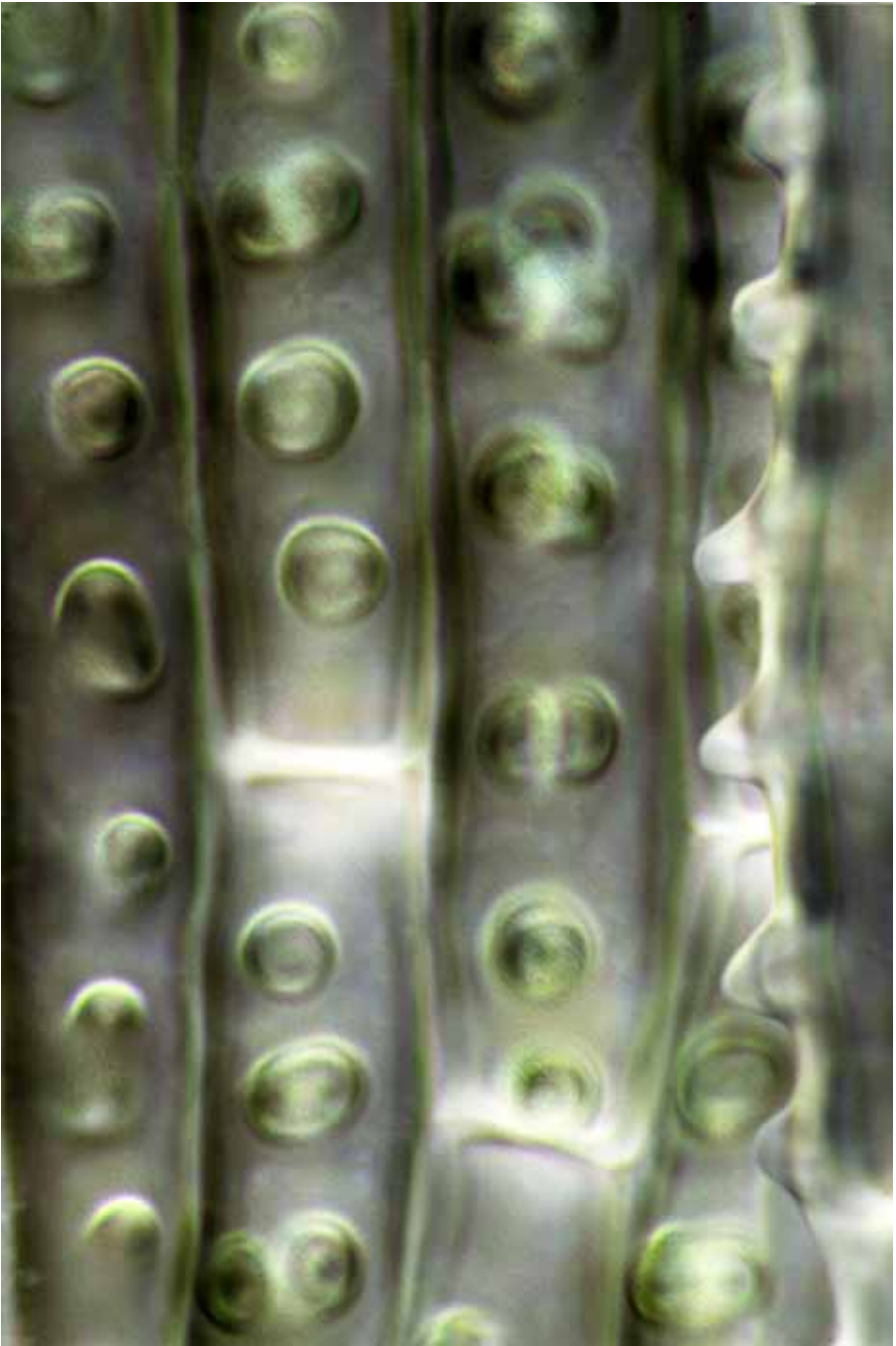
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*Barbula calycina* surface papillae midleaf  
10  $\mu\text{m}$

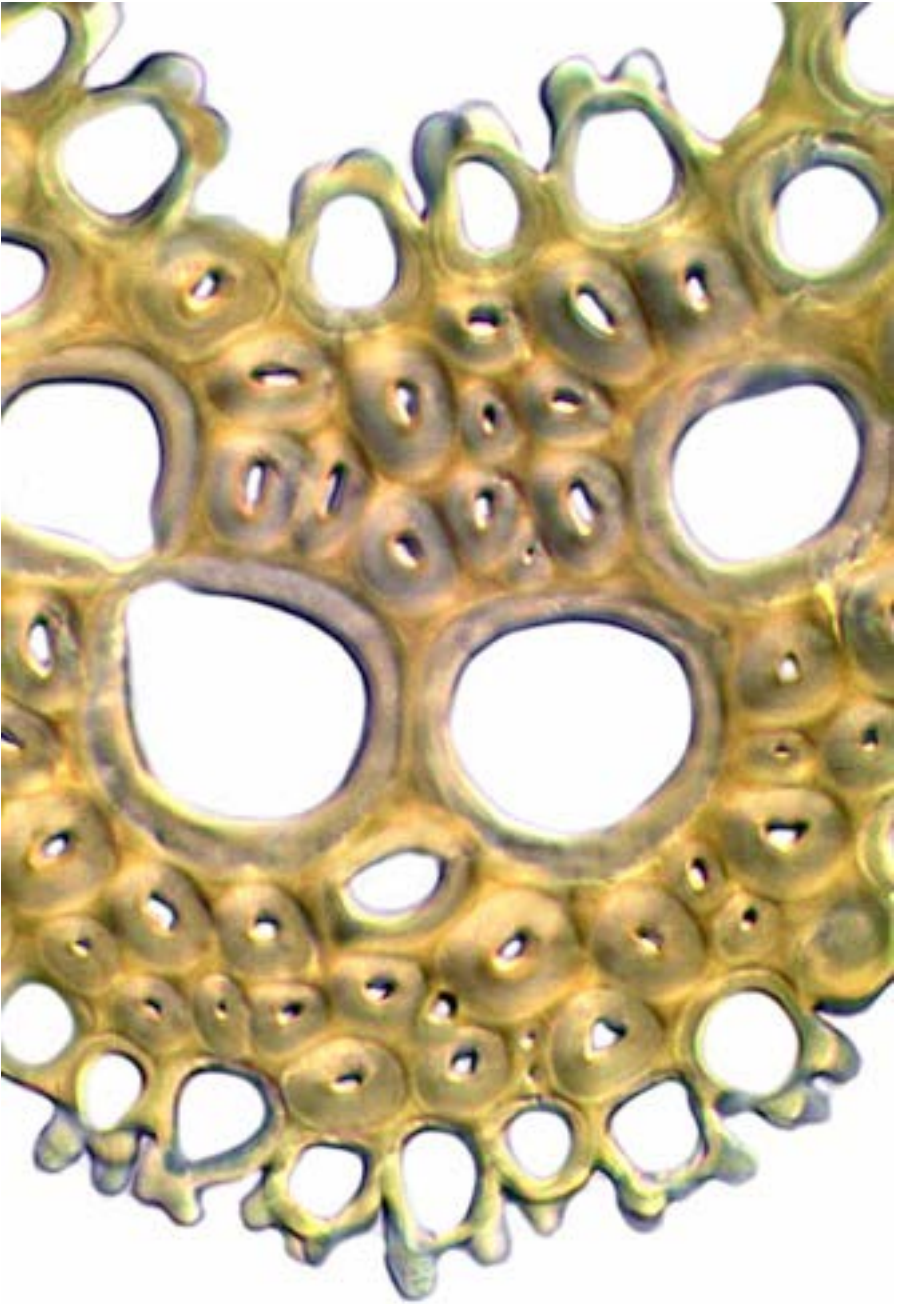
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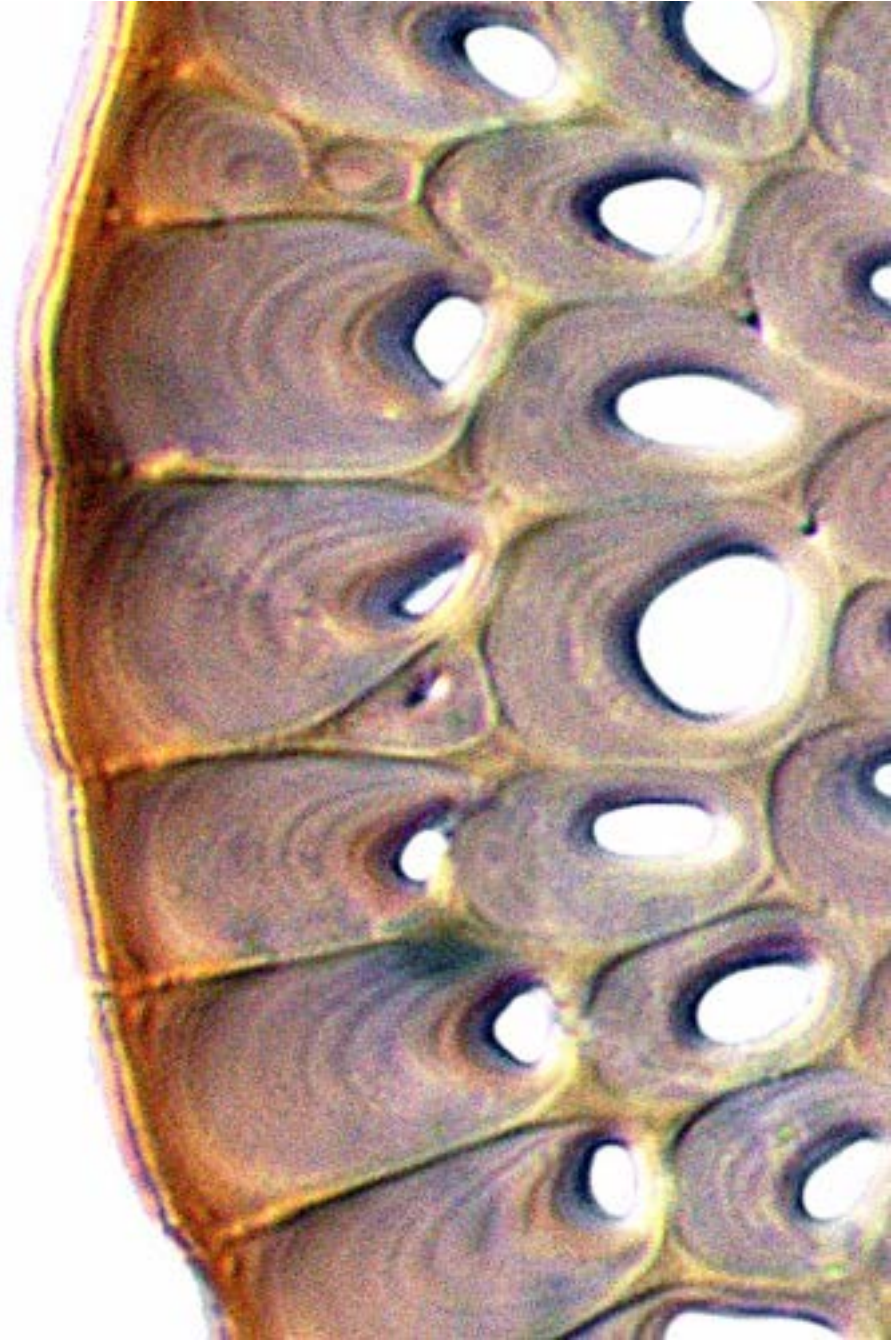
*Barbula calycina* juxtacostal cells in lower leaf, showing single rows of surface papillae  
10  $\mu\text{m}$

continued next page



*Barbula calycina* costa cross-section  
10  $\mu$ m

continued next page



*Barbula calycina* seta cross-section  
10  $\mu$ m

continued next page

**Barbula convoluta** Hedw.**form:** densely tufted, green or yellowish stems, 5–15 mm tall**habitat:** calcareous soil or rock in open, disturbed sites such as roadsides**leaf:** size: 0.8–1.5 mm*shape:* oblong-lanceolate to oblong-ligulate*tip:* rounded-obtuse to broadly acute, usually minutely apiculate*base:* basal cells rectangular, firm-walled, pale, smooth*costa:* failing or excurrent in an apiculus*border:* not differentiated*margin:* crenulate-papillose, plane or revolute on one side toward the base*cells:* 6–9  $\mu\text{m}$ , quadrate to hexagonal, thin-walled, densely papillose**capsule:** 1.2–1.8 mm, oblong-cylindric, erect to slightly inclined, light brown, short-necked,  $\pm$  furrowed when dry; seta 10–20 mm, slender, yellow or straw; annulus revolute; operculum a long narrow tilted cone; peristome teeth pink; spores 7–9  $\mu\text{m}$  in diam.

vegetative shoots (the left two dry, the right one moist), leaf outline, and leaf apex  
 ─── 1 mm (3), ─── 0.25 mm, ─── 10  $\mu\text{m}$



margin midleaf, costa midleaf, and costa cross-section  
 ─── 10  $\mu\text{m}$ , ─── 10  $\mu\text{m}$ , ─── 10  $\mu\text{m}$

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**Barbula unguiculata** Hedw.

**form:** patchy to densely tufted, sparsely branched stems, 5–35 mm tall  
**habitat:** calcareous soil and rock in the open, often in disturbed sites

**leaf:** size: 1–2.5 × 0.3–0.6 mm

*shape:* oblong-lanceolate from a widened base, contorted when dry

*tip:* blunt to broadly acute, abruptly apiculate

*base:* basal cells hyaline, rectangular, thin-walled, smooth

*costa:* shortly excurrent, papillose on the back

*border:* not differentiated

*margin:* entire to crenulate, revolute in the lower half or two-thirds

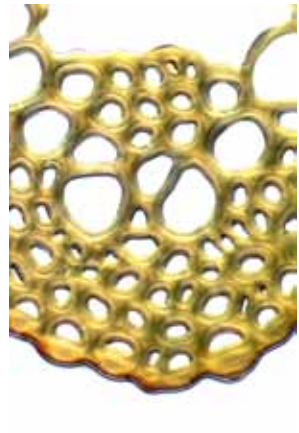
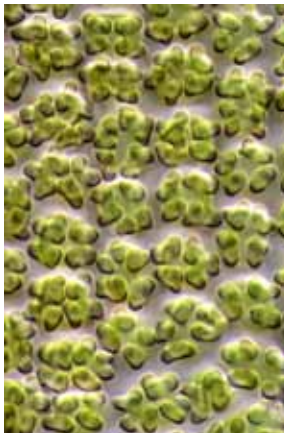
*cells:* 8–10 μm, rounded-hexagonal, firm-walled, pluripapillose

**capsule:** 1–2 mm, narrowly ellipsoid, straight, erect, stomatose at only the base; annulus absent; seta 5–13 mm, reddish; operculum a long, subulate cone; peristome orange or red; spores 9–13 μm in diam.

**note:** the stout, smooth apiculus of the leaf tip is a distinctive trait



vegetative habit, shoot (moist), leaf outline, and leaf apex  
 1 mm, 1 mm, 0.1 mm, 50 μm



margin midleaf, surface papillae, and costa cross-section  
 10 μm, 10 μm, 10 μm



*Barbula unguiculata* habit  
1 mm

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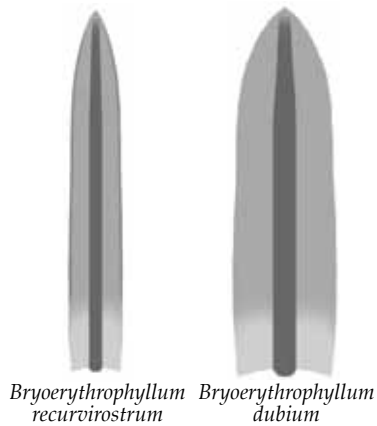


*Barbula unguiculata* leaf surface papillae  
10  $\mu$ m

**Key\* to the New Zealand species of *Bryoerythrophyllum* (2)**

- 1 Leaves linear; margin recurved to near the apex ..... ● ***Bryoerythrophyllum recurvirostrum***  
 1: Leaves widely oblong-lanceolate; margin slightly recurved only near the base..... ● ***Bryoerythrophyllum dubium***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 159.





**Bryoerythrophyllum dubium** (Schwägr.) P.Sollman

**form:** tufted, erect, unbranched stems, bright rust-coloured, to 10 mm tall  
**habitat:** soil or rock, often in disturbed sites, to high elevations

**leaf:** size: 1.5–2.5 mm

*shape:* oblong-lanceolate

*tip:* acute, with a ± hyaline apiculus

*base:* basal cells rectangular, hyaline, smooth

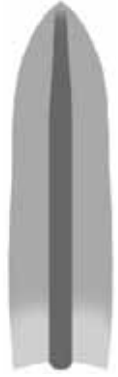
*costa:* failing below the apex

*border:* not differentiated

*margin:* faintly toothed toward the apex, plane or slightly recurved below

*cells:* 7–10  $\mu\text{m}$ , subquadrate, firm-walled, multi-papillose

**capsule:** 2 mm, cylindric, ± curved, pale brown; annulus revoluble; seta 10 mm, flexuose; operculum obliquely short- to long-rostrate; peristome teeth 16, brown, short, divided from a short basal membrane into two papillose articulated filaments; spores 12  $\mu\text{m}$  in diam.



vegetative habit, leaf outline, and leaf apex

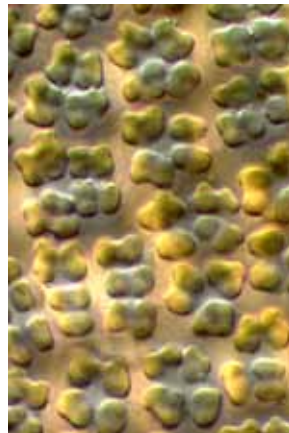
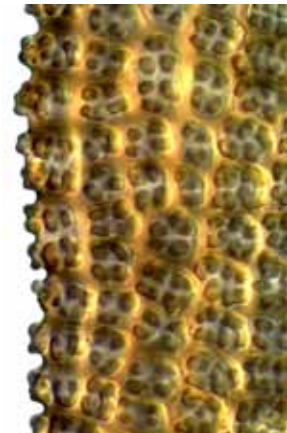
1 mm, 0.5 mm, 100  $\mu\text{m}$



margin midleaf, costa midleaf, and leaf base cells

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

**Bryoerythrophyllum recurvirostre** (Hedw.) P.C.Chen**form:** loosely to densely tufted stems, brick-red above, 5–20(–30) mm tall**habitat:** moist soil, logs, or calcareous rock in shady or open, ± disturbed sites**leaf:** *size:* 2.0–2.8 × 0.3–0.5 mm, crisped or curled when dry  
*shape:* linear-lanceolate to ligulate from an oblong, erect base*tip:* bluntly acute, with a ± hyaline apiculus*base:* basal cells rectangular, hyaline to pale reddish brown, smooth*costa:* failing below the apex or shortly excurrent as a pellucid mucro*border:* not differentiated*margin:* faint toothing toward the apex, ± revolute throughout*cells:* 7–10 μm, subquadrate, firm-walled, multi-papillose (C-shaped)  
**capsule:** 1.3–2.5 mm, cylindrical, symmetric to slightly curved, reddish brown; annulus revolute; seta 6–16 mm, flexuose, red; peristome teeth tan to yellow, perforate or bifid, papillose**note:** *Bryoerythrophyllum recurvirostrum*'s most distinctive vegetative traits are its thin-walled basal cells and smooth irregular apical teethvegetative habit, leaf outline, leaf apex, and apical hyaline apiculus  
1 mm, 0.5 mm, 10 μm, 10 μmmargin midleaf, papillose midleaf cells, and rectangular leaf base cells  
10 μm, 10 μm, 10 μm

**Calyptopogon mnioides** (Schwägr.) Broth.

**form:** robust, tufted or matted, yellowish green stems, sparsely branched, rhizoidal below, 10–40 mm tall

**habitat:** scattered on bark of twigs in high-altitude forest

**leaf:** size: 3–4 × 0.9–1.2 mm

**shape:** oblong-lanceolate to elliptic, crisped when dry

**tip:** shortly acuminate

**base:** basal cells rectangular to linear, hyaline, thin-walled

**costa:** excurrent as a cusp; projecting abaxially

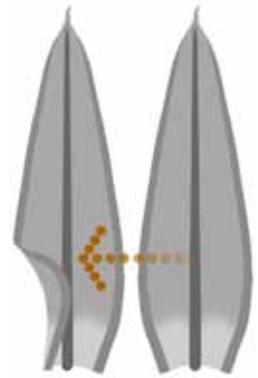
**border:** 2–3 intramarginal rows of long, thick-walled cells

**margin:** entire or minutely crenulate, undulate

**cells:** 10 μm, isodiametric, incrassate, papillose

**capsule:** 2–2.5 mm, erect, oblong-cylindric, erect, symmetrical, red-mouthed; seta 3–4 mm; calyptra mitriform, deeply lobed; peristome of 32 red filaments

**note:** brood bodies on the adaxial costa toward the leaf tip

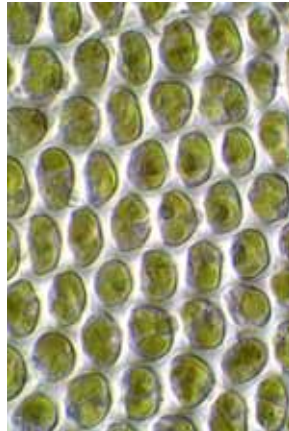


coverslipped



vegetative shoots (wet/dry), leaf outline, shoot (dry), and leaf apex with brood bodies

1 mm (2), 0.5 mm, 1 mm, 100 μm



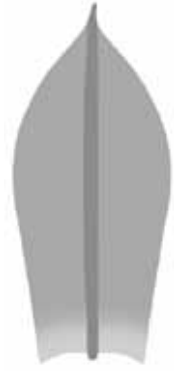
intramarginal leaf border, cells midleaf, and brood bodies

10 μm, 10 μm, 30 μm

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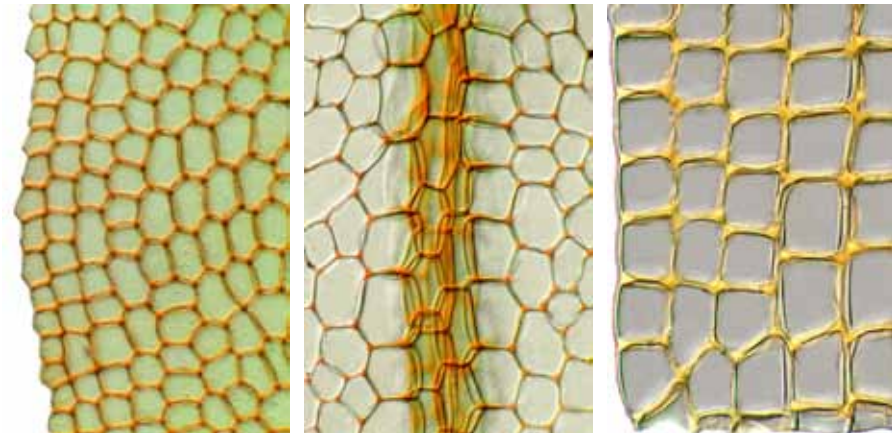


*Calyptopogon mnioides* costa and brood bodies cross-section  
10  $\mu\text{m}$

**Chenia leptophylla** (Müll.Hal.) R.H.Zander**form:** solitary or clustered, erect, dark green stems, 3–8 mm tall**habitat:** moist soil, rock or rock walls, lowland to montane**leaf:** size: 1.4–2.0 × 0.4–0.6 mm*shape:* oblong to spatulate*tip:* acute, often apiculate*base:* basal cells 30–50 × 15–20 μm*costa:* percurrent to slightly excurrent*border:* not differentiated*margin:* irregular with projecting cells, plane*cells:* 17–30 × 15–20 μm, ± quadrate, irregularly thickened, ± smooth**capsule:** not seen in New Zealand; 0.5–0.7 mm, elliptic, erect, cleistocarpous, pale brown, with an oblique beak; seta 0.2 mm; annulus absent; calyptra cucullate to mitrate, smooth; operculum absent; spores 15–20 μm, smooth to papillose**note:** vegetative reproduction by rhizoidal tubers and deciduous leaves

vegetative habit (dry and moist), leaf outline, and leaf apex

1 mm, 1 mm, 0.1 mm, 10 μm



margin midleaf, costa midleaf, and leaf basal angle

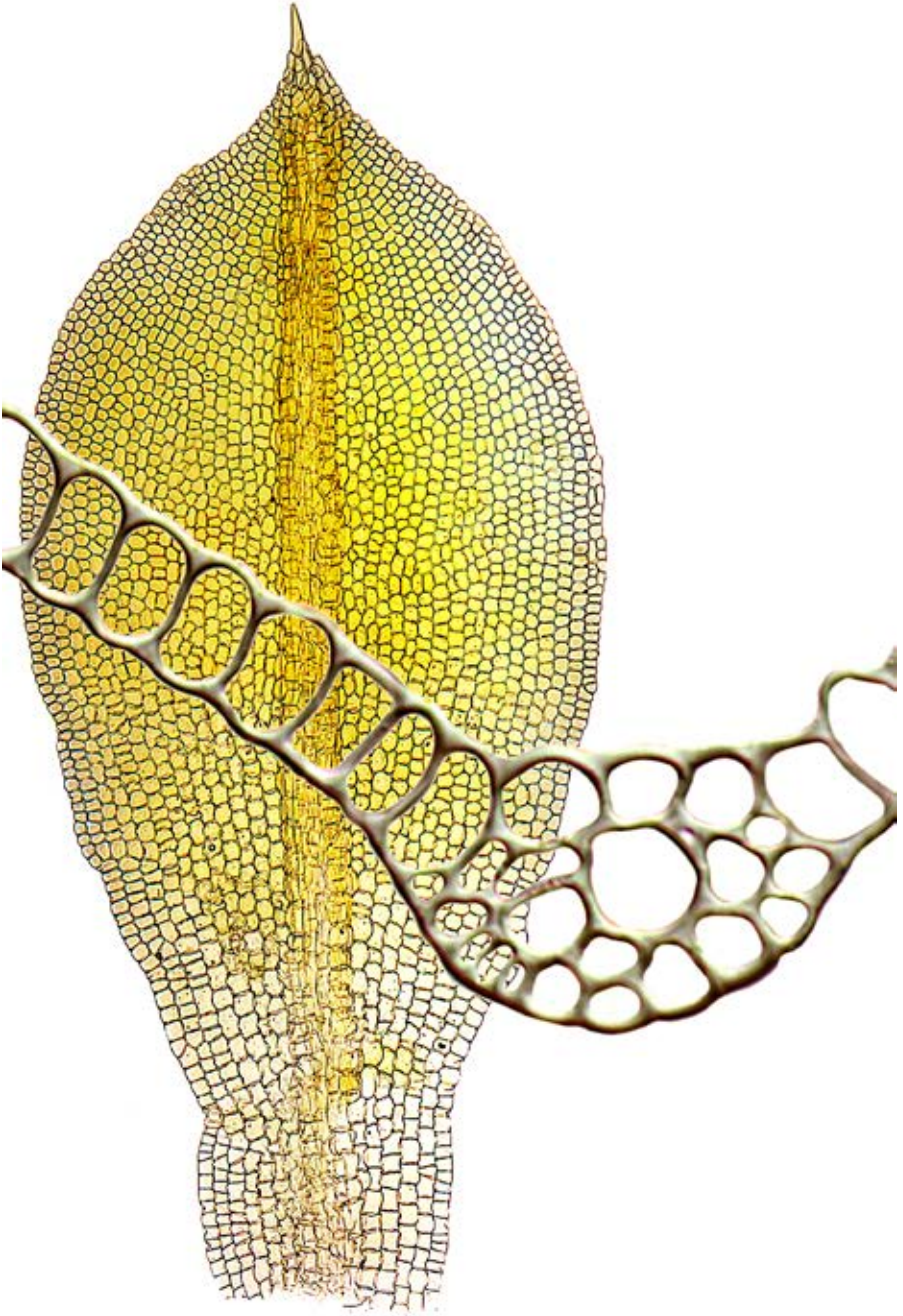
10 μm, 10 μm, 10 μm

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*Chenia leptophylla* habit  
1 mm

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*Chenia leptophylla* leaf outline and costa cross-section  
100  $\mu\text{m}$  (outline), 10  $\mu\text{m}$  (section)

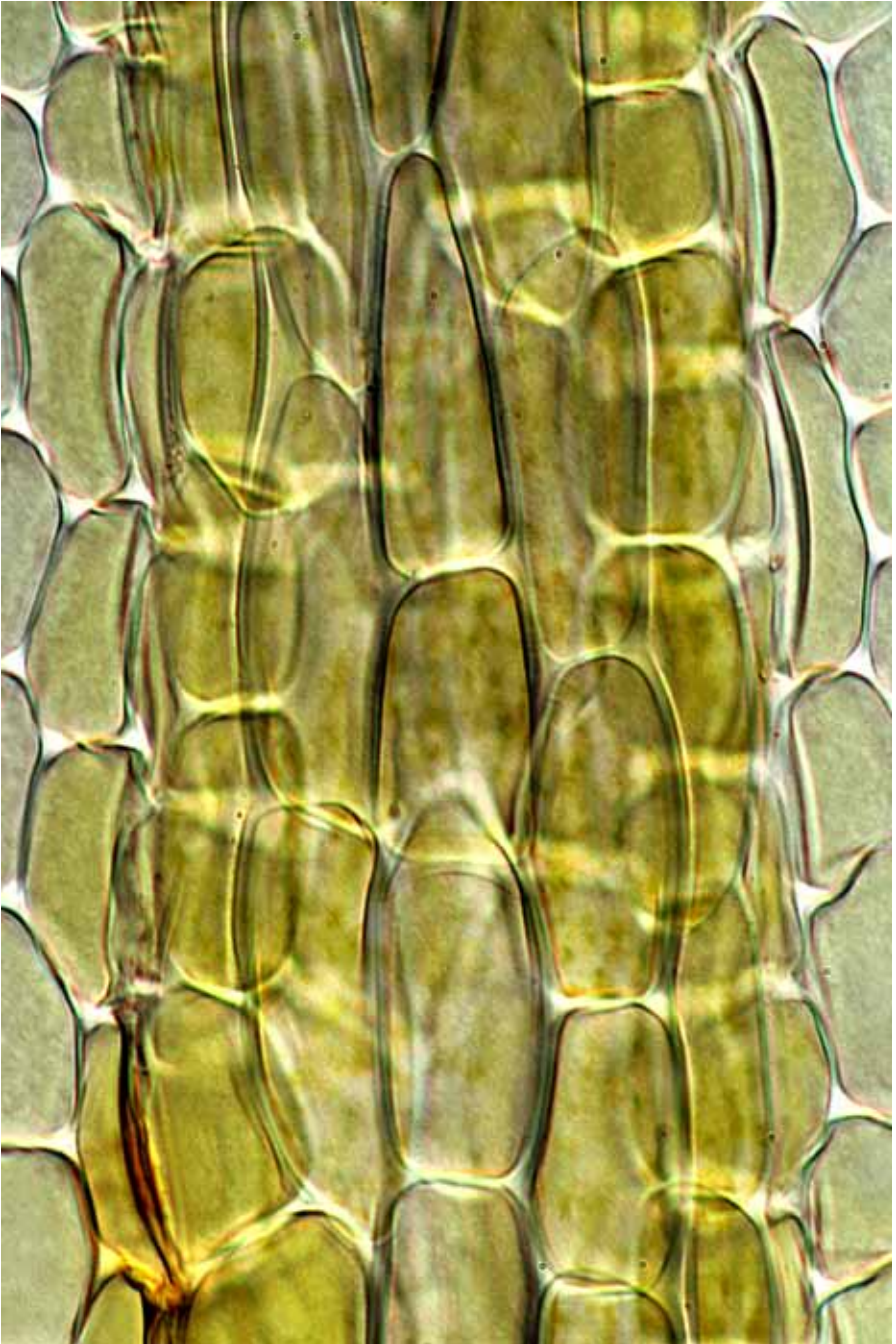
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*Chenia leptophylla* leaf apex  
10  $\mu\text{m}$

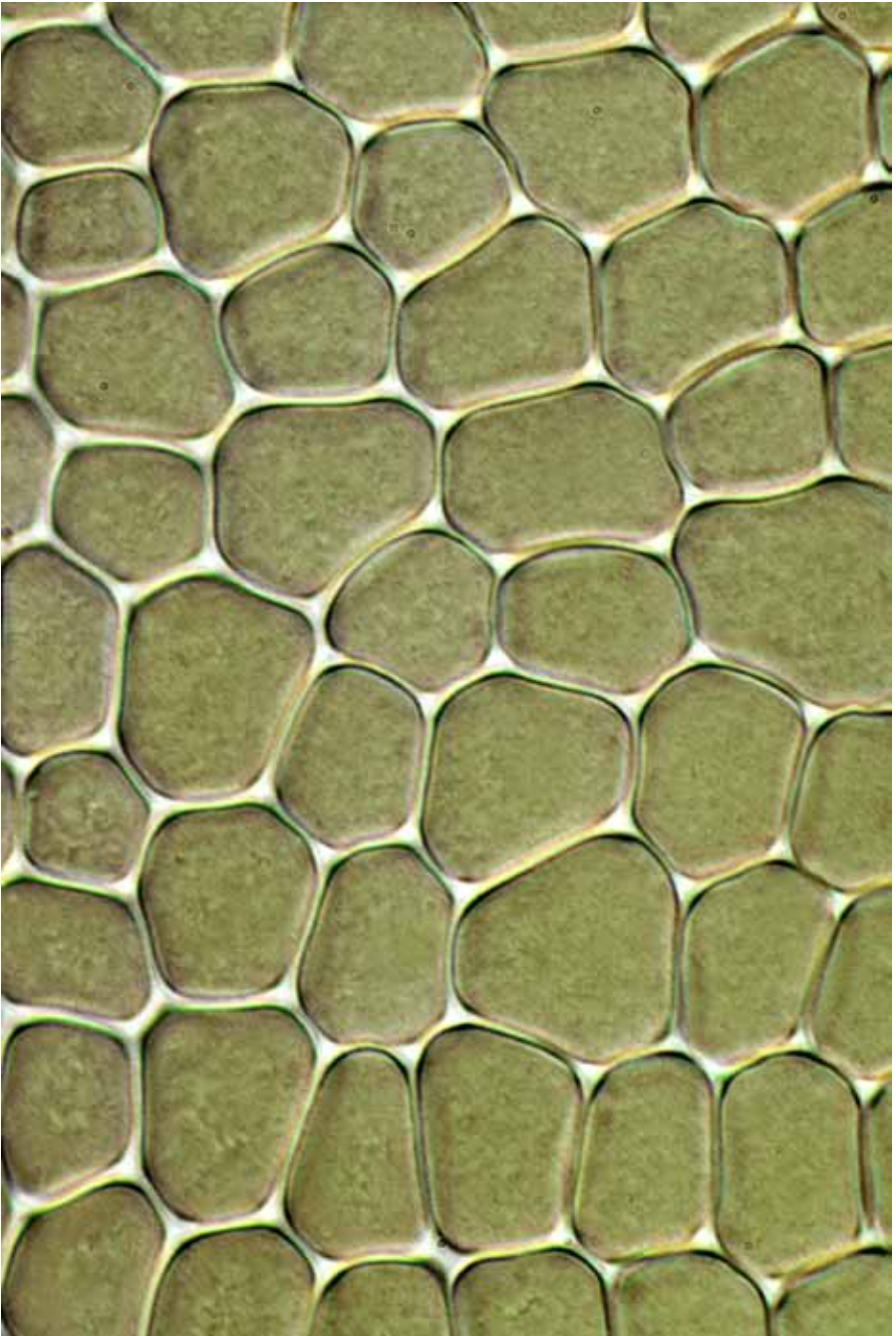
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*Chenia leptophylla* costa midleaf  
10  $\mu$ m

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*Chenia leptophylla* cells midleaf  
10  $\mu$ m

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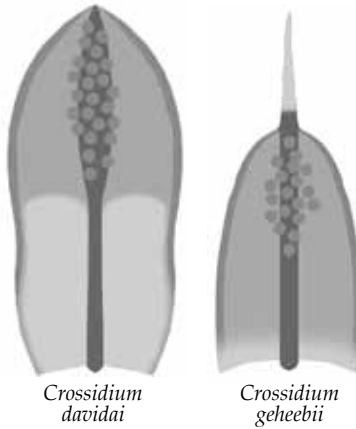


*Chenia leptophylla* margin midleaf  
10  $\mu$ m

**Key\* to the New Zealand species of *Crossidium* (2)**

- 1 Costa excurrent in a mucro; upper lamina cells papillose ..... ● ***Crossidium davidai***  
 1: Costa excurrent in a hair-point; upper lamina cells ± smooth ..... ● ***Crossidium geheebii***

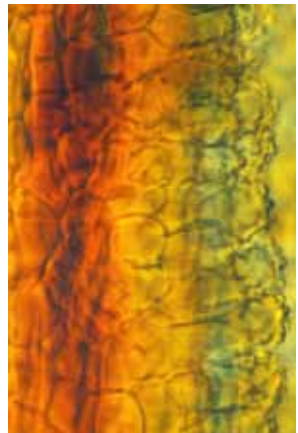
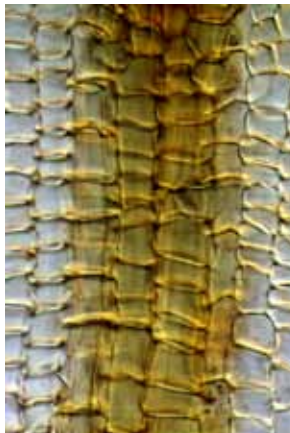
\* based on Catcheside, DG (1980): *Mosses of South Australia*. Government Printer, Adelaide.



**Crossidium davidai** Catches.**form:** gregarious, erect stems, brown above**habitat:** soil in dry scrub**leaf:** size: 1.5–1.9 × 0.5–0.7 mm**shape:** linguulate-obovate; adaxial filaments 1–4 cells tall, the terminal cell ± globose, 20–25 μm in diam., with 4–6 mammillae**tip:** broadly acute to obtuse or rounded, subcucullate**base:** basal cells rectangular, 18–50 μm long**costa:** percurrent to excurrent in a short mucro, in cross-section with 6–8 rows of stereids**border:** not differentiated**margin:** entire, revolute to recurved to nearly the base**cells:** 12–16 μm, quadrate to rectangular, firm-walled, 1–4-papillose**capsule:** 2.0–2.3 mm, cylindric, erect, exserted, brown; seta 5–9 mm, pale brown; peristome of 32 pale papillose teeth; operculum conic

vegetative shoot (dry and moist), leaf outline, and leaf apex

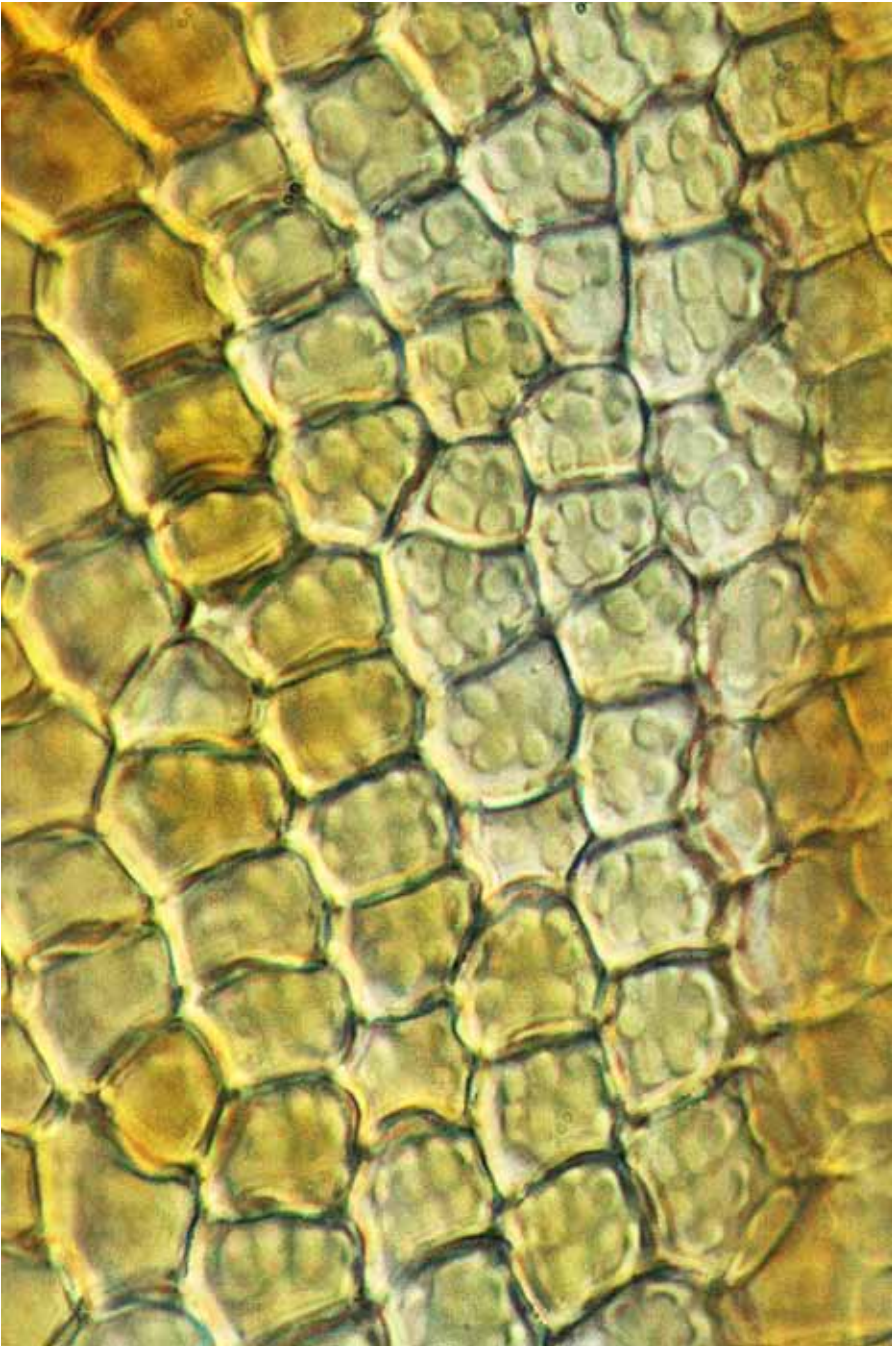
0.1 mm, 0.1 mm, 0.1 mm, 50 μm



revolute margin midleaf, costa below midleaf, and massed propagules

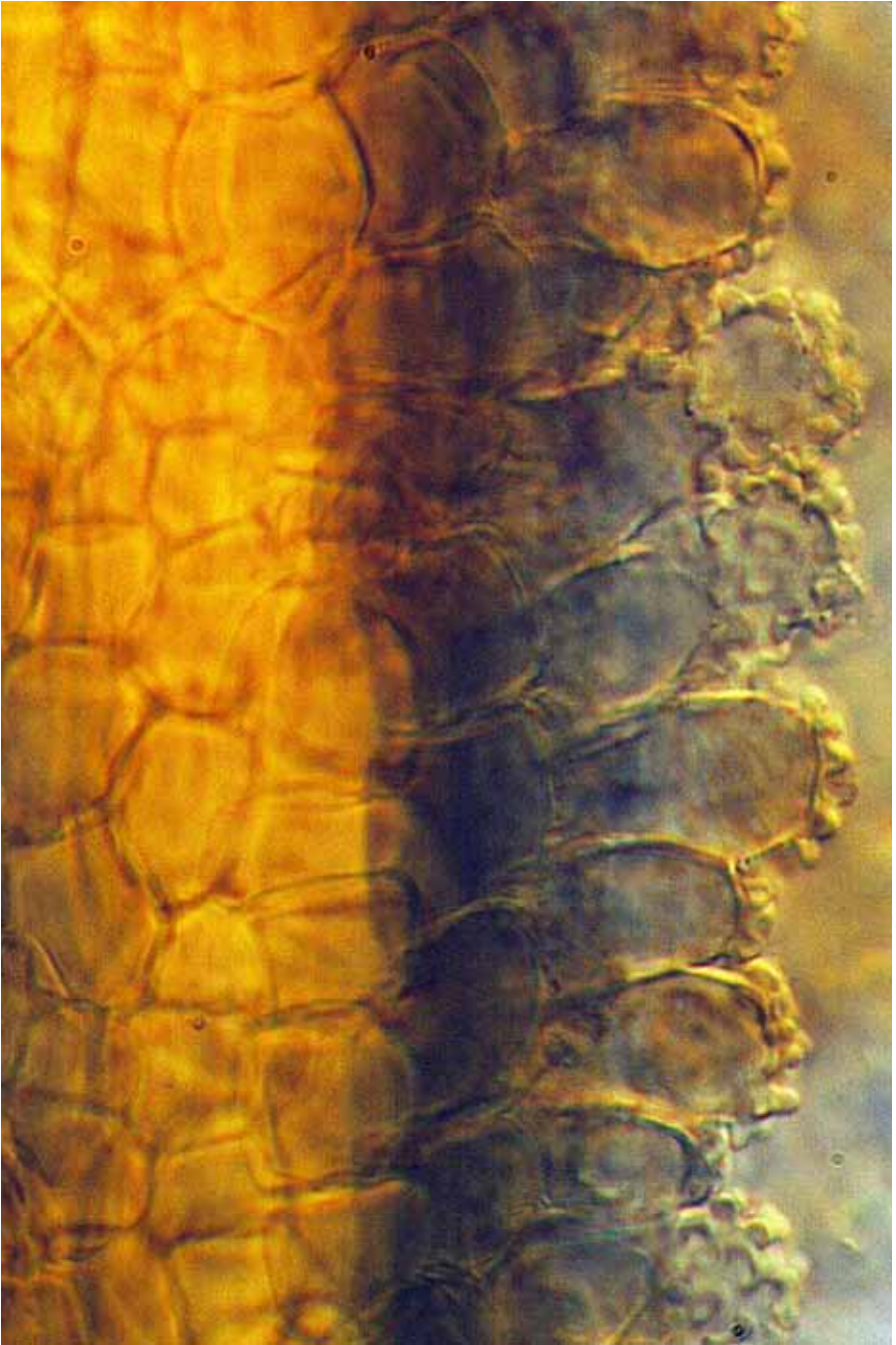
50 μm, 50 μm, 50 μm

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*Crossidium davidai* leaf surface papillae  
10  $\mu\text{m}$

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*Crossidium davidai* propagules, showing globose, mammillose terminal cells  
10  $\mu\text{m}$

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**Crossidium geheebii** (Broth.) Broth.

**form:** gregarious, erect, comose, light yellow-brown stems, 2–6 mm tall  
**habitat:** limestone rock, lowland to upper montane elevations

**leaf:** size: 0.7–1.5 × 0.4–0.7 mm

*shape:* oblong to ovate, reacting yellow to orange in 2% KOH

*tip:* obtuse to rounded

*base:* basal cells rectangular to quadrate, 14–50 μm long

*costa:* excurrent in a mucro or hyaline hair-point

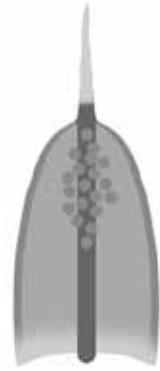
*border:* not differentiated

*margin:* entire, recurved below, incurved near the apex

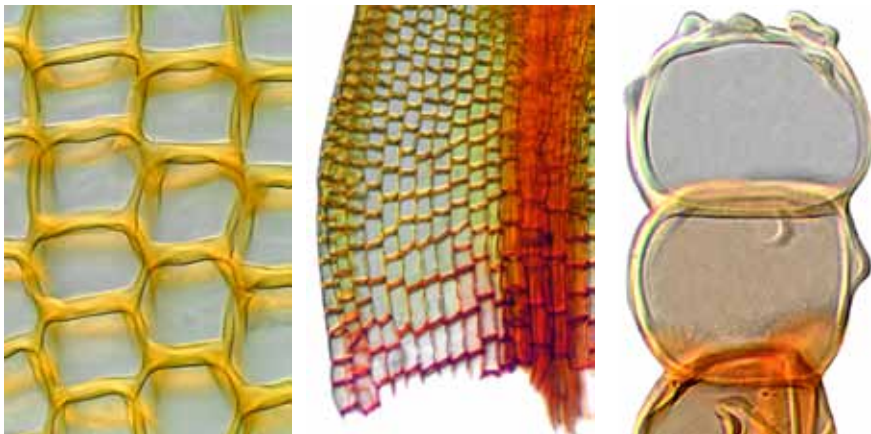
*cells:* 15 μm, subquadrate, firm-walled, smooth

**capsule:** 1.3–2.2 mm, cylindric to long-ovoid, erect; seta 10–40 mm, flexuose; operculum narrowly conic; calyptra cucullate, smooth; peristome teeth 32 from a low cylinder

**note:** asexual reproduction is by abundant branched filaments on the distal adaxial surface of the costa



vegetative shoot (cleared), leaf outline, hair-point base, and margin midleaf  
 0.5 mm, 0.5 mm, 50 μm, 10 μm



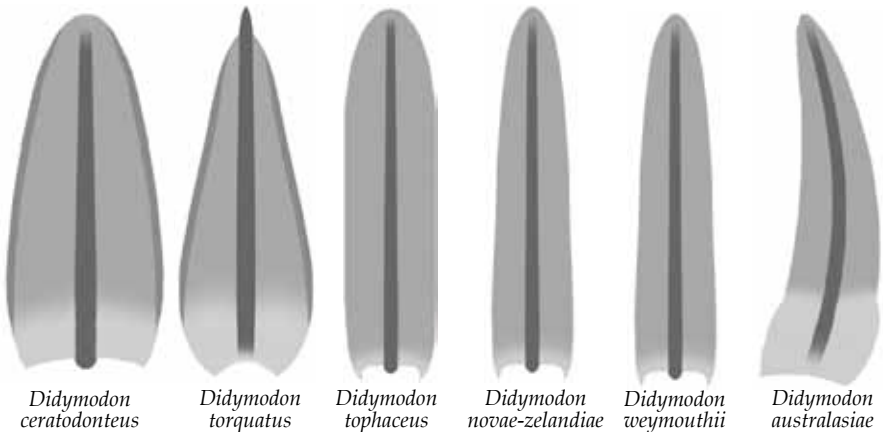
cells midleaf, leaf basal angle, and propagule apex  
 10 μm, 50 μm, 10 μm



Key\* to the New Zealand species of *Didymodon* (6)

- 1 Costa excurrent as a stout point..... ● *Didymodon torquatus*  
 1: Costa not excurrent..... 2
- 2(1): Leaf bistratose at the margin; plant of dry habitats..... ● *Didymodon australasiae*  
 2: Leaf unistratose at the margin; plant of damp or wet habitats..... 3
- 3(2): Plants on calcareous rock or soil ..... ● *Didymodon tophaceus*  
 3: Plants on acidic rock or soil ..... 4
- 4(3): Leaf apex cucullate..... ● *Didymodon novae-zelandiae*  
 4: Leaf apex not cucullate..... 5
- 5(4): Leaves < 1 mm long; stems < 3 mm tall, bulbil-like, usually on soil.....  
 ..... ● *Didymodon ceratodonteus*  
 5: Leaves > 1.8–4 mm long; stems up to 30 mm tall, not bulbil-like, usually on rock.....  
 ..... ● *Didymodon weymouthii*

\* based on Catcheside, DG (1980): *Mosses of South Australia*. Government Printer, Adelaide, 172, plus Zander, RH (2007): *Didymodon*. *Flora of North America* 27, 299.



**Didymodon australasiae** (Hook. & Grev.) R.H.Zander

**form:** erect, branched, dark stems in tufts or cushions, 10(–15) mm tall  
**habitat:** exposed gravelly soil or rock, dry to wet, to high elevations

**leaf:** size: 1.0–2.5 × 0.4–1.0 mm

*shape:* short-lanceolate

*tip:* broadly to narrowly acute

*base:* basal cells larger and thinner-walled than the blade cells

*costa:* percurrent or failing a few cells below the apex

*border:* not differentiated

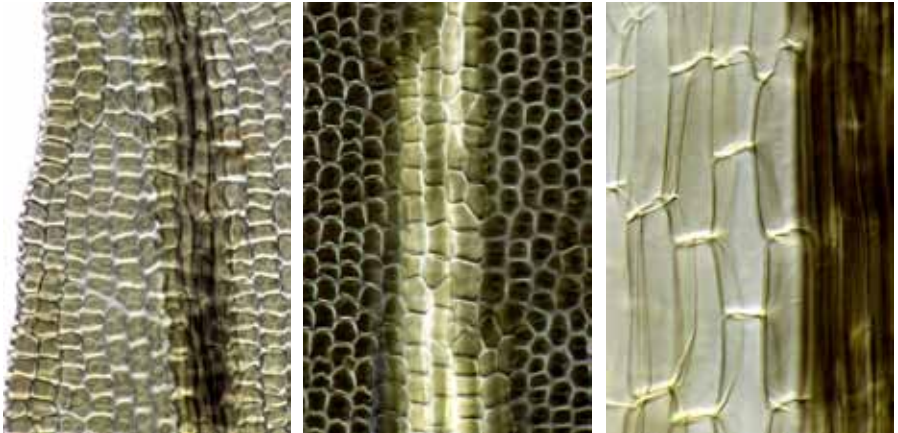
*margin:* entire, plane or recurved at midleaf

*cells:* 7–12 μm, subquadrate, firm-walled, corners thickened, ± papillose

**capsule:** 1–2 mm, oblong-ellipsoid, erect, straight, reddish when mature; seta 7–10 mm; calyptra cucullate, naked, smooth; operculum rostrate; peristome of 32 weakly twisted, linear teeth; spores 11–15 μm in diam., smooth to papillose



fertile shoot (dry), capsule, vegetative shoot (dry and wet), leaf outline, and leaf apex  
 1 mm, 1 mm, 10 μm (2), 1 mm, 10 μm



margin midleaf, adaxial distal costa cells, and hyaline cells near leaf base  
 50 μm, 50 μm, 10 μm

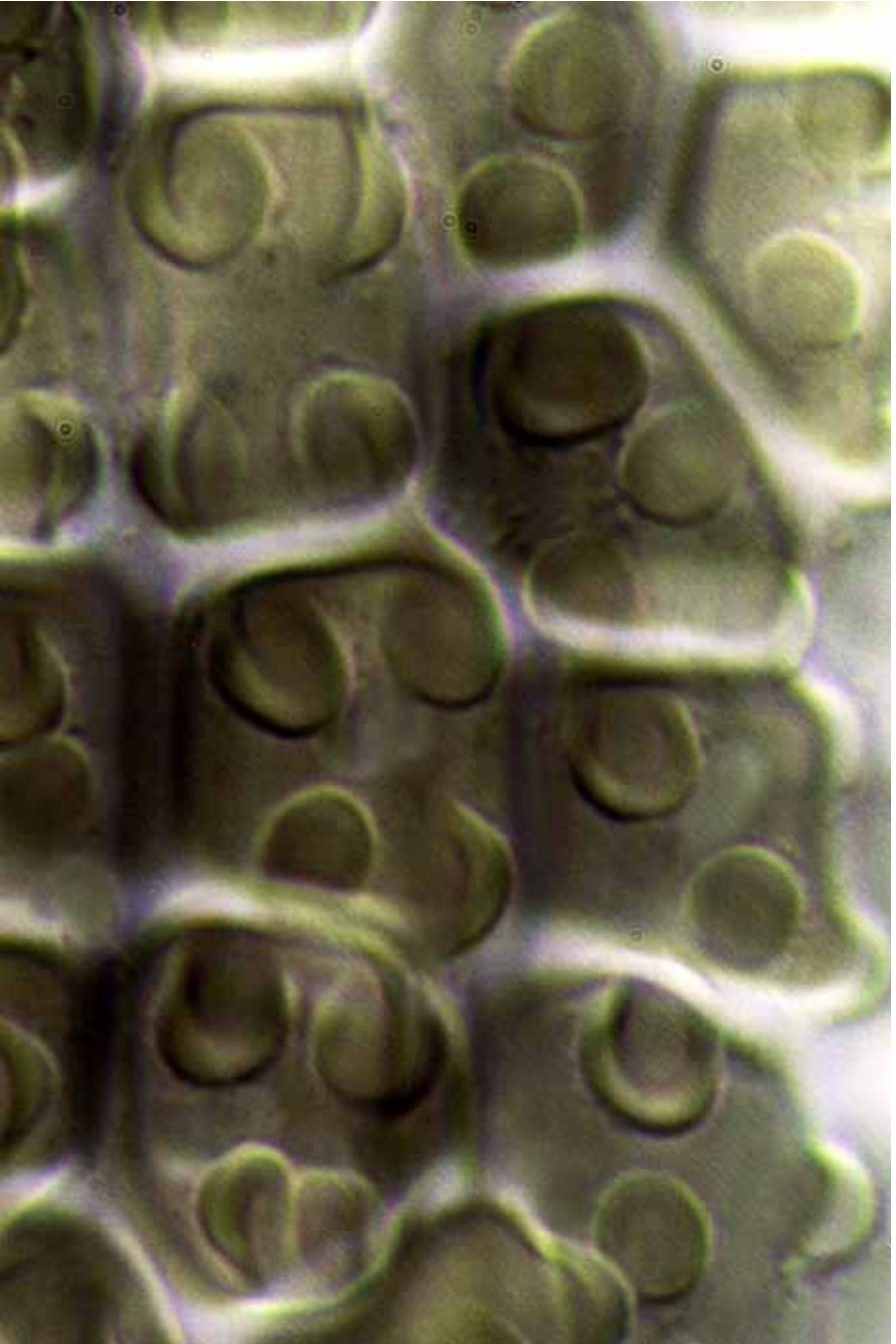
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*Didymodon australasiae* short cells of prominent abaxial costa.

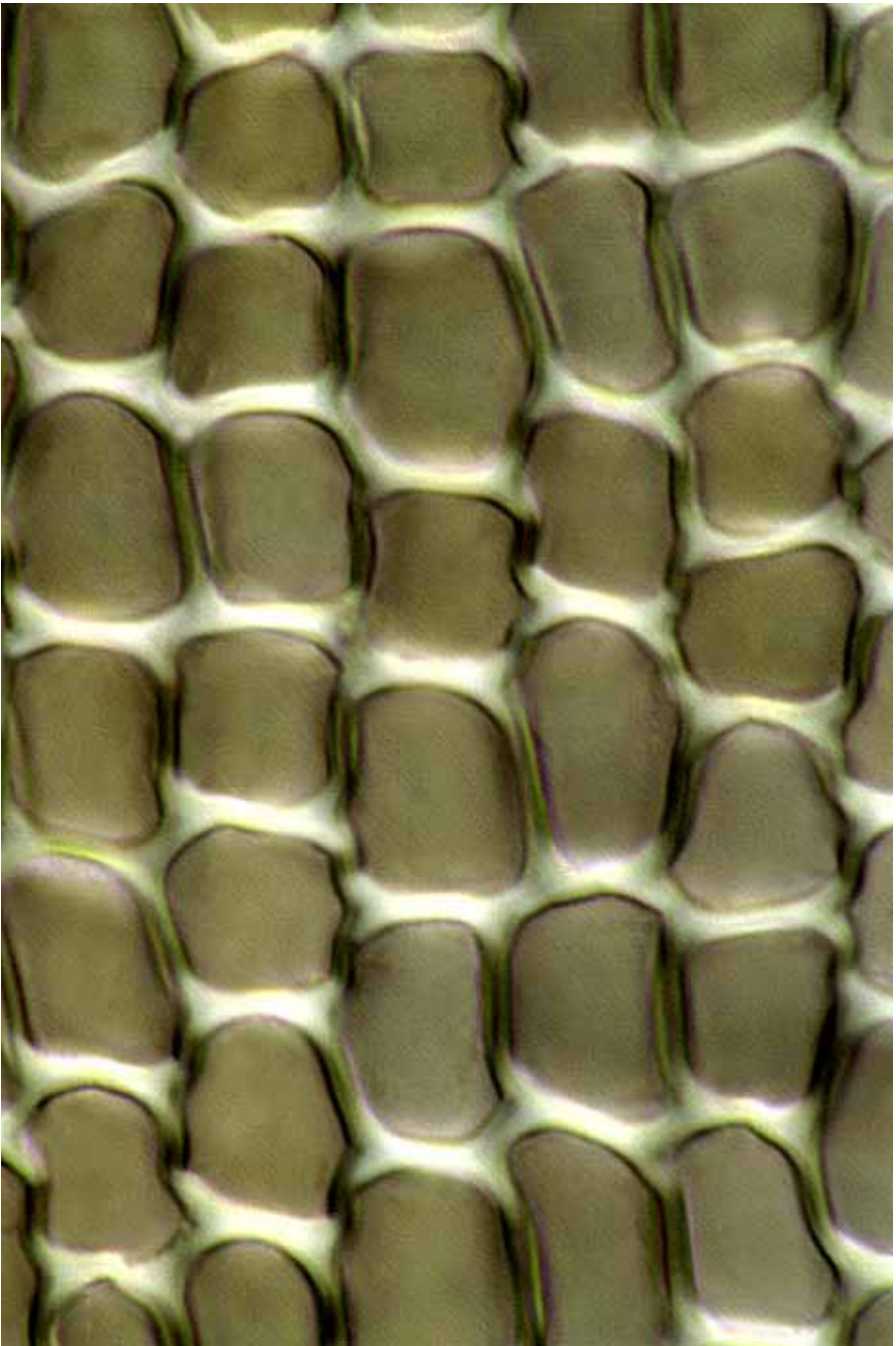
10  $\mu\text{m}$

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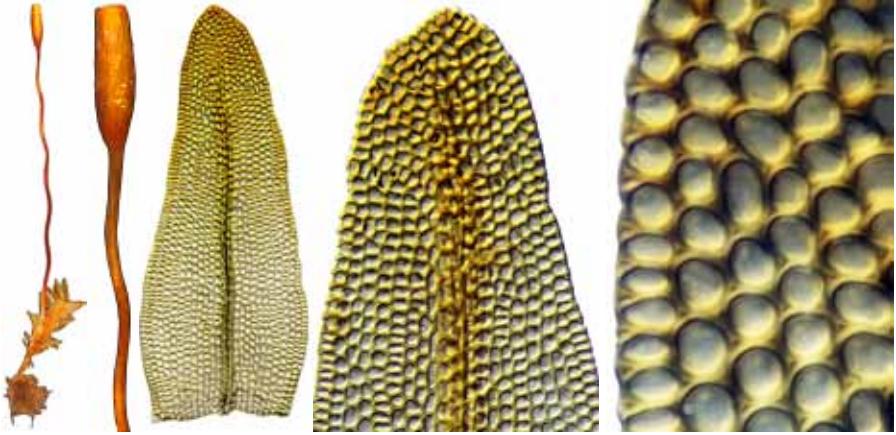
*Didymodon australasiae* papillose lamina cells  
10  $\mu$ m

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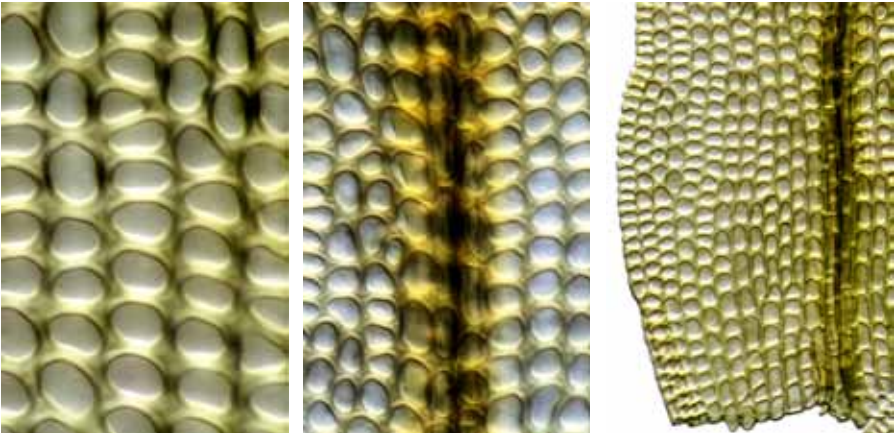


*Didymodon australasiae* cells about midleaf.  
10  $\mu\text{m}$

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**Didymodon ceratodonteus** (Müll.Hal.) Dixon**form:** gregarious, tufted, minute, erect, brownish shoots**habitat:** damp clay or rock**leaf:** *size:* less than 1 mm long*shape:* widely oblong-lingulate*tip:* rounded*base:* basal cells slightly longer than the other lamina cells*costa:* failing below the apex, adaxial surface cells  $\pm$  quadrate distally*border:* not differentiated*margin:* entire to minutely crenate, plane to  $\pm$  revolute*cells:* 7–10  $\mu\text{m}$ ,  $\pm$  quadrate-rounded, firm-walled, smooth to  $\pm$  papillose**capsule:** 0.5–1.3 mm, oblong to elliptic, erect, long-exserted, brown;  
seta 5–10 mm, red, wavy when dry; peristome teeth 16, brown,  
papillose, divided nearly to the basal membrane

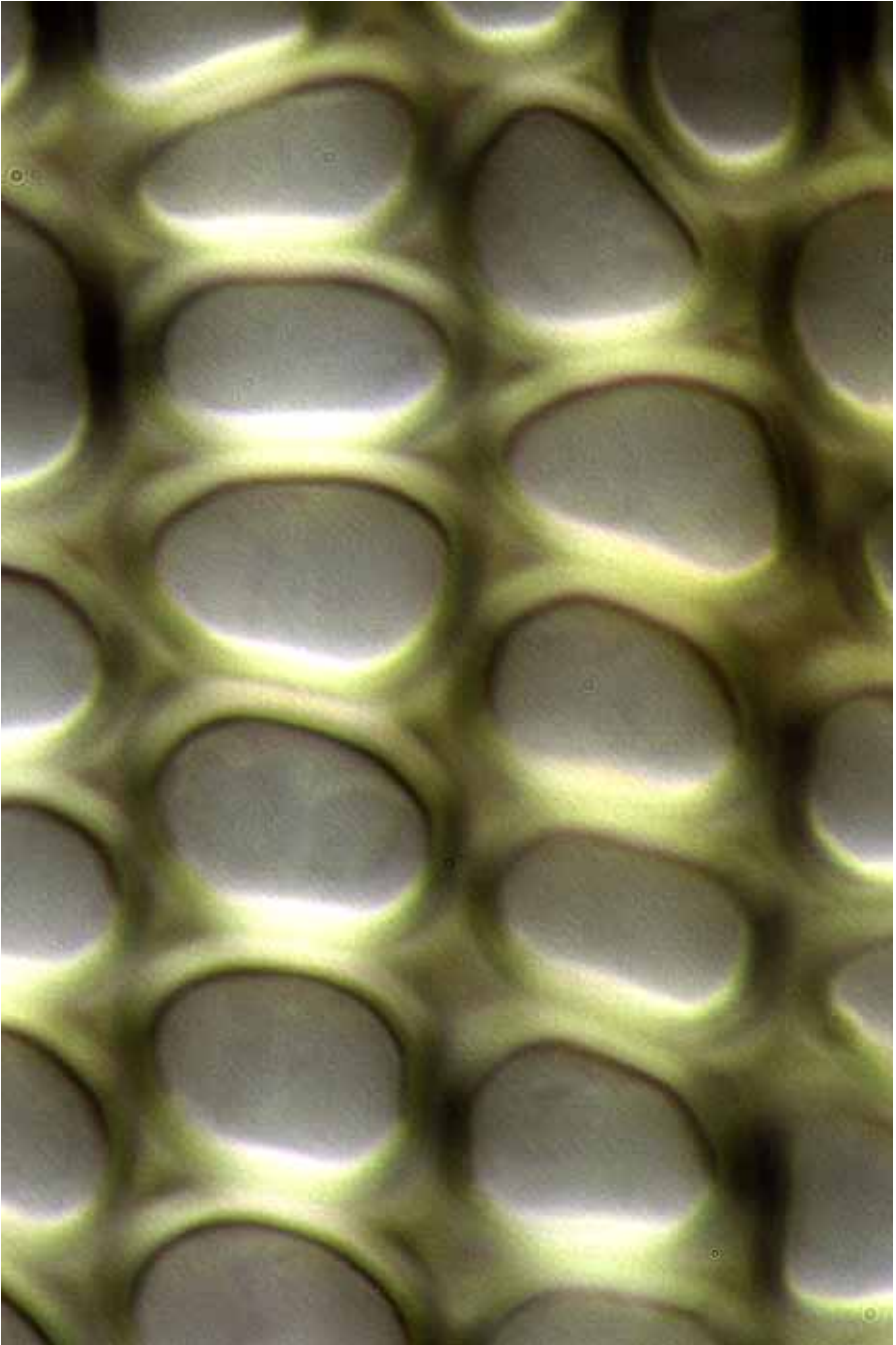
fertile shoot, capsule, leaf outline, leaf apex, and margin of upper leaf

 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ 


lamina cells midleaf, superficial adaxial costa cells, and leaf basal angle

 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$ 

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*Didymodon ceratodonteus* lamina cells upper leaf  
10  $\mu\text{m}$

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**Didymodon novae-zelandiae** J.E.Beever & Fife

**form:** gregarious, erect, sparsely branched stems, brownish green, to 30 mm  
**habitat:** damp to wet calcareous mudstone

**leaf:** size: about  $1.5 \times 0.3$  mm

*shape:* lingulate

*tip:* rounded, cucullate

*base:* basal cells slightly longer and thinner-walled than other lamina cells

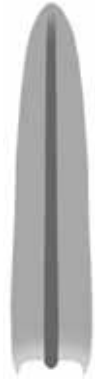
*costa:* failing below the apex; adaxial cells  $\pm$  quadrate in distal two-thirds

*border:* not differentiated

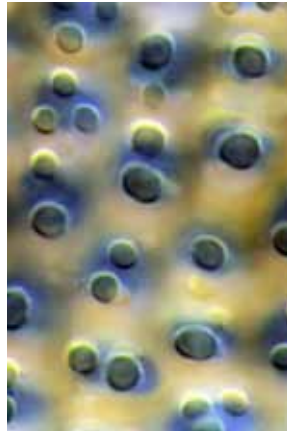
*margin:* entire, plane above,  $\pm$  recurved to reflexed below

*cells:* 8–12  $\mu\text{m}$ , rounded-isodiametric, firm-walled, 2–4 low papillae per cell

**capsule:** 1.5 mm, oblong-elliptic, erect, long-exserted, brown; seta to 6 mm long; peristome teeth 16,  $\pm$  hyaline, narrowly lanceolate, papillose,  $\pm$  divided to about a third from the tip



vegetative shoot (moist), leaf outline, cucullate leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



peristome, papillae above midleaf, and leaf basal angle  
 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$





*Didymodon novae-zelandiae* vegetative shoot (moist) and cucullate leaf apex  
1 mm, 100  $\mu$ m

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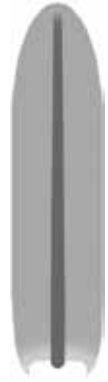
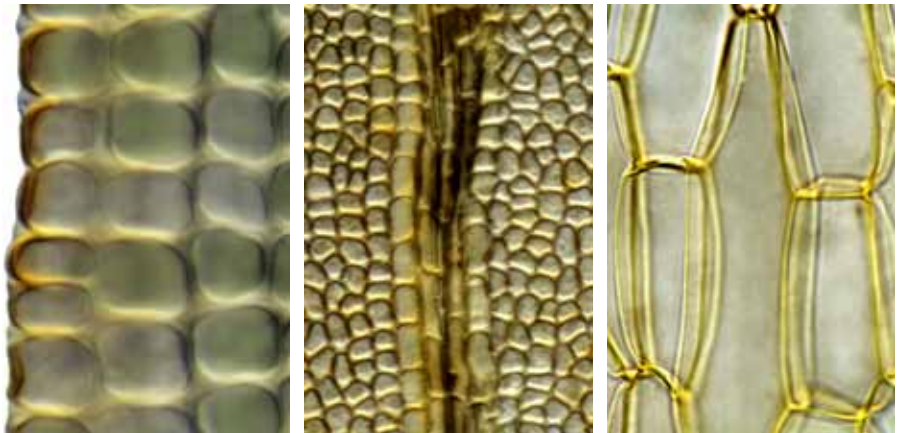
*Didymodon novae-zelandiae* adaxial superficial costal cells at about midleaf  
10  $\mu\text{m}$

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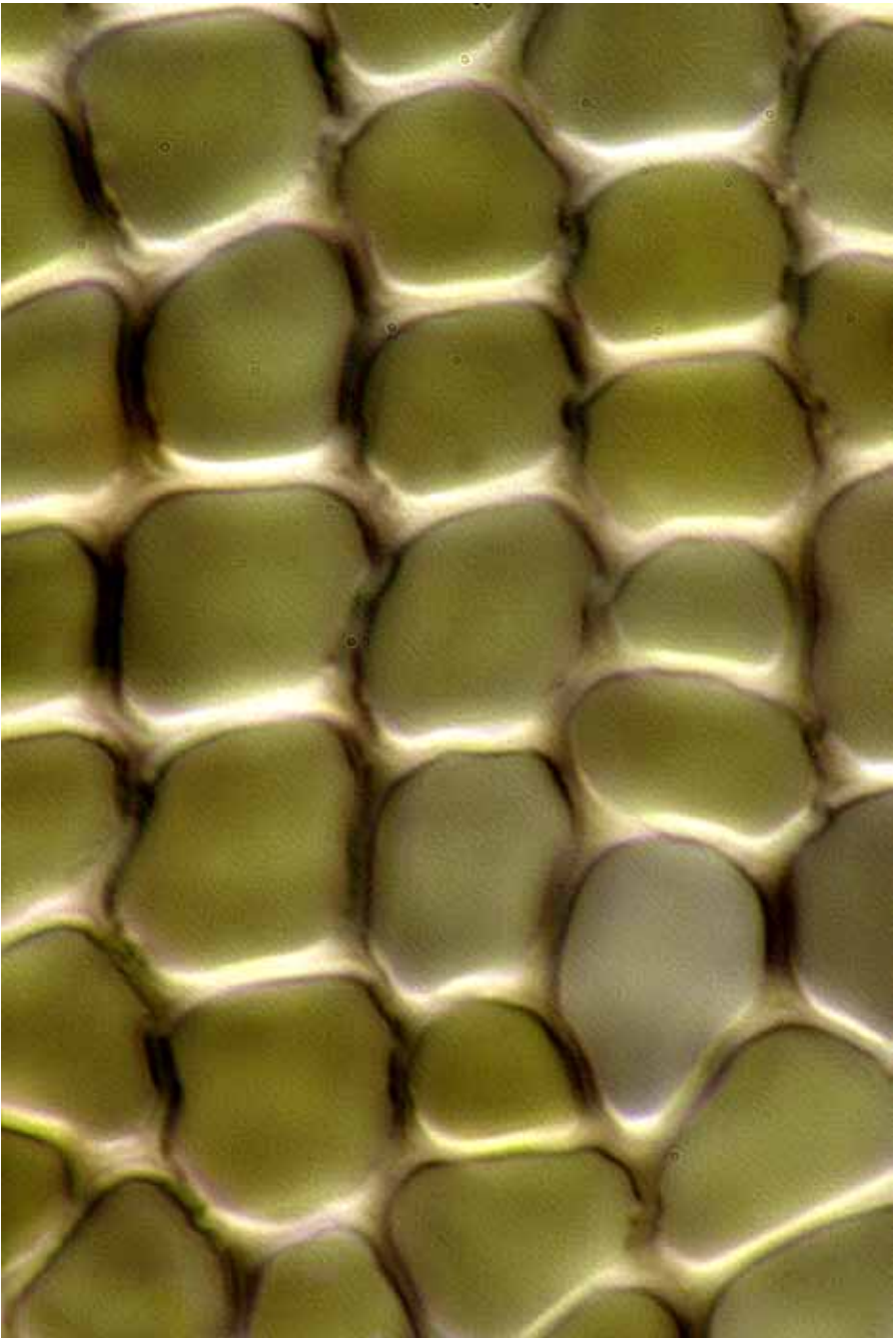


*Didymodon novae-zelandiae* peristome, abaxial face (fragment)  
10  $\mu\text{m}$

continued next page

**Didymodon tophaceus** (Bridel) Lisa**form:** loosely to densely tufted, erect, branched, often lime-encrusted**habitat:** rock or soil in calcareous springs, seeps, and streams**leaf:** size: 1–2 × 0.5–1.0 mm*shape:* lingulate*tip:* rounded-obtuse*base:* undifferentiated*costa:* failing below the apex; superficial adaxial cells elongate*border:* basal cells thin-walled, larger than other lamina cells*margin:* entire, ± recurved below on both sides*cells:* 7–13 μm, irregularly subquadrate, firm-walled, mostly smooth**capsule:** 1–1.5 mm, oblong-cylindric, red-brown; seta 10–12 mm, dark red-brown; peristome of long, pale filaments, ± twisted**note:** *Didymodon ceratodonteus* differs in having ± quadrate superficial adaxial costal cellsfertile shoot (dry), capsule and peristome, leaf outline, leaf apex, and failing costa  
 1 mm, 1 mm, 0.1 mm, 100 μm, 50 μmmargin midleaf, elongate adaxial costa cells, and lamina cells near leaf base  
 10 μm, 50 μm, 10 μm

continued next page



*Didymodon tophaceus* cells at about midleaf  
10  $\mu$ m

continued next page

**Didymodon torquatus** (Taylor) Catcheside

**form:** in cushions, erect, sparsely branched, olive-green, brownish below  
**habitat:** soil, usually in exposed, semi-arid to arid sites

**leaf:** size: 1–2.5 mm

*shape:* broadly lanceolate, twisted around the stem when dry

*tip:* stout cusp

*base:* basal cells short-rectangular

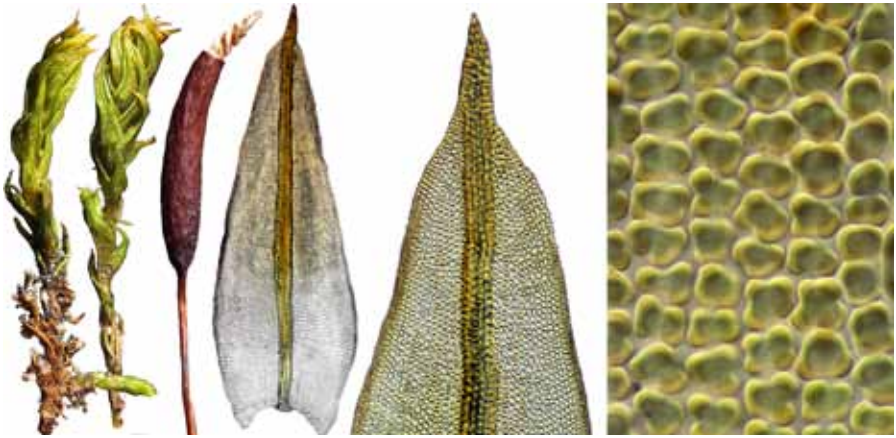
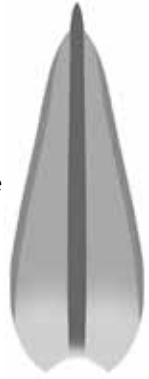
*costa:* yellow, percurrent to shortly excurrent; adaxial distal cells  $\pm$  quadrate

*border:* not differentiated

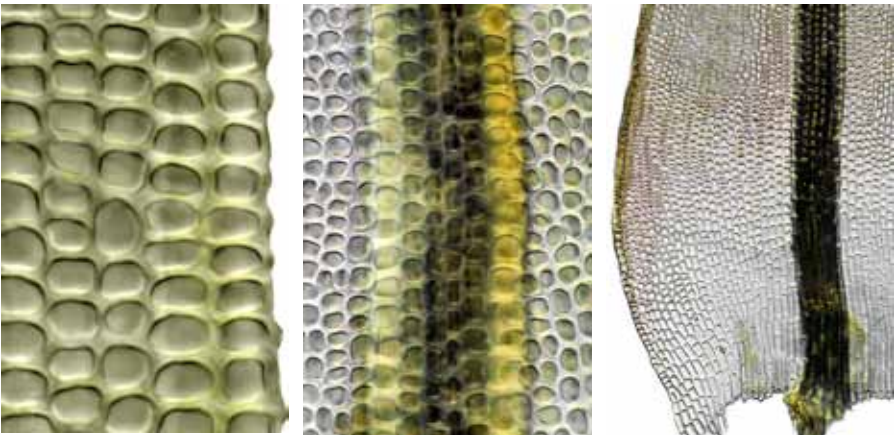
*margin:* entire, recurved on both sides

*cells:* 8–10  $\mu\text{m}$ ,  $\pm$  isodiametric, firm-walled, sparsely papillose

**capsule:** 1.8–2.5 mm, narrowly cylindric to oval,  $\pm$  curved, erect, exserted, reddish brown; seta 10–18 mm, slender, reddish; operculum bluntly conically rostrate, half the urn length; peristome of 16 teeth on a low basal membrane and divided into twin papillose filaments



vegetative shoots (dry), capsule, leaf outline, leaf apex, and upper leaf papillae  
 1 mm (2), 1 mm, 0.5 mm, 100  $\mu\text{m}$ , 10  $\mu\text{m}$



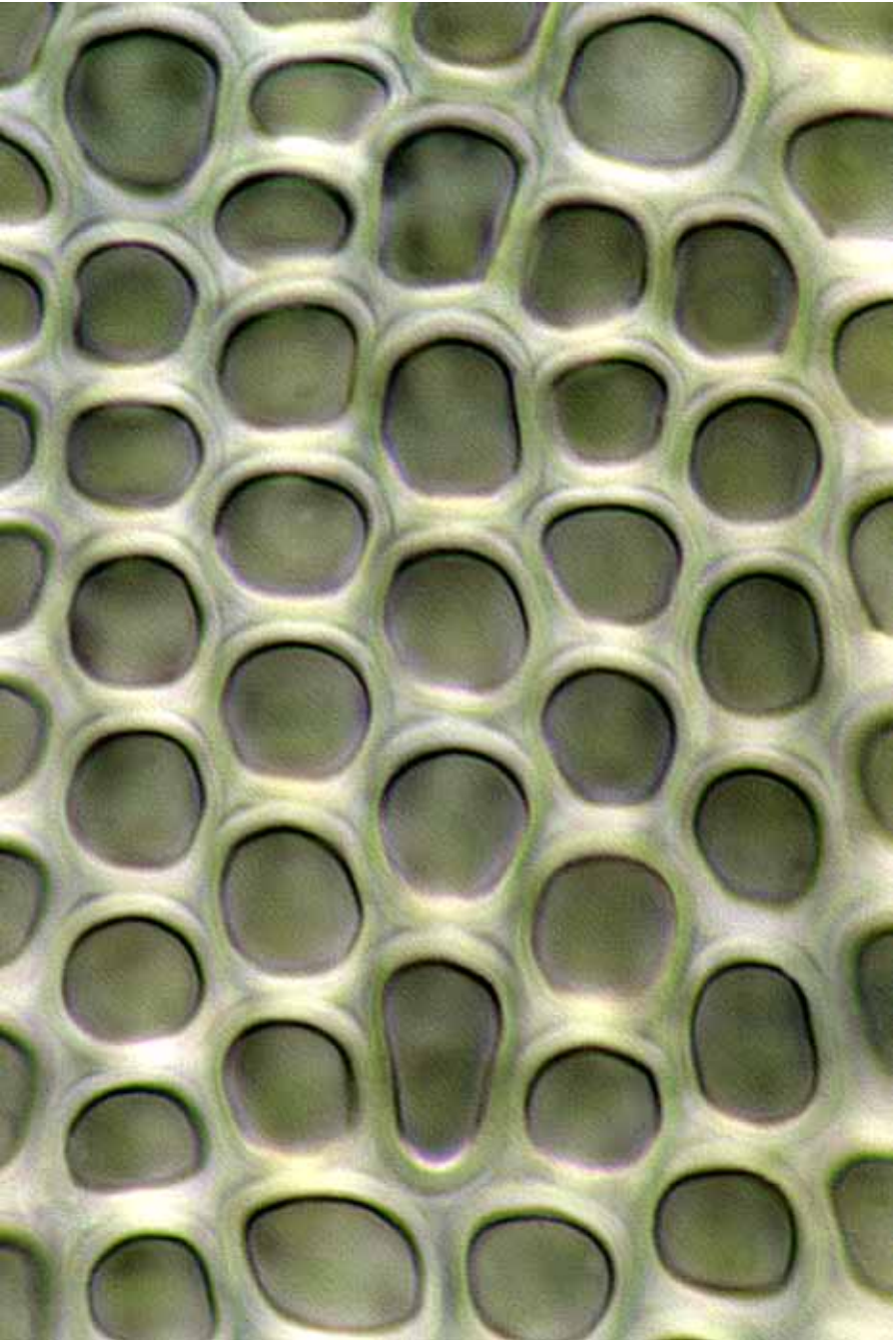
margin at about midleaf, adaxial distal costa cells, and leaf basal angle  
 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 100  $\mu\text{m}$

continued next page



*Didymodon torquatus* mature capsule, peristome (whole-mount)  
0.1 mm, 0.1 mm

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*Didymodon torquatus* laminal cells at about midleaf  
10  $\mu\text{m}$

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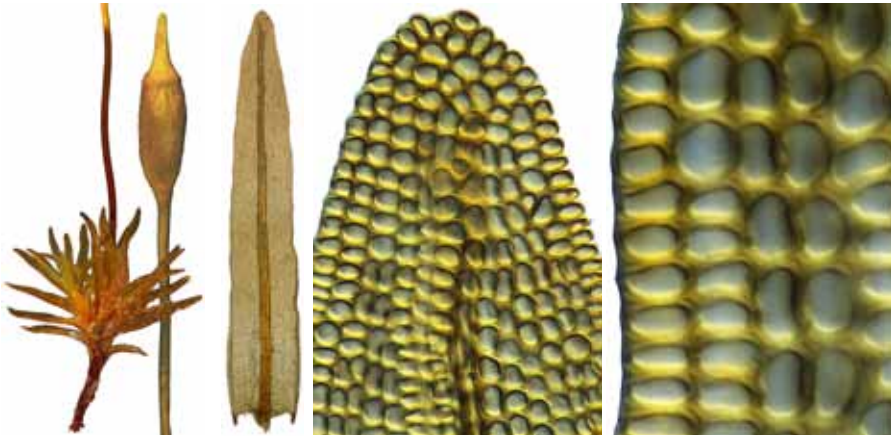
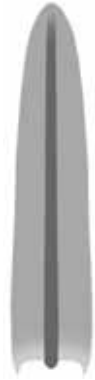


**Didymodon weymouthii** (R.Br.bis) R.H.Zander**form:** densely tufted, erect, ± branched stems, yellowish, 3–30 mm tall**habitat:** damp to wet rock or less commonly soil**leaf:** size: 1.8–4 mm*shape:* lingulate to linear-lanceolate, concave to canaliculate*tip:* rounded or obtuse to subacute*base:* basal cells longer than other lamina cells, ± pigmented*costa:* percurrent to failing below the apex; distal adaxial cells ± elongate*border:* not differentiated*margin:* entire, plane above, recurved to reflexed below*cells:* 7–10 μm, rounded-isodiametric, firm-walled, smooth to ± papillose**capsule:** 0.8–2 mm, ovate to cylindric, erect, exserted, brown; seta 10–15 mm,

reddish; operculum rostrate, the beak from 1/3 to as long as the urn;

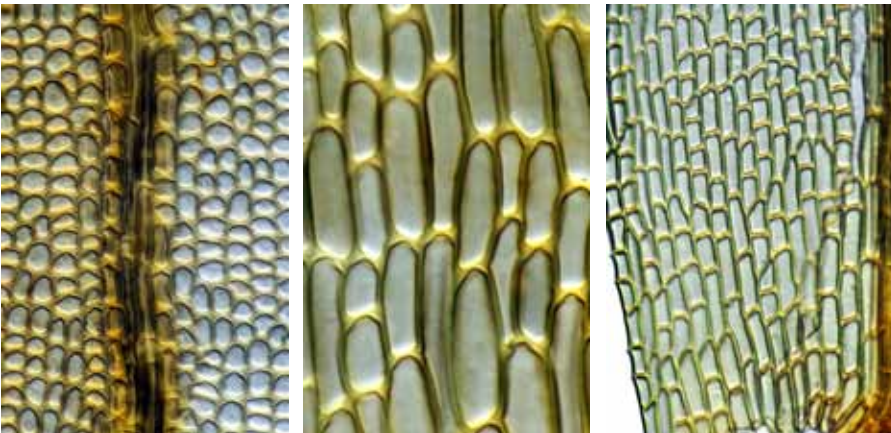
peristome variable, rudimentary to toothed, the teeth hyaline to yellow,

irregularly divided, smooth to finely papillose; spores 25–30 μm in diam.



fertile shoot, capsule, leaf outline, leaf apex, and margin midleaf

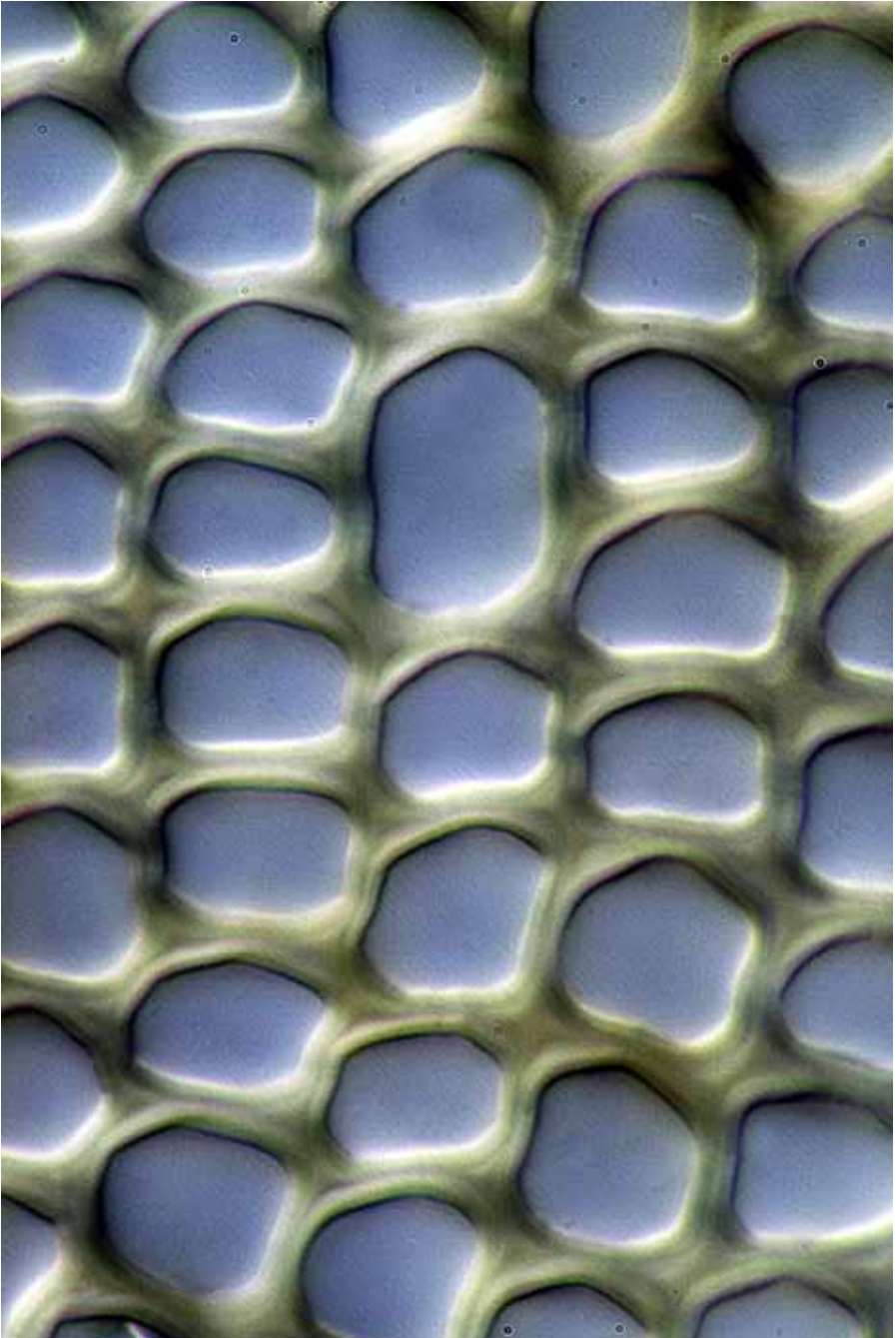
5 mm, 1 mm, 1 mm, 50 μm, 10 μm



adaxial distal costal cells, cells of lower leaf, and leaf basal angle

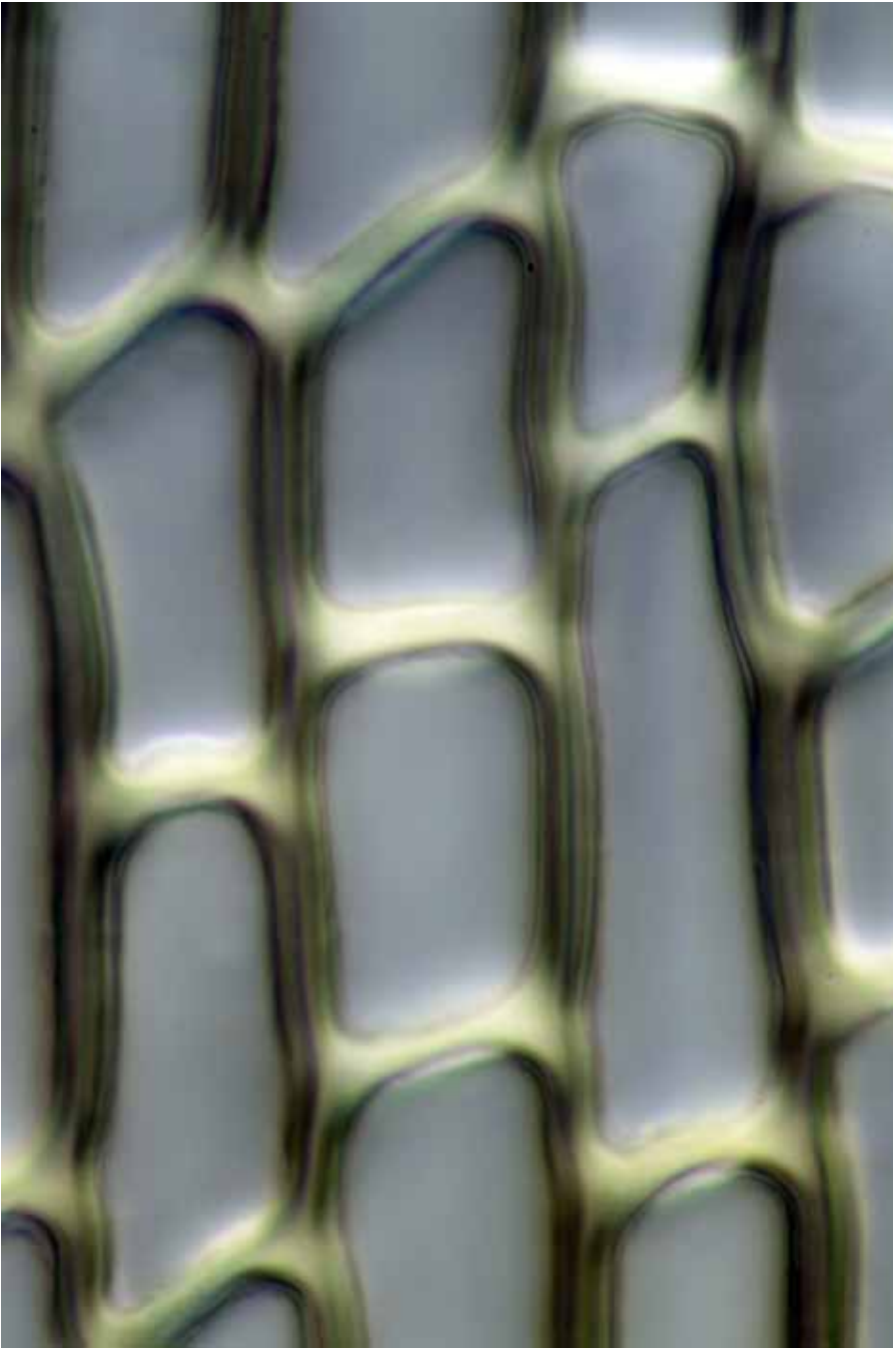
10 μm, 10 μm, 50 μm

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*Didymodon weymouthii* cells at midleaf  
10  $\mu$ m

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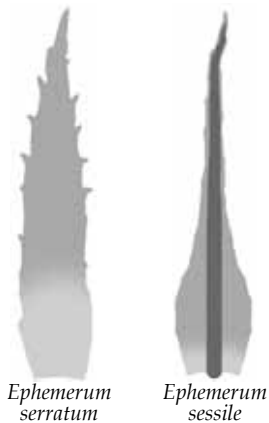


*Didymodon weymouthii* cells of lower leaf  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Ephemerum* (2)**

- 1 Leaves ecostate; margin spinose-toothed ..... ● ***Ephemerum serratum***  
 1: Leaves costate; margin  $\pm$  entire ..... ● ***Ephemerum sessile***

\* based on Smith, AJE; Smith, R (1978): *The Moss Flora of Britain and Ireland*. Cambridge University Press, Cambridge. 347.



**Ephemerum serratum** (Hedw.) Hampe**form:** rosettes of leafy stems in persistent mats of protonemata**habitat:** compacted, moist, exposed clayey soil, fields or alluvium, lowland**leaf:** size: 1.0–2.0 × 0.3 mm**shape:** narrowly lanceolate**tip:** acute or gradually acuminate, often ending in a single, sharp cell**base:** basal cells rectangular, hyaline**costa:** not differentiated or faint and restricted to the upper leaf**border:** not differentiated**margin:** irregularly spinose-dentate in the upper two-thirds, plane**cells:** 100–160 × 12–30 μm, irregularly rhombic, thin-walled, smooth**capsule:** 0.5 mm, ovoid to globose, conic-apiculate, immersed, indehiscent, stomatose at only the base; seta very short, the capsule appearing sessile; calyptra mitrate, naked, erose at the base; operculum absent; spores reniform, 50–90 μm long**note:** the protonema forms a dense green persistent mat

fertile habit, shoot (whole mount), leaf outline, and leaf apex

0.5 mm, 0.5 mm, 0.5 mm, 10 μm



subapex, margin midleaf, and margin near leaf base

10 μm, 10 μm, 10 μm

continued next page

**Ephemerum sessile** (Bruch) Müll.Hal.

**form:** gregarious, light green stems, on persistent protonema mats, to 1 mm tall  
**habitat:** damp, compacted soil in open fields or tracks, low elevations

**leaf:** size: 1.5–2.0 × 0.2 mm

*shape:* narrowly lanceolate, narrowing to a costa-filled subula

*tip:* acuminate

*base:* basal cells larger and wider than other blade cells

*costa:* weak below, strong above, excurrent

*border:* not differentiated

*margin:* denticulate, plane

*cells:* 35–50 × 10–12 μm, ± rectangular, thin-walled, smooth

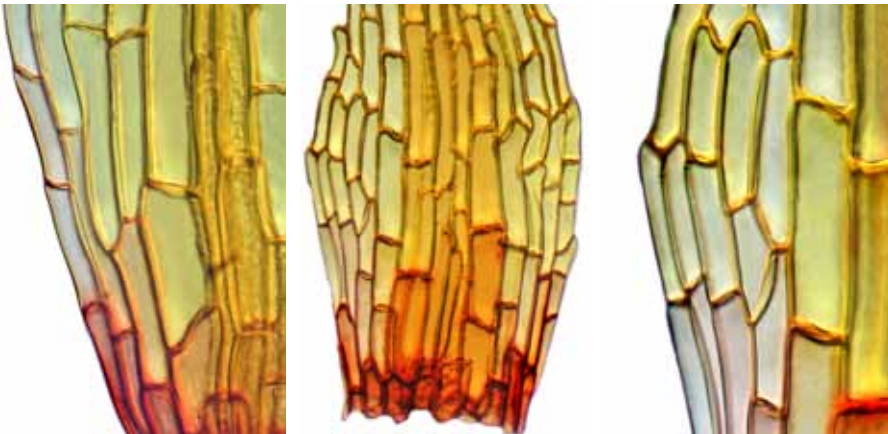
**capsule:** 0.5 mm, globose, short-apiculate, uniformly stomatose, cleistocarpous;  
 seta very short; calyptra mitrate, erose at the base; spores reniform, brown,  
 70–80 μm long, coarsely papillose

**note:** ephemeral



vegetative shoot, leaf outline, leaf apex, leaf subapex, and margin midleaf

■ 0.1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm, ■ 10 μm



margin near base, leaf base, and margin of lower leaf

■ 10 μm, ■ 10 μm, ■ 10 μm

**Gymnostomum calcareum** Nees & Hornsch.

**form:** tufted or matted, erect, slender, simple or branched stems, 3–20 mm tall  
**habitat:** damp calcareous soil or rock in shaded sites at middle elevations

**leaf:** size: 0.7–1.0 × 0.2–0.3 mm

*shape:* narrowly lingulate, ligulate, or linear

*tip:* variably rounded, obtuse, acute, or apiculate

*base:* basal cells rectangular

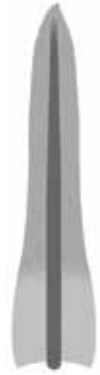
*costa:* failing just below the apex

*border:* not differentiated

*margin:* entire, plane

*cells:* 4–6 μm, quadrate, thick-walled, papillose

**capsule:** 0.6–1.0 mm, elliptic-oblong or cylindrical, erect, red-mouthed, gymnostomous; seta 5 mm, yellow; calyptra cucullate, naked, smooth; operculum obliquely rostrate; spores 9–11 μm in diam.



habit (moist), vegetative shoot (dry), capsule, leaf outline, and leaf apex

1 mm,

1 mm,

0.5 mm,

0.1 mm,

10 μm



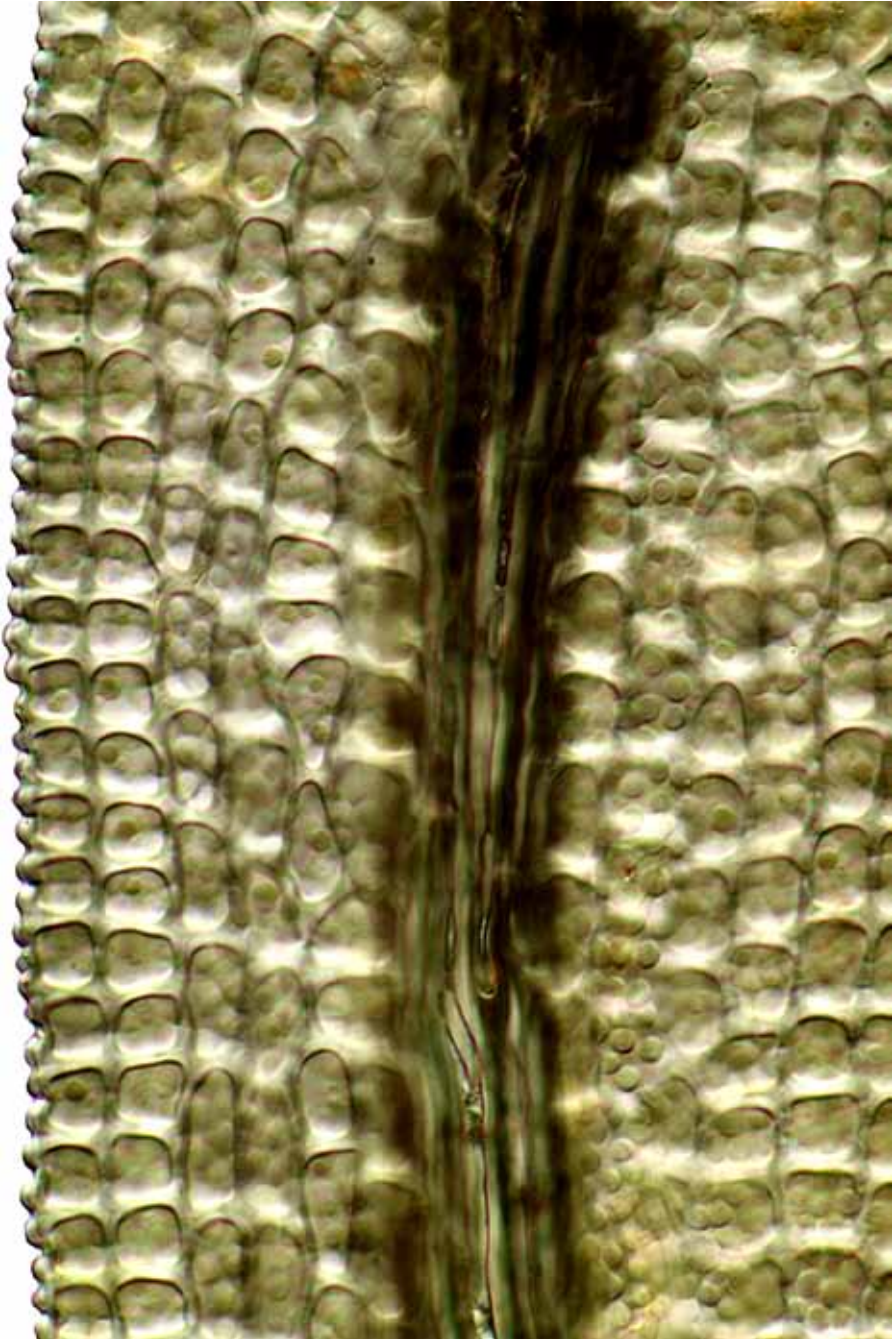
margin midleaf, costa midleaf, and midleaf cross-section

10 μm,

5 μm,

10 μm

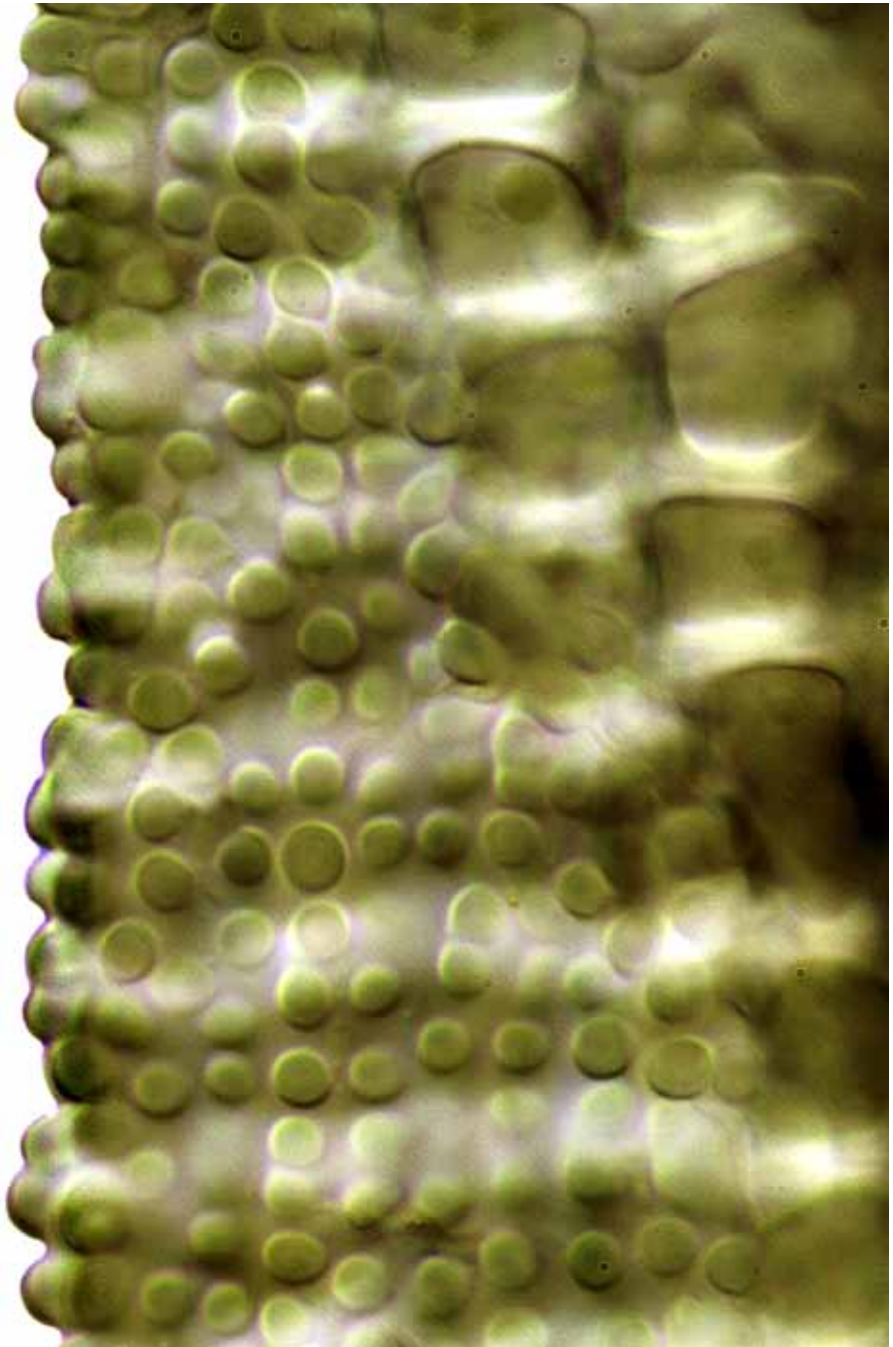
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*Gymnostomum calcareum* margin, costa, and laminal papillae midleaf  
10  $\mu$ m

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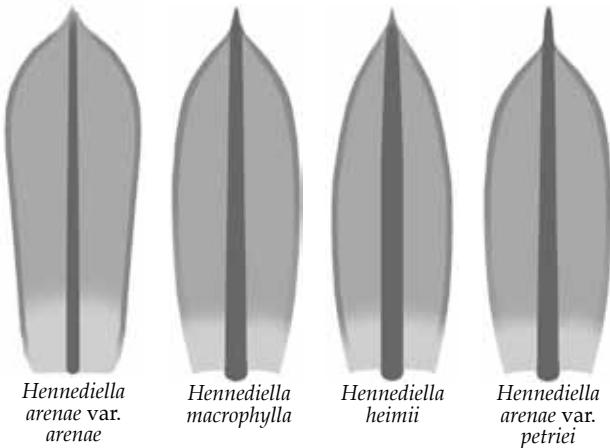


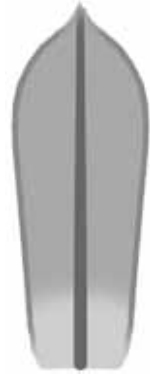
*Gymnostomum calcareum* margin and surface papillae  
5  $\mu$ m

### Key to the New Zealand species and varieties of *Hennediella* (4)

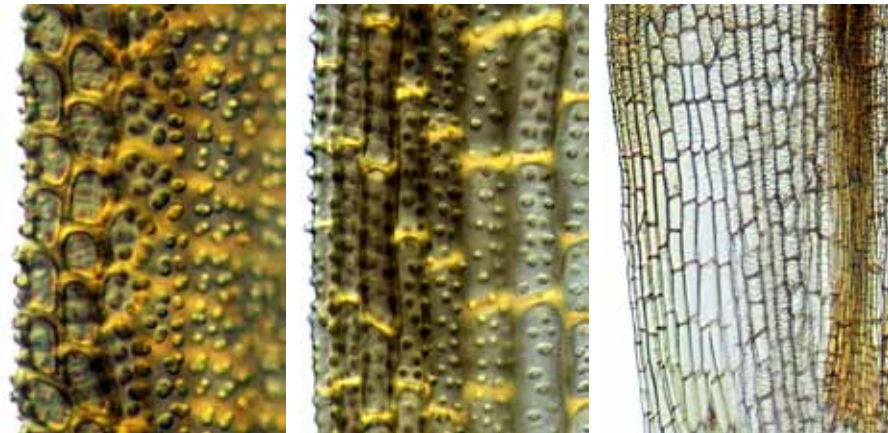
- 1 Peristome well-developed .....2  
 1: Peristome none .....3
- 2(1) Border of 1–7(–10) cell rows; length/width ratio of mid-border cells at midleaf mostly less than 2..... ● *Hennediella arenae* var. *arenae*  
 2: Border of 6–12 cell rows; length/width ratio of mid-border cells at midleaf mostly greater than 4..... ● *Hennediella arenae* var. *petriei*
- 3(1:) Leaf margin unistratose; seta 5–12 mm..... ● *Hennediella heimii*  
 3: Leaf margin at least partly bistratose; seta 1.7–4 mm..... ● *Hennediella macrophylla*

\* based partly on Cano, MJ (2008): Taxonomic revision of *Hennediella* Paris (Pottiaceae, Bryophyta). *Bryophytorum Bibliotheca* **64**, 1–142.



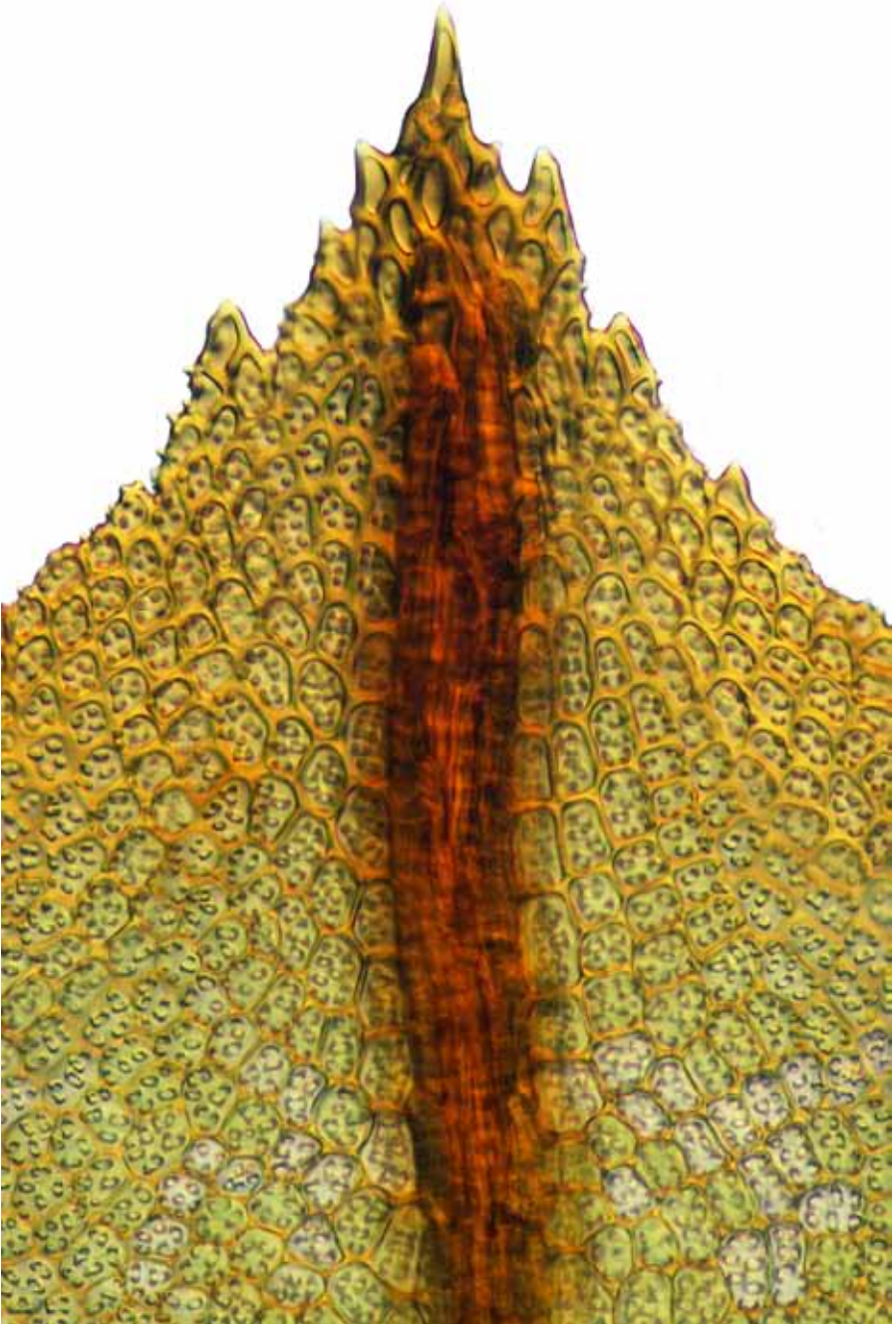
**Hennediella arenae** (Besch.) R.H.Zander var. **arenae****form:** tufted, erect, ± branched stems, light green above, 5–10 mm tall**habitat:** soil or soil over rock or in rock crevices**leaf:** size: 3–4 mm*shape:* ovate-lanceolate to spatulate*tip:* acute*base:* basal cells rectangular, pellucid, sparsely papillose to smooth*costa:* ending just below the apex*border:* 1–7(–10) rows, firm-walled, papillose; length/width ratio < 2*margin:* crenulate-papillate below, irregularly dentate near apex, plane*cells:* 17–20 μm, subquadrate to hexagonal, firm-walled, multipapillose**capsule:** 2.5 mm, cylindric, erect, ± curved, exserted, glossy, brown; seta 13–20 mm; operculum red, conic-subulate, to half the length of the capsule; calyptra cucullate, naked, smooth; peristome pale, to 1/3 the length of the capsule, basal tube long; spores 14–18 μm in diam.

vegetative shoot (dry), capsule, peristome, leaf outline, leaf apex, and margin upper leaf  
 0.5 mm, 1 mm, 0.5 mm, 0.5 mm, 10 μm, 10 μm



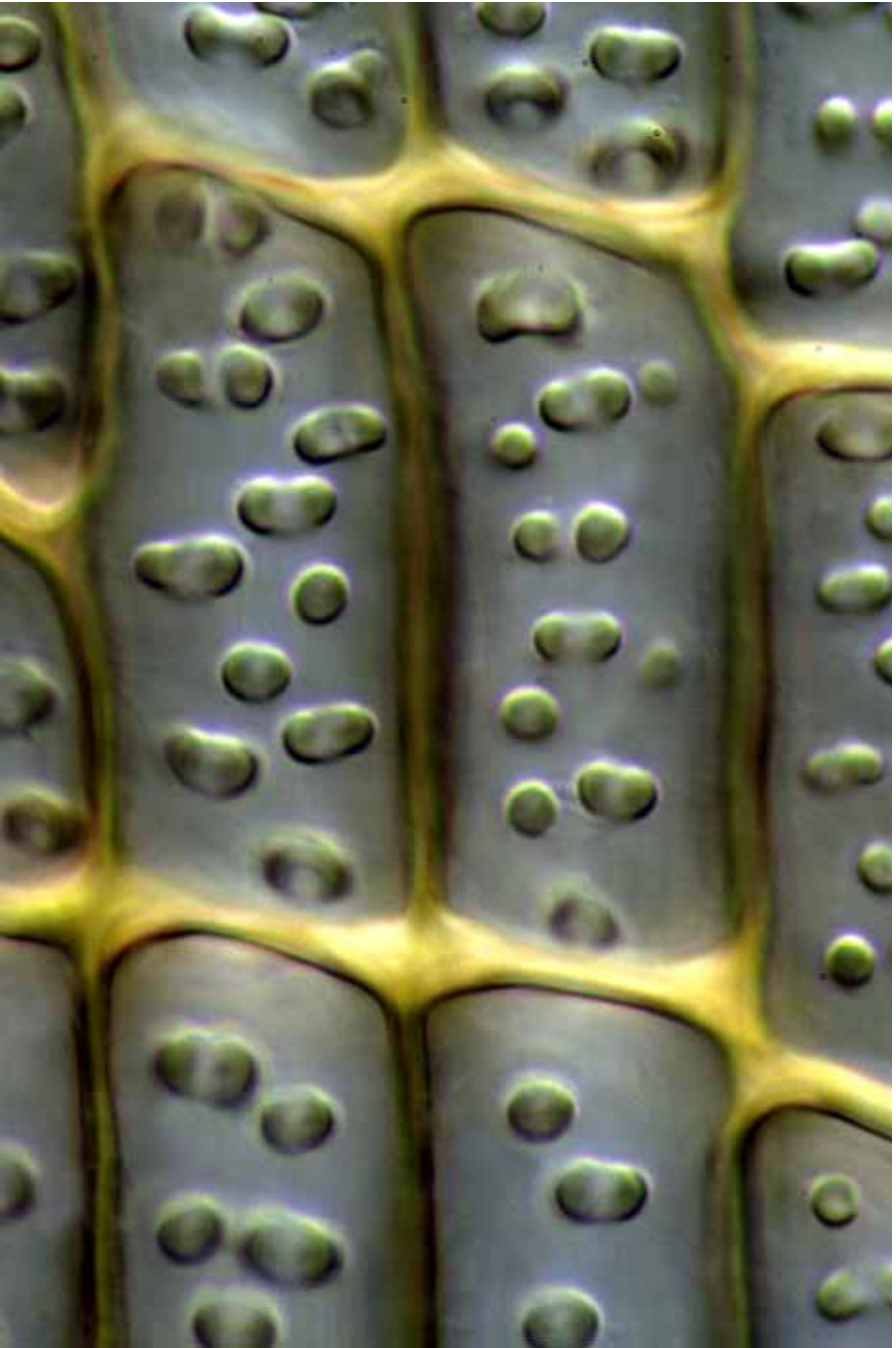
bordered margin midleaf, bordered margin of lower leaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

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*Henediella arenae* var. *arenae* leaf apex  
■ 10  $\mu$ m

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*Henediella arenae* var. *arenae* cells of lower leaf  
10  $\mu$ m

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**Hennediella arenae** var. **petriei** (Broth.) R.H.Zander

**form:** densely tufted, erect, ± branched stems, light green, 5–10 mm tall  
**habitat:** exposed to shaded soil at subalpine to alpine elevations

**leaf:** size: 3–4 mm

*shape:* ovate- to oblong-lanceolate or subspathulate

*tip:* acute

*base:* basal cells rectangular, pellucid, sparsely papillose to smooth

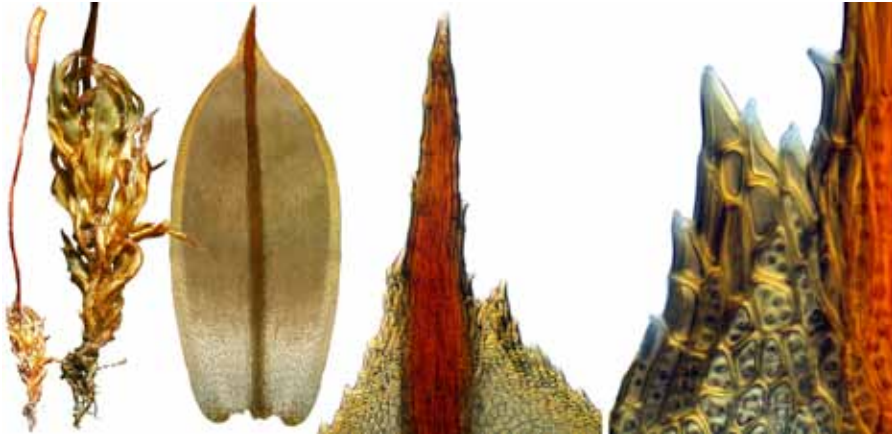
*costa:* strong, excurrent in a stout red point

*border:* 6–12 rows, firm-walled, ± papillose; length/width ratio mostly > 4

*margin:* entire below, ± toothed near apex, plane

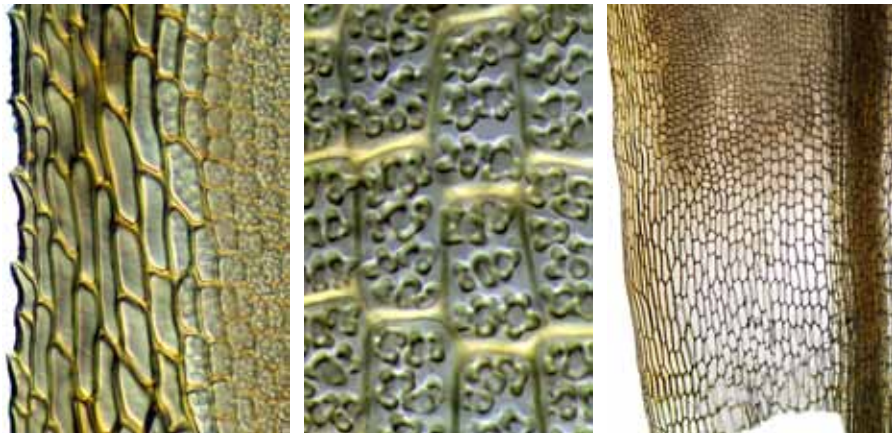
*cells:* 17–20 μm, subquadrate to hexagonal, firm-walled, multipapillose

**capsule:** 2.5–5 mm, cylindrical, ± curved, erect, exserted, glossy, brown; seta 13–20 mm, red; calyptra cucullate, smooth, naked; operculum conic-subulate, to half the capsule length; peristome pink, to 1/3 the length of the capsule; basal tube long; spores 14–18 μm in diam.



fertile shoot (dry), leaf outline, leaf apex, and margin at base of apical point

5 mm, 1 mm, 1 mm, 100 μm, 50 μm



bordered margin midleaf, cells below midleaf, and leaf basal angle

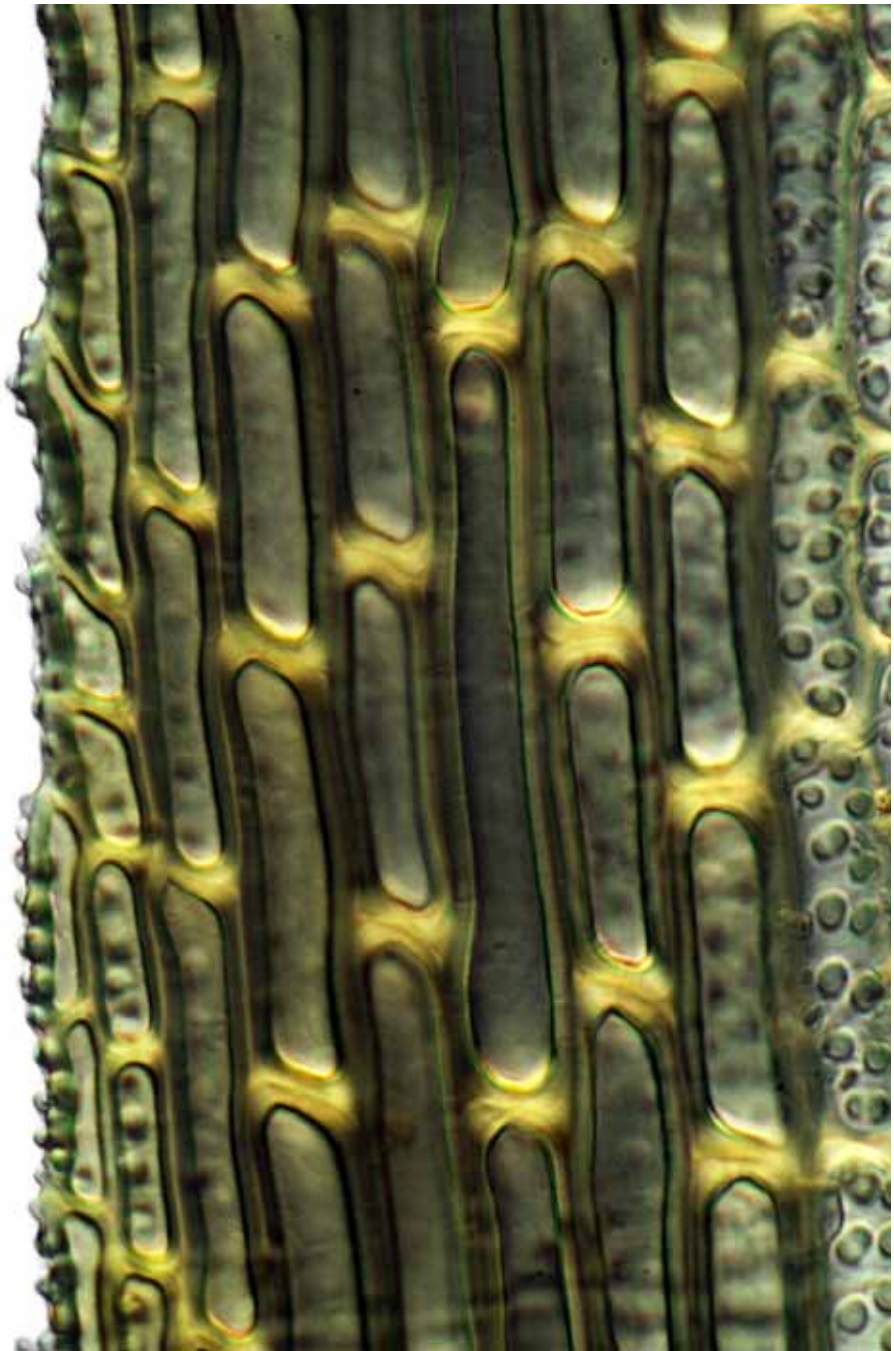
50 μm, 10 μm, 50 μm

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*Henediella arenae* var. *petriei* margin at base of apical point  
— 10  $\mu$ m

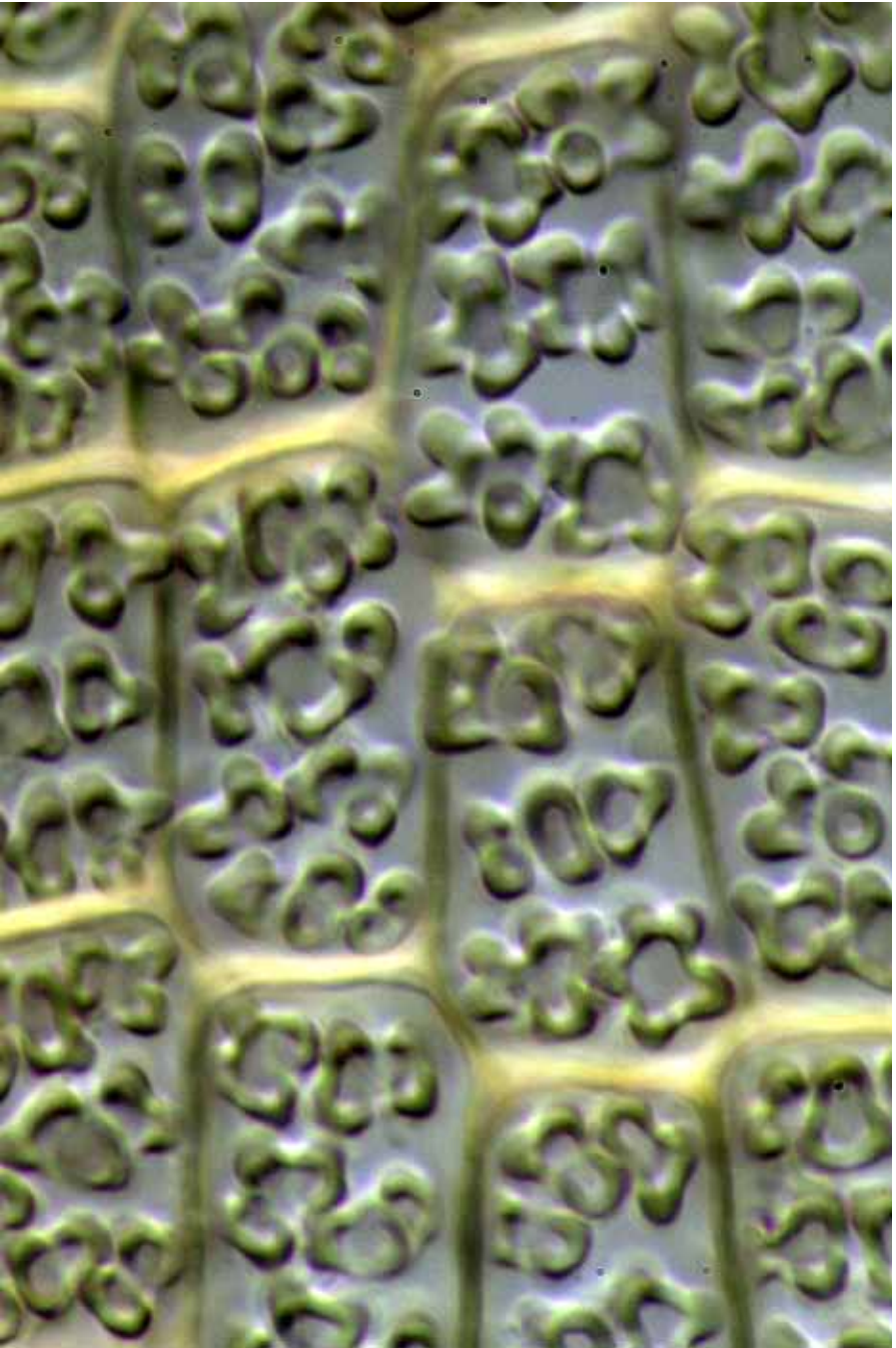
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*Hennediella arenae* var. *petriei* bordered margin below midleaf  
10  $\mu$ m

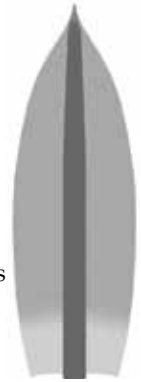
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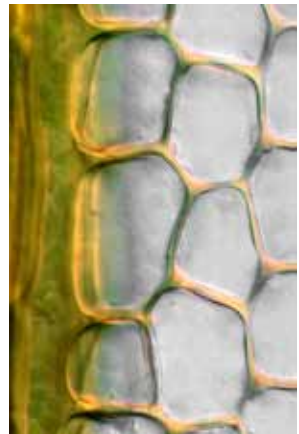
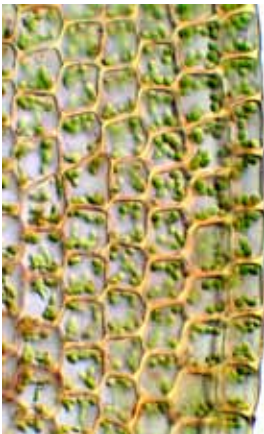


*Hennediella arenae* var. *petriei* cells just below midleaf  
10  $\mu$ m

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**Hennediella heimii** (Hedw.) R.H.Zander**form:** densely tufted, erect, irregularly branched, reddish below**habitat:** soil or soil over rock; salt-tolerant**leaf:** size: 2.0–2.5 × 0.5–0.6 mm*shape:* narrowly oblong-lanceolate*tip:* acute, ± acuminate*base:* undifferentiated*costa:* excurrent in a cuspidate point*border:* not differentiated*margin:* entire to ± denticulate toward the apex, plane*cells:* 12–16 μm, subquadrate, firm-walled, papillose, the papillae ± bifid**capsule:** 1–2 mm, oblong, wide-mouthed, brown; seta 5–12 mm; lid persists attached to the columella

fertile habit, fertile shoots (2) and immature capsule, leaf outline, and leaf apex



margin midleaf, costa midleaf, and cells midleaf

continued next page

**Hennediella macrophylla** (R.Br.bis) Paris

**form:** gregarious or tufted stems, ± branched, light green, 3–6 mm tall  
**habitat:** soil, rock, roots, or rotting logs in damp sites

**leaf:** size: 2–4 mm

*shape:* ovate- to oblong-spathulate, unistratose, flexuose when dry

*tip:* acute to acuminate, ending in an acute, dentate point

*base:* basal cells 60–120 × 20 μm, thin-walled, smooth

*costa:* excurrent in the dentate point

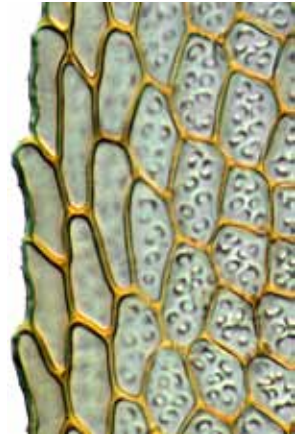
*border:* 2–4 rows of narrow, firm-walled, smooth cells

*margin:* denticulate above, minutely crenulate below, plane

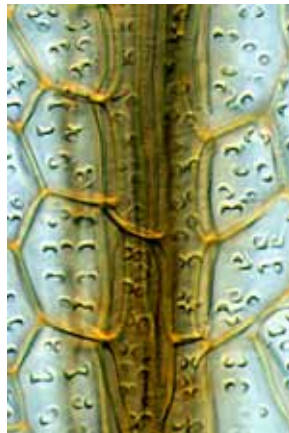
*cells:* 15–20 μm, subquadrate or short-rectangular, thin-walled, C-papillose

**capsule:** 1.5–2.5 mm, oval to cylindric, erect, exserted, brown; seta 2–4 mm, stout, reddish, twisted when dry; peristome none; operculum rostrate; calyptra pale, large, campanulate, mitriform to nearly cucullate, with a dark apex; spores 18–6 μm in diam., reddish brown

**note:** endemic

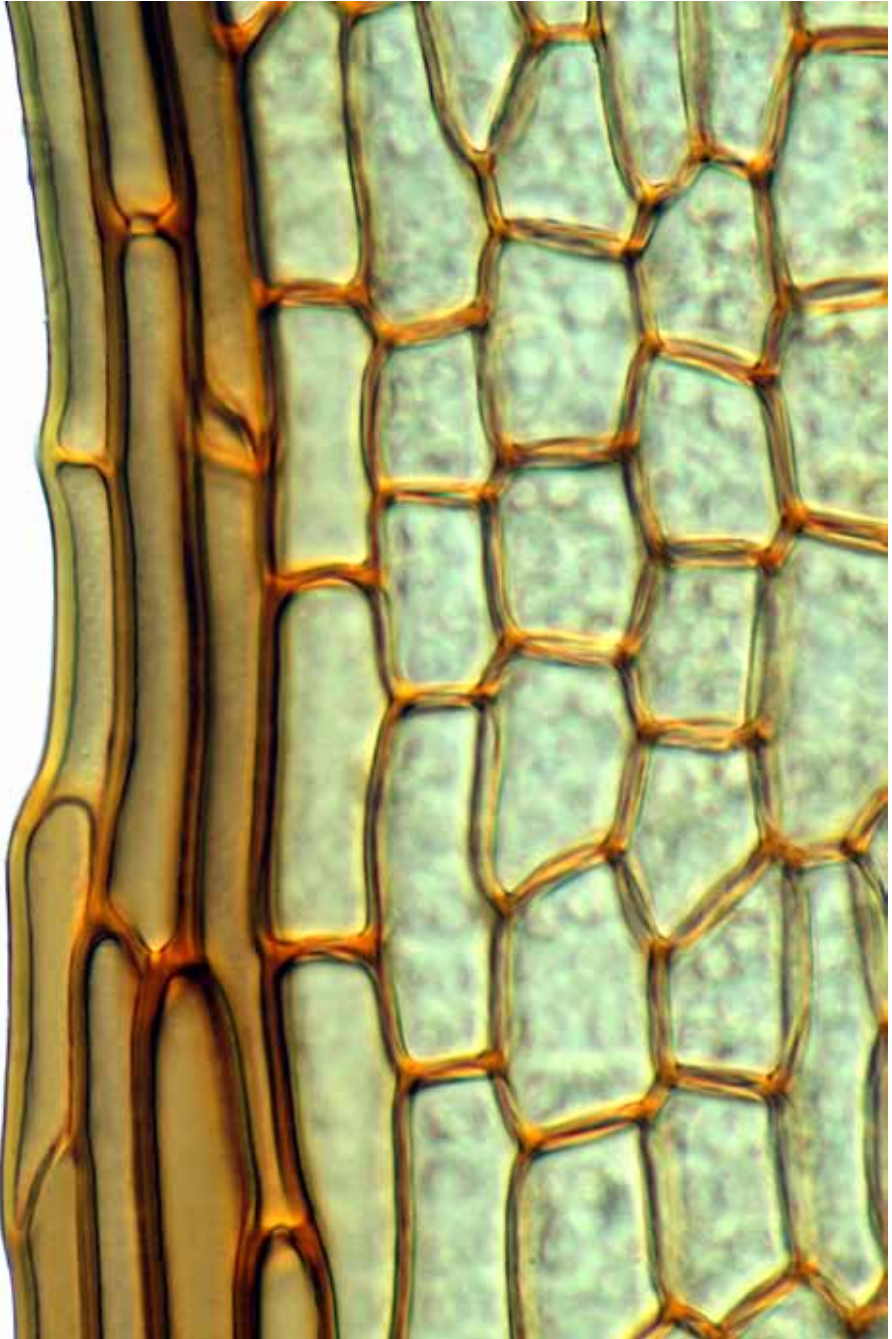


fertile shoot (moist), leaf outline, leaf apex, and margin upper leaf  
 ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 10 μm



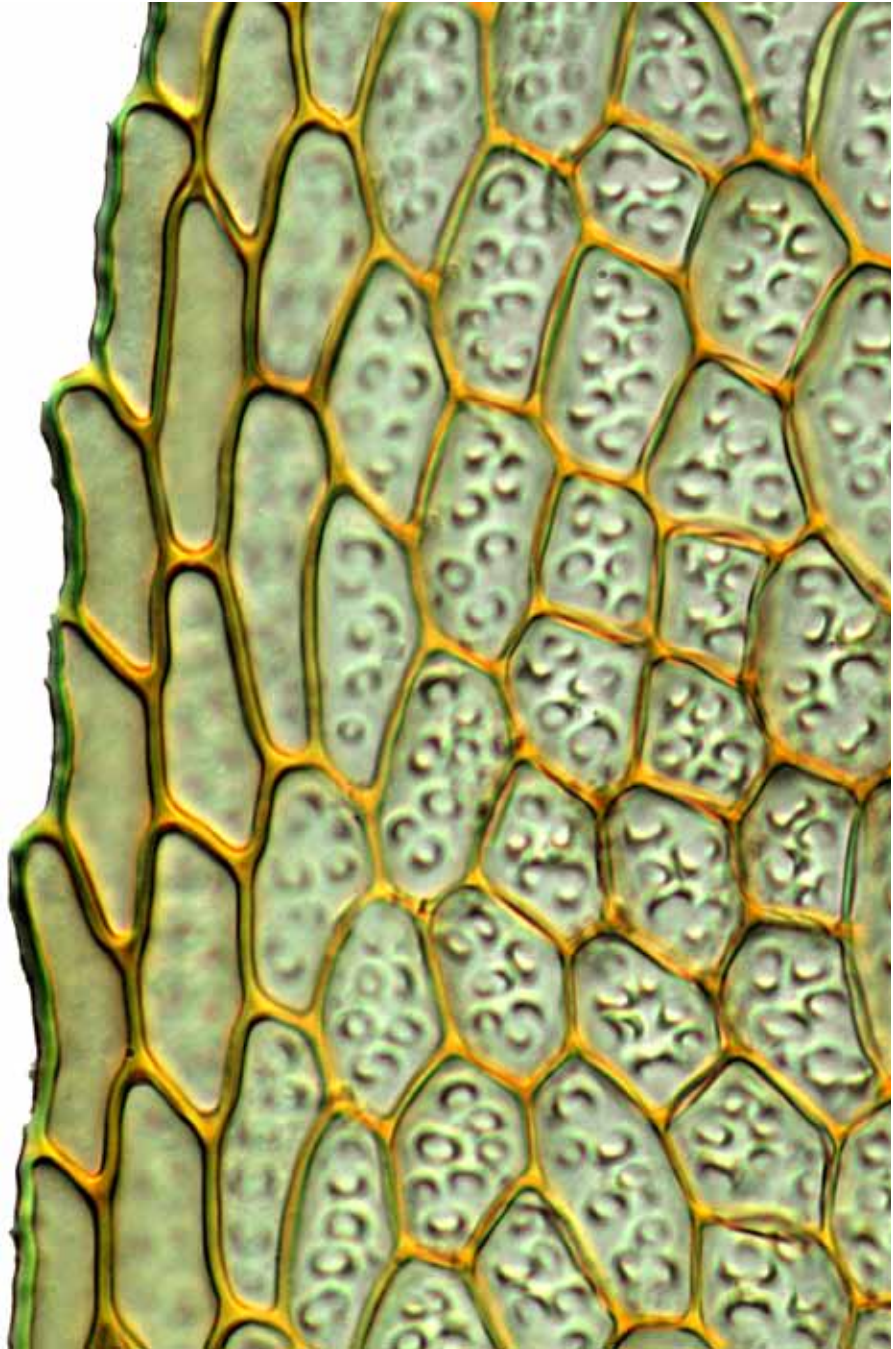
bordered margin midleaf, costa midleaf, and cells near leaf base  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

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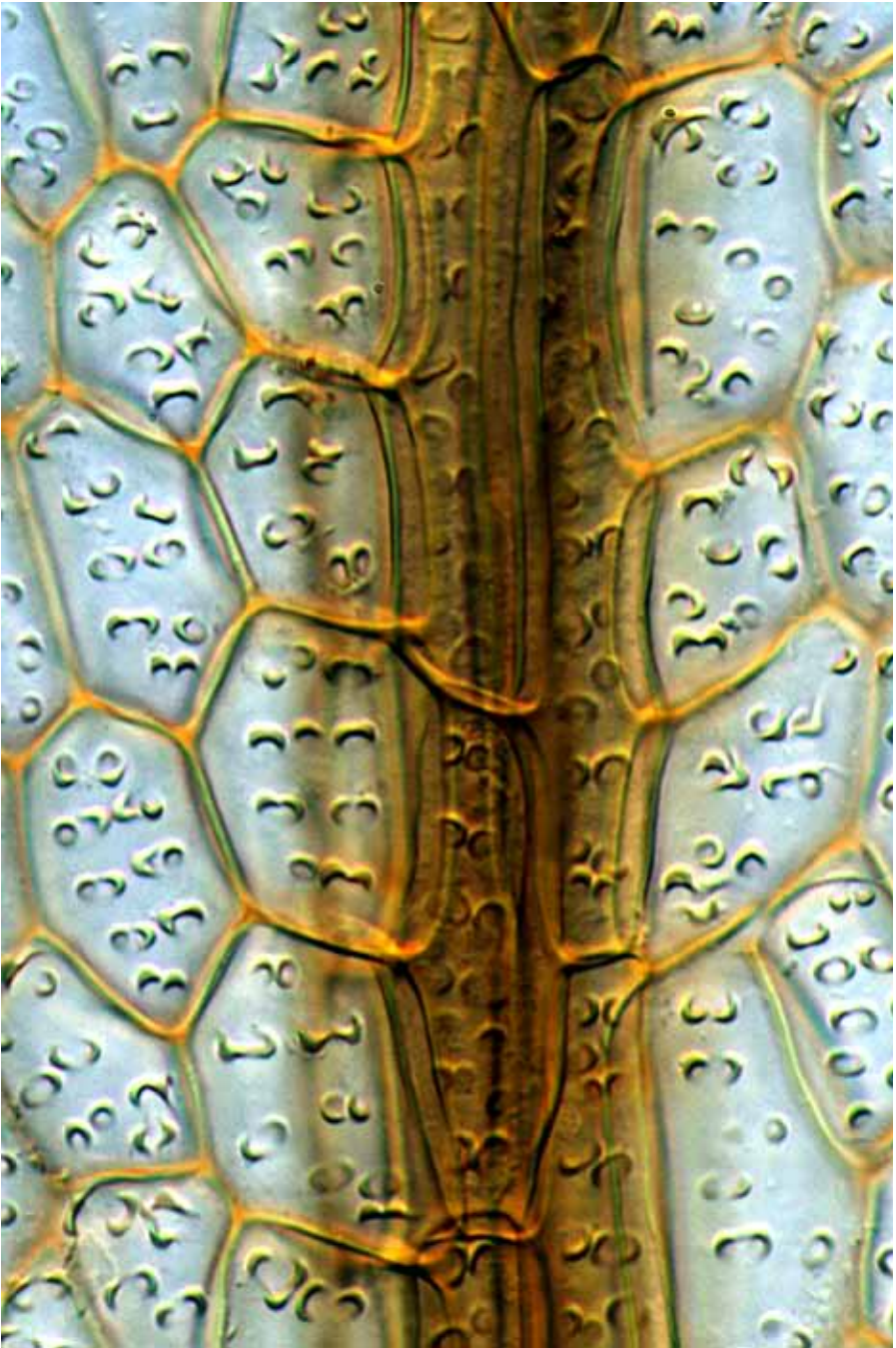
*Henediella macrophylla* margin midleaf  
10  $\mu\text{m}$

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*Henediella macrophylla* weakly bordered margin upper leaf  
10  $\mu\text{m}$

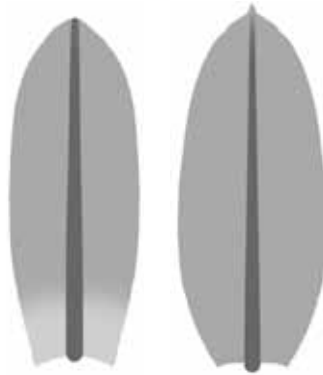
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*Henediella macrophylla* costa midleaf  
10  $\mu\text{m}$

**Key to the New Zealand species of *Hyophila* (2)**

- 1 Peristome well-developed; leaf tip round ..... ● ***Hyophila novae-seelandiae***  
 1: Peristome none; leaf tip mucronate..... ● ***Hyophila involuta***



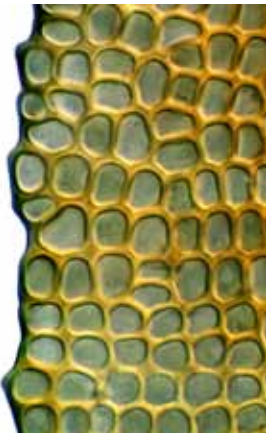
*Hyophila  
novae-seelandiae*

*Hyophila  
involuta*

**Hyophila involuta** (Hook.) A.Jaeger**form:** tufts of erect unbranched stems**habitat:** wet concrete and calcareous rocks or soil-covered rocks**leaf:** *size:* 1.5–3 mm*shape:* oblong to oblong-spathulate*tip:* obtuse, mucronate*base:* cells rectangular near leaf insertion*costa:* vanishing in mucro*border:* not differentiated*margin:* irregularly serrulate above, plane when wet, inrolled when dry*cells:* 7–9  $\mu\text{m}$ , subquadrate, firm-walled, bulging but not papillose**capsule:** 1.5–2.5 mm, narrowly cylindric, erect; seta 6–17 mm

fertile shoot, leaf outline, and leaf apex (2)

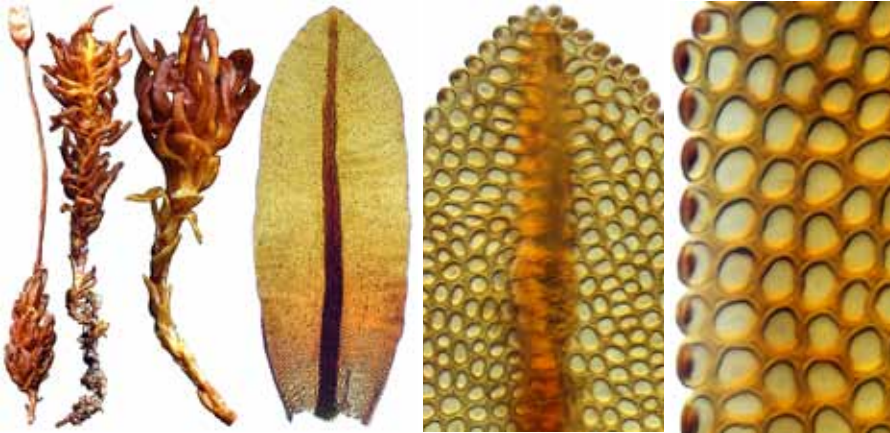
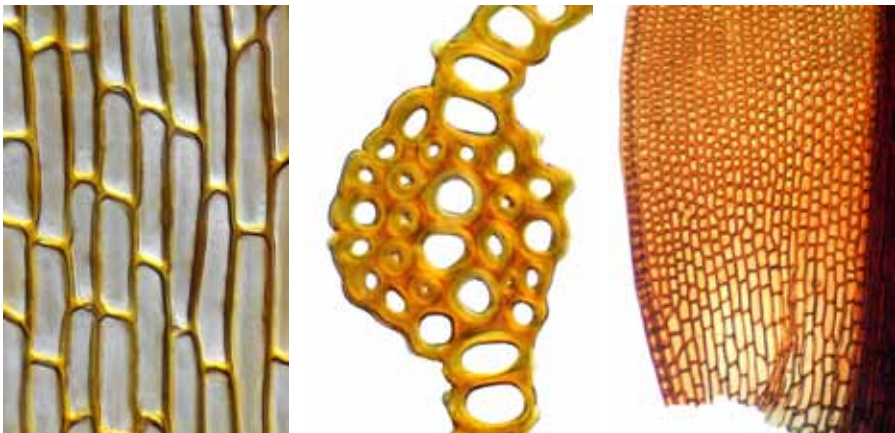
1 mm, 
  0.5 mm, 
  10  $\mu\text{m}$  (left), 
  10  $\mu\text{m}$  (right)



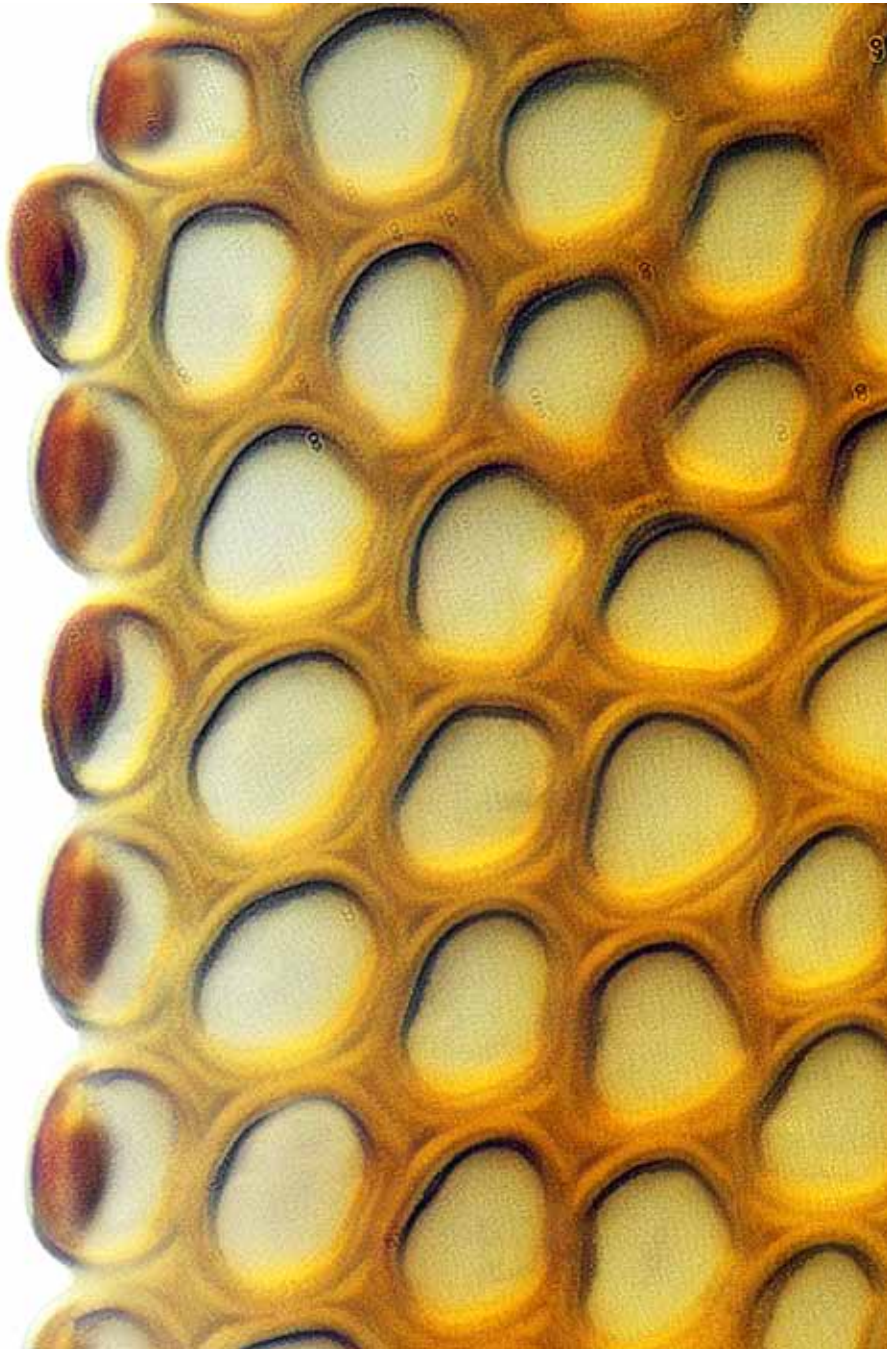
margin midleaf, costa terminus, and propagule

10  $\mu\text{m}$ , 
  10  $\mu\text{m}$ , 
  10  $\mu\text{m}$



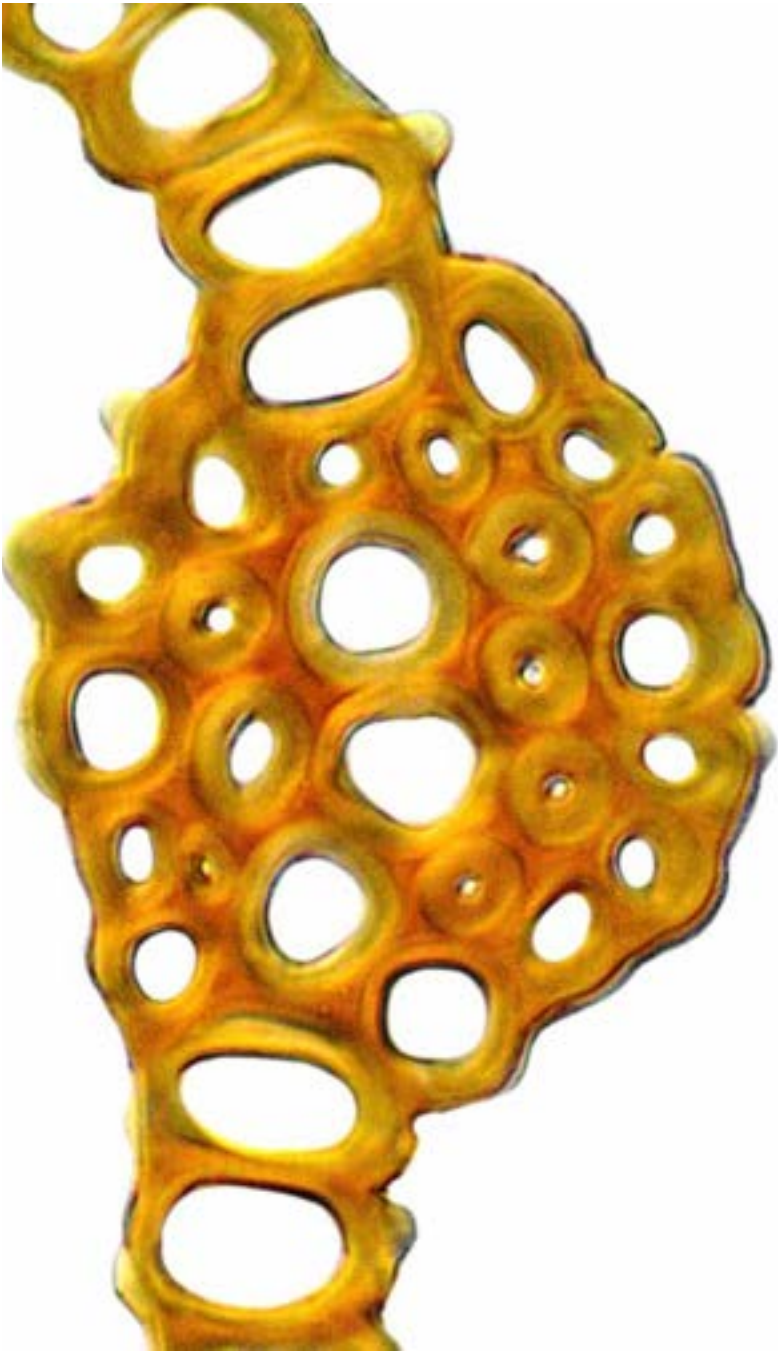
**Hyophila novae-seelandiae** Dixon & Sainsbury**form:** densely tufted, dull, erect, sparsely branched stems, 5–10 mm tall**habitat:** moist rock (limestone or sandstone) or soil, lowland to montane**leaf:** size: 2 mm*shape:* widely oblong, concave, carinate*tip:* obtuse, slightly recurved, rarely minutely apiculate*base:* basal cells rectangular, hyaline, thin-walled*costa:* strong, reddish, vanishing below the apex*border:* not differentiated*margin:* entire, plane*cells:* 7  $\mu\text{m}$ , subrotund, incrassate, smooth**capsule:** 1 mm, narrowly elliptic or ovoid, gymnostomous; seta 5(–10) mm; operculum obliquely rostrate, the beak about as long as the urn; spores 14–15  $\mu\text{m}$  in diam.**note:** endemicfertile and vegetative shoots (dry), leaf outline, leaf apex, and margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ cells near leaf base, costa cross-section, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$ 

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*Hyophila novae-seelandiae* margin midleaf  
10  $\mu$ m

continued next page



*Hyophila novae-seelandiae* costa cross-section  
10  $\mu\text{m}$

**Leptodontium interruptum** (Mitt.) Broth.

**form:** loosely tufted, simple or branched stems with comal tufts, 20–50 mm tall  
**habitat:** exposed soil or rock, to high elevations

**leaf:** size: 2–3 mm

*shape:* lanceolate from a wide ovate base

*tip:* acuminate

*base:* basal cells elongate to linear, mostly smooth

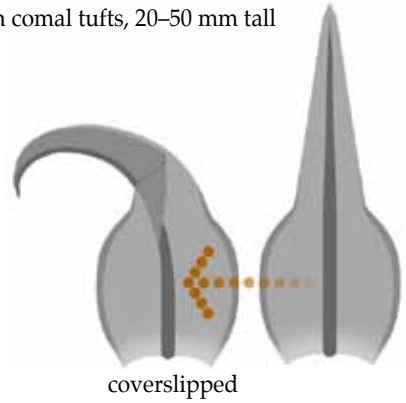
*costa:* failing below the apex

*border:* not differentiated

*margin:* erose or denticulate above, recurved below, sometimes undulate

*cells:* 7–9  $\mu\text{m}$ , isodiametric, thick-walled, papillose

**capsule:** 1–1.5 mm, narrowly elliptic, erect, pale brown; seta 8–10 mm, yellow, flexuose,  $\pm$  paired; calyptra cucullate, naked, smooth; operculum subulate; peristome teeth 16, irregularly cleft



vegetative shoots (dry), leaf outline, and leaf apex  
 1 mm, 0.5 mm, 10  $\mu\text{m}$



margin upper leaf, costa in lower leaf, costa cross-section  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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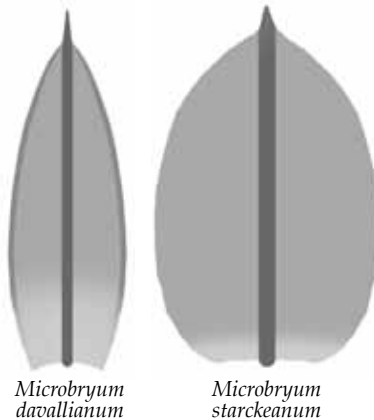
*Leptodontium interruptum* margin upper leaf  
1 mm

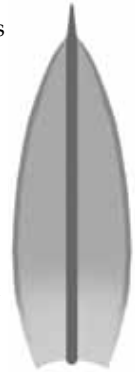
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**Key\* to the New Zealand species of *Microbryum* (2)**

- 1 Peristome teeth absent or reduced to stumps; spores papillose or spiculose, opaque .... ● ***Microbryum davallianum***  
 1: Peristome teeth to 120  $\mu\text{m}$  tall; spores smooth or tuberculate, clear ..... ● ***Microbryum starckeanum***

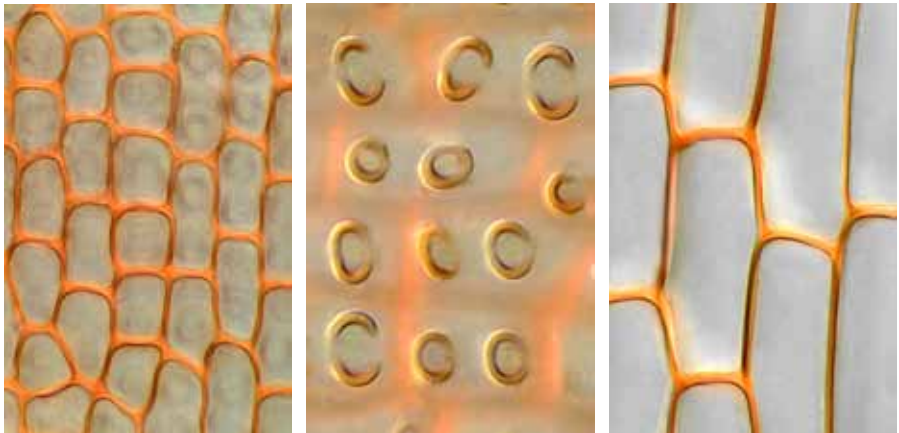
\* based on Zander, RH (2007): *Microbryum*. *Flora of North America* 27, 628.



**Microbryum davallianum** (Sm.) R.H.Zander**form:** gregarious, erect, forked, red-brown stems, in turves, to 2 mm tall**habitat:** calcareous soil in old fields, pastures, lawns, or disturbed roadsides**leaf:** size: 1–1.6 × 0.3–0.5 mm*shape:* lanceolate to ovate-lanceolate*tip:* gradually acuminate, ending in a short red apiculus*base:* basal cells rectangular, hyaline, thin-walled, smooth*costa:* excurrent in an apiculus*border:* not differentiated*margin:* entire, revolute below*cells:* 12–15 μm, hexagonal, firm-walled, papillose, the papillae C-shaped**capsule:** 0.4–1 mm, short-oval to hemispheric, wide-mouthed when empty, brown; seta 1.5–3 mm; calyptra minutely papillose; operculum low-conic; peristome teeth none or reduced to stumps; spores 29–33 μm in diam., spinulose**note:** an ephemeral pioneer species on bare soil

vegetative shoot, leaf outline, leaf apex, and margin midleaf

1 mm, 0.1 mm, 10 μm, 10 μm



cells midleaf, leaf papillae, and leaf base cells

10 μm, 10 μm, 10 μm

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**Microbryum starckeanum** (Hedwig) Zander

**form:** gregarious, short, erect, unbranched stems, to 2 mm tall  
**habitat:** moist, bare, compacted soil in fields or disturbed sites

**leaf:** size: 0.5–1.8 × 0.3–1.0 mm

*shape:* ovate to elliptic

*tip:* acute to obtuse

*base:* basal cells elongate, thin-walled, and smooth

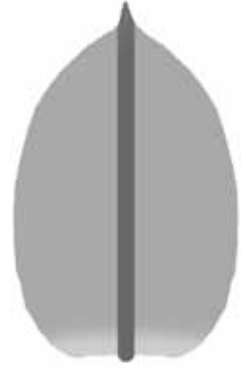
*costa:* reddish, excurrent in a short cusp or mucro, reddish

*border:* not differentiated

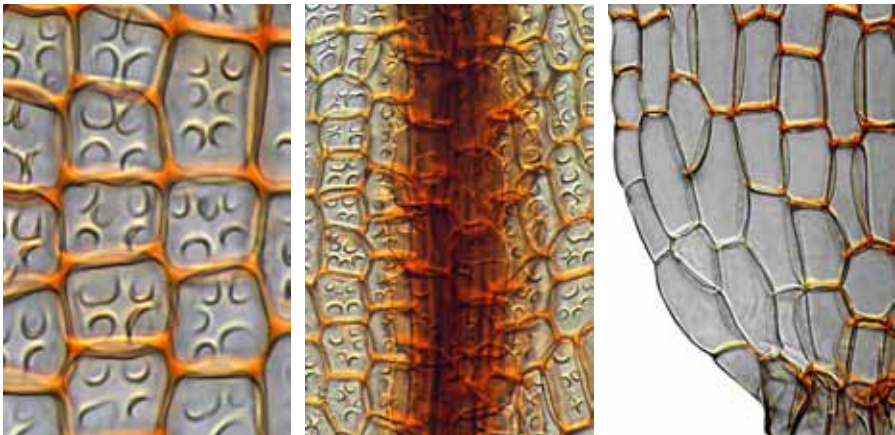
*margin:* entire, plane to ± revolute

*cells:* 10–15 μm, subquadrate, firm-walled, multipapillose

**capsule:** to 1 mm, oval, erect, dark brown, glossy, the mouth not wide when dry; seta to 4 mm; calyptra roughly papillose; operculum conic, obtuse or short-pointed; peristome teeth variable, flattened-linear, pale yellow; papillose; spores 25–30 μm, coarsely tuberculate



fertile shoot (dry), capsule (dry), leaf outline, leaf apex, and margin upper leaf  
 — 1 mm, — 0.1 mm, — 0.1 mm, — 10 μm, — 10 μm

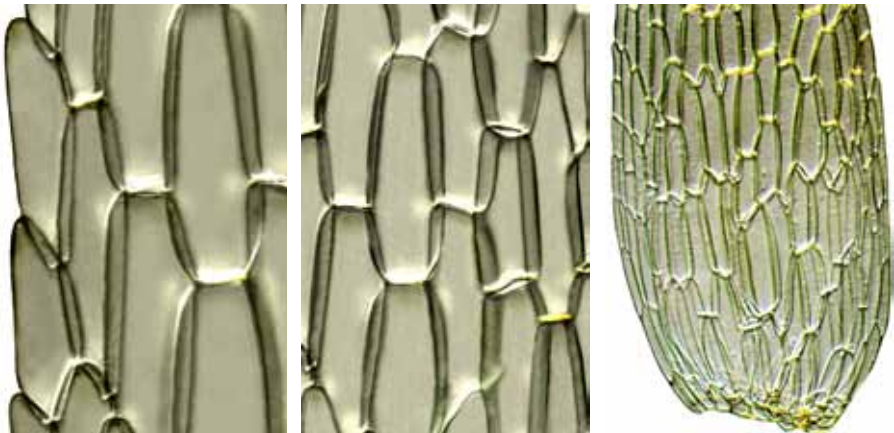


cells of upper leaf, costa in upper leaf, and leaf basal angle  
 — 10 μm, — 10 μm, — 10 μm



**Micromitrium tenerum** (Bruch & Schimp.) Crosby**form:** scattered on thin protonema, minute, erect, unbranched**habitat:** exposed soil or sandy banks**leaf:** *size:* upper leaves  $1.0\text{--}1.5 \times 0.2$  mm*shape:* linear-lanceolate*tip:* gradually attenuate, involute*base:* basal cells longer than the other blade cells but otherwise not differentiated*costa:* none*border:* not differentiated*margin:* serrulate or indistinctly crenate toward the apex, plane*cells:*  $60\text{--}100 \times 16\text{--}20$   $\mu\text{m}$ , rhombic-hexagonal, thin-walled, smooth**capsule:** 0.5–0.8 mm, globose, not apiculate, erect, emergent, cleistocarpous, usually dehiscent near the middle along a line of built-in weakness; seta very short

fertile shoot, immature capsule, leaf outline, and leaf apex

 1 mm, 0.1 mm, 0.5 mm, 10  $\mu\text{m}$ 


margin midleaf, cells in midleaf, and leaf base

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$ 

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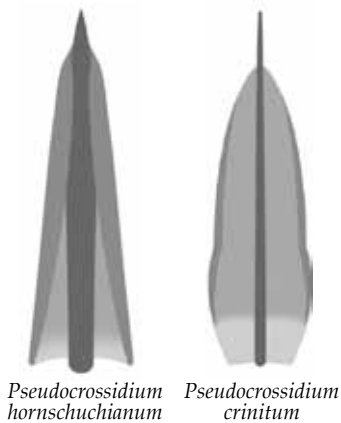


*Micromitrium tenerum* margin midleaf  
10  $\mu\text{m}$

**Key\* to the New Zealand species and varieties of *Pseudocrossidium* (2)**

- 1 Leaf apex narrowly acute at the base of the awn; costa convex adaxially, in cross-section with two guide cells ..... ● ***Pseudocrossidium hornsouchianum***  
 1: Leaf apex rounded-obtuse at the base of the awn; costa concave adaxially, in cross-section with four guide cells ..... ● ***Pseudocrossidium crinitum***

\* based partly on Zander, RH (2007): *Pseudocrossidium*. *Flora of North America* 27, 570.

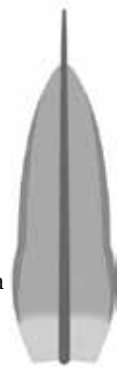


**Pseudocrossidium crinitum** (Schultz) R.H.Zander**form:** robust, yellowish, erect, comose, ± branched stems, 15–20 mm tall**habitat:** soil, usually sandy or gravelly in semi-arid sites**leaf:** size: 3–4.5 × 0.8–1.2 mm*shape:* linguulate-lanceolate, ± concave, twisted when dry*tip:* subacute, ending in a slender awn*base:* basal cells long-rectangular to linear, pellucid, smooth*costa:* excurrent in a yellowish, ± smooth arista, prominent abaxially*border:* absent*margin:* entire to minutely crenulate with projecting papillae, recurved*cells:* upper cells 9–12 μm, isodiametric, firm-walled, densely papillose**capsule:** 2.5–3 mm, narrowly cylindric, slightly curved, exserted, brown; seta

10–20 mm, pale or reddish; operculum long-beaked, up to 2 mm; calyptra

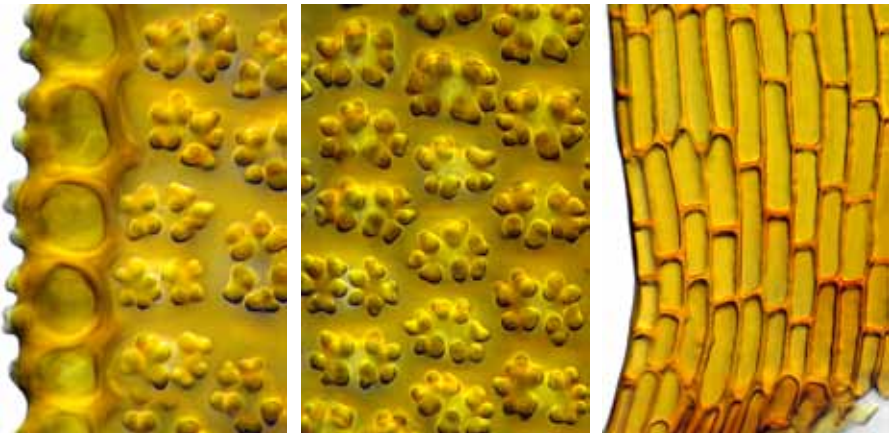
cucullate, smooth; peristome divided into 32 filaments on a low basal

membrane; spores 8–15 μm in diam., weakly papillose

**note:** common

vegetative shoot (dry), leaf outlines (2), and leaf apex (3)

5 mm, 1 mm (2), 50 μm, 10 μm, 10 μm



margin midleaf, leaf papillae, and leaf basal angle

10 μm, 10 μm, 10 μm

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*Pseudocrossidium crinitum* habit  
1 mm

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*Pseudocrossidium crinitum* immature and mature capsules, calyptrae, and peristome

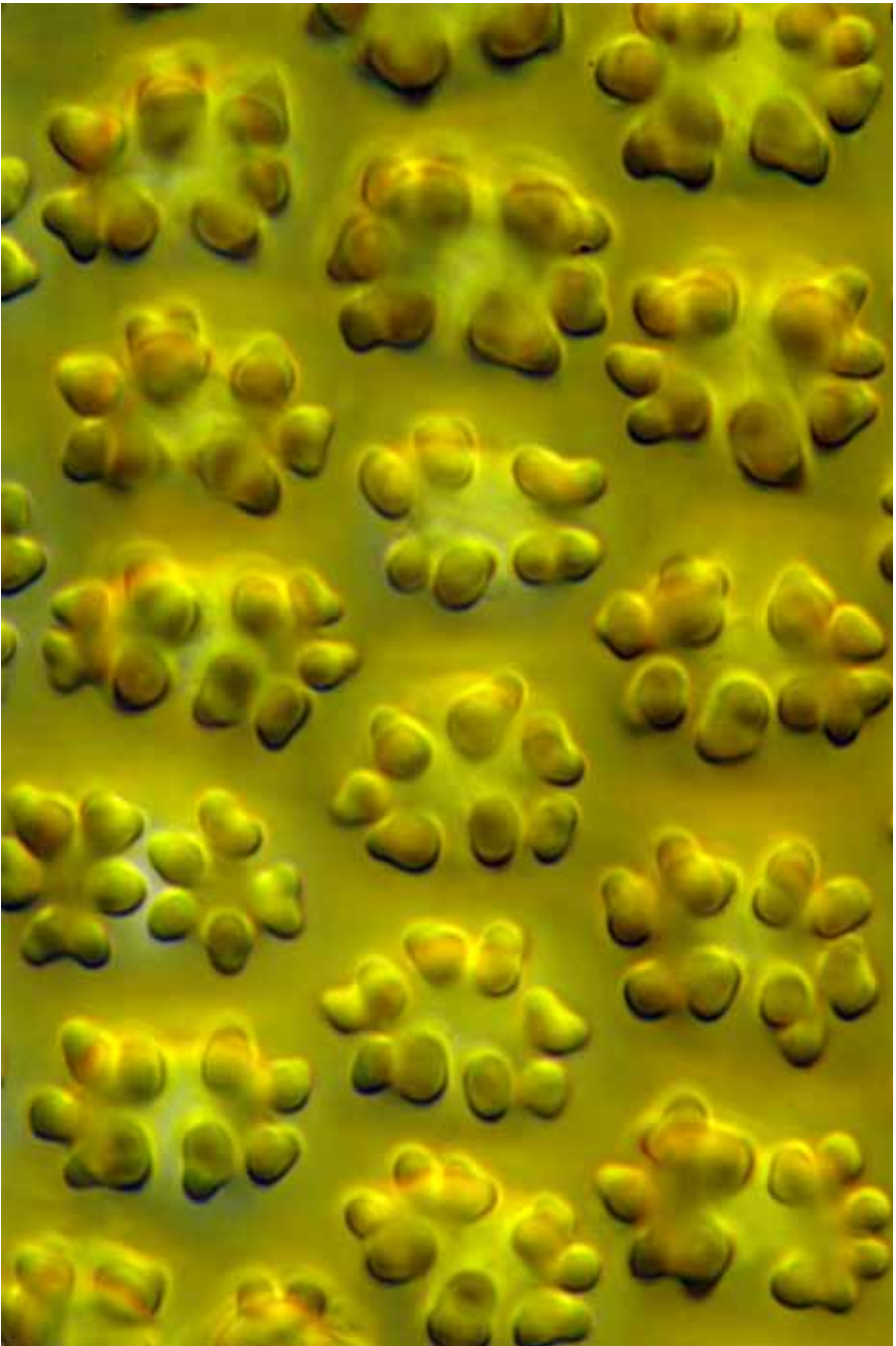
1 mm,

1 mm,

1 mm,

1 mm

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*Pseudocrossidium crinitum* leaf surface papillae  
10  $\mu$ m

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*Pseudocrossidium crinitum* leaf and costa cross-sections  
10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



**Pseudocrossidium hornschurchianum** (Schultz) R.H.Zander

**form:** dark olive- to brownish green, erect, sparsely branched stems in dense, flat turves, weakly radiculose, 5–10 mm tall

**habitat:** bare soil in semi-arid areas, especially disturbed road verges

**leaf:** size: 1–1.5 × 0.3–0.5 mm

*shape:* narrowly triangular

*tip:* acuminate, ending in a stout awn

*base:* undifferentiated

*costa:* wider above, excurrent in the awn

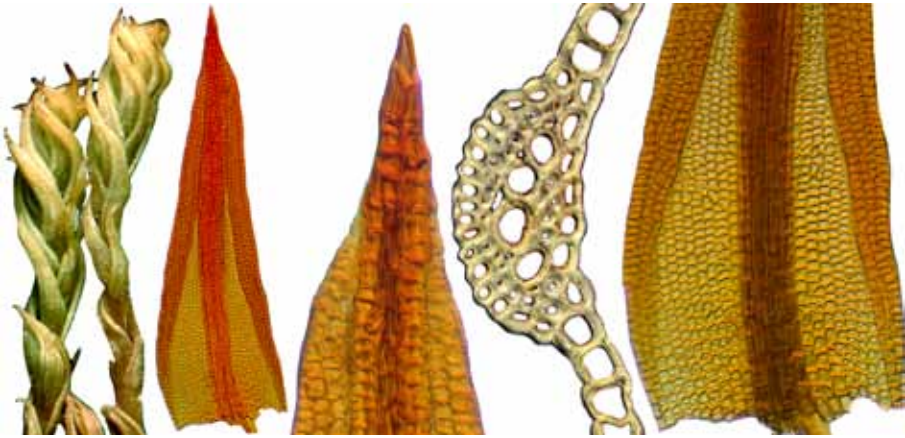
*border:* not differentiated

*margin:* entire, strongly revolute from the base to the apex

*cells:* 10–14 μm, rounded, rectangular near the costa, thick-walled, papillose

**capsule:** 0.8–1.5 mm, cylindric, straight, erect; calyptra narrowly conic; seta 6 mm, slender, reddish brown; operculum obliquely long-rostrate; the peristome divided into 32 spiculose filaments

**note:** possibly introduced



vegetative shoots (dry), leaf outline, leaf apex, costa cross-section, and leaf base

1 mm, 100 μm, 50 μm, 10 μm, 100 μm

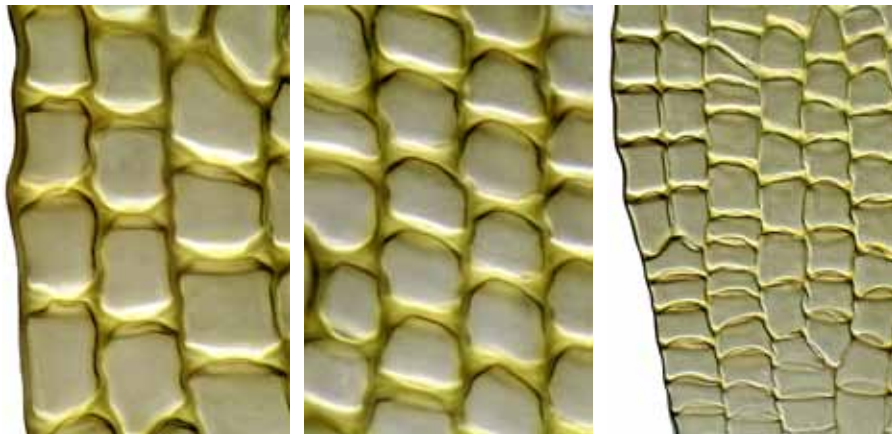


costa and revolute margin, cells in midleaf, and revolute margin

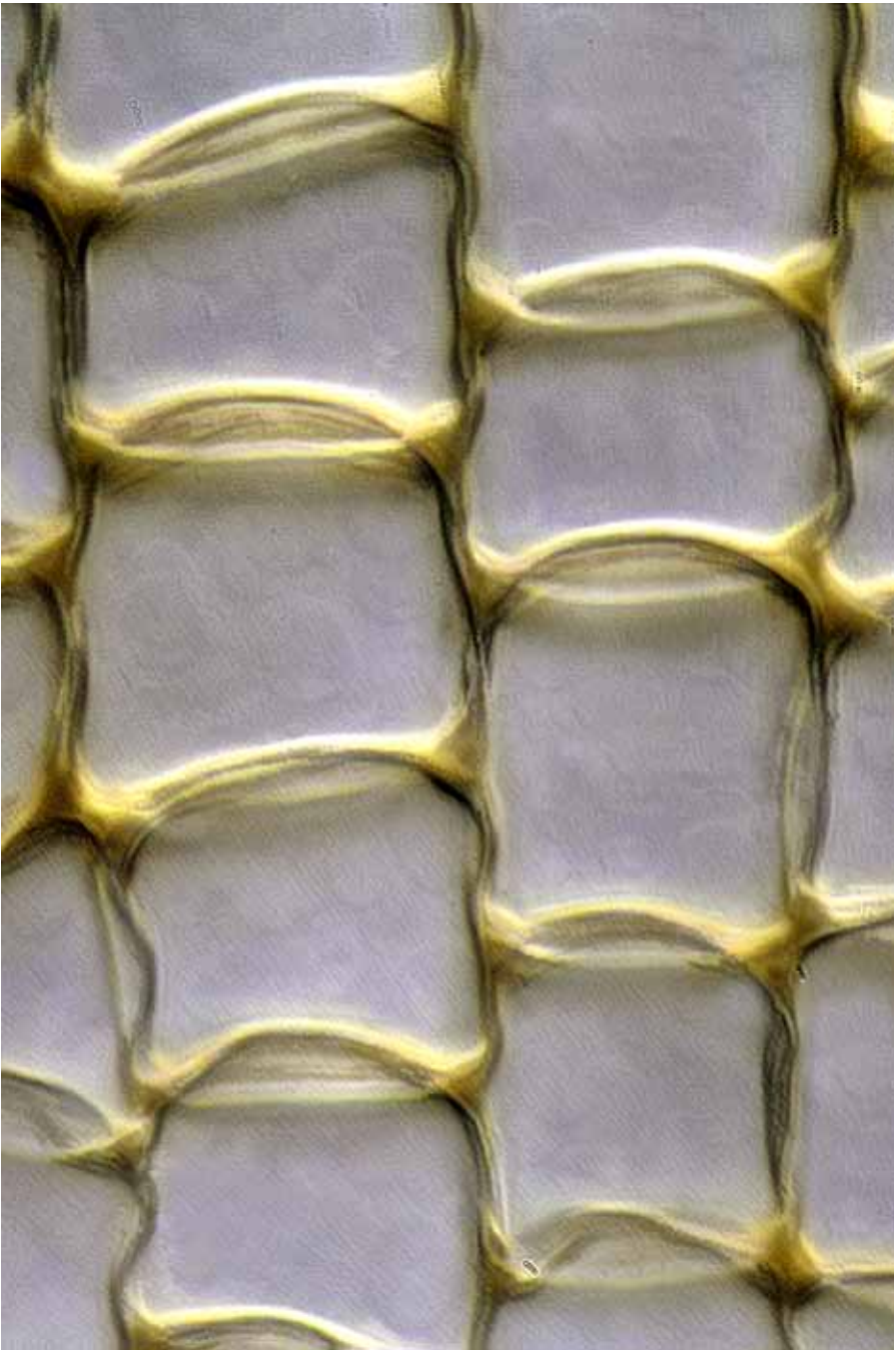
50 μm, 10 μm, 10 μm

**Pterygoneurum ovatum** (Hedw.) Dixon**form:** densely tufted, brownish, erect, unbranched stems, 3–5 mm tall**habitat:** exposed soil in disturbed sites like lawns, fields, and road verges**leaf:** size: 1.5–2 mm (including the awn)*shape:* oblong-ovate*tip:* obtuse to broadly acute, ending in a hyaline, ± serrulate awn*lamellae:* 2–4, each 5–7 cells tall, strongly crenate on the margin*base:* alar cells not differentiated*costa:* excurrent in a hyaline awn that can exceed the length of the lamina*border:* not differentiated*margin:* entire, plane to erect*cells:* 11–15  $\mu\text{m}$ , rounded-quadrate, firm-walled, smooth**capsule:** 1–1.5 mm, long-cylindric, erect, symmetric, shortly exserted, dark brown, wrinkled-plicate when dry and empty; seta 1.5–3.5 mm, brown; operculum obliquely rostrate; calyptra cucullate; peristome none; spores 22–33  $\mu\text{m}$ , papillose

fertile habit (dry), mature capsule (dry), leaf outline, leaf apex, and lamella (upended)



margin midleaf, cells in midleaf, and leaf basal angle

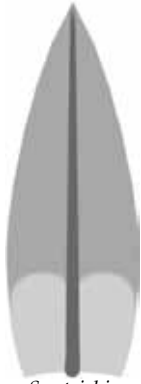


*Pterygoneurum ovatum* cells near leaf base  
10  $\mu\text{m}$

**Key\* to the New Zealand species and varieties of *Syntrichia* (14)**

- 1 Plants bearing propagula ..... 2  
 1: Plants not bearing propagula ..... 5
- 2(1) Propagula in upper axils or clustered at the stem apex ..... 3  
 2: Propagula on tip or adaxial surface of the costa ..... 4
- 3(2) Stems tipped with a rosette of tightly packed brood leaves .. ● *Syntrichia laevipila*  
 3: Leaf-like propagules in upper leaf axils ..... ● *Syntrichia pagorum*
- 4(2): Propagula on adaxial surface of costa ..... ● *Syntrichia papillosa*  
 4: Propagula at costa apex but soon shed, leaving a truncate tip ..... *Syntrichia pygmaea*
- 5(1): Leaf bordered ..... *Syntrichia rubella*  
 5: Leaf not or only weakly bordered near the base ..... 6
- 6(5): Costa typically failing ..... *Syntrichia robusta*  
 6: Costa typically excurrent ..... 7
- 7(6): Margin entire or nearly so ..... 8  
 7: Margin toothed, at least near the apex ..... 11
- 8(7) Plant on dry limestone; costa short-excurrent ..... ● *Syntrichia phaea*  
 8: Plant not on dry limestone; costa short- to long-excurrent ..... 9
- 9(8): Leaf strongly narrowed in the middle ..... *Syntrichia brevisetacea*  
 9: Leaf not or only weakly narrowed in the middle ..... 10
- 10(9): Costa red to the lamina apex ..... ● *Syntrichia antarctica*  
 10: Costa red only near the lamina base ..... ● *Syntrichia ruralis*
- 11(7): Margin spinulose-dentate; costa red ..... ● *Syntrichia serrata*  
 11: Margin denticulate to dentate; costa orange or red only near the leaf base ..... 12
- 12(11.): Stems < 30 mm tall; leaf < 4 mm long ..... ● *Syntrichia anderssonii*  
 12: Stems > 30 mm tall; leaf > 4 mm long ..... 13
- 13(12.): Cells densely papillose; plant on shaded alpine rock .....  
 ..... ● *Syntrichia rubra* var. *rubra*  
 13: Cells sparsely papillose; plant on soil ..... *Syntrichia rubra* var. *subantarctica*

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 182.



*Syntrichia  
robusta*



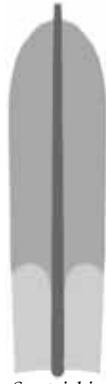
*Syntrichia  
phaea*



*Syntrichia  
rubra* var.  
*subantarctica*



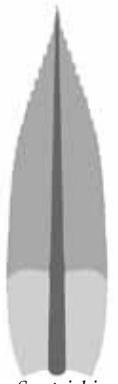
*Syntrichia  
rubra* var.  
*rubra*



*Syntrichia  
pygmaea*



*Syntrichia  
anderssonii*



*Syntrichia  
serrata*



*Syntrichia  
brevisetacea*



*Syntrichia  
rubella*



*Syntrichia  
pagorum*



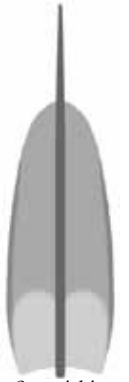
*Syntrichia  
papillosa*



*Syntrichia  
laevipila*



*Syntrichia  
ruralis*



*Syntrichia  
antarctica*

**Sytrichia anderssonii** (Ångstr.) R.H.Zander

**form:** loosely tufted, erect, ± branched, foliate, hoary stems, to 30 mm tall  
**habitat:** soil or rock in upland sites

**leaf:** size: 3–4 mm

*shape:* ovate- to oblong-lanceolate, twisted when dry

*tip:* acute

*base:* basal cells narrowly oblong to linear, 70–120 μm long, thin-walled

*costa:* excurrent in a narrow red or ± hyaline point

*border:* weak, a single row of transversely elliptic cells

*margin:* entire below, ± denticulate above, recurved in lower half

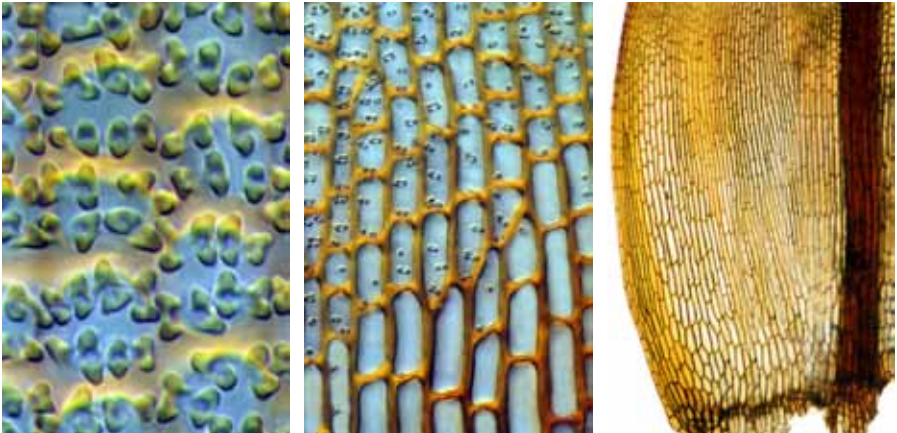
*cells:* 8–10 μm, irregularly hexagonal, firm-walled, pluri- to multipapillose

**capsule:** 2.5–5.5 mm, cylindric, erect, exserted, reddish brown; seta to 15 mm, reddish; operculum conic-subulate, to half the capsule length; calyptra cucullate; peristome tube pale below, teeth reddish, spirally twisted, papillose; spores 14–18 μm in diam., green, papillose



fertile shoot (2), peristome (dry), leaf outline, leaf apex, and margin midleaf

5 mm, 1 mm, 0.5 mm, 0.5 mm, 50 μm, 10 μm



cells midleaf, cells in lower leaf, and leaf basal angle

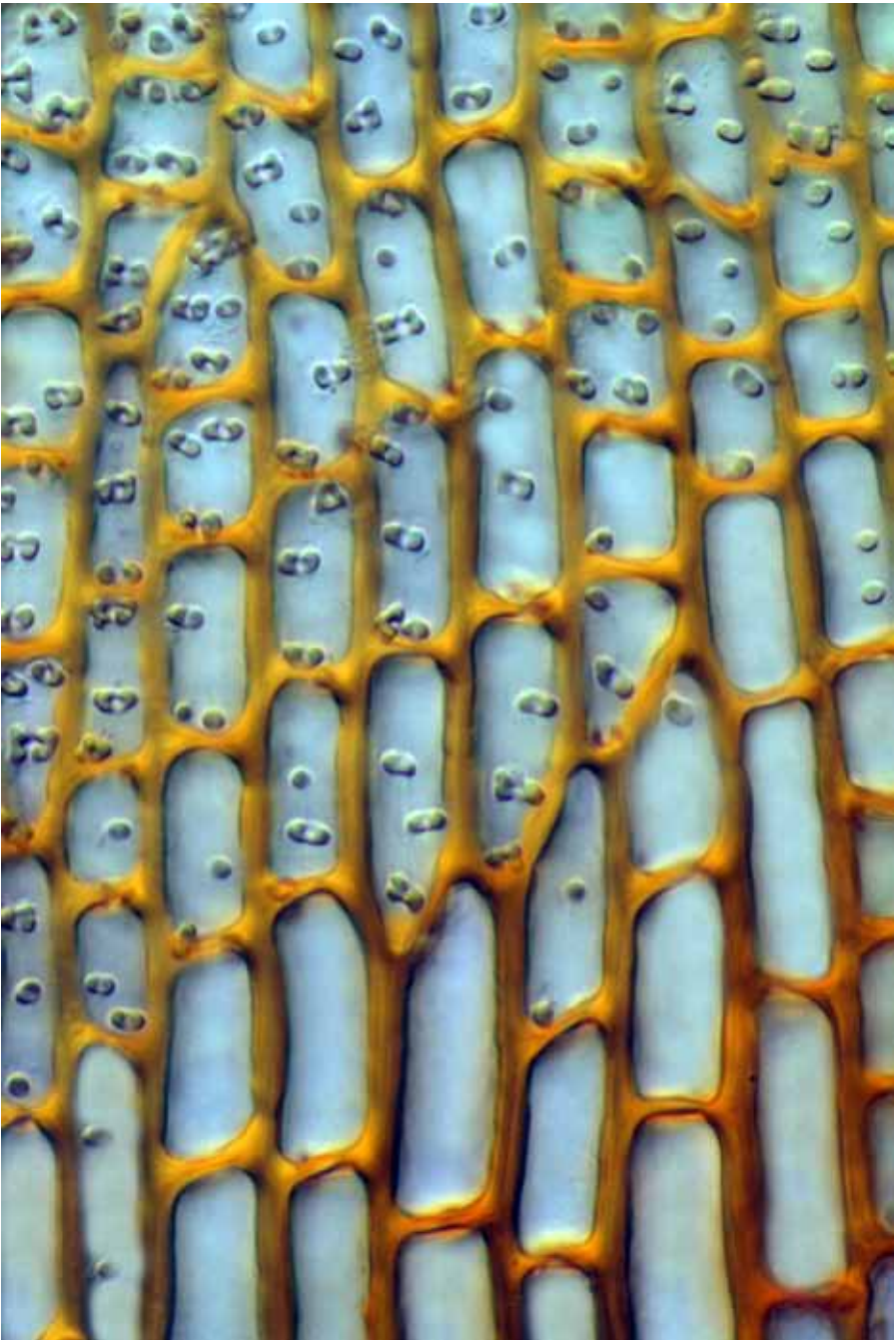
10 μm, 10 μm, 100 μm

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*Syntrichia anderssonii* fertile shoot, shoot apex, and peristome (dry)  
 1 mm, 1 mm, 0.5 mm

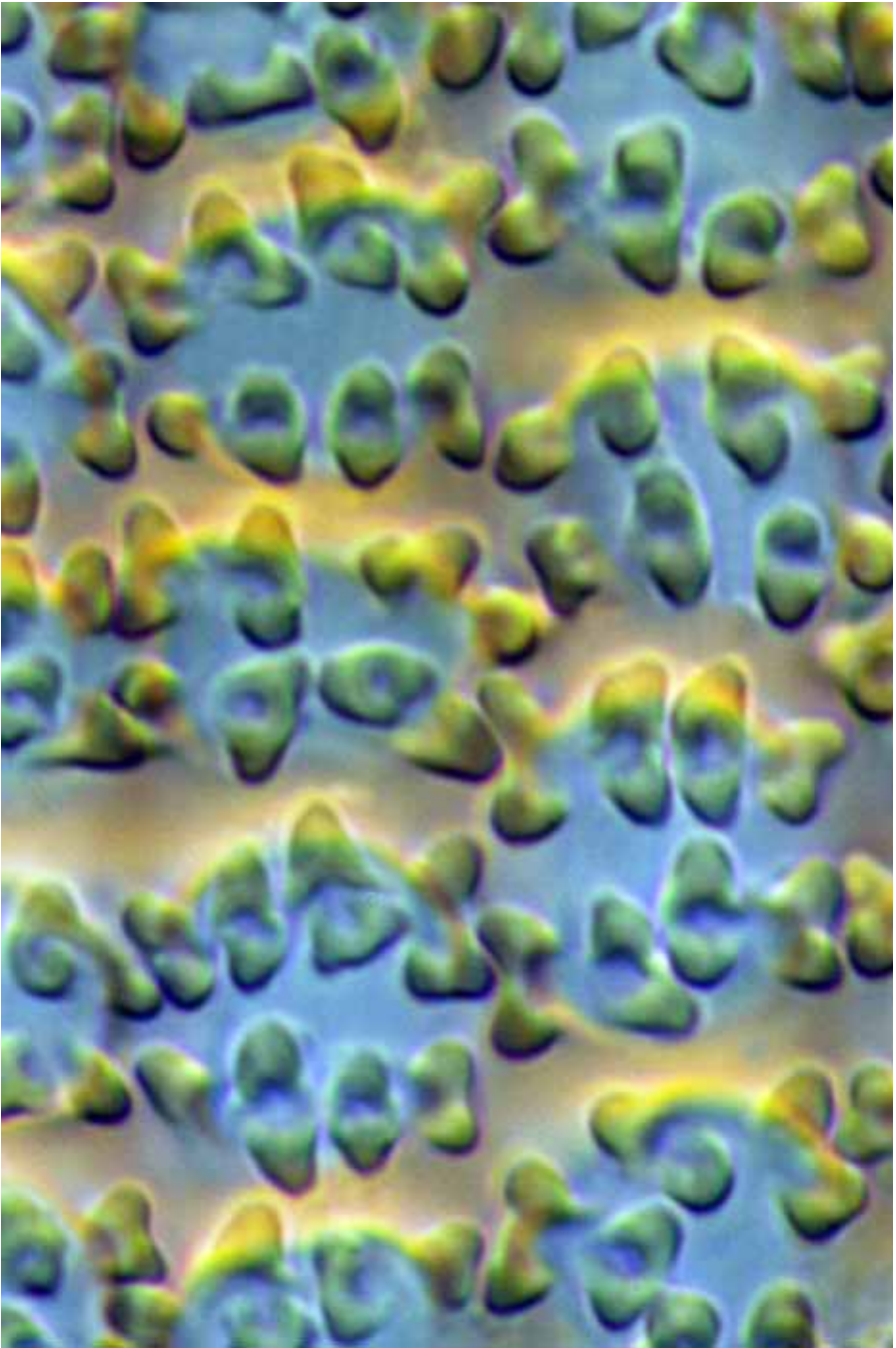
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*Syntrichia anderssonii* lower leaf cells  
10  $\mu$ m

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*Syntrichia anderssonii* papillae midleaf  
10  $\mu\text{m}$

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***Syntrichia antarctica*** (Hampe) R.H.Zander

**form:** tufted, olive-green, erect,  $\pm$  unbranched stems, tomentose, to 20 mm tall  
**habitat:** sandy soil, rotting logs, bark, or rock, lowland to high-montane

**leaf:** size:  $4-5 \times 1.5$  mm

*shape:* elliptic to oblong-spathulate,  $\pm$  constricted below midleaf

*tip:* obtuse to emarginate, ending in a long,  $\pm$  reddish hair-point

*base:* basal cells hyaline, rectangular to linear, smooth

*costa:* excurrent in a denticulate, hyaline hair-point, reddish at the base

*border:* not differentiated

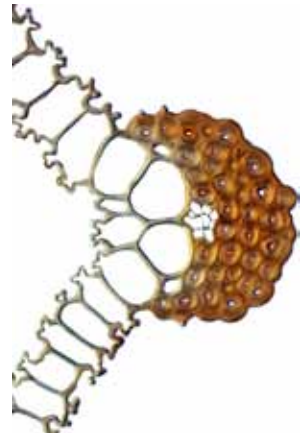
*margin:* entire, revolute to two-thirds up the leaf blade

*cells:*  $12-20 \mu\text{m}$ , hexagonal, firm-walled, papillose above, smooth below

**capsule:** 3.5–6 mm, cylindrical, erect,  $\pm$  curved, reddish brown; calyptra cucullate, operculum long-rostrate, curved; seta 10–30 mm, reddish, twisted; peristome teeth of 32 long, spiculate filaments, red-orange above, from a tall, pale to white tessellated cylinder, tightly twisted when dry, fragile



vegetative habit (moist), vegetative shoots (dry), leaf outline, capsules, and peristome  
 ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 0.5 mm (2), ■ 0.1 mm



revolute margin midleaf, hyaline basal cells, and costa cross-section  
 ■  $10 \mu\text{m}$ , ■  $10 \mu\text{m}$ , ■  $10 \mu\text{m}$

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*Syntrichia antarctica* immature capsules and top view of vegetative shoots (moist)  
1 mm

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*Syntrichia antarctica* vegetative shoots (dry)  
1 mm

continued next page



*Syntrichia antarctica* peristome  
100  $\mu$ m

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**Syntrichia laevipila** Brid.

**form:** densely packed, erect,  $\pm$  unbranched stems, the leaves comose, dark green, the hair-points hoary from a distance, 12–20 mm tall

**habitat:** bark or rock in dry,  $\pm$  shaded, disturbed woodland and grassland

**leaf:** size: 1.8–2.5  $\times$  0.7–0.8 mm

**shape:** spatulate to panduriform,  $\pm$  constricted just below midleaf

**tip:** obtuse or emarginate

**base:** basal cells abruptly differentiated, rectangular, cross-walls  $\pm$  thickened

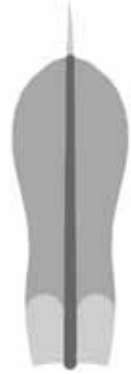
**costa:** reddish, excurrent in a  $\pm$  smooth yellowish or hyaline awn

**border:** weak, 0–4 rows of  $\pm$  translucent, incrassate, and less papillose cells

**margin:** entire, plane to recurved in midleaf

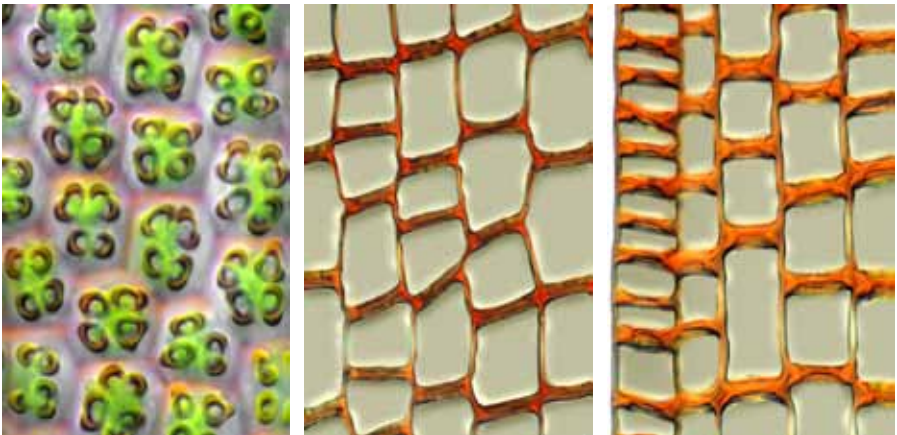
**cells:** 10–14  $\mu$ m, quadrate-hexagonal, firm-walled, 3–6-papillose

**capsule:** 2.0–2.5 mm, cylindric, erect, exserted, brown, red-mouthed; seta 5–9 mm; calyptra narrowly conic, cucullate; peristome tubular and pale in lower half



fertile shoot (dry) (2), capsule, peristome, leaf outline, leaf apex, and margin midleaf

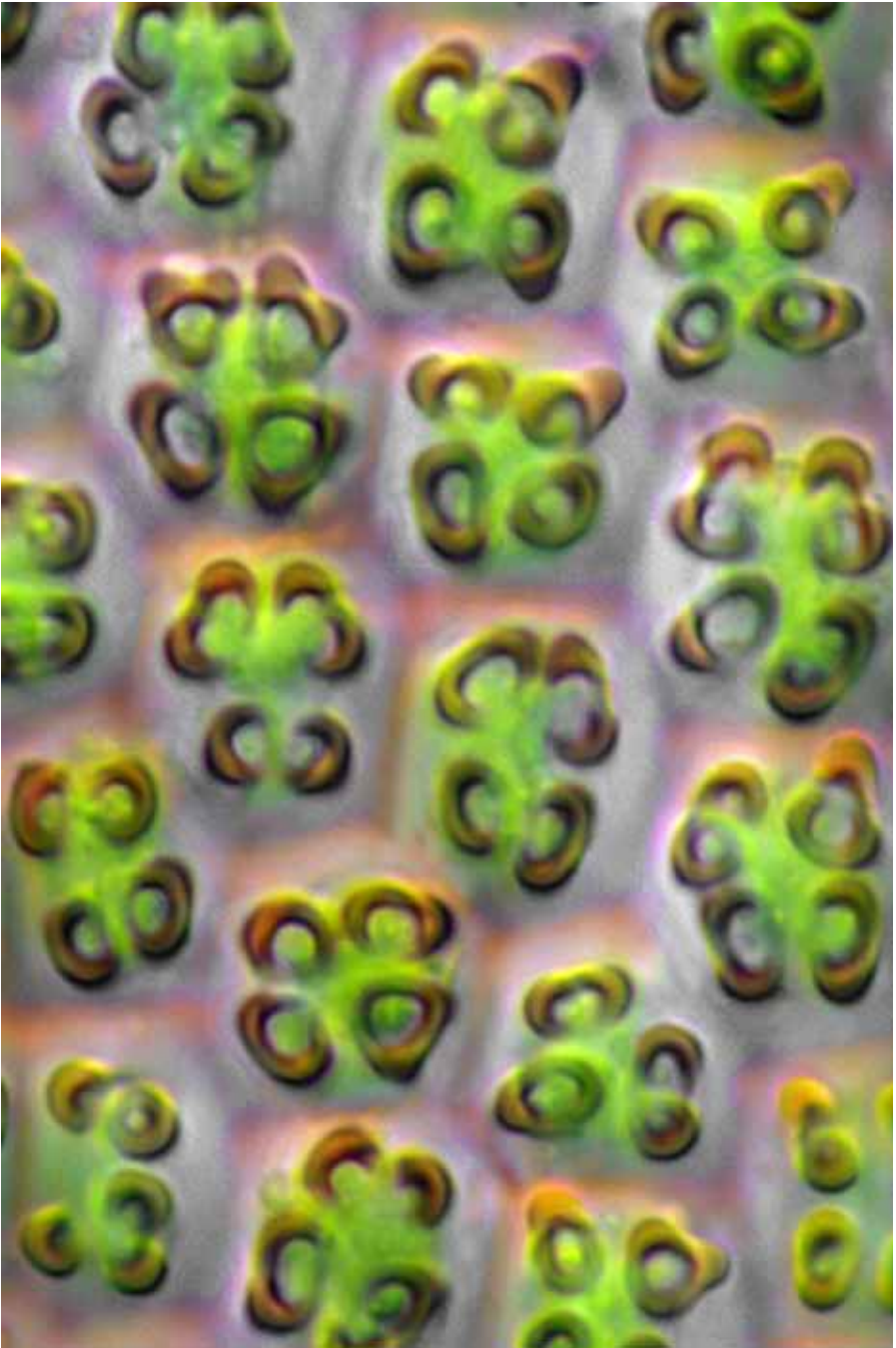
1 mm, 1 mm, 1 mm, 0.5 mm, 0.1 mm, 50  $\mu$ m, 10  $\mu$ m



surface papillae midleaf, lower leaf cells, and margin near leaf base

10  $\mu$ m, 10  $\mu$ m, 10  $\mu$ m

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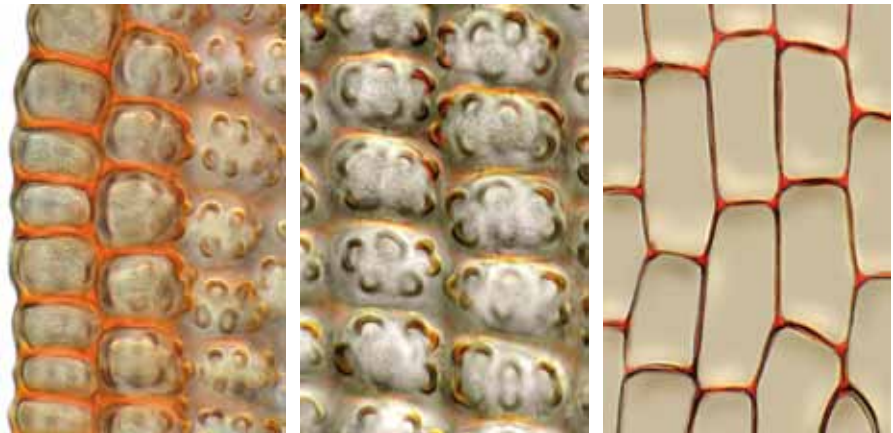


*Syntrichia laevipila* leaf surface papillae  
10  $\mu\text{m}$

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**Syntrichia pagorum** (Milde) Amann**form:** loosely matted, erect, unbranched, radiculose stems, 5–10 mm tall**habitat:** bark of shrubs and trees, especially hardwoods, lowland**leaf:** size: 2.0–2.5 mm (not including the awn)*shape:* oblong, lingulate, or panduriform, concave above*tip:* rounded or rarely retuse*base:* basal cells rectangular, thin-walled, hyaline, smooth*costa:* excurrent in a smooth, hyaline awn*border:* not differentiated*margin:* entire, usually plane but rarely recurved below*cells:* 12  $\mu\text{m}$ , subquadrate, firm-walled, several C-shaped papillae**capsule:** 2–2.5 mm, cylindrical, erect, brown; seta 5–9 mm; calyptra cucullate; operculum narrowly conic; peristome 32 filaments on a pale tessellated tube**note:** produces abundant leaf-like, ecostate, multicellular, densely papillose, axillary gemmae measuring 200–250  $\times$  80–100  $\mu\text{m}$ 

vegetative shoot (dry), leaf outline, awn (3), and gemma

 0.5 mm, 0.1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 20  $\mu\text{m}$ 


recurved margin midleaf, C-shaped leaf papillae, and basal leaf cells

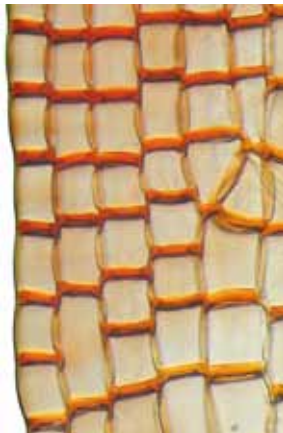
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 

continued next page



**Sytrichia papillosa** (Wilson *in* Spruce) Juratzka**form:** patchy or tufted, erect, unbranched stems, 2–10 mm tall**habitat:** bark of tree trunks, mostly hardwoods**leaf:** size: 1.5–3.0 (excluding the arista)**shape:** broadly obovate-spathulate, often constricted below the middle; nearly carinate when dry**tip:** rounded to acute**base:** basal cells rectangular, thin-walled, smooth**costa:** excurrent in a smooth, hyaline awn, gemmiferous adaxially**border:** not differentiated**margin:** entire, inflexed above**cells:** 16–24  $\mu\text{m}$ , quadrate-hexagonal, thick-walled, papillose**capsule:** 2–2.5 mm, cylindric, straight, erect; seta 5 mm; calyptra cucullate; operculum narrowly conic; peristome of 32 spiculose, pale orange or pink filaments from a whitish tessellated tube; spores 8–10  $\mu\text{m}$ , green-brown,  $\pm$  papillose

vegetative habit (moist), leaf outline, leaf apex, and margin midleaf



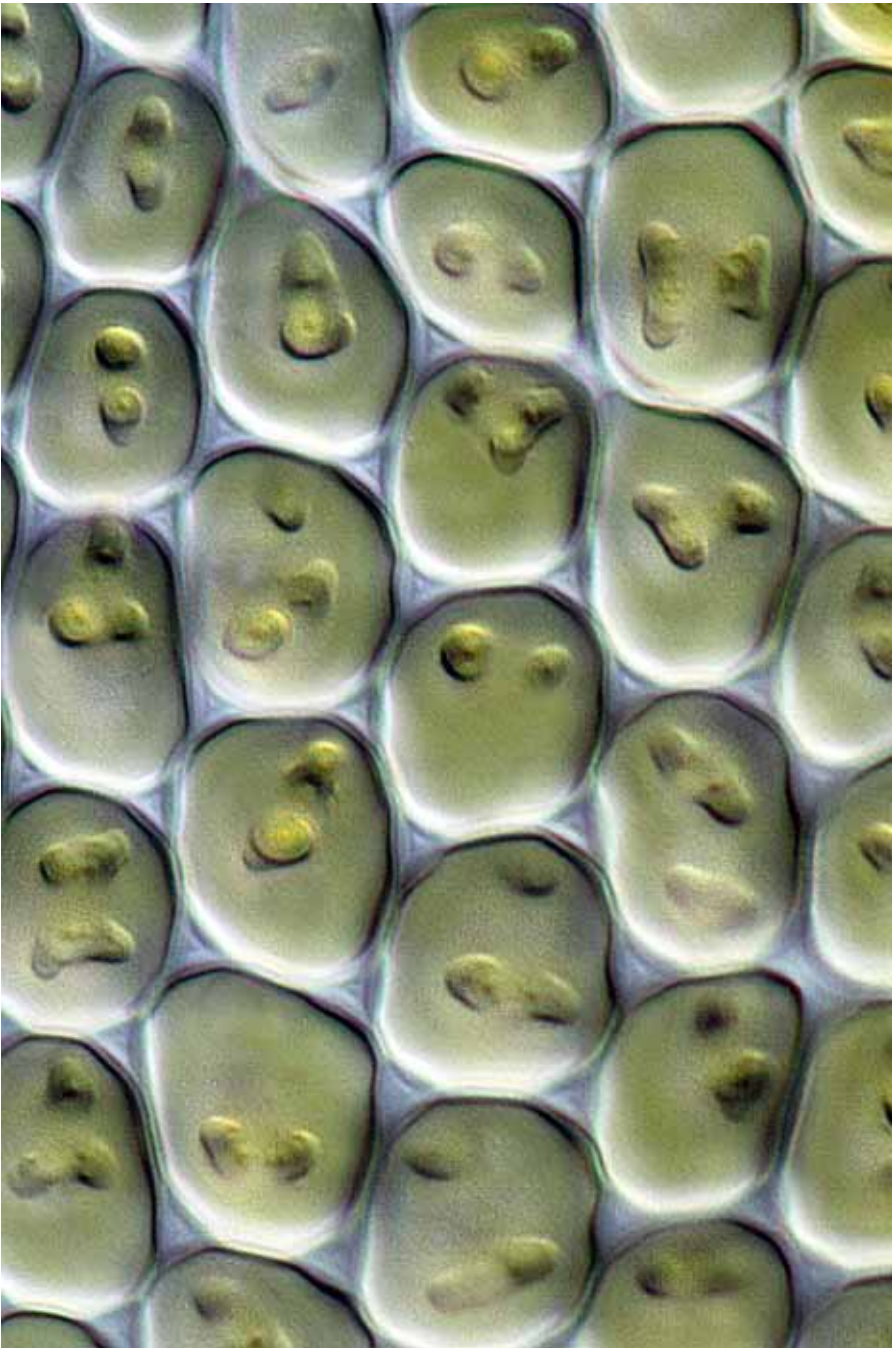
cells midleaf, margin near leaf base, and gemma whole-mount

continued next page



*Syntrichia papillosa* leaf subapex  
10  $\mu\text{m}$

continued next page



*Syntrichia papillosa* cells midleaf, showing papillae  
10  $\mu$ m

continued next page

**Sytrichia phaea** (Hook.f. & Wilson) R.H.Zander

**form:** densely tufted, branched, erect stems, dark brown above, 5–10 mm tall  
**habitat:** calcareous rock in semi-arid sites

**leaf:** size: 2–2.3 mm

*shape:* variable, oblong- or lingulate-lanceolate to ± spatulate

*tip:* acute to obtuse, ± concave, marginal walls of apical cells silvery-hyaline

*base:* basal cells rectangular, pellucid, 1–2 rows along the margin shorter

*costa:* projecting abaxially, failing in the apex to excurrent

*border:* not differentiated

*margin:* entire, plane above, recurved or reflexed below

*cells:* 9–13 μm, subquadrate, firm-walled, densely papillose

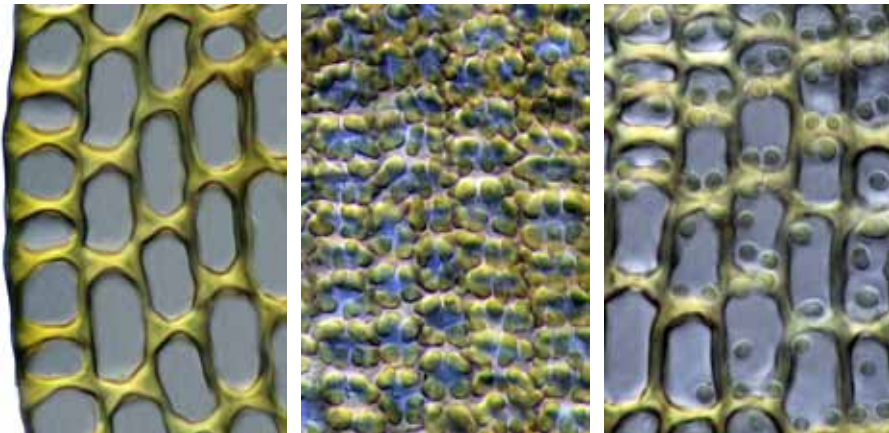
**capsule:** 1.5–2 mm, cylindrical, erect, exserted, brown; operculum conic-rostrate, as long as the urn; seta 5–8 mm, stout, reddish; peristome teeth dark red, filiform, twisted; basal tube about 1/5 the length of the teeth; spores 12 μm in diam.

**note:** endemic



fertile shoot (dry) (2), capsule (dry), leaf outline, leaf apex, and shoulder

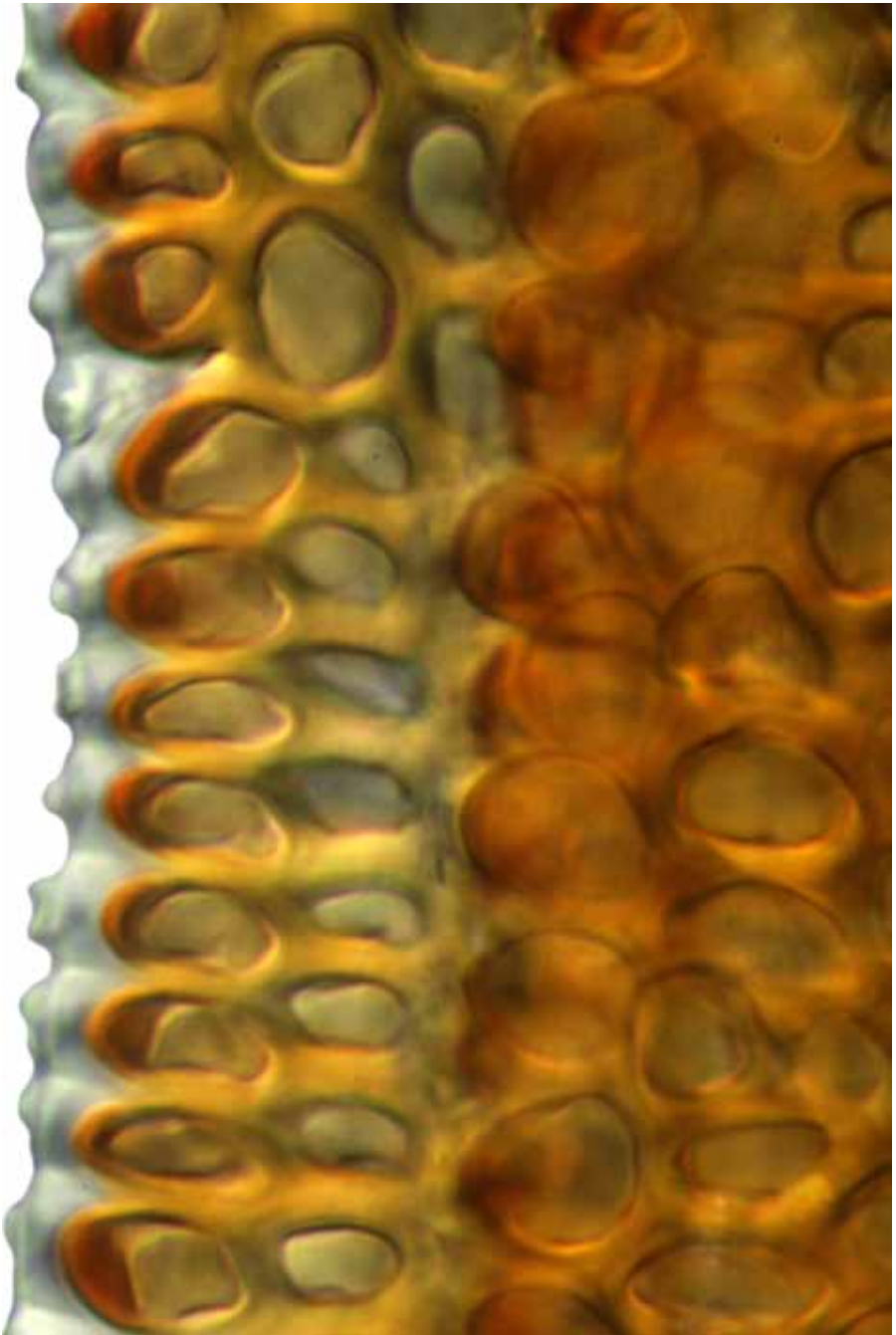
1 mm, 0.5 mm, 0.5 mm, 0.1 mm, 10 μm, 50 μm



margin below shoulder, cells midleaf, and cells just above shoulder

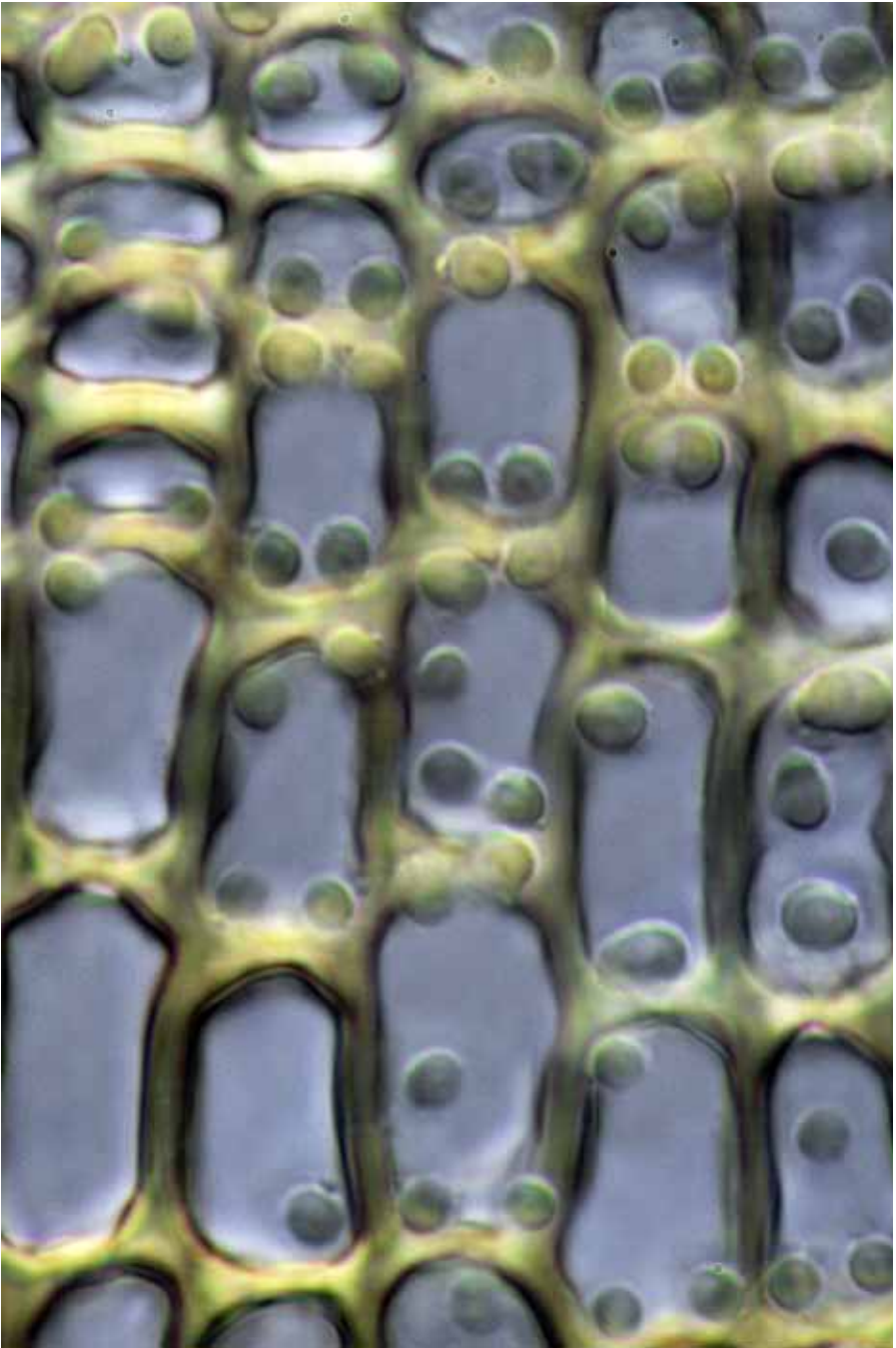
10 μm, 10 μm, 10 μm

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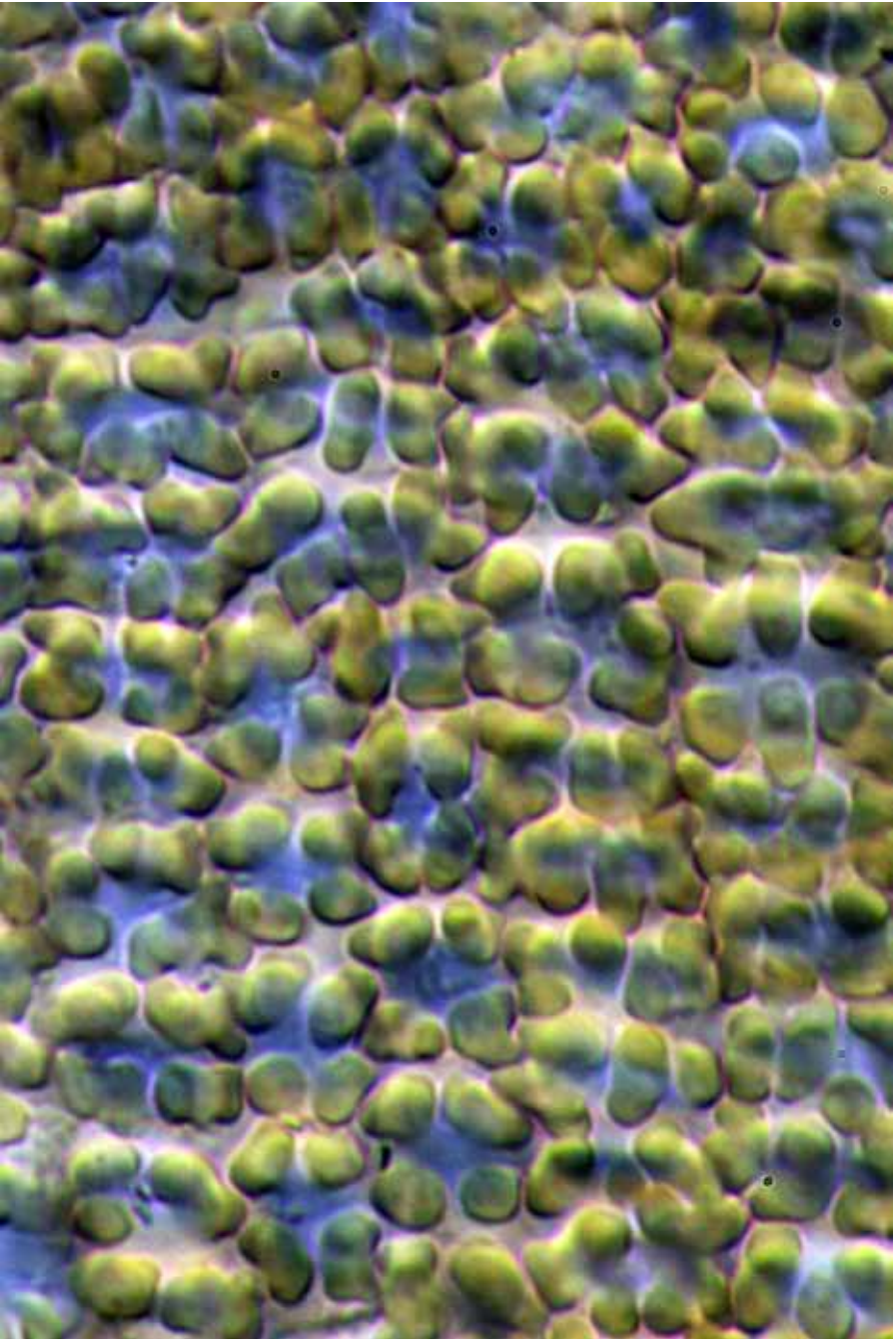
*Syntrichia phaea* margin near apex  
10  $\mu\text{m}$

continued next page



*Syntrichia phaea* cells of upper shoulder  
10  $\mu\text{m}$

continued next page



*Syntrichia phaea* leaf papillae  
10  $\mu\text{m}$

continued next page

**Sytrichia rubra** (Mitt.) R.H.Zander var. **rubra**

**form:** erect, branched, reddish stems, in loose cushions, to 50 mm tall  
**habitat:** shaded alpine rock

**leaf:** size: to 6 mm

*shape:* oblong-lanceolate to broadly lingulate

*tip:* acute

*base:* suprabasal cells biserially papillose; basal cells rectangular, thin-walled, smooth

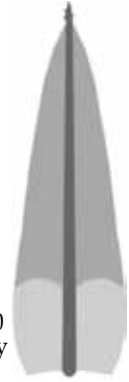
*costa:* reddish, prominent abaxially, excurrent in a stout, red, toothed point

*border:* not differentiated

*margin:* irregularly spinose-serrate close to the apex, plane

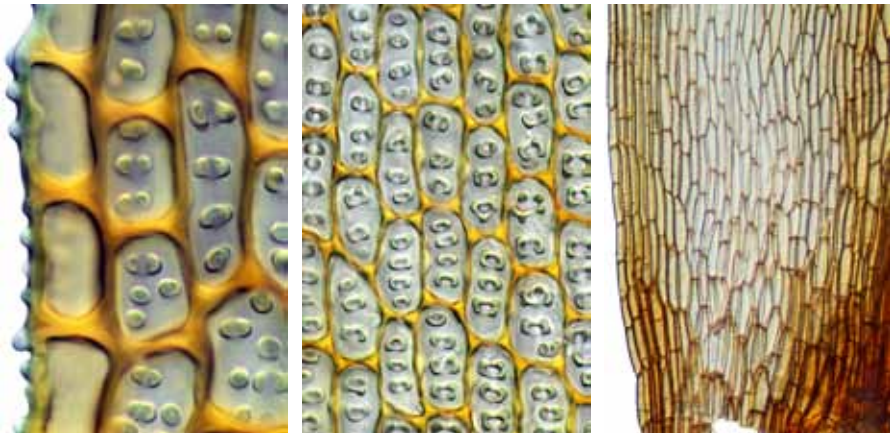
*cells:* 12–20  $\mu\text{m}$ , subquadrate to oblong-hexagonal, firm-walled, sparsely papillose

**capsule:** 3–4 mm, cylindric,  $\pm$  curved, erect, exserted, light brown; seta 15–20 mm, glossy, red; peristome filaments  $\pm$  pinkish from a whitish tube, readily breaking off



vegetative shoot (dry) (2), capsule (dry), leaf outline, and leaf apex (2)

1 mm, 1 mm, 1 mm, 1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$

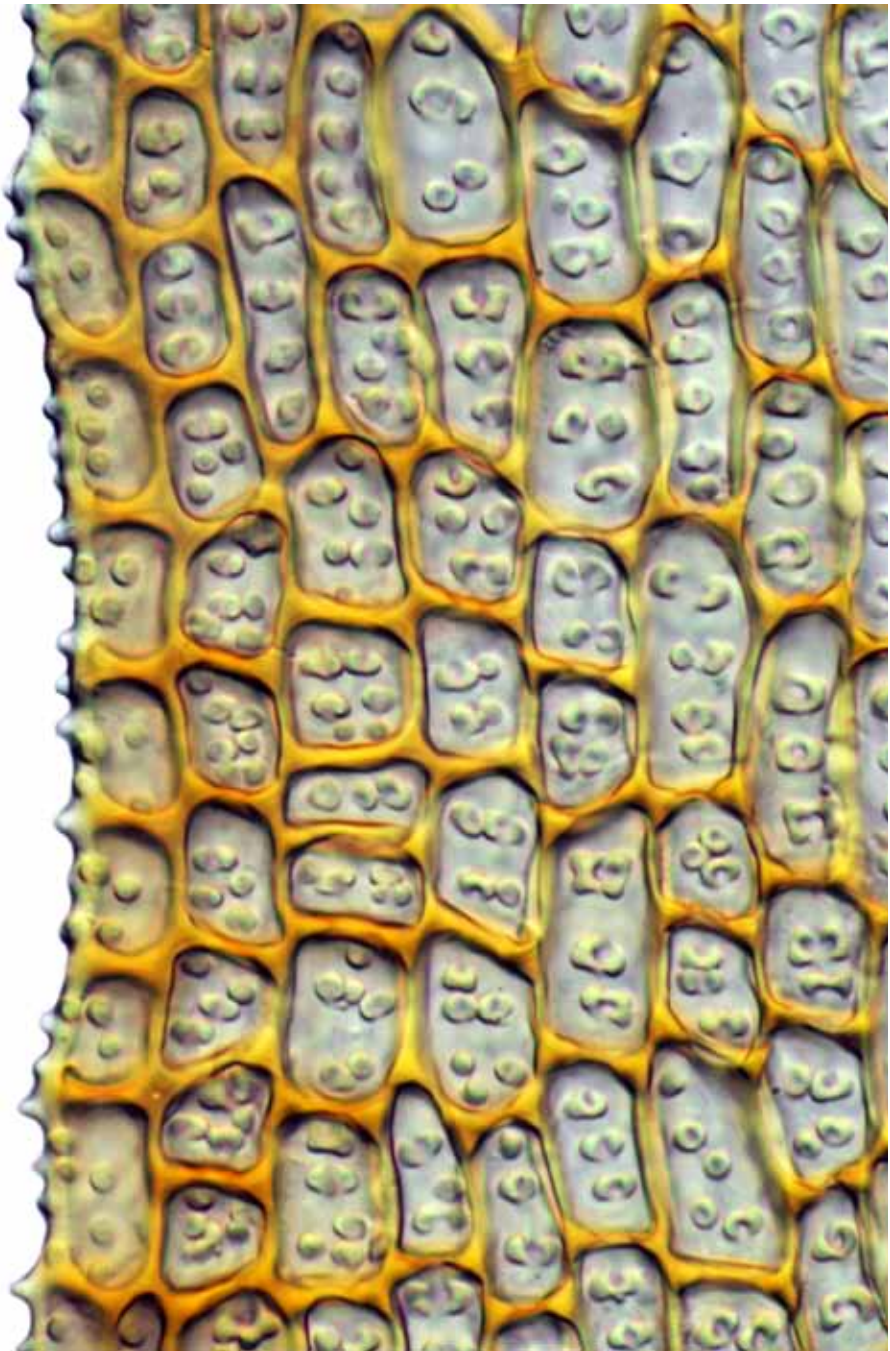


margin below midleaf, cells below midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page





*Syntrichia rubra* var. *rubra* margin below midleaf  
10  $\mu$ m

continued next page

***Syntrichia rubra* var. *subantarctica* Sainsb.**

**form:** densely tufted, sparsely branched, erect stems, dull brown to greenish brown above, to 50 mm tall

**habitat:** soil

**leaf:** size: 1–6 mm

**shape:** ± lanceolate, patent when moist, contorted when dry

**tip:** acute

**base:** basal cells rectangular, pellucid, 1–3 rows along the margin narrower

**costa:** simple, excurrent in a stout point, papillose at the back

**border:** not differentiated

**margin:** irregularly spinose-serrate near apex, plane

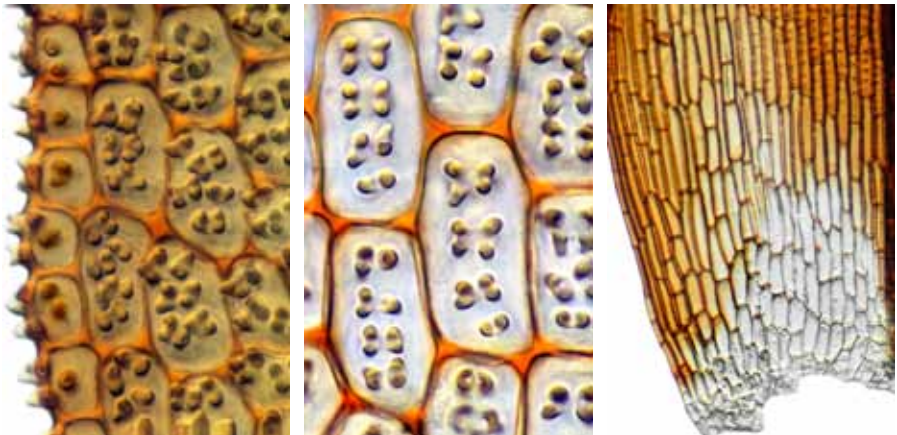
**cells:** 16–20 × 20–32 μm, subquadrate to oblong-hexagonal, thin-walled, biserially C-shaped papillose

**capsule:** not known

**note:** formerly *Tortula subantarctica*.

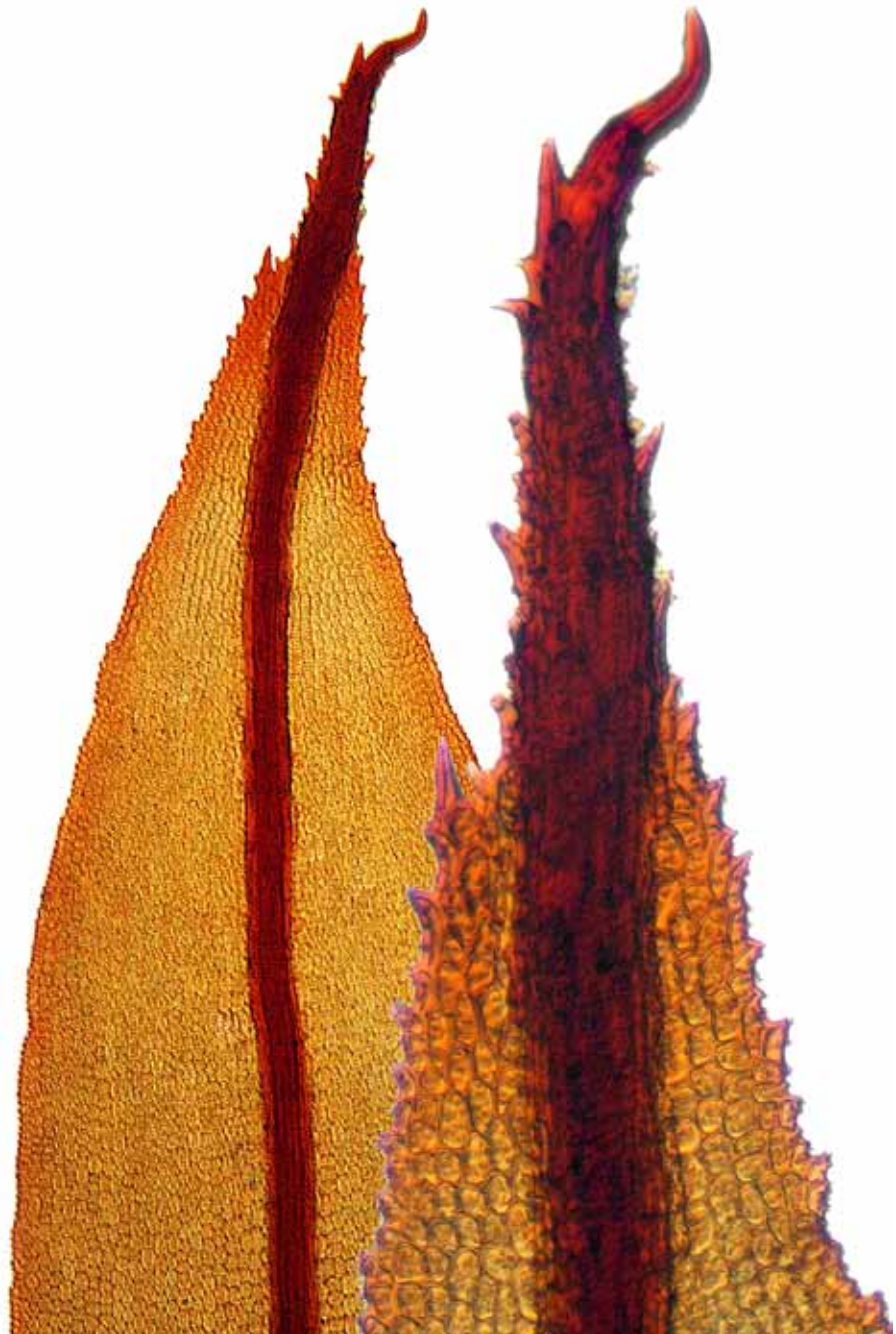


vegetative shoot (two on left dry, one on right moist), leaf outline, margin subapex  
 ─── 1 mm, ─── 1 mm, ─── 1 mm, ─── 1 mm, ─── 50 μm



margin midleaf, cells in lower leaf, and leaf basal angle  
 ─── 10 μm, ─── 10 μm, ─── 50 μm

continued next page



*Syntrichia rubra* var. *subantarctica* upper leaf, showing excurrent costa  
0.1 mm, 0.1 mm

continued next page



*Syntrichia rubra* var. *subantarctica* cells in lower leaf, showing papillae  
10  $\mu$ m

continued next page

*Syntrichia ruralis* (Hedw.) F.Weber & D.Mohr

**form:** tufted, hoary, dull, erect, sparsely branched stems, reddish above, radiculose to tomentose, 10–40(–70) mm tall

**habitat:** exposed soil or rock, usually calcareous, also sandy lakesides

**leaf:** size: 2–4 mm, not including the awn

*shape:* oblong, keeled

*tip:* obtuse, rounded, or emarginate, ending in a ± spinulose awn

*base:* basal cells ± rectangular, hyaline, thin-walled, smooth, abruptly forming a distinct V-shaped area

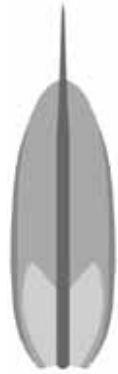
*costa:* excurrent in the awn

*border:* not differentiated

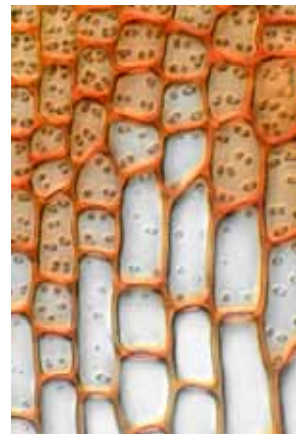
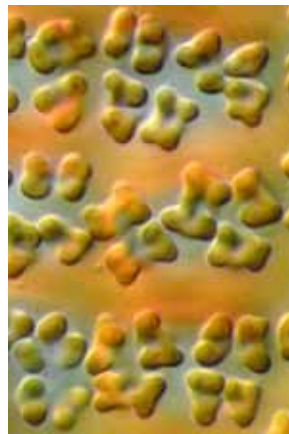
*margin:* entire, revolute in at least the lower two-thirds

*cells:* 9–15 μm, hexagonal, firm-walled, densely papillose (C-shaped)

**capsule:** 2.5–4 mm, cylindric, straight, erect, brown; seta 11–18 mm, red; operculum high-conic; peristome teeth 32, filamentous from a tall, pale, tessellated basal membrane; spores 7–13 μm in disam.



vegetative shoot (top view moist, side view dry), leaf outline, leaf apex, and subapex  
 1 mm, 1 mm, 0.5 mm, 10 μm, 10 μm



margin midleaf, leaf papillae, and leaf base cells  
 50 μm, 10 μm, 10 μm

continued next page

**Syntrichia serrata** (Dixon) R.H.Zander

**form:** tufted, erect, ± branched, green to reddish brown stems, 15–40 mm tall  
**habitat:** rock or silty soil, lowland to alpine

**leaf:** size: 3.5–5 mm, twisted and apically curved when dry

*shape:* lanceolate from an ovate base, concave above

*tip:* acute to acuminate

*base:* basal cells rectangular to linear, thin-walled, smooth

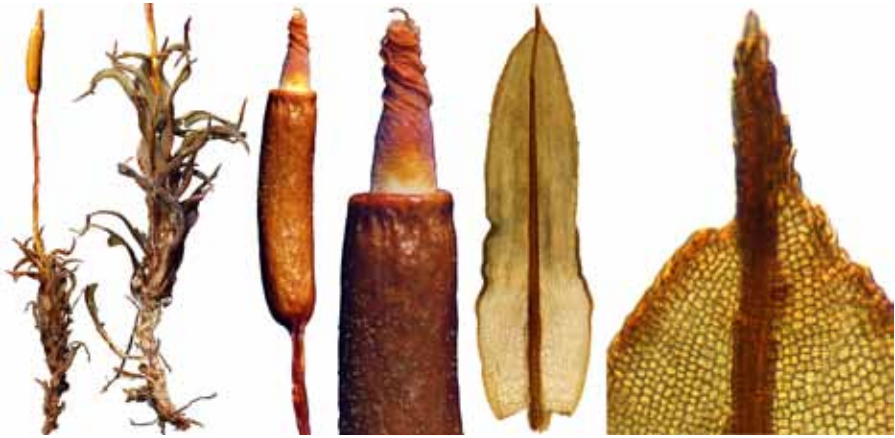
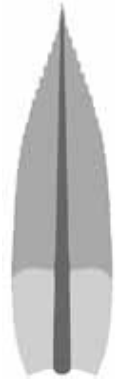
*costa:* strong, red, excurrent in an acute point

*border:* not differentiated

*margin:* irregularly dentate in upper third, ± recurved in lower half

*cells:* 6–10  $\mu\text{m}$ , isodiametric to subquadrate, firm-walled, pluripapillose

**capsule:** 2.5–3 mm, cylindrical, erect, exserted, brown; operculum conic-subulate, over half the length of the capsule; seta 10–15 mm, reddish; calyptra cucullate; peristome filaments spiculose, red, spirally twisted, the tube pale at its very base; spores 10–12  $\mu\text{m}$  in diam.



vegetative shoot (dry) (2), capsule (dry), peristome, leaf outline, and leaf apex

■ 5 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 50  $\mu\text{m}$



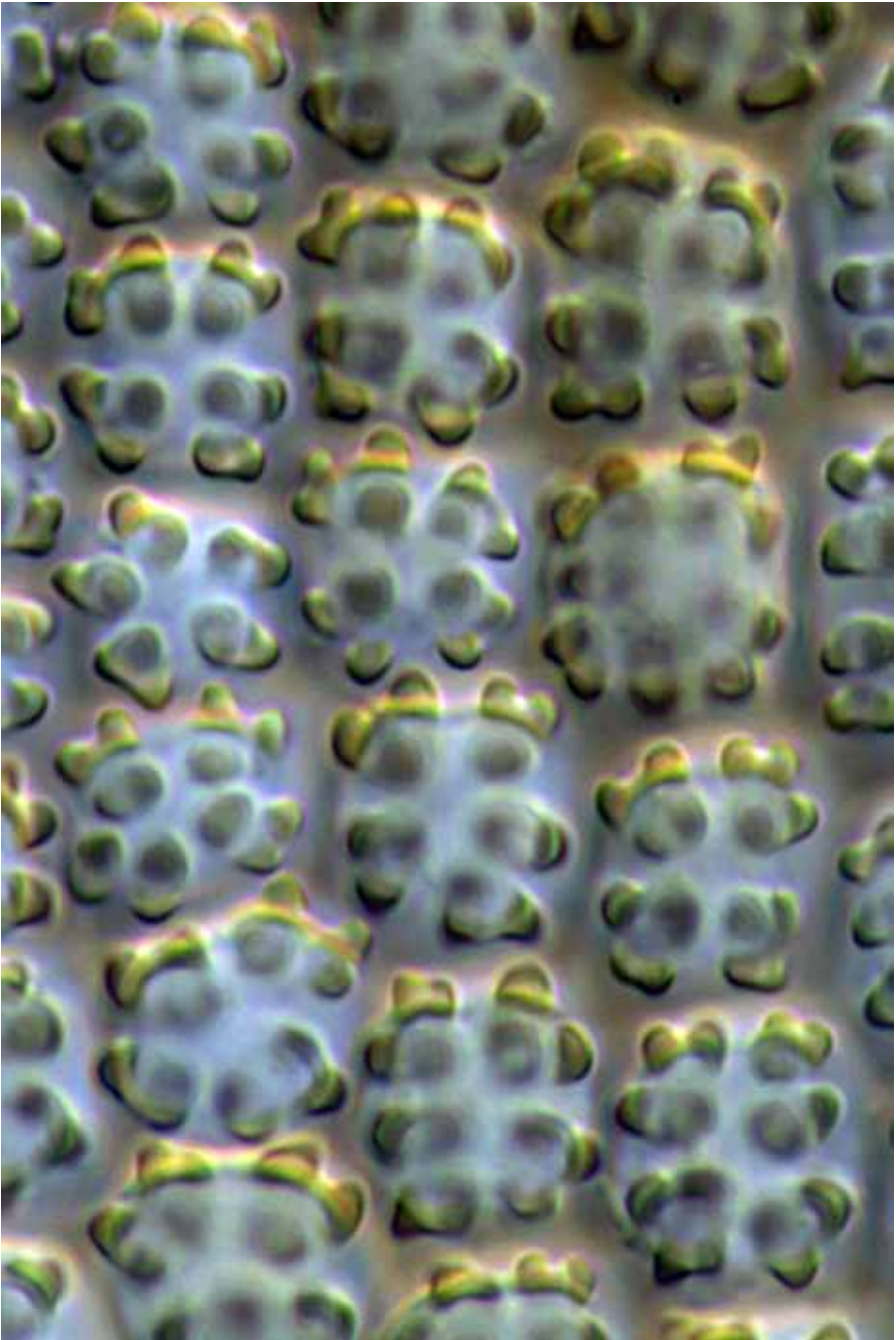
margin upper leaf, lower leaf cells, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 100  $\mu\text{m}$



*Syntrichia serrata* margin upper leaf  
10  $\mu\text{m}$

continued next page



*Syntrichia serrata* papillae midleaf  
10  $\mu\text{m}$



**Tetracoscinodon irroratus** (Mitt.) R.H.Zander

**form:** densely tufted, erect, sparsely branched stems, often lime-encrusted, 10–30 mm tall

**habitat:** dripping limestone rock faces, lowland

**leaf:** size: 2–2.5 mm

*shape:* lanceolate-subulate from a widened base

*tip:* rounded or obtuse

*base:* basal cells rectangular or hexagonal, thin-walled

*costa:* stout, orange, filling most of the subula, vanishing below the apex

*border:* not differentiated

*margin:* crenulate-papillose, plane

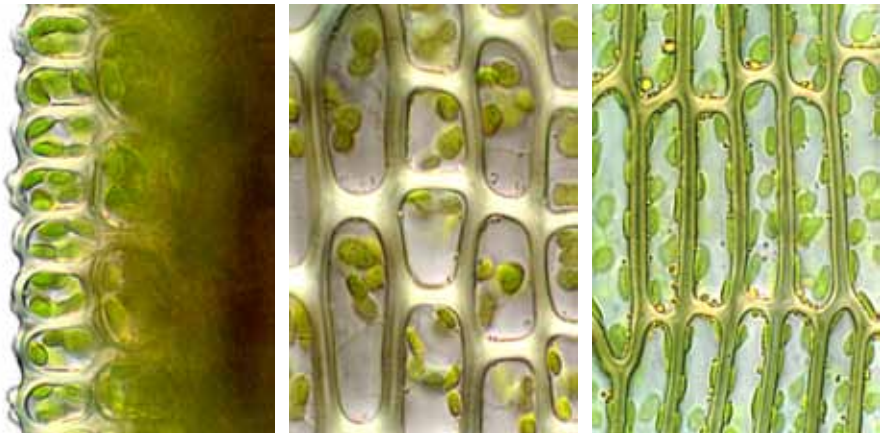
*cells:* 10  $\mu\text{m}$ , subquadrate, incassate, papillose

**capsule:** 1–1.4 mm, oblong, erect, glossy, reddish brown to near-black; seta 10–15 mm, stout, red; operculum obliquely long-rostrate, up to the length of the capsule; peristome teeth short,  $\pm$  yellow, irregularly perforate, split, and re-joined



vegetative shoots (dry) (2), capsule (young and mature), leaf outline and leaf apex

1 mm, 0.5 mm, 0.5 mm, 0.5 mm, 0.5 mm, 10  $\mu\text{m}$



margin of subula, cells in subula, and cells below subula

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

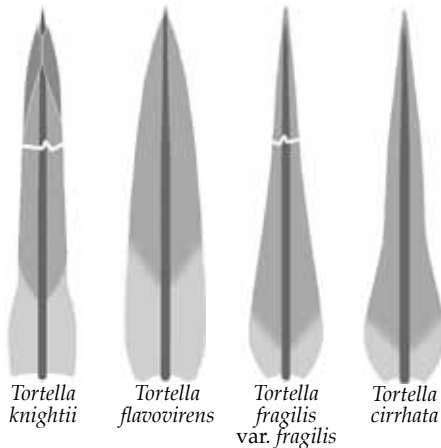
**Key\* to the New Zealand species and varieties of *Tortella* (4)**

- 1 Peristome teeth spirally twisted.....2  
 1: Peristome teeth straight or nearly so.....3

- 2(1) Leaves 4–5 mm long; operculum high-conic..... ● ***Tortella fragilis* var. *fragilis***  
 2: Leaves 2.8–3.5 mm long; operculum long-beaked..... ● ***Tortella knightii***

- 3(1:) Costa percurrent or short-excurrent..... ● ***Tortella flavovirens***  
 3: Costa excurrent in an acute rigid point..... ● ***Tortella cirrhata***

\* based on Smith, AJE; Smith, R (1978): *The Moss Flora of Britain and Ireland*. Cambridge University Press, Cambridge, 291, plus Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 161.



***Tortella cirrhata* Broth.**

**form:** densely tufted, erect, sparsely branched stems, 5–10 mm tall, radiculose

below, leaves crowded, dull, yellowish green, curled and glossy when dry

**habitat:** soil or rock, especially sparsely vegetated costal sand dunes, but also on fences, derelict houses, and stone bridges

**leaf:** size: 2–2.5 mm

*shape:* lanceolate or lanceolate-subulate

*tip:* acute, concave below

*base:* basal cells thin-walled, hyaline, widely rectangular, extending obliquely slightly higher up the margin

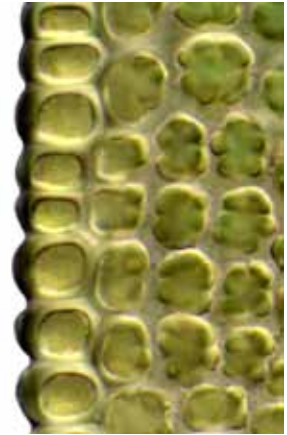
*costa:* weak below, stout above, excurrent in an acute, rigid point

*border:* not differentiated

*margin:* finely crenulate, incurved or convolute in the subula

*cells:* 8–10  $\mu\text{m}$ , rounded-subquadrate, incrassate,  $\pm$  papillose

**capsule:** 1.5–2 mm, narrowly cylindric, erect, exserted, pale brown, the mouth reddish; seta 15 mm, slender, reddish



vegetative habit, capsules (4), leaf outline, and margin midleaf

■ 1 mm, ■ 0.5 mm (4), ■ 0.1 mm, ■ 10  $\mu\text{m}$



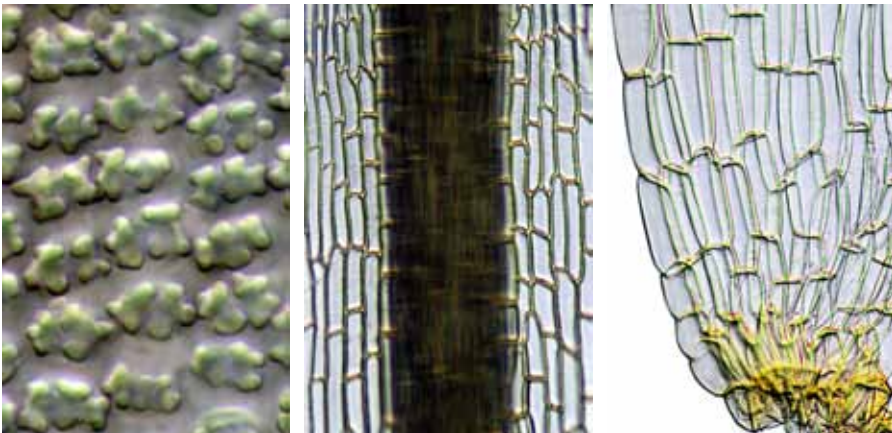
costa midleaf, leaf base cells, and leaf papillae

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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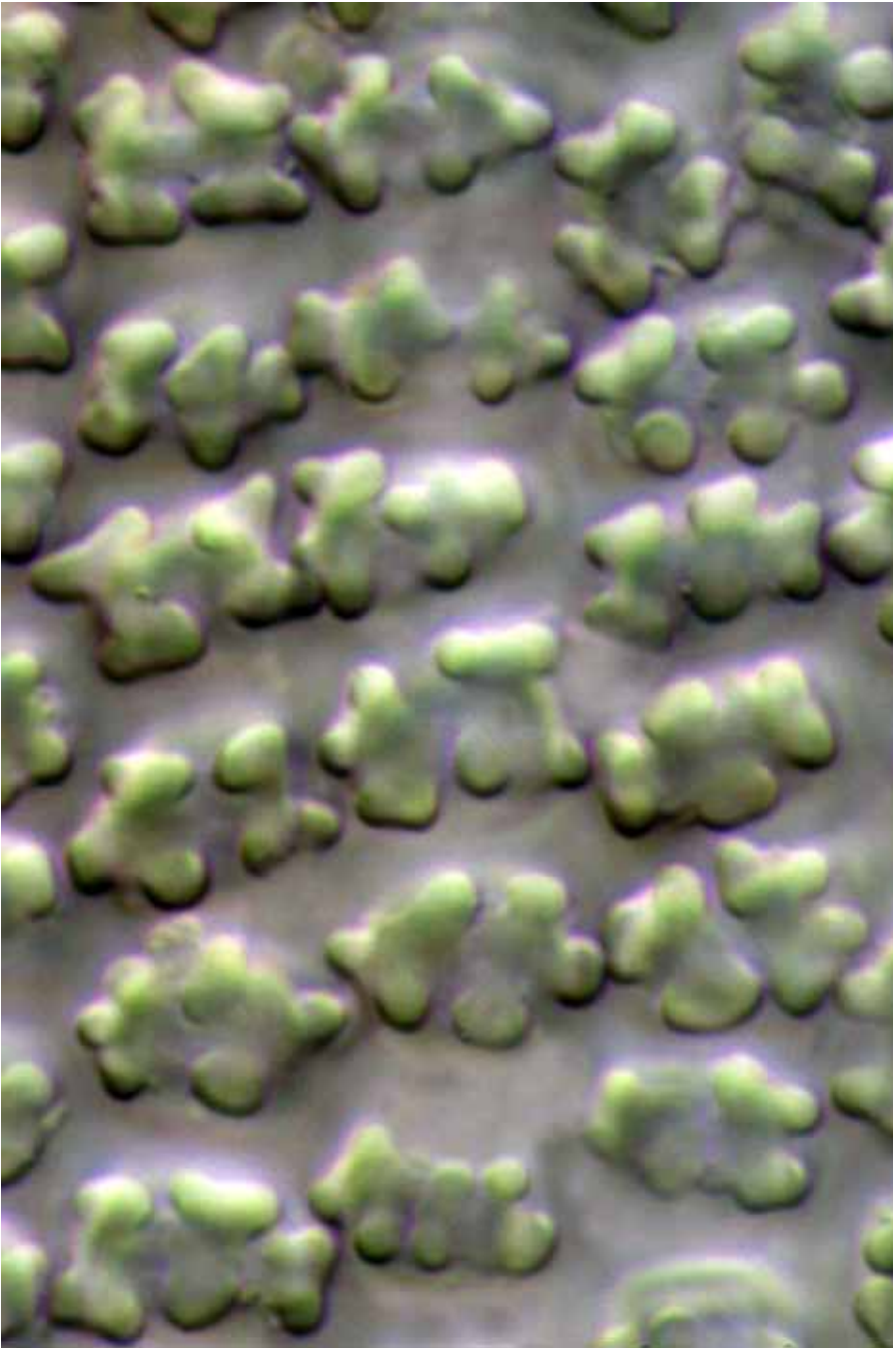
***Tortella flavovirens*** (Bruch) Broth.**form:** tufted, erect,  $\pm$  comose stems, yellowish above, brown below, 3–10 mm tall**habitat:** sandy soil in exposed,  $\pm$  disturbed coastal sites, scrub, or lawns, and mortar or damp concrete, lowland**leaf:** size: 2–3.5 mm*shape:* oblong-ovate to ovate-lanceolate, strongly keeled above*tip:* acute to subobtusate,  $\pm$  cucullate*base:* basal cells long-rectangular; marginal cells  $\pm$  extending up the blade*costa:* percurrent to shortly excurrent*border:* not differentiated*margin:* entire, incurved to involute above*cells:* 9–12  $\mu\text{m}$ , isodiametric, firm-walled, pluripapillose**capsule:** 1.8–2.2 mm, cylindric, erect, exserted, brown; seta 11–13 mm; annulus none; operculum subulate to long-conic; peristome teeth short,  $\pm$  twisted; spores 12–14  $\mu\text{m}$  in diam.**note:** salt-tolerant

fertile shoot (dry), capsule with peristome, leaf outline, leaf apex, and margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



leaf papillae, costa midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Tortella flavovirens* leaf papillae  
10  $\mu$ m

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**Tortella fragilis** (Hook.f. and Wilson) Limpr. var. **fragilis**

**form:** densely tufted, rigid, erect stems, yellowish or brownish, to 45 mm tall  
**habitat:** calcareous rock or soil, less often on rotting logs or peaty humus

**leaf:** size: 4–5 mm

*shape:* linear-lanceolate from a broader base

*tip:* subulate, fragile and often broken off

*base:* basal cells longer than the other lamina cells

*costa:* percurrent, filling the subula

*border:* marginal cells narrower and less papillose than the other lamina cells

*margin:* ± entire, plane

*cells:* upper cells 9–11  $\mu\text{m}$ , rounded-quadrate, thick-walled, low-papillose

**capsule:** 1.8–3 mm, cylindric, erect, exserted, yellow to reddish brown; seta 15–20 mm; operculum high-conic; annulus none or weak; peristome teeth long, spirally twisted 1–3 times; spores 8–11  $\mu\text{m}$  in diam.

**note:** recognized by its long fragile leaf tips, little contorted when dry



tuft split open, vegetative shoot (moist), leaf outline, and leaf apex (2)  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$



margin in lower leaf (2), and costa near leaf base  
 ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$



*Tortella fragilis* var. *fragilis* habit (moist)

1 mm

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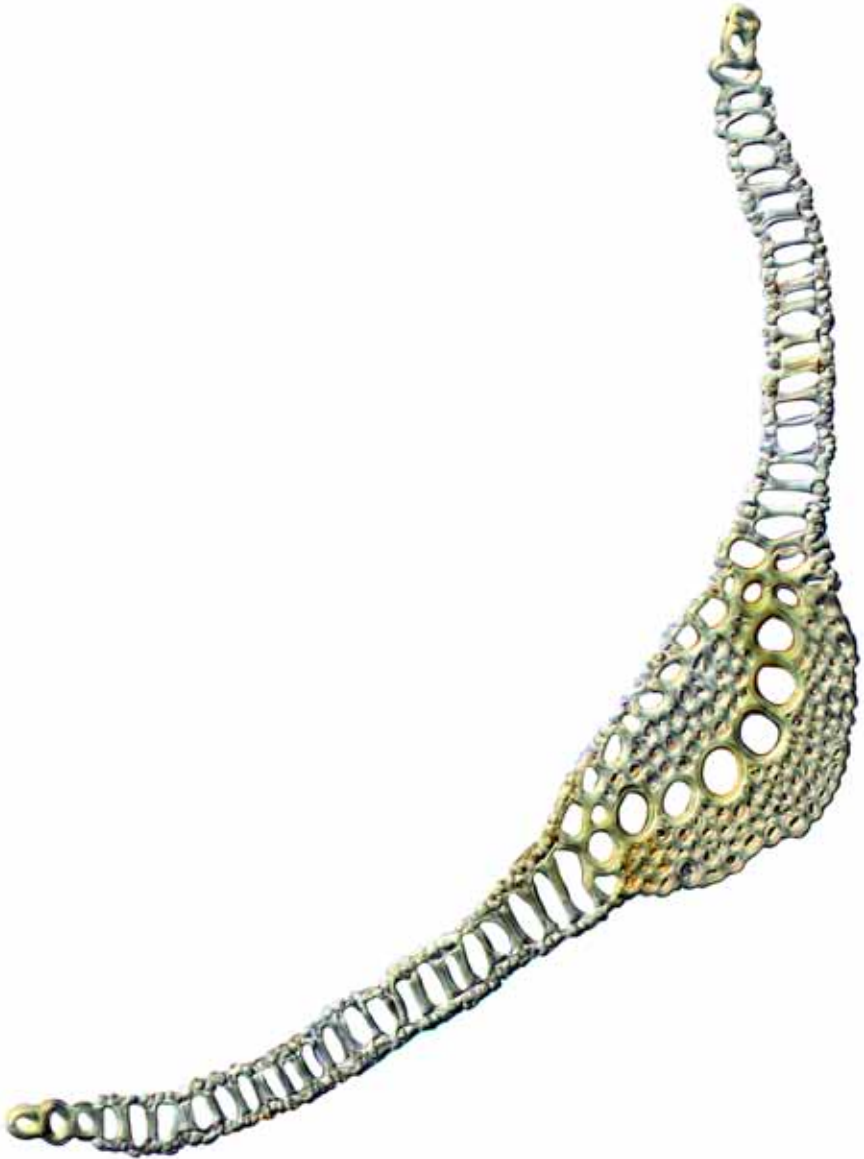


*Tortella fragilis* var. *fragilis* vegetative shoot (moist)

1 mm

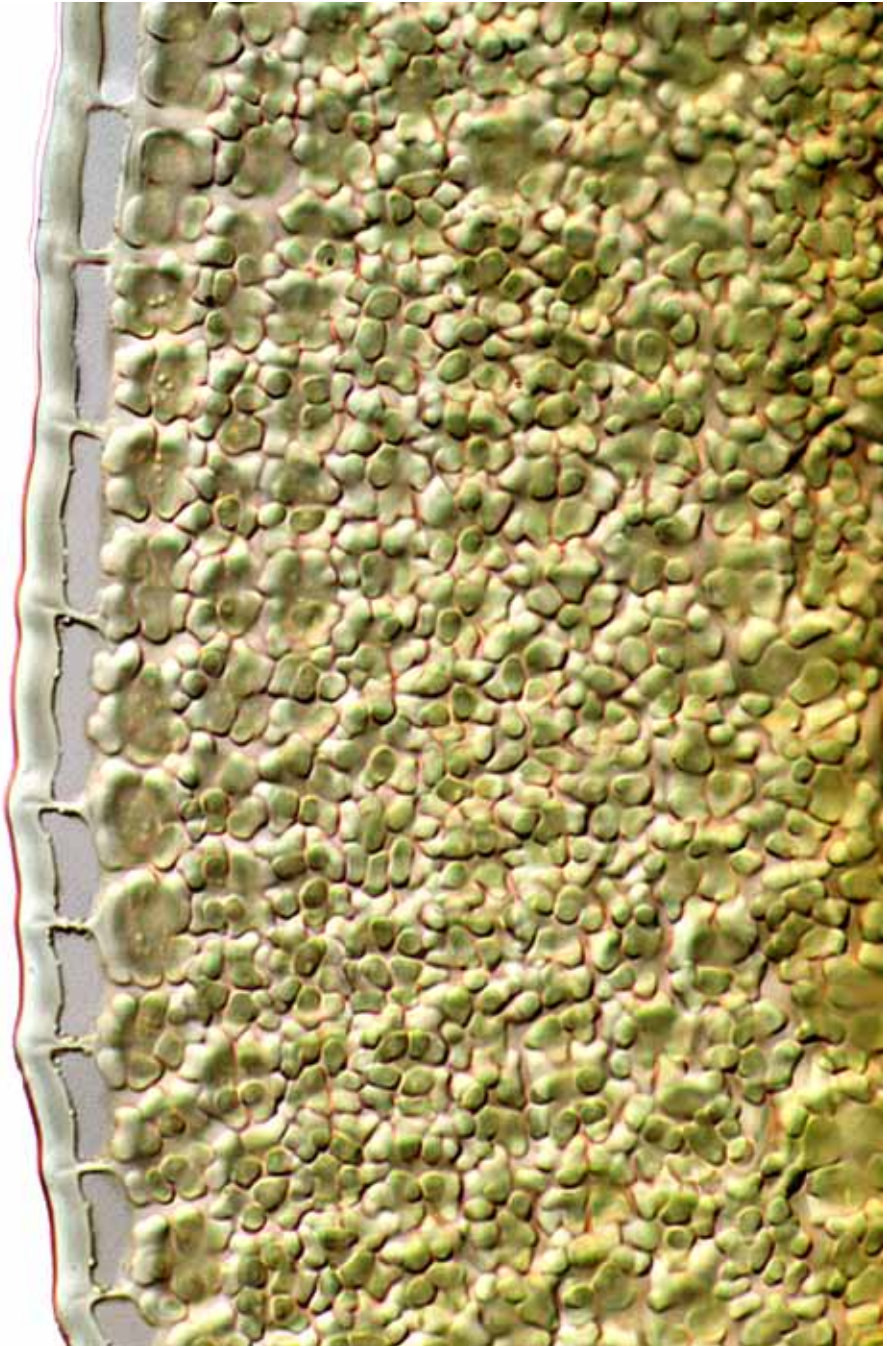
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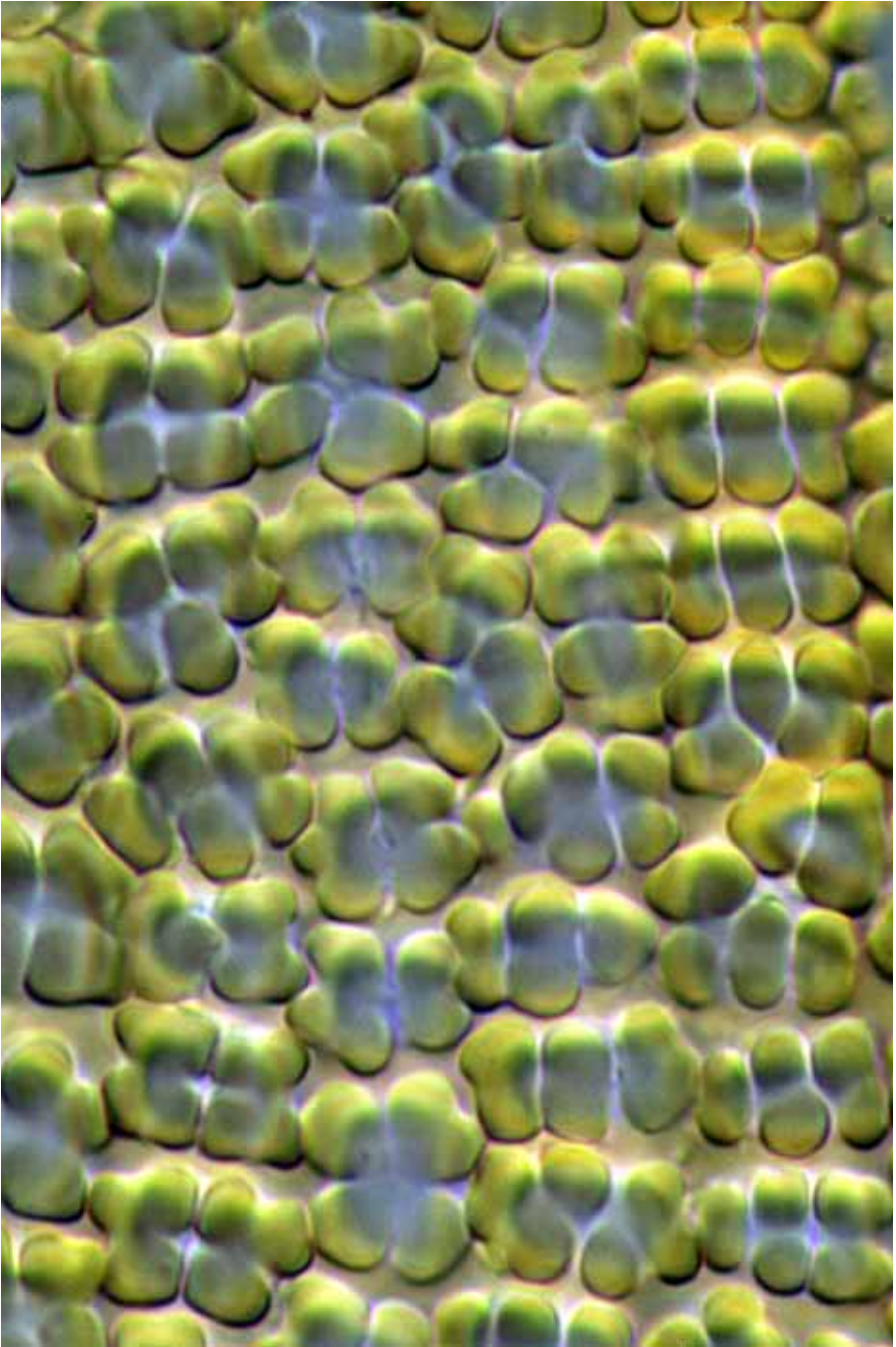
*Tortella fragilis* var. *fragilis* leaf cross-section showing glabrous margin  
50  $\mu$ m

continued next page



*Tortella fragilis* var. *fragilis* glabrous leaf margin  
10  $\mu$ m

continued next page



*Tortella fragilis* var. *fragilis* leaf surface papillae  
10  $\mu$ m

continued next page

***Tortella knightii*** (Mitt.) Broth.

**form:** densely tufted, erect, pale, simple or branched stems, 8–20 mm tall  
**habitat:** soil, the bark of rotting logs, or rock

**leaf:** size: 2.5–3.5 × 0.5–0.7 mm

*shape:* linear-lanceolate from an oblong transparent base, often fragile

*tip:* finely acuminate

*base:* basal cells rectangular, thin-walled, hyaline

*costa:* excurrent in a fine point

*border:* not differentiated

*margin:* irregularly denticulate above, narrowly revolute below, undulate

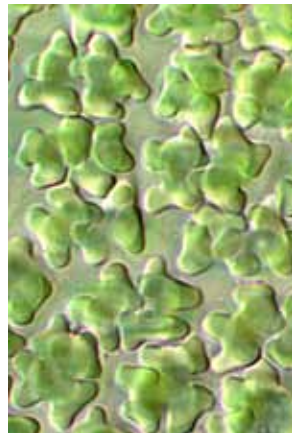
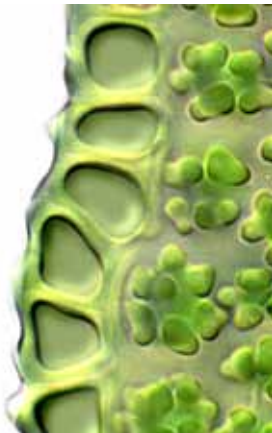
*cells:* 7–8  $\mu\text{m}$ ,  $\pm$  isodiametric, thick-walled, densely stellate-papillose

**capsule:** 2–2.5 mm, narrowly cylindrical to elliptic, erect,  $\pm$  curved, pale brown, red-mouthed; seta 10–18 mm, slender,  $\pm$  flexuose, yellowish above; operculum straight, long-rostrate, the cells in spiral rows; calyptra cucullate; peristome teeth 16, reddish, on a low basal membrane, cleft into two reddish papillose filaments, spirally twisted twice; spores 8–10  $\mu\text{m}$  in diam.



fertile shoot, peristome, leaf outline, and leaf apex and subapex

■ 1 mm, ■ 0.1 mm, ■ 0.5 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



margin midleaf, leaf surface papillae, and leaf base cells

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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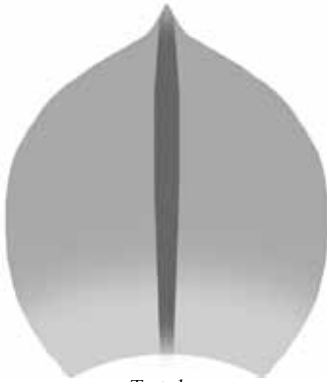


*Tortella knightii* habit  
1 mm

**Key\* to the New Zealand species of *Tortula* (11)**

- 1 Capsule cleistocarpous, splitting at about the middle ..... ● ***Tortula splashnoides***  
 1: Capsule stegocarpous..... 2
- 2(1): Peristome rudimentary or absent..... 3  
 2: Peristome well-developed ..... 6
- 3(2) Costa usually failing ..... ● ***Tortula areolata***  
 3: Costa usually at least shortly excurrent..... 4
- 4(3): Leaf  $\pm$  ovate ..... ● ***Tortula acaulon***  
 4: Leaf oblong to lanceolate ..... 5
- 5(4): Plant coastal, on sandy soil  $\pm$  inundated at high tide ..... ● ***Tortula maritima***  
 5: Plant not coastal, on calcareous soil ..... ● ***Tortula truncata***
- 6(2): Leaf constricted in the middle ..... ● ***Tortula muralis***  
 6: Leaf not constricted in the middle..... 7
- 7(6): Costa apex bearing gemma, or truncate from gemma loss ● ***Tortula abruptinervis***  
 7: Costa apex not gemmiferous..... 8
- 8(7): Leaf ovate; costa ending in a red point ..... ● ***Tortula atrovirens***  
 8: Leaf narrower; costa not ending in a red point ..... 9
- 9(8): Peristome teeth arising from a tall tessellated tube..... ● ***Tortula mucronifolia***  
 9: Peristome teeth arising from a low membrane..... 10
- 10(9:) Plants on calcareous soil; borderless; margin recurved midleaf . ***Tortula viridipila***  
 10: Plants on basic rock and walls; border of 2–4 rows of incrassate cells; margin plane .  
 ..... ● ***Tortula marginata***

\* based partly on Scott, GAM; Stone, IG; Rosser, C (1976): *The Mosses of Southern Australia*. Academic Press, London. 186.



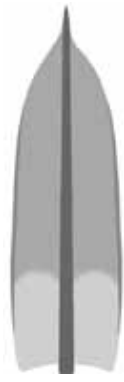
*Tortula  
splachnoides*



*Tortula  
maritima*



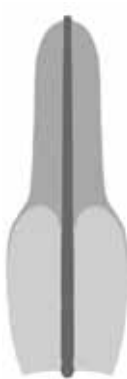
*Tortula  
atrovirens*



*Tortula  
acaulon*



*Tortula  
truncata*



*Tortula  
abruptinervis*



*Tortula  
areolata*



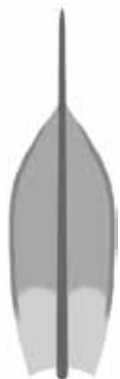
*Tortula  
mucronifolia*



*Tortula  
marginata*



*Tortula  
muralis*



*Tortula  
viridipila*

**Tortula abruptinervis** Dixon

**form:** densely matted, ± branched stems, dark green above, 2–7 mm tall  
**habitat:** bark (mostly willow and ngiao) or more rarely rotting logs

**leaf:** size: to 1 mm

**shape:** lingulate from an oblong base, ending with a fusiform, multi-celled, hyaline-tipped gemma up to 300 μm long, soon deciduous

**tip:** rounded-obtuse

**base:** basal cells rectangular to linear, thin-walled, smooth

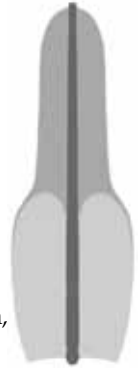
**costa:** excurrent, truncate-mucronate from the loss of the apical gemma

**border:** not differentiated

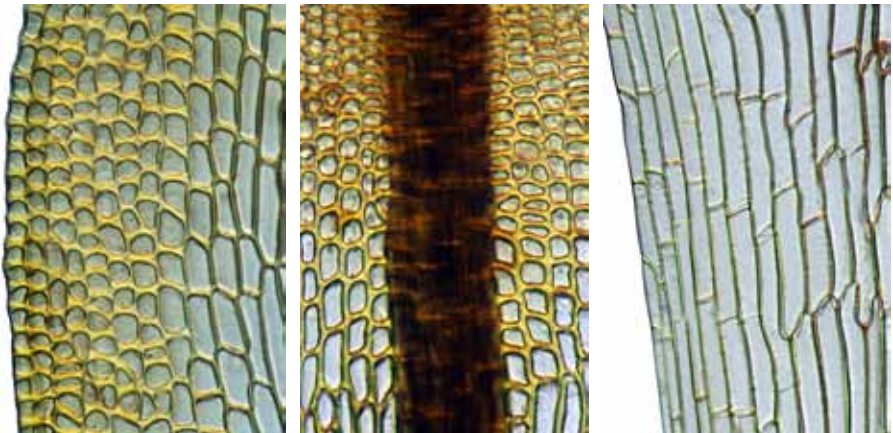
**margin:** entire, plane

**cells:** 9–14 μm, rounded-quadrate, firm-walled, pluripapillose

**capsule:** 1–1.3 mm, cylindrical to elliptic, erect, exserted, brown; seta 4–5 mm, reddish; annulus none; calyptra cucullate; operculum long-rostrate; peristome teeth ± conjoined, 300 μm tall, papillose, the basal tube low; spores 10–12 μm in diam.



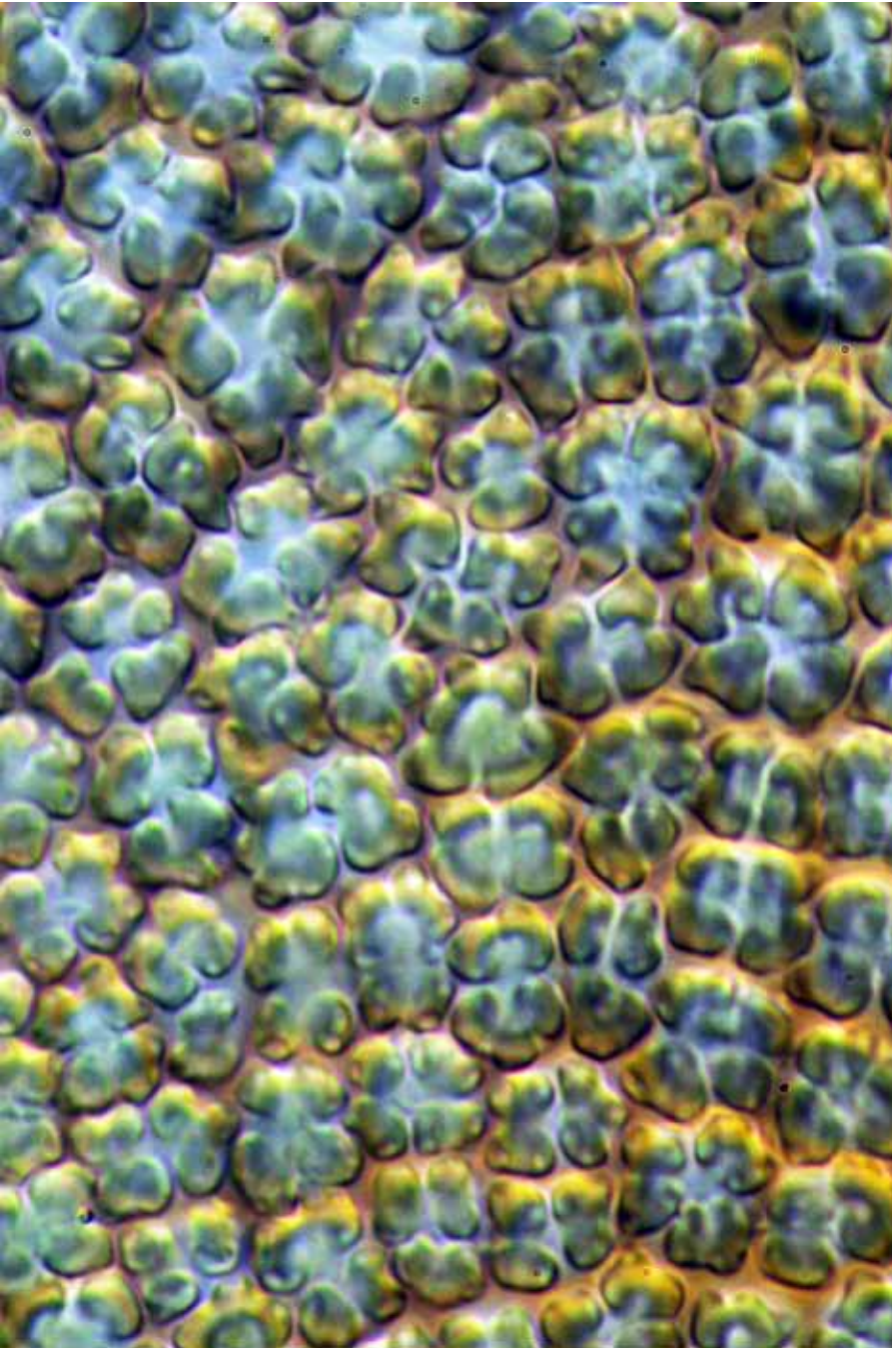
fertile shoots (dry, young), leaf outlines, gemma, and leaf apex after gemma abscission  
 1 mm (2), 0.1 mm, 0.1 mm, 50 μm, 100 μm



margin midleaf, costa midleaf, and margin near leaf base  
 10 μm, 10 μm, 50 μm

continued next page





*Tortula abruptinervis* leaf surface papillae  
10  $\mu\text{m}$

continued next page

**Tortula acaulon** (With.) R.H.Zander

**form:** gregarious to crowded, erect shoots, papery and glossy when dry  
**habitat:** soil in lawns, fields, and banks, low- to mid-elevations

**leaf:** size: 1.5–2 mm

*shape:* ovate to oblong-lanceolate

*tip:* acute to mucronate or short-awned

*base:* basal cells rectangular, thin-walled, smooth

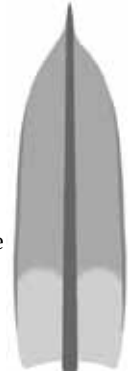
*costa:* excurrent, covered adaxially with 2–3 cells across the width

*border:* not differentiated

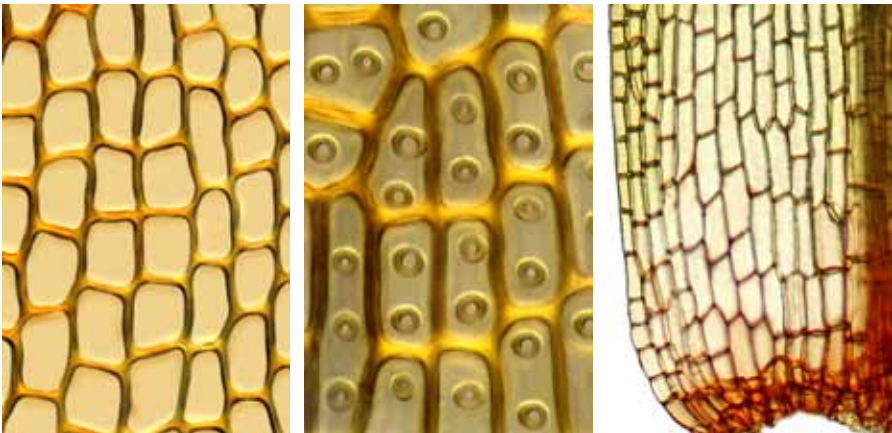
*margin:* entire, plane to recurved on both sides to near the apex

*cells:* 13–17  $\mu\text{m}$ , quadrate-hexagonal above, increasing in length toward base of blade, firm-walled, from smooth to 1–2-papillose

**capsule:** 0.9–1.3 mm, short-ellipsoid, cleistocarpous, erect, immersed, purplish brown; seta very short; operculum and peristome absent; spores 33–40  $\mu\text{m}$  in diam., globose, densely papillose

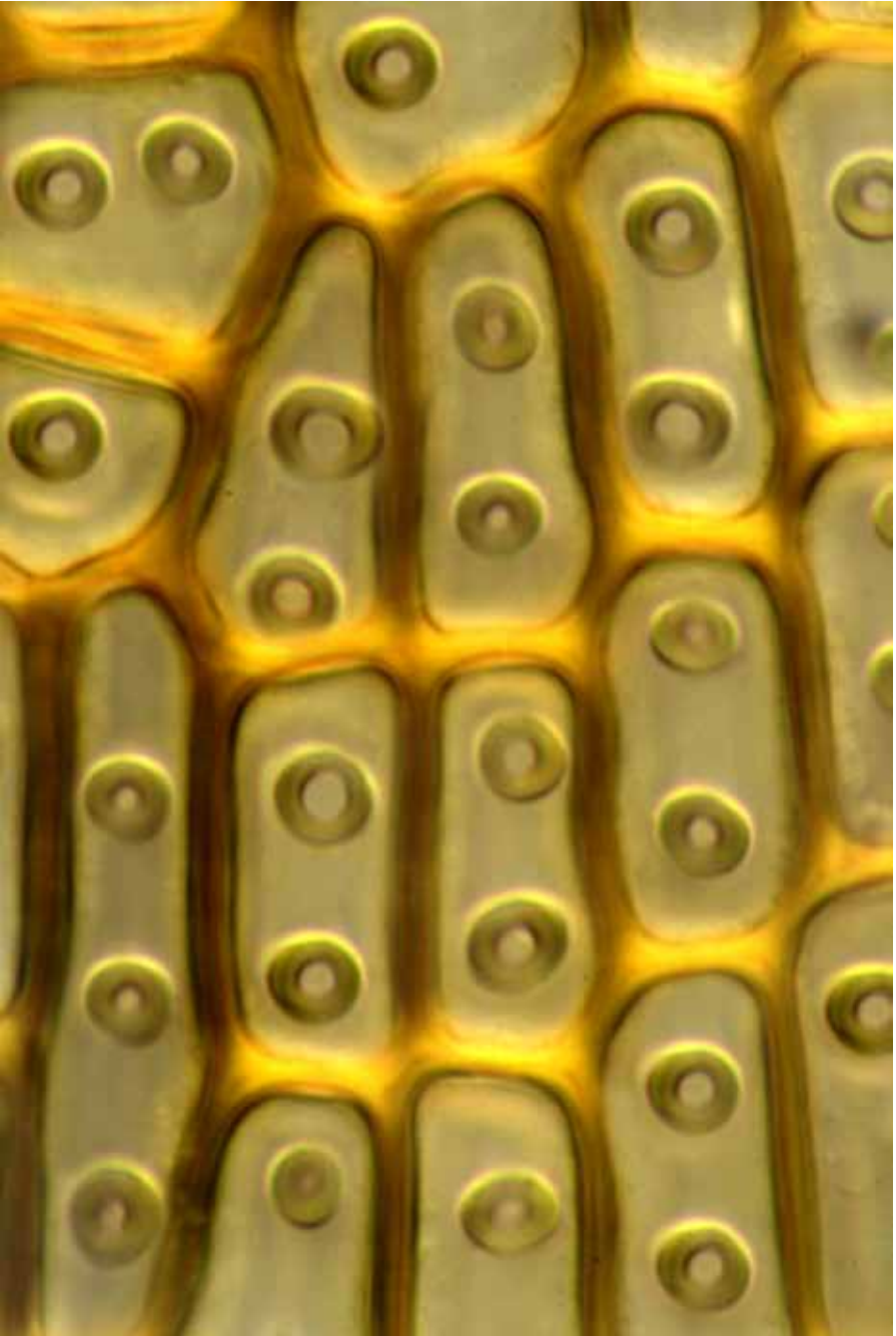


fertile habit (dry), leaf outline, leaf apex, and margin upper leaf  
 ■ 1 mm, ■ 0.1 mm, ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



cells upper leaf, papillae below midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

continued next page



*Tortula acaulon* papillose cells below midleaf  
10  $\mu$ m

continued next page

***Tortula areolata*** (C.Knight) Fife

**form:** gregarious, erect, unbranched stems, leaves imbricate, to 1.5 mm tall  
**habitat:** soil

**leaf:** size: 1–1.3 mm

*shape:* subspathulate to oblong, little altered when dry

*tip:* subacute, apiculate

*base:* basal cells enlarged, rectangular, hyaline, thin-walled

*costa:* subpercurrent, less often percurrent or slightly excurrent

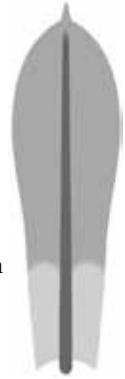
*border:* not differentiated

*margin:* entire, plane below, the apex slightly incurved

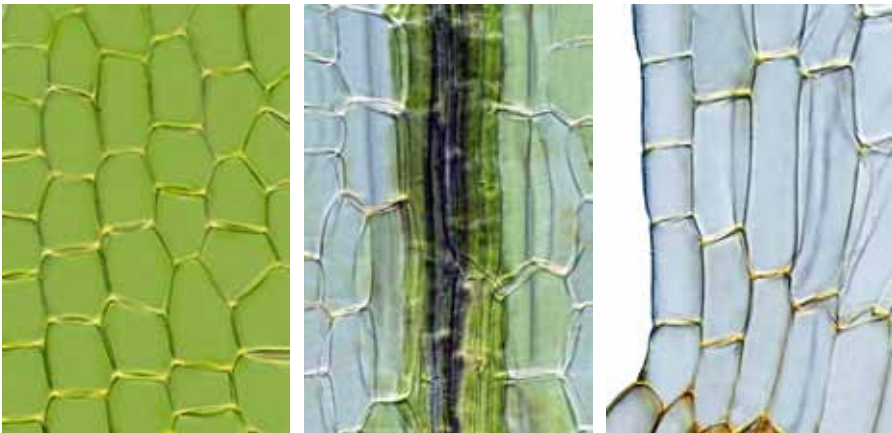
*cells:* 20  $\mu\text{m}$ , isodiametric, subquadrate, or hexagonal, firm-walled, smooth

**capsule:** 1 mm, ovate, erect, exserted, brown, the mouth wide when dry; seta 2–3 mm; operculum conico-rostrate; peristome none; spores 18–24  $\mu\text{m}$  in diam.

**note:** endemic



mature capsule, fertile shoot (moist) (2), leaf outline, leaf apex, and margin midleaf  
 0.5 mm, 1 mm, 0.5 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



cells midleaf, costa midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Tortula areolata* margin midleaf  
10  $\mu$ m

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***Tortula atrovirens* (Sm.) Lindb.**

**form:** densely gregarious, erect, ± branched stems, yellow-green, 2 mm tall  
**habitat:** soil or calcareous rock in exposed arid to semi-arid sites

**leaf:** size: 0.8–1.2 × 0.8 mm

*shape:* ovate to lingulate or subspathulate

*tip:* broadly acute to rounded, ending in a mucro

*base:* basal cells elongate, thin-walled

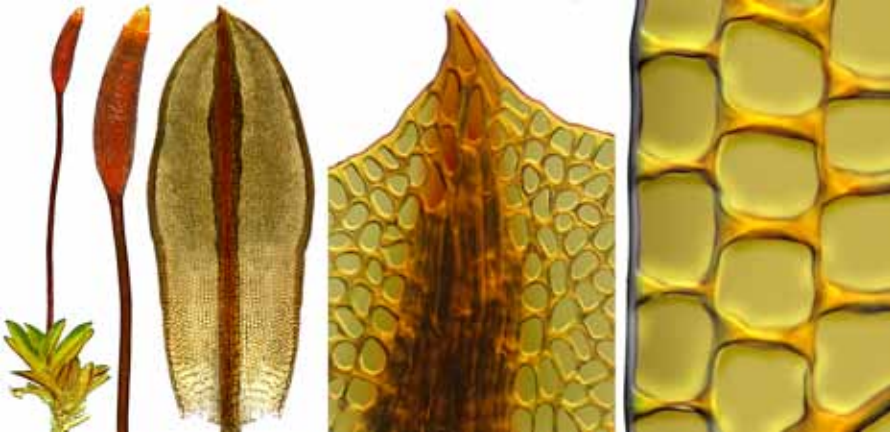
*costa:* strong, widened above, excurrent in the mucro

*border:* not differentiated

*margin:* entire, plane to revolute throughout

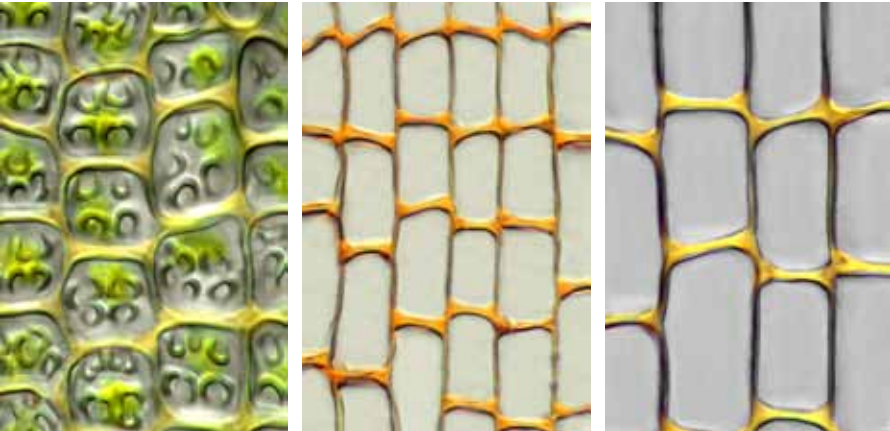
*cells:* 10–20 μm, rounded-quadrate, firm-walled, 4–6-C-papillose

**capsule:** 1–1.5 mm, narrowly oblong to elliptic, erect, exserted, red-brown, annulus none; seta 5–10 mm, reddish below, yellow above; operculum long-rostrate, to about half the length of the urn; peristome teeth to 400 μm long, inserted on a short basal membrane, papillose, oblique or twisted when moist



fertile shoot (dry), capsule, leaf outline, leaf apex, and margin midleaf

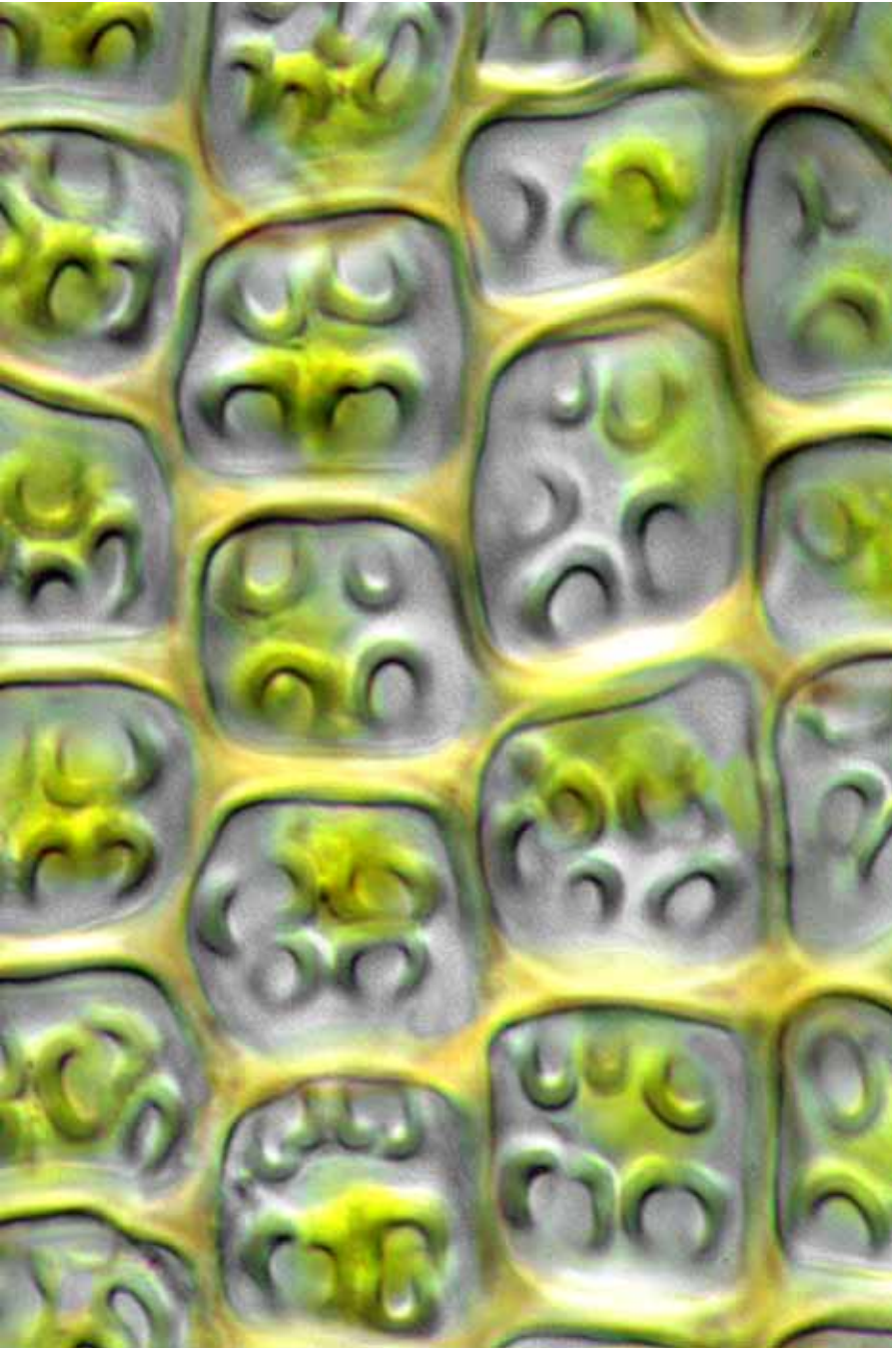
1 mm, 1 mm, 0.1 mm, 50 μm, 10 μm



papillose cells midleaf, and cells near leaf base (2)

10 μm, 10 μm, 10 μm

continued next page



*Tortula atrovirens* papillose cells midleaf  
10  $\mu$ m

continued next page

***Tortula marginata*** (Bruch & Schimp.) Spruce

**form:** patchy or loosely tufted stems, the leaves yellow-green, 2–3 mm tall  
**habitat:** damp basic rock and walls in shady sites

**leaf:** size: to 2 mm

**shape:** narrowly lanceolate or lingulate to narrowly lingulate-spathulate

**tip:** obtuse to acute

**base:** basal cells narrowly rectangular

**costa:** excurrent in a yellow point up to a quarter the length of the blade

**border:** 2–4 rows of incrassate cells from base to nearly the apex

**margin:** sinuose with projecting cell walls, plane

**cells:** 8–14  $\mu\text{m}$ , irregularly quadrate-hexagonal, firm-walled, papillose

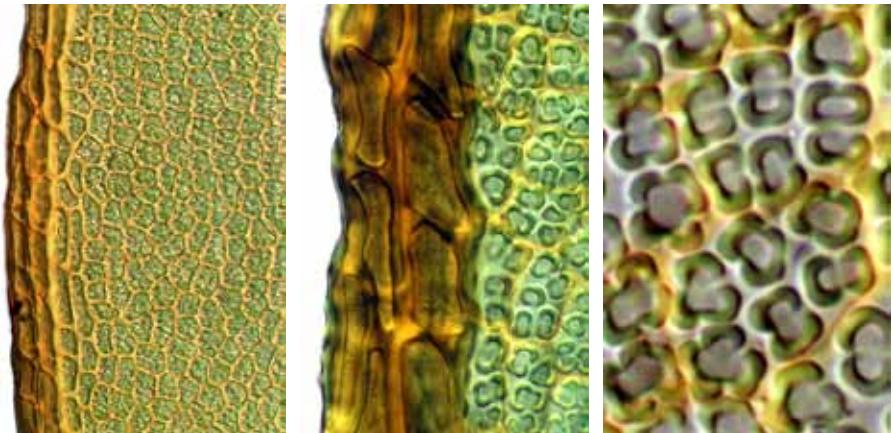
**capsule:** 2.5 mm, short-cylindric, symmetrical, erect; seta 10 mm, orange-red; peristome teeth free down to their insertion; spores 8  $\mu\text{m}$  in diam.

**note:** New Zealand's only *Tortula* species with a distinct border



vegetative shoot, leaf outline, and leaf apex and subapex

0.5 mm, 0.1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$



border midleaf (2), and leaf papillae

50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



***Tortula maritima*** (R.Br.bis) R.H.Zander

**form:** gregarious, erect, unbranched stems, 15–20 mm tall, the leaves yellow-green

**habitat:** damp sandy soil occasionally inundated at high tide

**leaf:** size: 1.2 mm

*shape:* widely oblong, deeply concave

*tip:* acute to subobtusate

*base:* basal cells rectangular, pellucid, thin-walled

*costa:* percurrent to excurrent

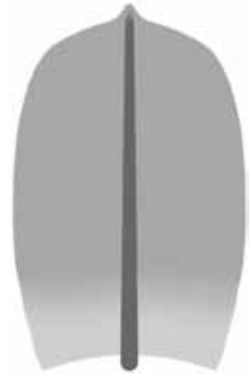
*border:* not differentiated

*margin:* entire, plane

*cells:* 18–28  $\mu\text{m}$ , subquadrate, firm-walled, smooth

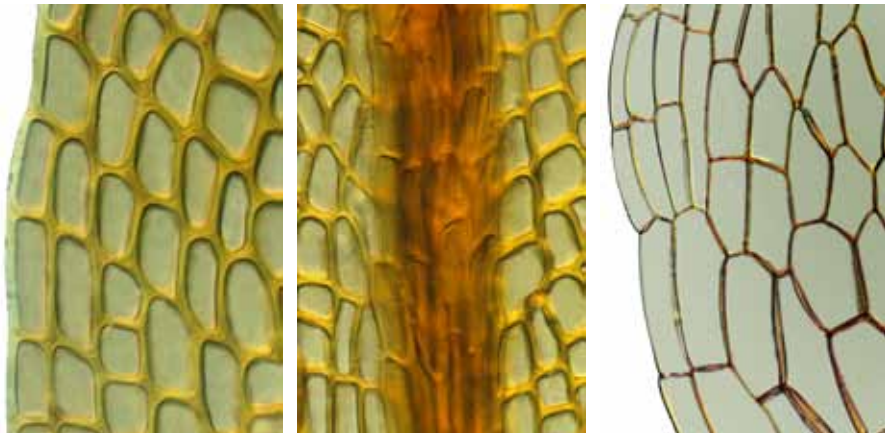
**capsule:** 1–1.5 mm, ovate,  $\pm$  beaked even though cleistocarpous, reddish brown, breaking in roughly the middle; seta 2–3 mm, orange,  $\pm$  flexuose when dry; spores 30–36  $\mu\text{m}$  in diam.

**note:** a coastal endemic



fertile shoot, capsule (dry), leaf outline, and leaf apex

1 mm, 1 mm, 0.1 mm, 10  $\mu\text{m}$



margin midleaf, costa midleaf, and margin near base

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

***Tortula mucronifolia*** Schwägr.

**form:** densely tufted, erect, branched stems, comal, 5–15 mm tall, the leaves dark green

**habitat:** calcareous soil on ledges or crevices of exposed cliffs or rock-piles

**leaf:** size: 2.0–3.5 mm

*shape:* oblong-lanceolate to spatulate, concave

*tip:* acute to acuminate

*base:* basal cells progressively longer toward the base, thin-walled

*costa:* tapering above, excurrent in a short to spinose mucro

*border:* not differentiated

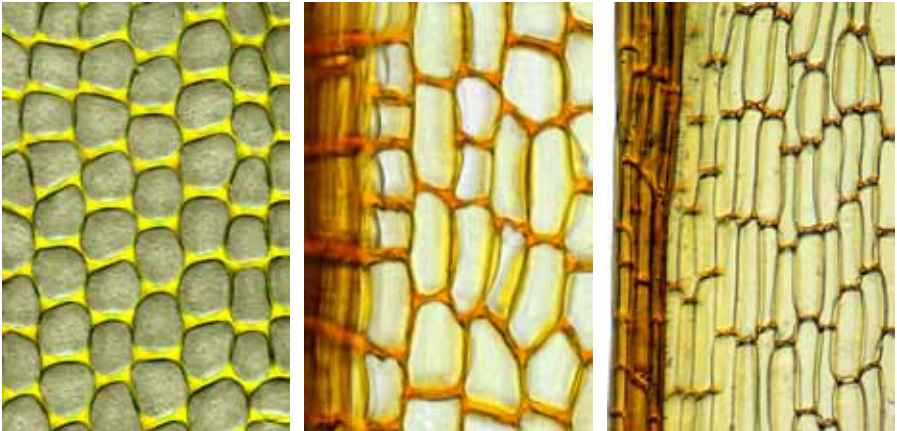
*margin:* entire, plane above, narrowly revolute on both sides below

*cells:* 16–28  $\mu\text{m}$ , subquadrate to rounded-hexagonal, firm-walled, smooth

**capsule:** 2–2.5 mm, long-cylindric, erect, exserted, reddish brown; seta 1–2.5 mm; operculum conic-subulate; peristome filiform, pink to orange, strongly twisted, from a tall tessellated tube about half the height of the peristome; spores 11–15  $\mu\text{m}$ , greenish

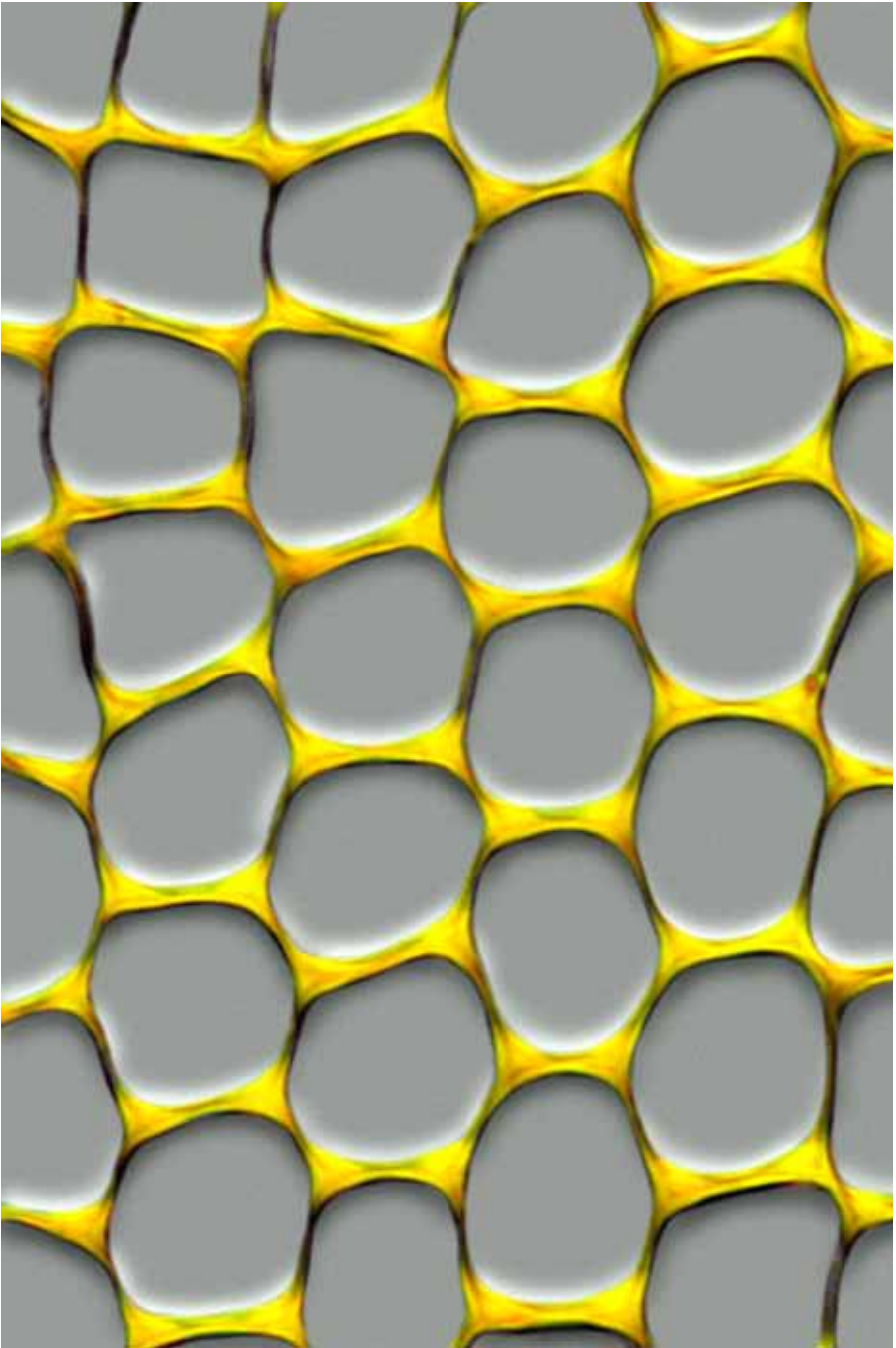


fertile shoots (dry) (2), capsule, leaf outline, leaf apex, and recurved margin midleaf  
 — 1 mm, — 1 mm, — 1 mm, — 0.1 mm, — 50  $\mu\text{m}$ , — 10  $\mu\text{m}$



cells midleaf, costa just below midleaf, and margin near leaf base  
 — 10  $\mu\text{m}$ , — 10  $\mu\text{m}$ , — 50  $\mu\text{m}$

continued next page



*Tortula mucronifolia* cells upper leaf  
10  $\mu\text{m}$

continued next page

**Tortula muralis** Hedw.

**form:** tufted or patchy, erect, glaucous, radiculose, hoary stems, 5–15 mm tall  
**habitat:** basic rock or mortar, concrete, and walls, an urban bryo-weed

**leaf:** size: 2–3.5 × 0.5–0.8 mm

*shape:* oblong-lanceolate

*tip:* acute to obtuse, with a long hyaline awn

*base:* basal cells rectangular, hyaline, smooth

*costa:* long-excurrent as a smooth, hyaline hair-point

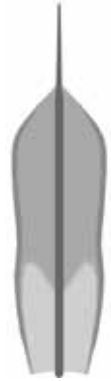
*border:* weak, 1–3 rows of incassate, smooth, yellow cells

*margin:* entire, revolute to nearly the apex

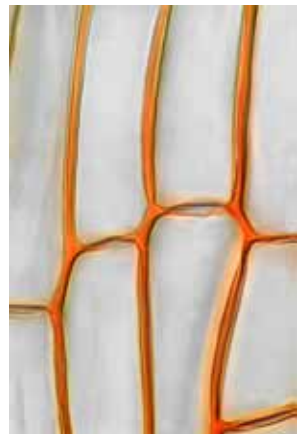
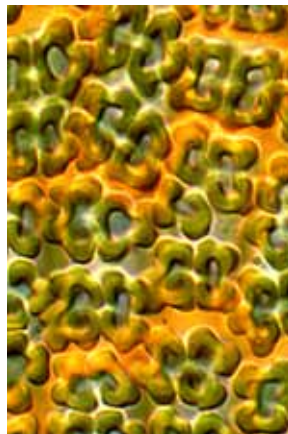
*cells:* 12–16 μm, rounded-hexagonal, incassate, densely C-papillose

**capsule:** 1–2.5 mm, cylindric, ± curved, erect, red-brown at maturity, stomatose at the base; seta 10–20 mm, flexuose, red with age; annulus revolute; operculum bluntly high-conic, the cells in spiral rows; peristome teeth pink, spirally twisted from a low basal tube; spores 10 μm in diam.

**note:** common in disturbed urban sites



fertile habit, leaf outline, leaf apex, and hair-point junction  
 5 mm, 0.5 mm, 10 μm, 50 μm



revolute margin midleaf, lamina cell papillae, and leaf base cells  
 10 μm, 10 μm, 10 μm

continued next page

***Tortula splachnoides*** (Hornsch.) R.H.Zander

**form:** gregarious ± bulbiform stems, yellow-green, 4 mm  
**habitat:** compacted soil in exposed coastal salt marsh

**leaf:** size: to 1 mm in length

*shape:* orbicular or nearly so, strongly concave

*tip:* apiculate to mucronate or cuspidate

*base:* basal cells larger and thinner-walled than the other lamina cells

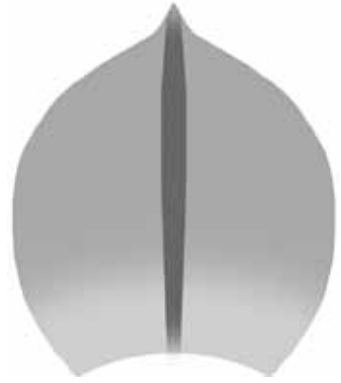
*costa:* percurrent to shortly excurrent

*border:* not differentiated

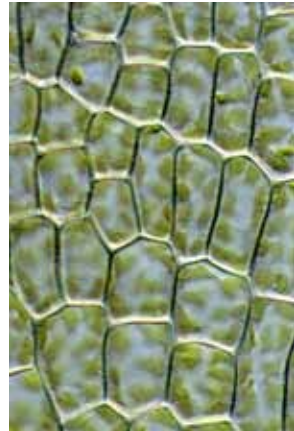
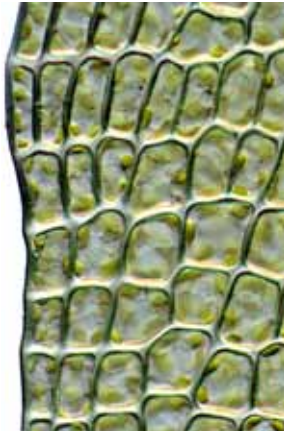
*margin:* entire

*cells:* 18–40 × 10–18 μm, quadrate to rectangular, firm-walled, 1–4-papillose (C-shaped)

**capsule:** 1 mm, ovoid, erect, exserted, glossy, red-brown when mature, cleistocarpous, splitting near the equator; seta 3–4 mm; calyptra cucullate



fertile shoots (dry), cleistocarpous capsule splitting, capsule remnant, and leaf outline  
 1 mm (2), 1 mm, 1 mm, 1 mm, 50 μm



leaf tip, margin midleaf, and cells near leaf base  
 10 μm, 10 μm, 10 μm

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*Tortula splachnoides* fertile habit

1 mm

continued next page

***Tortula truncata*** (Hedw.) Mitt.

**form:** scattered to gregarious, loosely tufted, erect stems, 3–5 mm tall  
**habitat:** calcareous soil in fallow fields, pastures, and roadside verges

**leaf:** size: 1.5–3 × 0.5–1.0 mm

*shape:* oblong-lanceolate to obovate

*tip:* acuminate or acute, ending in a stout apiculus

*base:* undifferentiated

*costa:* excurrent in the apiculus

*border:* not differentiated

*margin:* entire, variably recurved in midleaf

*cells:* 15–22 μm, irregularly hexagonal to rhombic, firm-walled, smooth

**capsule:** 0.4–0.8 mm, obovoid or obconic, erect, glossy, dark brown, widening at the mouth when dry; seta 2–6 mm, orange to red, sometimes paired; calyptra cucullate, smooth; operculum obliquely long-rostrate; peristome absent or rudimentary; spores 22–32 μm in diam., globose, brown, finely papillose



habit, turbinate capsules, leaf outline, and leaf apex

1 mm, 0.25 mm, 20 μm, 10 μm



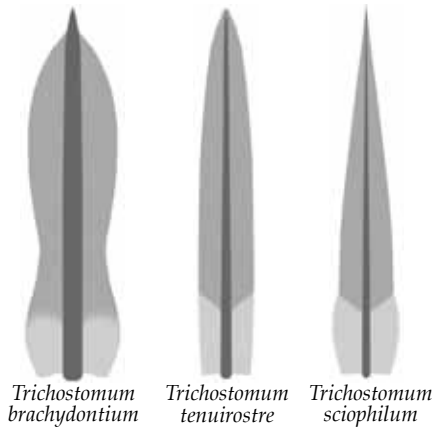
leaf subapex, costa edge midleaf, and margin midleaf

10 μm, 10 μm, 10 μm

**Key\* to the New Zealand species of *Trichostomum* (3)**

- 1 Leaf margin crenulate; papillae of upper cells low and scattered .....  
 ..... ● ***Trichostomum tenuirostre***
- 1: Leaf margin entire; papillae of upper cells large and crowded.....2
- 2(1:) Plants up to 25 mm tall; leaves crisped and incurved when dry, 2.0–2.5(–3.0) mm long; costa excurrent as a stout mucro..... ● ***Trichostomum brachydonium***
- 2: Plants 2–3 mm tall; leaves recurved when dry, 1.5–2.0 mm long; costa percurrent to short-excurrent as a cusp ..... ● ***Trichostomum sciophilum***

\* based partly on Zander, RH (2007): *Trichostomum*. *Flora of North America* 27, 489.





**Trichostomum brachydontium** Bruch

**form:** densely tufted, simple, yellowish stems, dark with age, 10–40 mm tall  
**habitat:** soil or soil in rock crevices, shaded to exposed sites

**leaf:** size: 2.5–3 × 0.5–0.7 mm, orange reaction to 2% KOH

**shape:** narrowly lingulate to ± spatulate, crisped and incurved when dry

**tip:** acute to obtuse or acuminate, not cucullate

**base:** basal cells more rectangular than the blade cells, 20–35 × 9–12 μm

**costa:** shortly excurrent in a mucro or cusp

**border:** not differentiated

**margin:** papillose-crenulate, plane to narrowly recurved

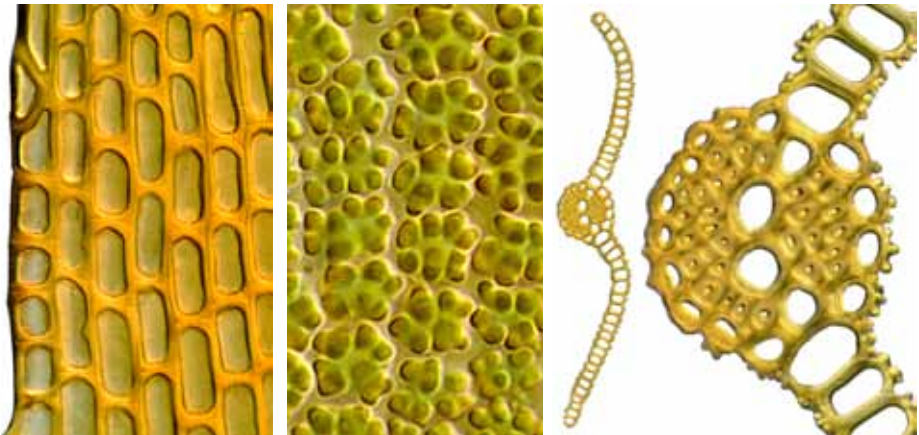
**cells:** 6–8 μm, subquadrate, firm-walled, papillose

**capsule:** 1.5–2 mm, ellipsoid, straight, erect; seta 6 mm, yellow; operculum obliquely rostrate; calyptra cucullate, naked, smooth; peristome teeth short, distally divided, fragile; spores 14–18 μm in diam., papillose

**note:** highly variable



vegetative shoot, leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 50 μm, 10 μm



margin near leaf base, leaf papillae, and costa and leaf cross-sections  
 10 μm, 10 μm, 50 μm, 10 μm

continued next page

**Trichostomum sciophilum** Müll.Hal.

**form:** gregarious erect shoots, olive-green above and brown below, 3–5 mm tall  
**habitat:** exposed soil, lowland

**leaf:** size: 1.5–2.0 mm

*shape:* narrowly lanceolate, short-sheathing

*tip:* long-acuminate

*base:* basal cells elongate, thin-walled; alar cells not differentiated

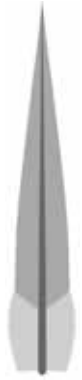
*costa:* percurrent to excurrent in a cusp

*border:* not differentiated

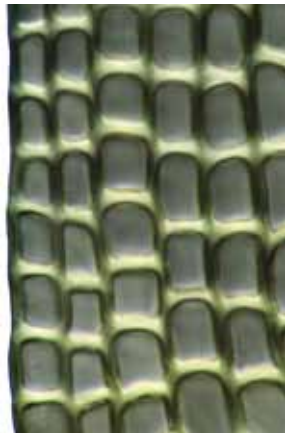
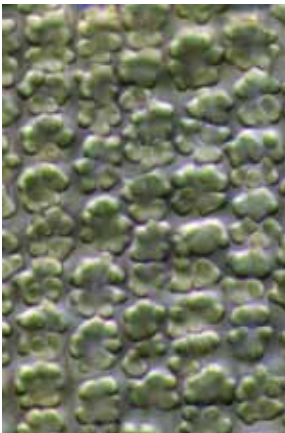
*margin:* entire, plane to recurved

*cells:* 10  $\mu\text{m}$ , quadrate to short-rectangular, thick-walled, multipapillose

**capsule:** 1.5 mm, elliptic, erect, exserted, brown; seta 5–8 mm; calyptra cucullate, naked, smooth; operculum obliquely rostrate; peristome rudimentary



immature capsules, vegetative shoot (dry), leaf outline, leaf apex, and margin midleaf  
 — 0.5 mm, — 0.5 mm, — 1 mm, — 0.1 mm, — 100  $\mu\text{m}$ , — 50  $\mu\text{m}$



leaf papillae, margin of lower leaf, and leaf basal angle  
 — 10  $\mu\text{m}$ , — 10  $\mu\text{m}$ , — 50  $\mu\text{m}$

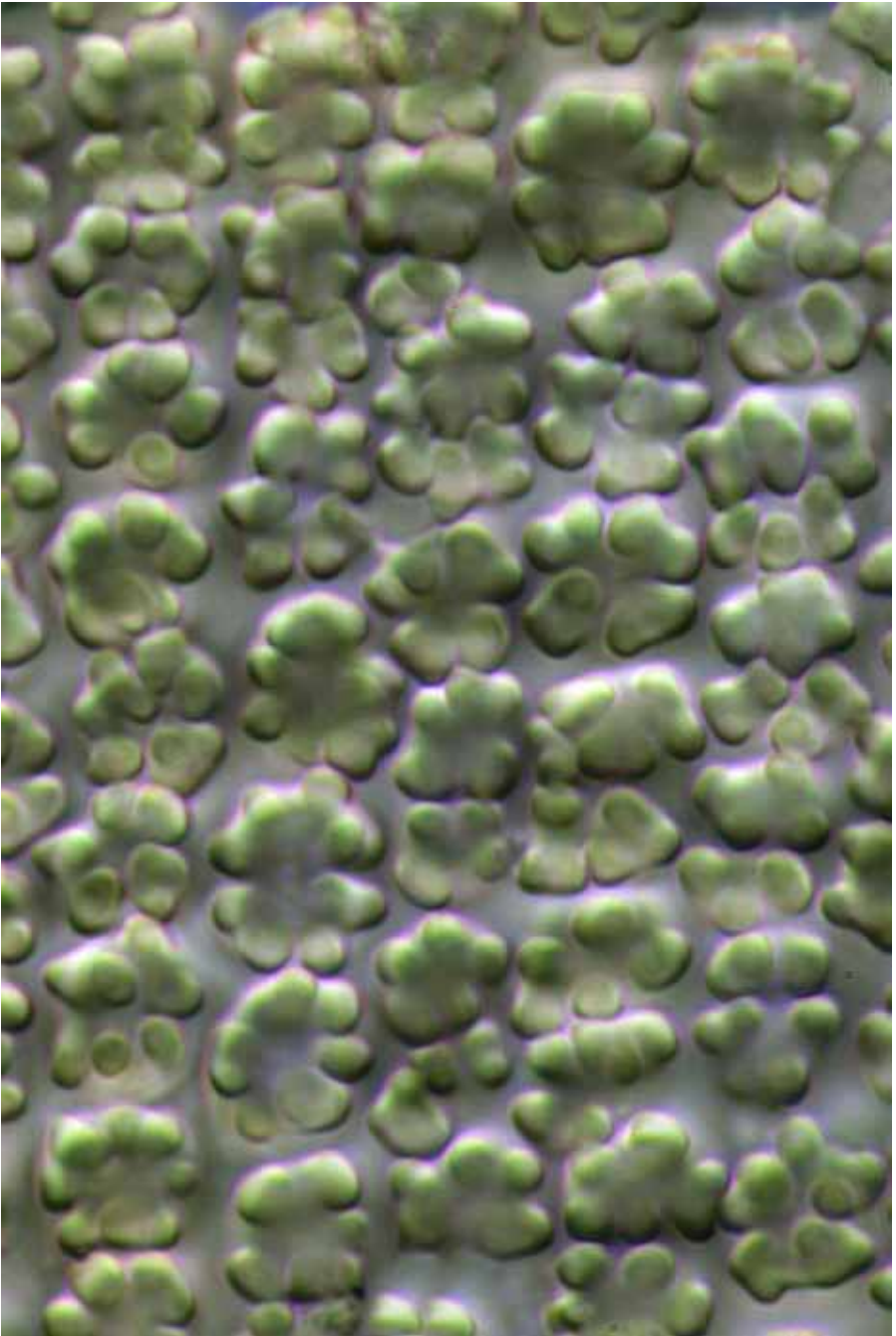
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*Trichostomum sciophilum* vegetative shoot (dry)

0.5 mm

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*Trichostomum sciophilum* leaf papillae  
10  $\mu$ m

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**Trichostomum tenuirostre** (Hook. & Taylor) Lindb.

**form:** loosely tufted, erect stems, to 10 mm tall, the leaves yellow-green or brown  
**habitat:** peat, bark of roots, soil, or soil over rock, from lowland to alpine

**leaf:** size: 2–7 mm

*shape:* linear-lanceolate to oblong-lanceolate, unistratose

*tip:* acute, ± apiculate, incurved and contorted when dry

*base:* basal cells 30–45 × 7–8 μm, ± inflated, hyaline, thin-walled, smooth

*costa:* glossy, prominent on the back, ending in the apex to ± excurrent

*border:* not or only obscurely differentiated

*margin:* entire to minutely serrulate-crenulate from papillae, ± undulate

*cells:* 6–9 μm, quadrate to irregular, firm-walled, pluri- to multipapillose

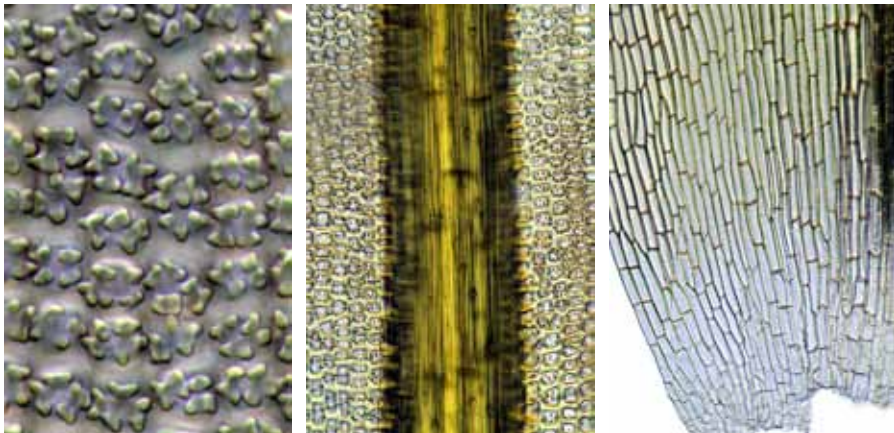
**capsule:** 1.2–1.8 mm, cylindric, erect, smooth to ± wrinkled when dry, exserted, brown; seta 7–10 mm; operculum long-conic to rostrate; peristome of 16 entire or irregularly divided, ± papillose teeth; spores 9–13 μm in diam.

**note:** capsules not seen in New Zealand



vegetative shoots (dry) (2), leaf outline, leaf apex, and margin midleaf

5 mm, 1 mm, 1 mm, 10 μm, 10 μm



leaf papillae, costa midleaf, and leaf basal angle

10 μm, 50 μm, 50 μm

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*Trichostomum tenuirostre* vegetative shoot (dry)

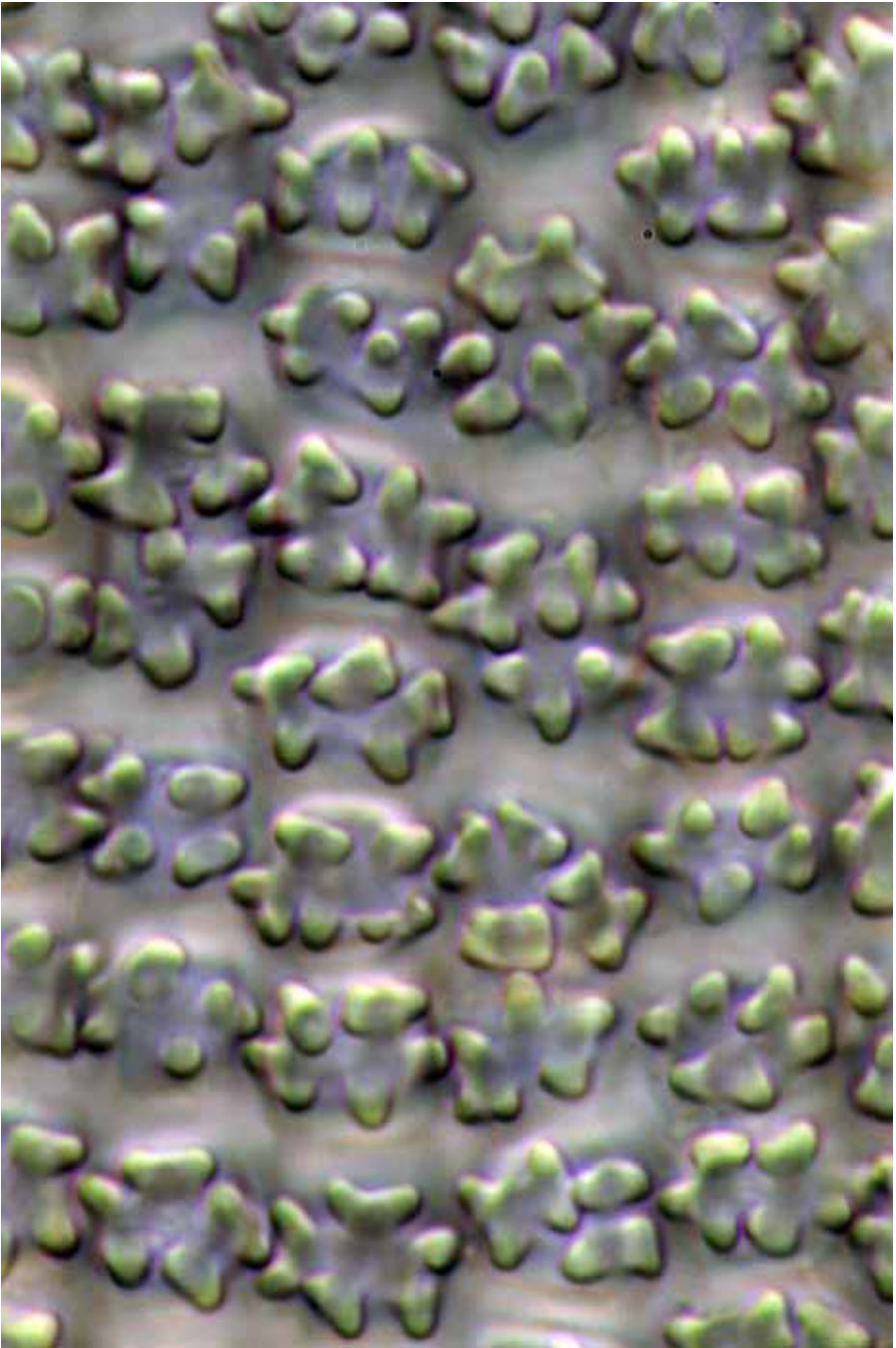
0.5 mm

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*Trichostomum tenuirostre* margin midleaf  
10  $\mu$ m

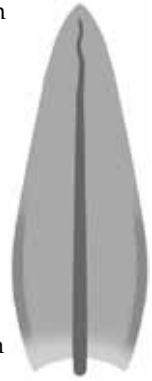
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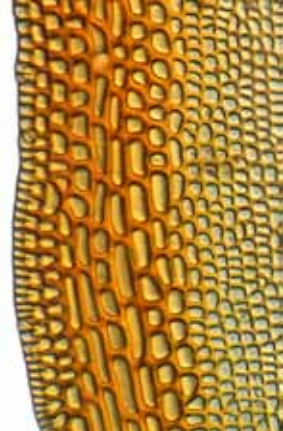
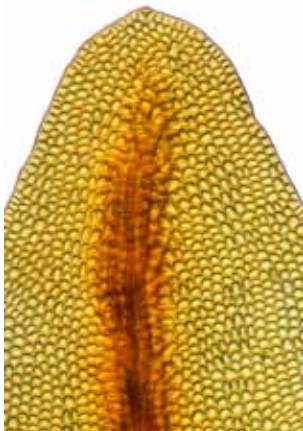
*Trichostomum tenuirostre* leaf papillae  
10  $\mu$ m

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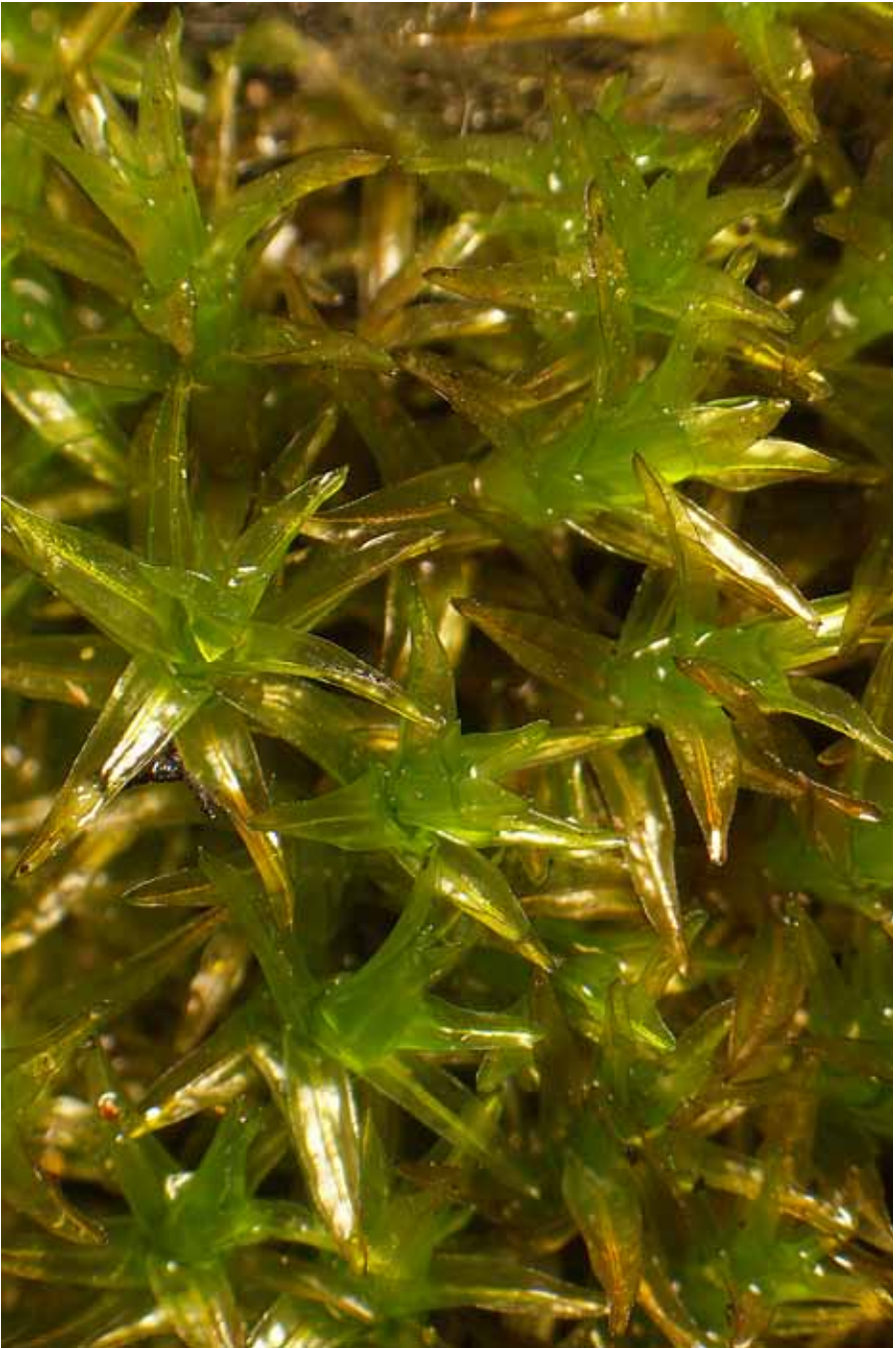
**Tridontium tasmanicum** Hook.f.**form:** robust, tufted, brownish, branched stems, denuded below, to 80 mm**habitat:** damp soil or rock, especially in stream beds**leaf:** size: 2–4.5 × 0.7–1.5 mm*shape:* oblong-lanceolate*tip:* obtuse to rounded, rarely acute*base:* undifferentiated*costa:* failing below the apex*border:* in the lower half, an intramarginal border of thick-walled cells*margin:* entire, inrolled above, plane or concave below*cells:* 8–10 μm, isodiametric, thick-walled, smooth**capsule:** 1.5–2 mm, turbinate, brown, pachydermatous, with a thickened mouth; seta 10–20 mm, erect, flexuose, red; calyptra cucullate; operculum long-rostrate; peristome teeth 16, short, yellowish, inserted under the rim, variably 2–3-split and perforated below; spores 16–20 μm

fertile shoot (wet), vegetative shoot (dry, wet), margin xs, capsule, tooth, and leaf outline  
 5 mm, 1 mm, 1 mm, 10 μm, 1 mm, 100 μm, 1 mm



leaf apex and costa terminus, margin midleaf, and intramarginal border in lower leaf  
 100 μm, 10 μm, 100 μm

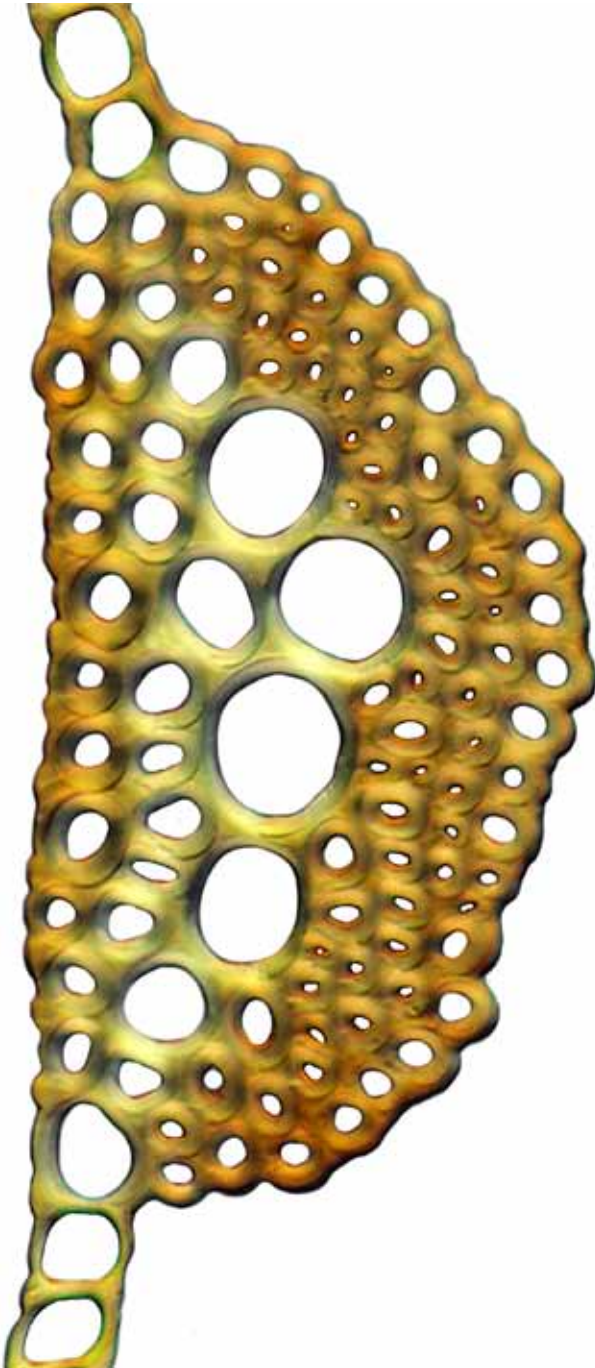
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*Tridontium tasmanicum* habit (moist)

1 mm

continued next page



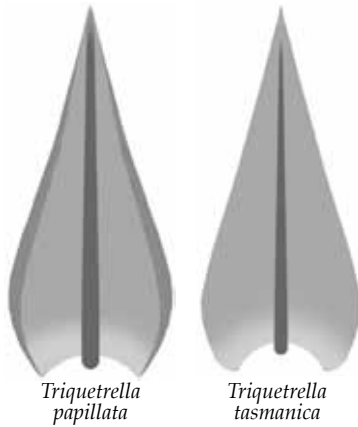
*Tridontium tasmanicum* costa cross-section  
10  $\mu\text{m}$

continued next page

**Key\* to the New Zealand species of *Triquetrella* (2)**

- 1 Papillae tall and mostly bifid; leaves unaltered when dry ..... ● ***Triquetrella papillata***  
 1: Papillae low and simple; leaves twisted around the stem when dry..... ● ***Triquetrella tasmanica***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 154.



**Triquetrella papillata** (Hook.f. & Wilson) Broth.

**form:** tufted, filiform, radiculose stems, the leaves distinctly 3-ranked,  
yellowish or brownish, 20–40 mm tall

**habitat:** exposed soil, sand, or rock, in pasture or near coasts

**leaf:** size: 1.5–2 × 0.5–0.7 mm

*shape:* triangular to ovate-triangular

*tip:* acute or acuminate

*base:* undifferentiated, decurrent

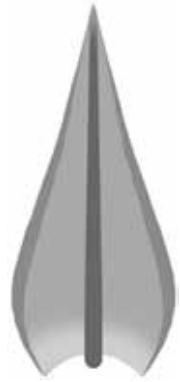
*costa:* percurrent or failing below the apex, papillose

*border:* not differentiated

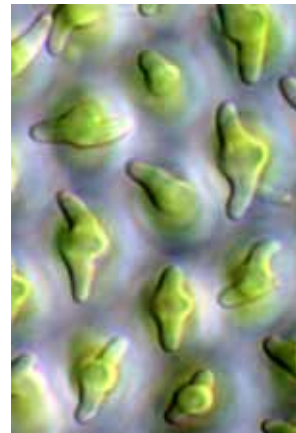
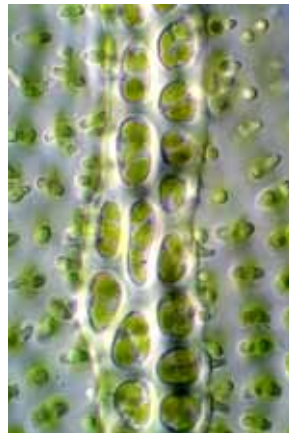
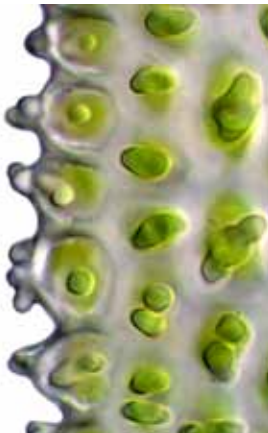
*margin:* entire, variably recurved midleaf

*cells:* 9–12 μm, rounded-hexagonal, thick-walled, papillose, the papillae mostly simple or bifid

**capsule:** 1.5 mm, narrowly cylindric, exserted, erect, straight; seta 15–23 mm, flexuose, yellow; operculum bluntly rostrate; peristome teeth 16, short, blunt, hyaline, obliquely striolate



vegetative habit (moist), immature capsule, leaf outline, leaf apex, and leaf cross-section  
 5 mm, 1 mm, 0.1 mm, 10 μm, 10 μm

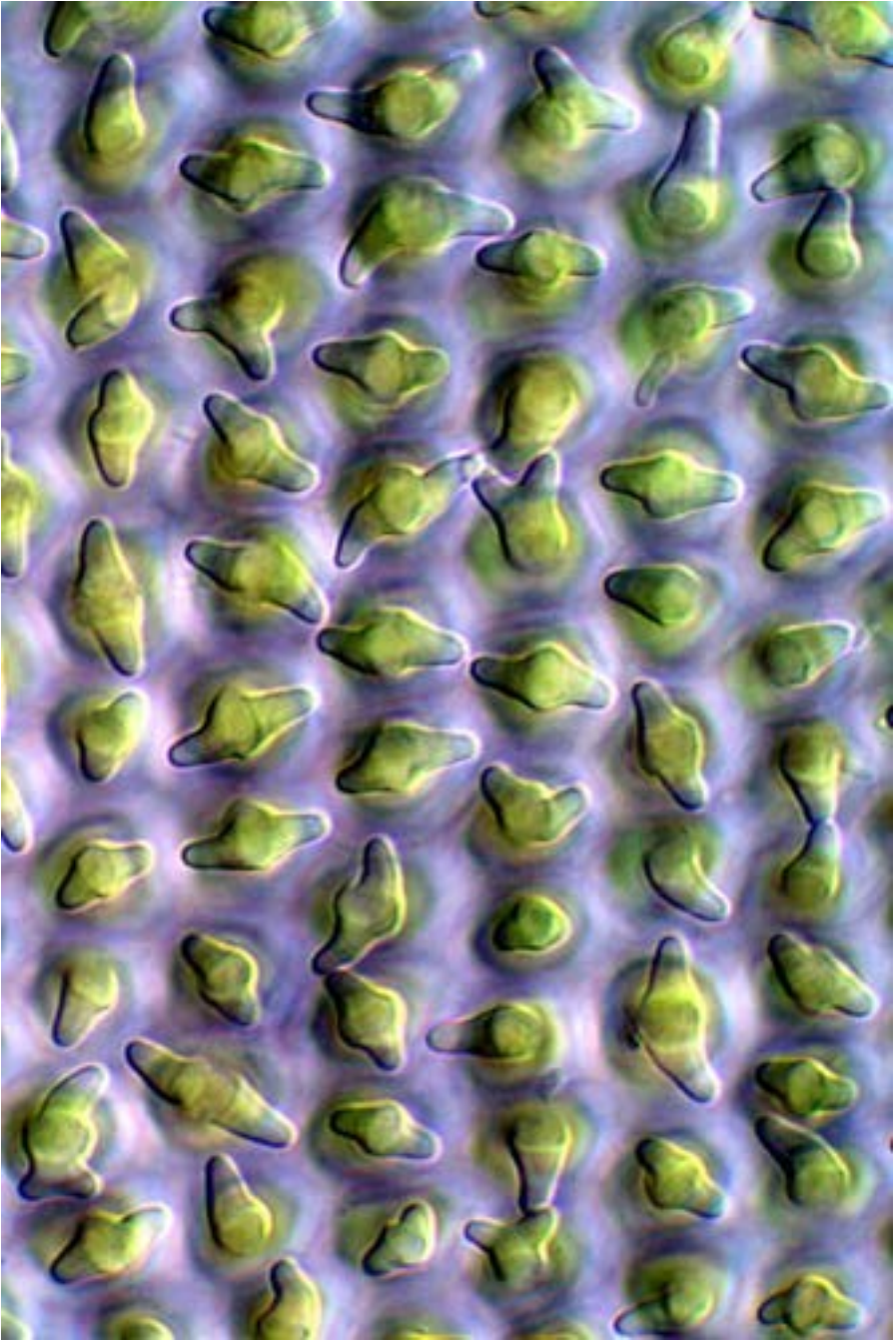


margin midleaf, costa and papillae midleaf, and leaf papillae detail  
 10 μm, 10 μm, 10 μm



*Triquetrella papillata* vegetative habit (moist)  
5 mm

continued next page



*Triquetrella papillata* leaf surface papillae  
10  $\mu$ m

continued next page

**Triquetrella tasmanica** (Broth.) Granzow-de la Cerda

**form:** tufted or matted, yellowish, branched stems, purple-radiculose;  
leaves  $\pm$  3-ranked, twisted around the stem when dry, 20–40 mm tall

**habitat:** soil or rock in sheltered sites

**leaf:** size: 1–1.5  $\times$  0.4–0.6 mm

*shape:* ovate-lanceolate or ovate-cordate

*tip:* acuminate or acute,  $\pm$  hyaline, often ending in a single long cell

*base:* not differentiated, decurrent

*costa:* failing below the apex

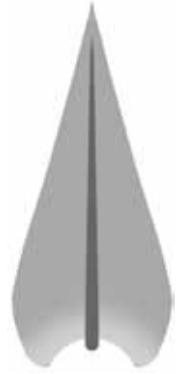
*border:* not differentiated

*margin:* entire, variably revolute below

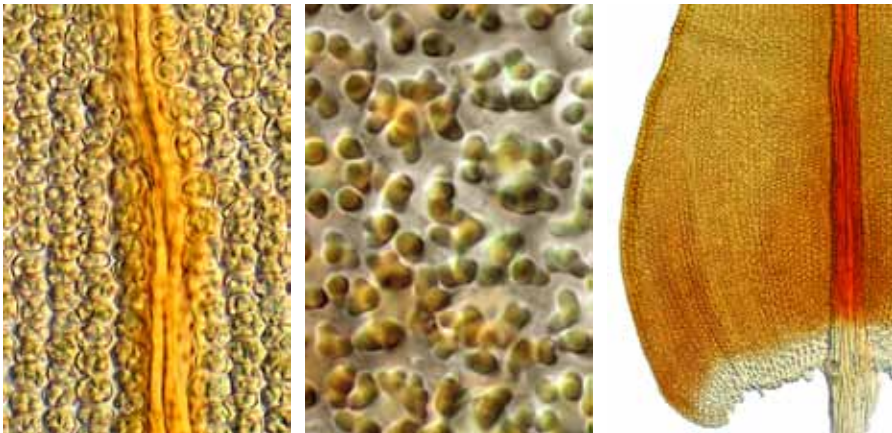
*cells:* 10–14  $\mu$ m, rounded, incrassate, papillose

**capsule:** unknown

**note:** rare, known from only a few widely scattered sites



vegetative shoot (dry on far left), leaf outline, upper third of leaf, and leaf apex  
 1 mm, 1 mm, 0.1 mm, 100  $\mu$ m, 10  $\mu$ m



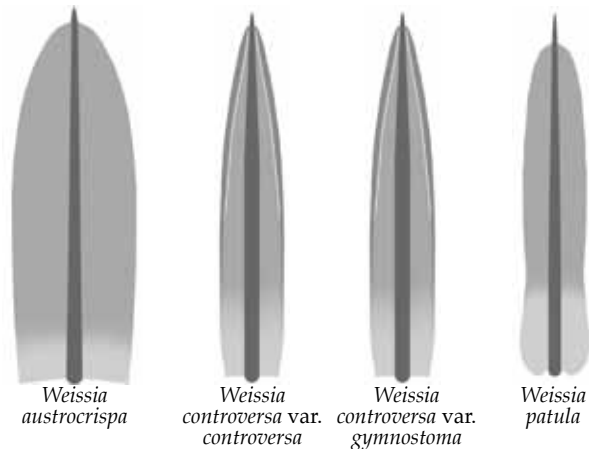
costa and papillae midleaf, papillae detail, and leaf basal angle  
 10  $\mu$ m, 10  $\mu$ m, 100  $\mu$ m



**Key\* to the New Zealand species of *Weissia* (4)**

- 1 Margin plane throughout..... ● ***Weissia austrocrispa***  
 1: Margin involute above or reflexed below .....2
- 2(1:) Margin reflexed midleaf; costa failing below the apex..... ● ***Weissia patula***  
 2: Margin strongly involute above; costa excurrent.....3
- 3(2:) Peristome teeth 16, red to hyaline..... ● ***Weissia controversa* var. *controversa***  
 3: Peristome teeth none ..... ● ***Weissia controversa* var. *gymnostoma***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 146, and Catcheside, DG (1980): *Mosses of South Australia*. Government Printer, Adelaide. 193.



**Weissia austrocrispa** (Beckett) I.G.Stone

**form:** densely gregarious, erect, yellowish stems, 3–5 mm tall  
**habitat:** exposed soil

**leaf:** size: 2–2.5 mm

**shape:** linear-lanceolate from an oval base

**tip:** mucronate

**base:** basal cells long-rectangular, thin-walled

**costa:** excurrent in a stout mucro

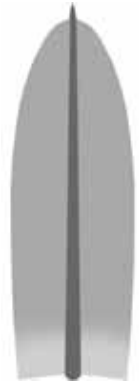
**border:** not differentiated

**margin:** entire, plane

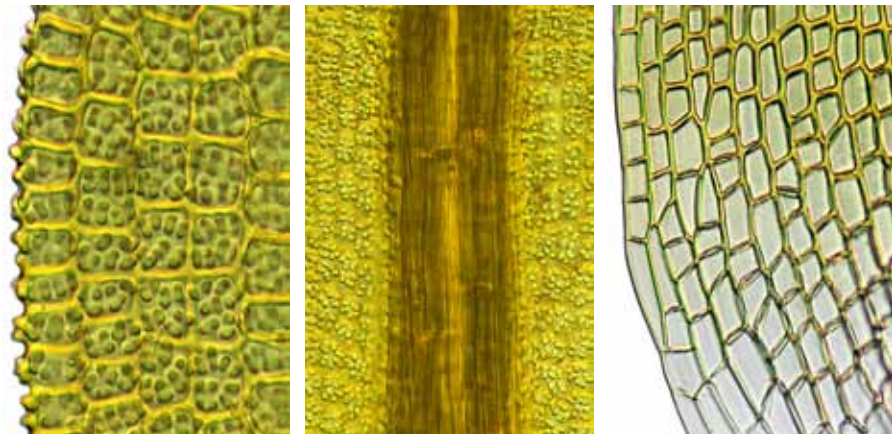
**cells:** 8–12  $\mu\text{m}$ , quadrate, firm-walled, pluri- to multipapillose

**capsule:** 1 mm, oval, erect, immersed, brown; seta very short; operculum conic, short-rostrate; calyptra only half-formed, smooth, the base entire; peristome absent

**note:** differs from *Barbula unguiculata* in having immersed capsules



vegetative shoot (moist on far left), leaf outline, leaf apex, and mucro  
 1 mm (2), 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



margin midleaf, costa midleaf, and margin near leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Weissia austrocrispa* vegetative shoot (dry)  
1 mm

continued next page

**Weissia controversa** Hedw. var. **controversa**

**form:** loosely to densely tufted stems, 3–10 mm tall, the leaves pale green

**habitat:** moist soil or rock on banks, walls, roadsides, cliffs, and coastal dunes

**leaf:** size: 2–3 × 0.4–0.6 mm

*shape:* linear-lanceolate, concave below, strongly crispate when dry

*tip:* acute, ± abruptly pointed by the excurrent costa

*base:* basal cells rectangular, ± thick-walled

*costa:* shortly excurrent

*border:* not differentiated

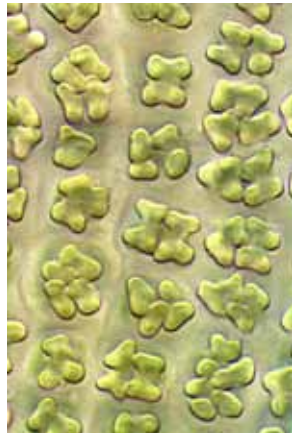
*margin:* entire, plane below, incurved or tightly involute above

*cells:* 6–8 μm, subquadrate, incrassate, densely papillose

**capsule:** 0.7–1.5 mm, ovoid, oblong, or cylindric, ± curved, erect, stomatose at the base; seta 4–13 mm, terminal, yellowish; calyptra cucullate, smooth, naked; mouth narrow, red, thickened; operculum obliquely rostrate; peristome variable or lacking, the teeth 16, red, short or rudimentary, entire or ± cleft and perforate, often filiform-divided to a low basal membrane



vegetative habit (dry), leaf outline and apex, leaf apex, and mature capsule  
 1 mm, 0.5 mm, 10 μm, 10 μm, 0.5 mm



margin midleaf, leaf papillae, and leaf cross-section  
 10 μm, 10 μm, 50 μm

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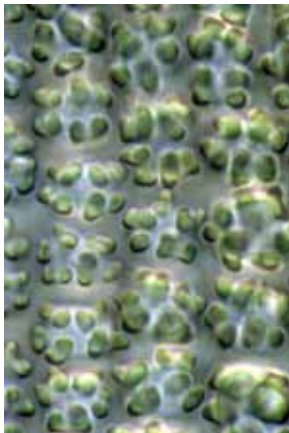
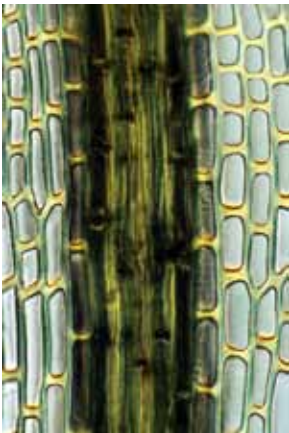
*Weissia controversa* var. *controversa* habit, immature capsules  
1 mm, 1 mm

continued next page

**Weissia controversa** var. **gymnostoma** (Dixon) Sainsbury**form:** loosely to densely tufted, erect stems, 3–10 mm tall, pale green**habitat:** moist calcareous soil or rock**leaf:** size: 2–3 × 0.4–0.6 mm*shape:* linear-lanceolate, concave below, strongly crispate when dry*tip:* acute, ± abruptly pointed by the yellow excurrent costa*base:* basal cells rectangular, firm-walled*costa:* shortly excurrent*border:* not differentiated*margin:* entire, plane below; ± incurved above*cells:* 6–8 μm, subquadrate, incrassate, pluripapillose**capsule:** 0.7–1.5 mm, ovoid, oblong, or cylindric, erect, ± curved, stomatose at the base; seta 4–13 mm, yellowish; calyptra cucullate, smooth, naked; mouth red, narrow, thickened; operculum obliquely rostrate; peristome none; spores 16–20 μm in diam.

fertile shoot (dry) (2), capsule, leaf outline, leaf apex, and margin midleaf

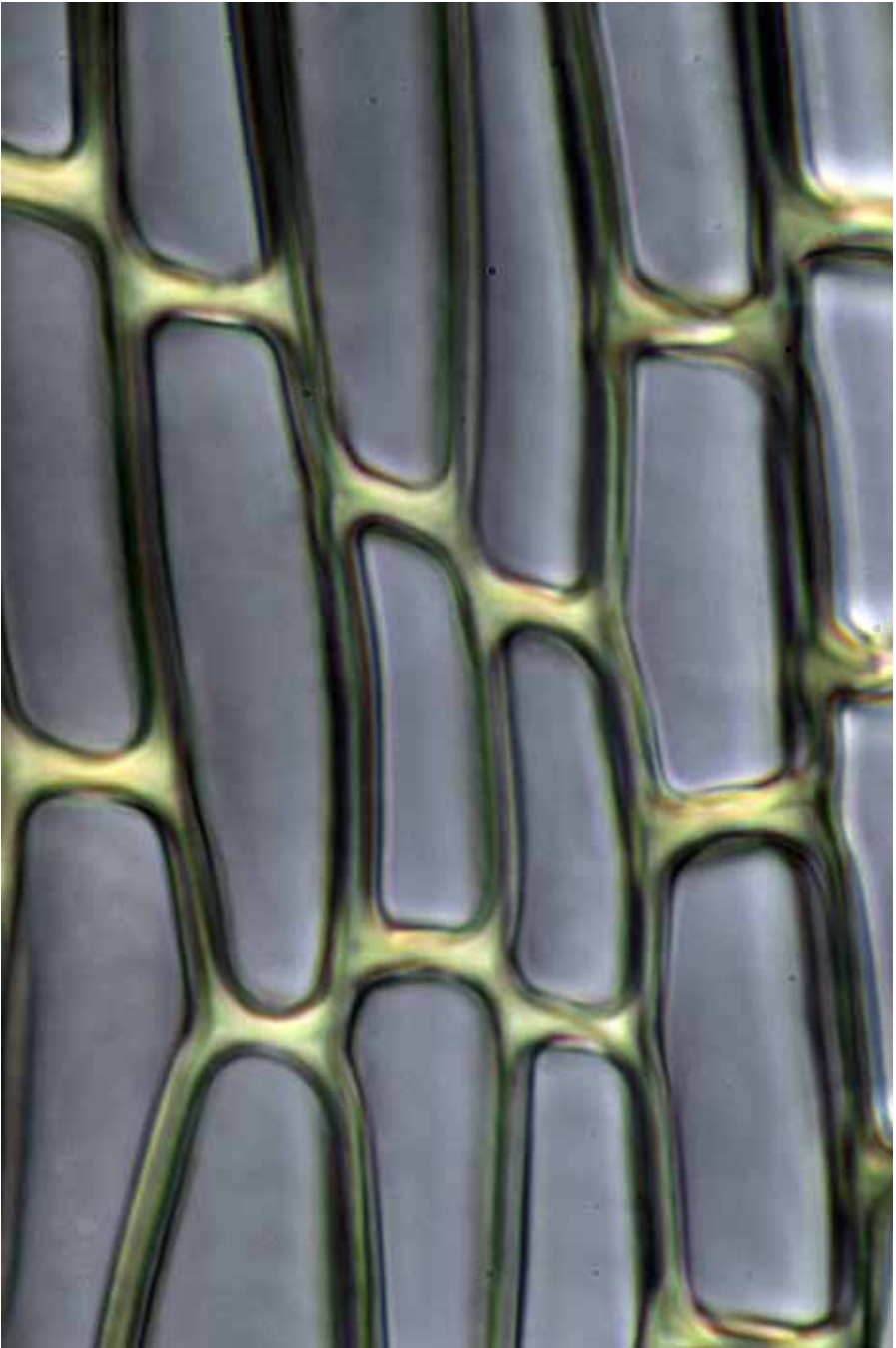
1 mm, 
  1 mm, 
  1 mm, 
  0.5 mm, 
  50 μm, 
  10 μm



costa lower leaf, surface papillae midleaf, and leaf basal angle

10 μm, 
  10 μm, 
  50 μm

continued next page



*Weissia controversa* var. *gymnostoma* cells lower leaf  
10  $\mu$ m

continued next page

**Weissia patula** (C.Knight) Fife

**form:** tufted, erect, sparsely branched stems, to 5 mm tall, yellow-green  
**habitat:** disturbed soil

**leaf:** size: to 2.5 mm

*shape:* narrowly ligulate

*tip:* acute, ending in a stout arista

*base:* basal cells short-rectangular, firm-walled, hyaline, smooth

*costa:* excurrent as a stout arista

*border:* not differentiated

*margin:* erect, involute to strongly incurved

*cells:* 7–10  $\mu\text{m}$ , subquadrate to hexagonal, firm-walled, pluripapillose

**capsule:** 1–1.5 mm, ovoid to cylindric, erect, exserted; seta 10–12 mm; peristome none, the mouth of the capsule closed by a membrane



vegetative shoot, leaf outline, and leaf apex

1 mm, 0.5 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



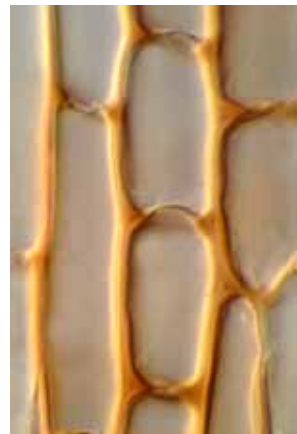
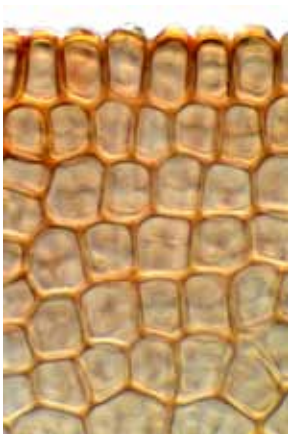
margin midleaf, costa in upper leaf, and costa cross-section

10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$



**Willia calobolax** (C.Müll.) Lightowlers**form:** tufted erect, sparsely branched stems, 10–15 mm tall, in cushions**habitat:** bark or rock, often coastal**leaf:** size: to 2.5 mm*shape:* oblong, concave, reacting red in 2% KOH*tip:* widely acute or obtuse*base:* basal cells rectangular, thin-walled, smooth*costa:* stout, excurrent in a stout mucro or arista, red*border:* not differentiated*margin:* entire, plane*cells:* 10–15  $\mu\text{m}$ , isodiametric, firm-walled,  $\pm$  papillose**capsule:** capsules not known

vegetative shoots (dry) (2), leaf outline, leaf apex, and costa cross-section

 1 mm (2), 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ 


margin midleaf, leaf papillae, and basal leaf cells

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

**Pleurophascum ovalifolium** Fife & P.J.Dalton

**form:** gregarious; primary stems creeping; secondary stems erect, sparsely branched, julaceous, 20–40(–60) mm tall

**habitat:** soil in cushion bogs on pakihi soils, and in grasslands

**leaf:** size: 2–3 × 1.5–2 mm

*shape:* broadly elliptic, strongly concave

*tip:* rounded

*base:* alar cells shorter and wider than adjacent blade cells

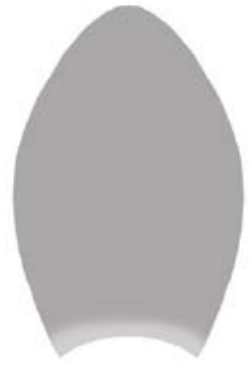
*costa:* none

*border:* weak, oblong in a few rows

*margin:* entire, narrowly recurved below

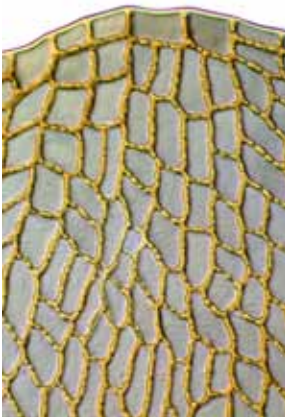
*cells:* 40–70 × 15–18 μm, oblong to hexagonal, firm-walled, strongly porose, smooth

**capsule:** 6–12 × 3 mm, globose and yellow when young, discoid and bright red at maturity, cleistocarpous; seta 10–35 mm, yellow; calyptra cucullate; spores 33–45 μm in diam.



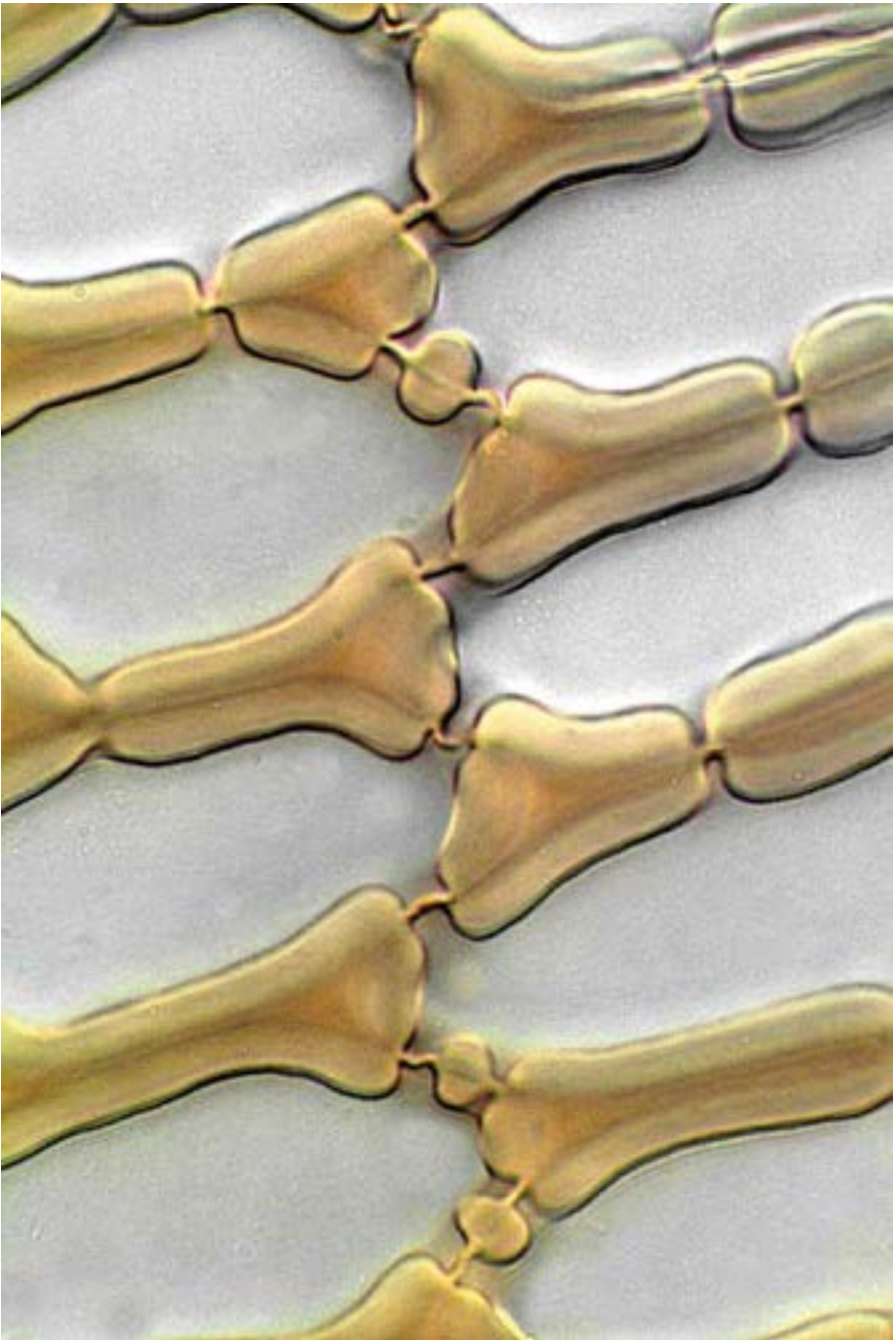
fertile habit, capsule, vegetative shoot, and leaf outline

■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm



leaf apex, margin midleaf, and cells midleaf

■ 10 μm, ■ 10 μm, ■ 5 μm



*Pleurophascum ovalifolium* porose leaf cells  
10  $\mu\text{m}$

continued next page

**Mittenia plumula** (Mitt.) Lindb.

**form:** gregarious or in swards, slender, unbranched stems, to 20 mm  
**habitat:** shaded soil, overhangs, and banks in beech forest, to 1200 m

**leaf:** size: 0.7–1.0 × 0.3–0.5 mm

*shape:* oblong-lingulate to oval, asymmetric, distichous

*tip:* obtuse, ± short-apiculate

*base:* basipetal margin decurrent; alar cells undifferentiated

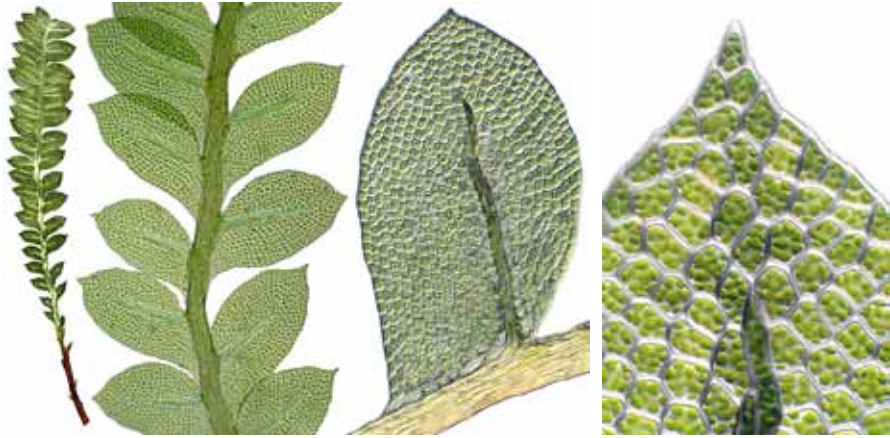
*costa:* pale, ending above midleaf, sometimes forked above

*border:* not differentiated

*margin:* entire, plane

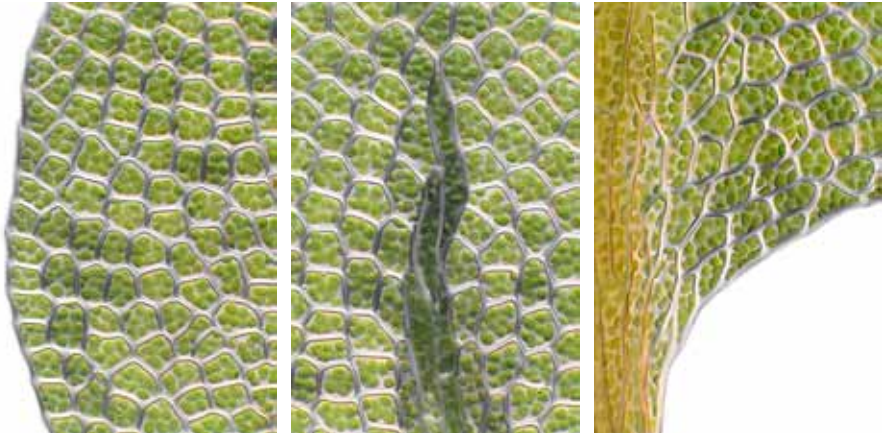
*cells:* 15–24 μm, ± isodiametric, firm-walled, smooth

**capsule:** 2 mm, narrowly oblong, erect to inclined, brown, not stomatose; seta 2–4 mm, geniculate at the base; annulus none; operculum obliquely long-rostrate; calyptra mitriform, smooth; peristome double; outer of 16 dark, long-filiform teeth, inner of 16 filiform nodulose processes; spores 9–12 μm in diam.



vegetative shoot, leaf outlines (2), and leaf apex

1 mm, 0.5 mm, 0.1 mm, 50 μm



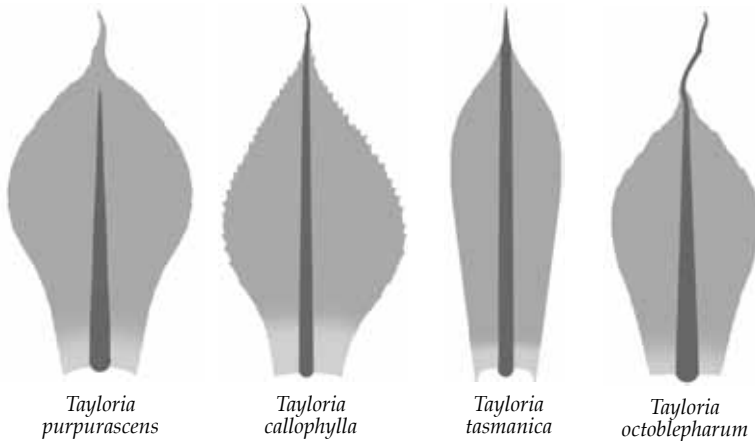
margin midleaf, costa terminus, and decurrent leaf base

50 μm, 50 μm, 50 μm

**Key\* to the New Zealand species of *Tayloria* (4)**

- 1 Leaf margin sharply toothed or spinose above ..... ● ***Tayloria callophylla***  
 1: Leaf margin entire or weakly toothed above ..... 2
- 2(1:) In upper leaves, the costa excurrent in a long, ± flexuose, pigmented arista .....  
 ..... ● ***Tayloria octoblepharum***  
 2: In upper leaves, costa not excurrent into an arista (at most, cuspidate to acuminate) .. 3
- 3 Costa ending well below the leaf apex; capsule elliptic, purple or brown, peristome  
 teeth erect or incurved when dry ..... ● ***Tayloria purpurascens***  
 3: Costa percurrent or shortly excurrent; capsule hypophysis inflated, grey; peristome  
 teeth recurved when dry ..... ● ***Tayloria tasmanica***

\* based partly on Goffinet, B (2006): *Tayloria*. *Flora of Australia* 51, 174.



**Tayloria callophylla** (Müll.Hal.) Mitt.

**form:** tufts of erect, glossy, tomentose stems, to 40 mm tall, green to red  
**habitat:** dung, bone, or moist, nutrient-rich soil, in montane scrub

**leaf:** size: 3–5 × 1.0–2.0 mm

*shape:* oblong-ovovate to elliptic from a narrow, weakly sheathing base

*tip:* long-acuminate, flexuose

*base:* basal cells longer than the blade cells; 1–2 rows of cells decurrent

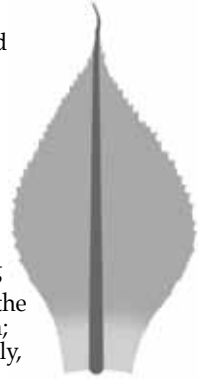
*costa:* ending below the apex or excurrent in the acumen

*border:* not differentiated

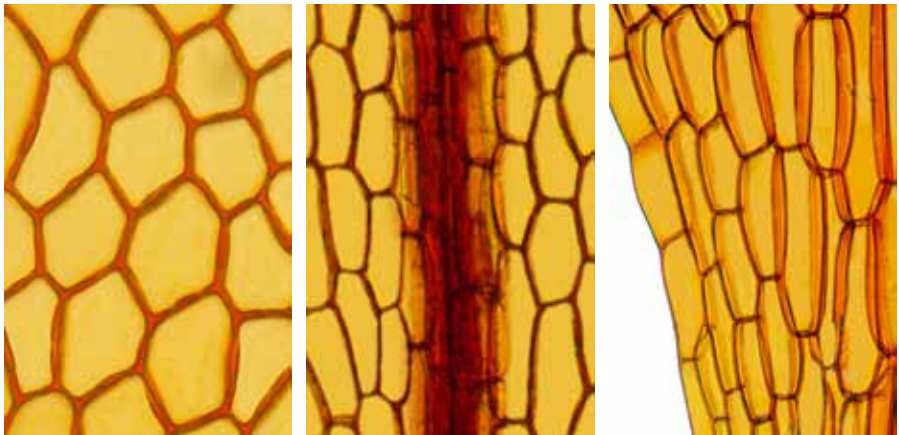
*margin:* strongly toothed to spinose, plane

*cells:* 50–120 × 20–60 μm, irregular to hexagonal, thin-walled, ± bulging

**capsule:** to 5 mm, ellipsoid, erect, long-necked, yellow to pale brown, the mouth narrow, upper neck stomatose; seta to 20 mm, yellow, smooth; calyptra mitrate, fimbriate; operculum conic; peristome exostome only, the teeth yellow, incurved when dry, completely closing the capsule mouth; spores 9–12 μm in diam., smooth



vegetative shoot (dry), leaf outline, leaf apex, and margin of upper leaf  
 1 mm, 0.5 mm, 100 μm, 50 μm



cells of upper leaf, costa at midleaf, and margin near leaf base  
 50 μm, 50 μm, 50 μm

continued next page

**Tayloria octoblepharum** (Hook.) Mitt.

**form:** densely tufted, erect, unbranched stems, 3–20 mm tall, matted with reddish or purple tomentum (smooth rhizoids)

**habitat:** dung, carcasses or bones, less often on bark, damp soil, or rock

**leaf:** size: 3.0–4.5 × 0.8–2.0 mm

*shape:* ovate-spathulate to elliptic; 1–2 rows of cells decurrent

*tip:* tapered to a long, slender, pigmented arista to 2 mm long

*base:* basal cells longer than the blade cells

*costa:* excurrent in the upper leaves in the flexuose awn

*border:* not differentiated

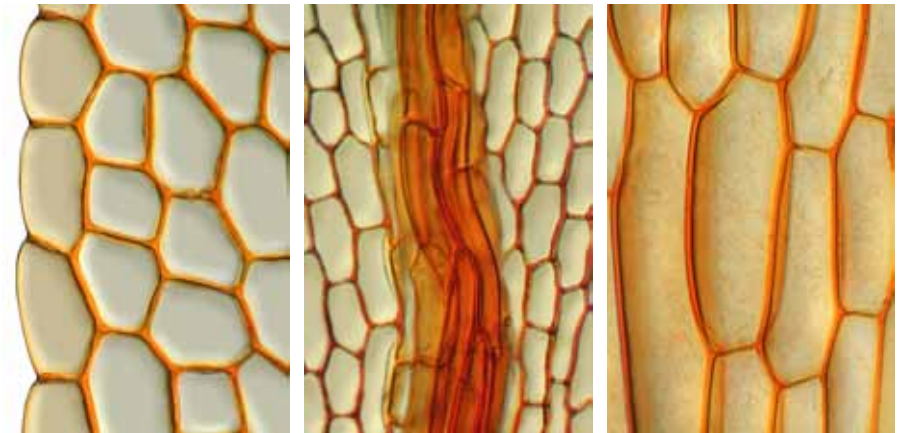
*margin:* entire to ± serrulate, recurved to revolute in midleaf

*cells:* 40–70 × 20–45 μm, oblong-hexagonal, thin-walled, smooth

**capsule:** 2–5 mm, fusiform, long-necked, yellowish, mouth narrow, purplish, the columella protruding from the urn at maturity; seta 3–15 mm, reddish; calyptra 4-lobed; peristome of 8 pairs of teeth reflexed against the mouth when dry; spores 12–15 μm in diam., smooth



fertile shoot (painting), capsules with and without a lid, leaf outline, and leaf apices (2)  
 5 mm, 1 mm (2), 0.5 mm, 100 μm (2)



margin midleaf, costa at midleaf, and leaf base cells  
 50 μm, 50 μm, 50 μm

continued next page

**Tayloria purpurascens** (Hook.f. & Wilson) Broth.

**form:** densely tufted, tomentose (red-brown, smooth rhizoids), glossy, erect, sparsely branched, wine-coloured stems, 15–40 mm tall

**habitat:** damp soil, animal droppings, decaying stumps, and rock

**leaf:** size: 2.3–3.3 × 1.0–2.5 mm

**shape:** broadly obovate

**tip:** abruptly tapered to a reflexed apiculus or long piliform point

**base:** basal cells rectangular; alar cells little differentiated

**costa:** failing below the apiculus

**border:** not differentiated

**margin:** ± denticulate toward the apex, entire below, plane

**cells:** 60–115 × 25–30 μm, hexagonal-rhombic, thin-walled, smooth

**capsule:** 3.5–6 mm, fusiform, erect, exserted, dark reddish brown; seta 10–25 mm, orange to reddish purple; operculum bluntly conic; calyptra 4-lobed at the base; peristome 8 pairs of teeth, erect when dry, incurved when moist; spores 8–14 μm in diam.



vegetative shoot, mature capsules (dry) (2), leaf outline, and leaf apex  
 1 mm, 1 mm, 0.5 mm, 0.5 mm, 1 mm



margin at midleaf, costa at midleaf, and young capsule and calyptra  
 50 μm, 50 μm, 1 mm, 0.1 mm

continued next page



**Tayloria tasmanica** (Hampe) Broth.

**form:** dense tufts of erect, sparsely branched, tomentose (dark red papillose thizoids) stems, female plants to 25 mm tall, males shorter

**habitat:** dung or wet soil in heathland, peatland, and alpine scrub, to 1200 m

**leaf:** size: 2.2–3.5 × 0.5–1.3 mm

*shape:* ovate-lanceolate

*tip:* tapering gradually to an acute or acuminate, ± reflexed tip

*base:* basal cells short- to long-rectangular

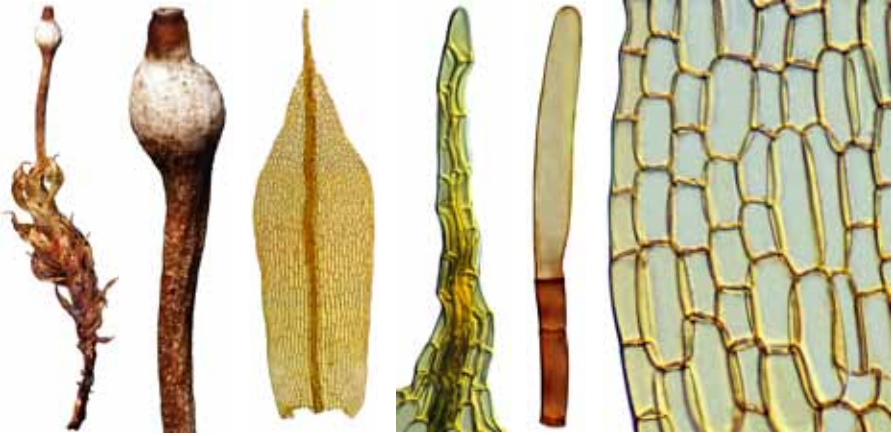
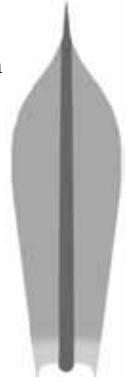
*costa:* percurrent or excurrent into a cusp or acumen, partially bistratose

*border:* not differentiated

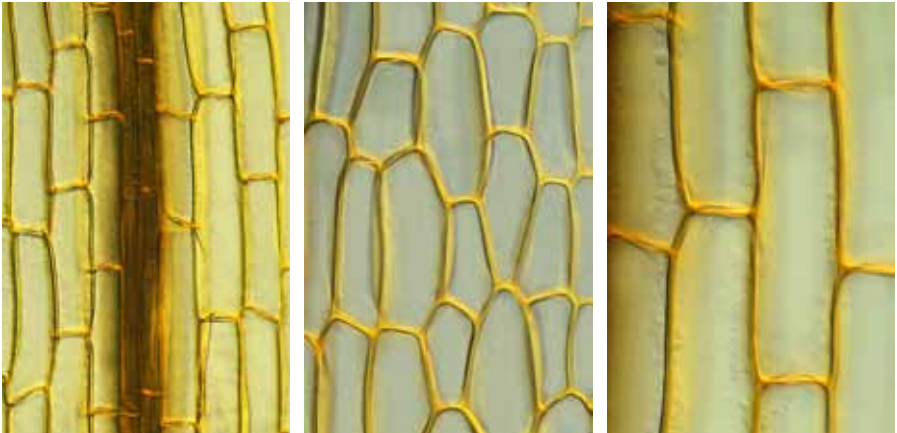
*margin:* entire, plane

*cells:* 30–80 × 15–45 μm, rectangular to ± hexagonal, thin-walled, smooth

**capsule:** to 1.2 mm, erect, exserted, with an inflated, ± globose, grey-white hypophysis; seta to 10 mm, rough below; peristome teeth 8, recurved when dry; spores 15–18 μm in diam., smooth



fertile shoot (dry), capsule (dry), leaf outline, leaf apex, club-hair, and margin midleaf  
 1 mm, 1 mm, 0.5 mm, 50 μm, 10 μm, 50 μm



costa midleaf, cells at midleaf, and cells near leaf base  
 50 μm, 50 μm, 50 μm

continued next page

**Leptobryum pyriforme** (Hedw.) Wilson

**form:** curves of slender, silky, pale,  $\pm$  unbranched, comose stems, radiculose below (reddish papillose rhizoids), pale green to yellowish, to 30 mm (sterile shoots)

**habitat:** damp soil or limestone, mostly in marshes, ditches, and glasshouses

**leaf:** size: 3.5–5.0  $\times$  0.8–1.0 mm

*shape:* subulate from a lanceolate base; perichaetial leaves much longer

*tip:* linear-setaceous subula, ending in an acute tip

*base:* alar region little differentiated

*costa:* wide, nearly filling the subula, percurrent

*border:* not differentiated

*margin:* entire or minutely denticulate above, plane

*cells:* 80–100  $\times$  8–10  $\mu$ m, linear, firm- to thin-walled, smooth

**capsule:** 1.5–2.5 mm, pyriform, inclined to pendent, wide-mouthed when empty, reddish brown and glossy when mature; seta 20–50 mm, slender, flexuose, reddish; operculum apiculate; peristome double; spores 10–13  $\mu$ m in diam.

**note:**  $\pm$  cosmopolitan, a NZ adventive, often invades flower-pots in glasshouses



vegetative shoot, capsule, operculum, calyptra, leaf outline, and leaf apex

■ 1 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 1 mm, ■ 10  $\mu$ m



upper leaf, margin in upper leaf, and margin in lower leaf

■ 10  $\mu$ m, ■ 10  $\mu$ m, ■ 10  $\mu$ m

**Meesia uliginosa** Hedw.

**form:** dense tufts of erect,  $\pm$  unbranched stems, tomentose, 20–50 mm

**habitat:** wet limey soil, peaty humus, or rarely rotting logs, to 1500 m

**leaf:** size: 1.0–3.2  $\times$  0.6 mm; hairs with pigmented bases abundant in axils

*shape:* lanceolate to oblong-lingulate, keeled above, not 3-ranked

*tip:* obtuse to broadly rounded

*base:* not decurrent; basal cells long-rectangular; alar cells not differentiated

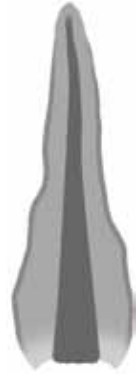
*costa:* subpercurrent, wide at base (half the leaf width), prominent abaxially

*border:* not differentiated

*margin:* entire to serrulate above, plane to recurved in midleaf

*cells:* 20–40  $\times$  9–13  $\mu$ m, oblong to rectangular, firm-walled, smooth

**capsule:** 1.5–4 mm, erect, clavate-pyriform, curved, long-necked, the neck wrinkled when dry; seta 15–40 mm; operculum bluntly conic; calyptra cucullate, smooth, naked; peristome double, the exostome teeth 16, reduced, the endostome segments 2–4 times longer, keeled, perforate, smooth; spores 45–55  $\mu$ m in diam., papillose



fertile shoot (dry), capsule, vegetative shoots (moist), leaf outline, and leaf apex

5 mm, 1 mm, 1 mm, 0.5 mm, 50  $\mu$ m



margin at midleaf, costa terminus, and leaf basal angle

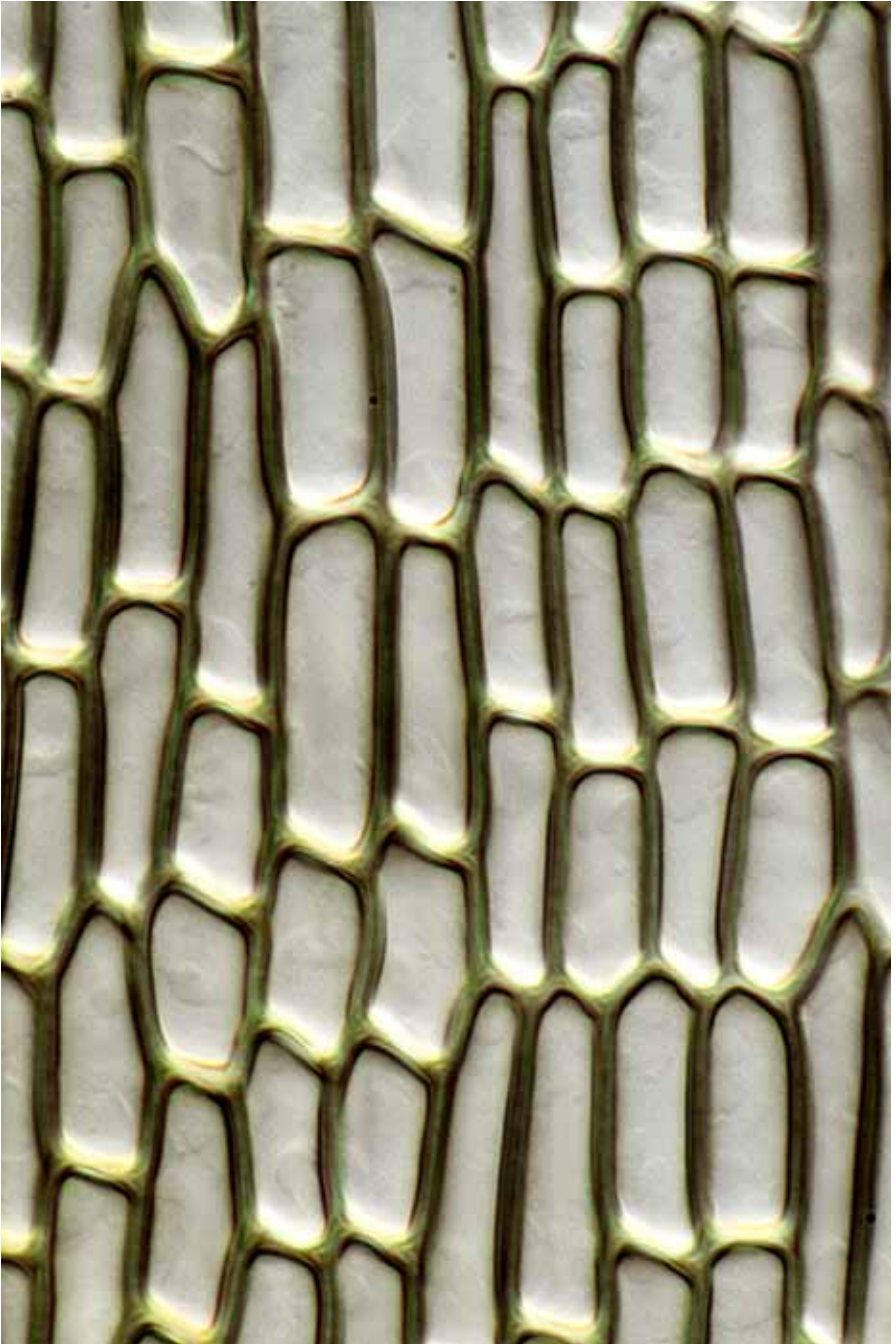
10  $\mu$ m, 50  $\mu$ m, 50  $\mu$ m

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*Meesia uliginosa* axillary hairs showing 2-3 pigmented basal cells  
10  $\mu$ m

continued next page



*Meesia uliginosa* lamina cells midleaf  
10  $\mu\text{m}$

**Pulchrinodus inflatus** (Hook.f. & Wilson) B.H.Allen

**form:** loosely matted, ± erect, sparsely branched stems, not tomentose, 10–50(–300) mm, with foliose-ciliate pseudoparaphyllia, the leaves papery, glossy, golden, and translucent

**habitat:** exposed damp soil, on volcanic rocks or in scrub in geothermal areas, to 1000 m

**leaf:** size: 5–8 × 2–3 mm, rugose-wrinkled wet or dry

**shape:** elliptic to narrowly ovate, concave, undulate, markedly papery

**tip:** acute with hyaline hair-point

**base:** alar regions hyaline, base pigmented at the insertion; axillary filaments 6–8 cells long, the basal cells pigmented; pseudoparaphyllia foliose-ciliate

**costa:** none or short and double

**border:** not differentiated

**margin:** entire to denticulate, convolute above, incurved below

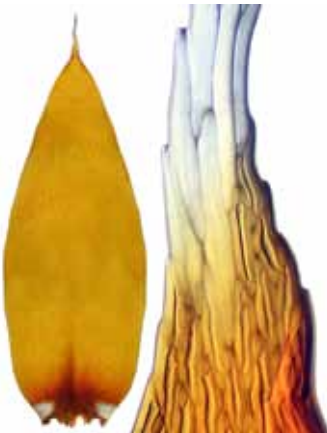
**cells:** 60–120 × 7–9 μm, rhombic-linear, incrassate, strongly porose, smooth

**capsule:** unknown



habit (dew-wetted) and fully hydrated shoots (2)

50 mm, 10 mm, 10 mm



leaf outline, base of hair-point, porose cells at midleaf, and alar region

1 mm, 10 μm, 10 μm, 10 μm

continued next page



*Pulchrinodus inflatus* vegetative habit (moist) (Rangitoto Island)  
5 mm

**Key\* to the New Zealand genera of Bryaceae (5)**

- 1 Main stems or innovations julaceous.....2  
 1: Main stems or innovations not julaceous .....3
- 2(1) Costa failing well below the leaf apex; apex rounded ..... **Plagiobryum**  
 2: Costa usually excurrent, but at least subpercurrent; leaf apex mostly acute ..... **Bryum**
- 3(1:) Plants rosulate; most leaves wider above midleaf..... **Rosulabryum**  
 3: Plants not rosulate; most leaves wider below midleaf .....4
- 4(3:) Propagula in leaf axils or underground ..... **Gemmabryum**  
 4: Propagula usually absent.....**Ptychostomum**

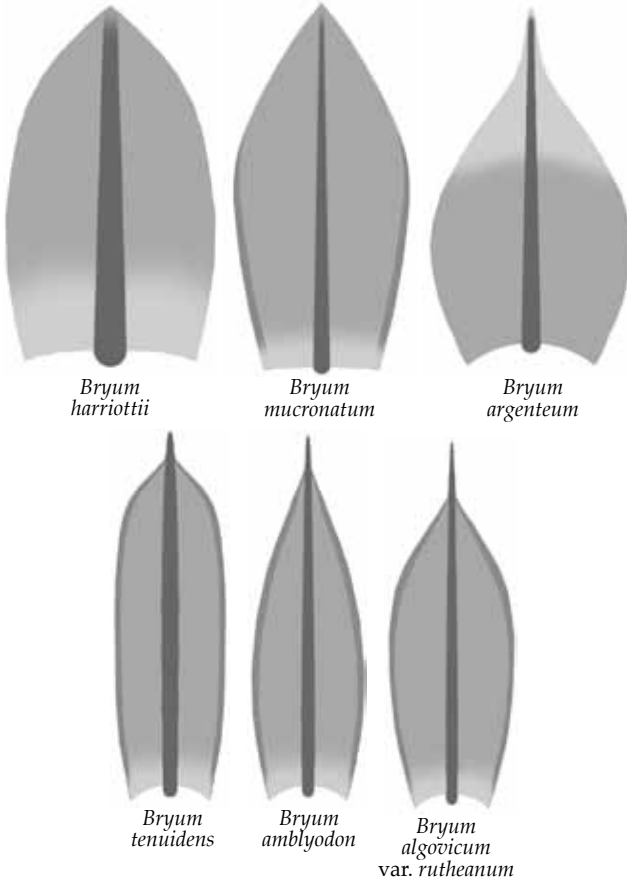
\* based partly on Spence, JR (2011): Bryaceae. Bryophyte Flora of North America, (provisional publication), BFNA web-site.

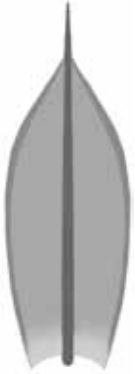


**Key\* to the New Zealand species and infraspecies of *Bryum* (6)**

- 1 Plants silvery from hyaline leaf tips ..... ● ***Bryum argenteum***  
 1: Plants not silvery ..... 2
- 2(1:) Leaf distinctly bordered ..... 3  
 2: Leaf not or only faintly bordered ..... ● ***Bryum harriottii***
- 3(2) Costa failing below the apex to percurrent ..... ● ***Bryum mucronatum***  
 3: Costa excurrent ..... 4
- 4(3:) Vertical and oblique joins clearly visible between adjacent transverse articulations  
 of the exostome teeth ..... ● ***Bryum algovicum* var. *rutheanum***  
 4: Joins between adjacent transverse articulations of the exostome teeth either absent or  
 obscure ..... 5
- 5(4:) Leaves ovate-lanceolate to lanceolate; margin recurved ..... ● ***Bryum amblyodon***  
 5: Leaves oblong; margin plane ..... ***Bryum tenuidens***

\* based partly on Smith, AJE; Smith, R (1978): *The Moss Flora of Britain and Ireland*.  
 Cambridge University Press, Cambridge, 384.



**Bryum algovicum** var. **rutheanum** (Warnst.) Crundw.**form:** tufts of erect, ± green, comose stems to 15 mm, often radiculose below**habitat:** sandy and basic soils or rock walls and crevices in dry, exposed sites**leaf:** size: 0.8–2.0 × 0.3–0.7 mm**shape:** ovate to lanceolate, slightly concave, not decurrent**tip:** acuminate**base:** basal cells rectangular, longer than other lamina cells**costa:** excurrent in a long narrow cusp**border:** 2–4 rows of linear, dark, thicker-walled cells**margin:** entire to ± denticulate above, recurved**cells:** 40–60 × 20 μm, hexagonal to rectangular, thin-walled, smooth**capsule:** 2–3 mm, pyriform, pendent, symmetric, red-mouthed; seta 10–30 mm; operculum apiculate; exostome strongly attached to endostome and thus appearing chambered; endostome processes ovately perforate; spores 22–35 μm in diam., strongly papillose, light brown**notes:** no tubers, gemmae, or other specialized asexual structures

vegetative shoots (dry), mature capsule, peristome tooth, leaf outline, and leaf apex (2)  
 1 mm, 1 mm, 1 mm, 50 μm, 0.1 mm, 50 μm, 50 μm



margin below midleaf, costa midleaf, and leaf basal angle  
 50 μm, 50 μm, 50 μm

continued next page



*Bryum algovicum* var. *rutheanum* mature capsule and "chambered" exostome tooth  
1 mm, 10  $\mu$ m

**Bryum amblyodon** Müll.Hal.

**form:** erect, strongly branching, turf-forming stems, 15–23 mm tall, comose, green to yellowish above, reddish below with papillose rhizoids

**habitat:** on thin soil over calcareous rock or in boulder fields up to 1470 m

**leaf:** size: 2–4 × 0.8–1

*shape:* oblong-lanceolate, erect when moist, twisted around stem when dry

*tip:* abruptly acuminate, with a narrow, often red-pigmented awn

*base:* basal cells ± red-pigmented, base weakly decurrent on both sides

*costa:* strong, merging with borders at apex, excurrent and filling the awn

*border:* 3–6 rows of linear, thick-walled cells

*margin:* entire to minutely denticulate, ± recurved at margins

*cells:* 50–75 × 15–18 μm, oblong-hexagonal, thin-walled, smooth

**capsule:** to 4 mm long, half of it neck, pendent, clavate, reddish; operculum

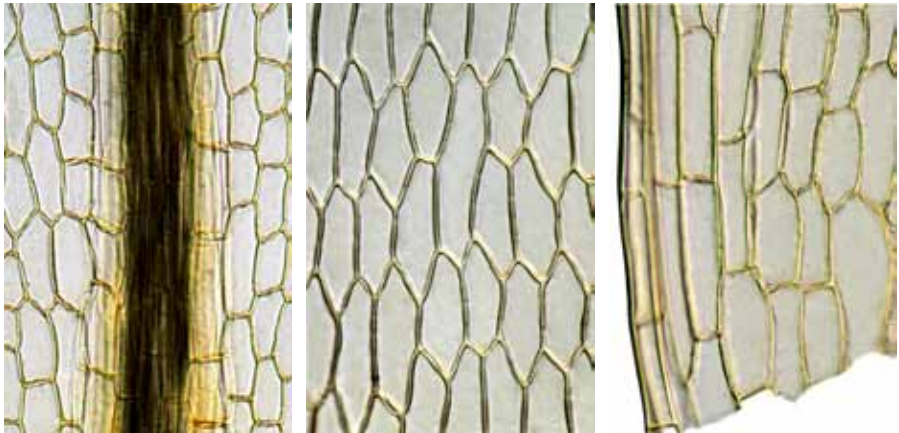
conic; exostome brownish, acuminate, lamellate; endostome from a high membrane, the segments fenestrate, as tall as the exostome, lacking cilia

**note:** inflorescences are irregular mixtures of male and female (synoicy)



vegetative shoots (dry), leaf apex (2), subapex, leaf outline, and margin above midleaf

■ 1 mm, ■ 1 mm, ■ 50 μm, ■ 10 μm, ■ 10 μm, ■ 1 mm, ■ 10 μm



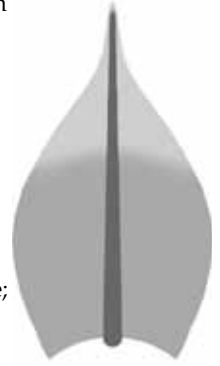
costa, lamina cells, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

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*Bryum amblyodon* midleaf border  
10  $\mu\text{m}$

**Bryum argenteum** Hedw.**form:** cushions of erect, julaceous stems, 5–20 mm, leaves silvery green**habitat:** soil, rock, concrete, asphalt, tiles, in disturbed sites, to 2300 m**leaf:** size: 0.6–0.9 × 0.4 mm*shape:* ovate, concave, the upper third of the leaf hyaline*tip:* acute to acuminate*base:* not decurrent; basal cells mostly quadrate, thin-walled*costa:* failing below the apex or disappearing in the acumen*border:* not differentiated*margin:* entire, plane*cells:* 40–70 × 12–15 μm, rhombic, thin-walled, smooth**capsule:** 0.9–2.0 mm, oblong-cylindric, reddish, ± pendent, the neck short and wrinkled; seta 8–20 mm, red; operculum convex, apiculate; peristome double, the exostome teeth 16, bordered, endostome segments 16, with cilia; spores 9–15 μm in diam., smooth**notes:** cosmopolitan; said to be the most abundant plant in the world

fertile habit, vegetative habit, and julaceous shoots

1 mm, 1 mm, 1 mm



leaf outline, margin at midleaf, and costa at midleaf

0.1 mm, 10 μm, 10 μm

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*Bryum argenteum* vegetative habit (moist)  
1 mm

continued next page



**Bryum harriottii** R.Br.ter

**form:** curves of branched, julaceous, erect stems, 5–20 mm, the leaves bright green

**habitat:** damp soil and wet rock or soil-filled crevices, to 1359 m

**leaf:** size: 0.6–1.0 × 0.4–0.6 mm

**shape:** ovate to orbicular, strongly concave

**tip:** rounded

**base:** not decurrent; basal cells rectangular

**costa:** red toward the base, failing shortly below the apex

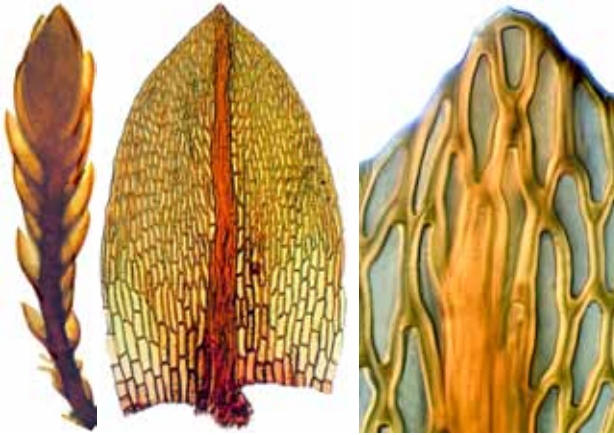
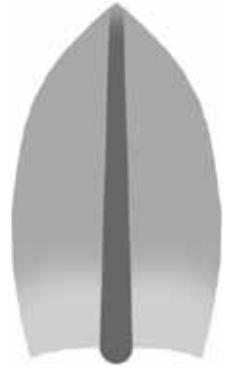
**border:** not differentiated

**margin:** entire, plane

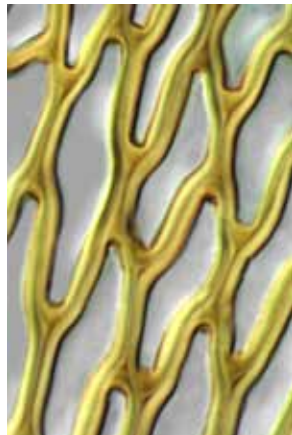
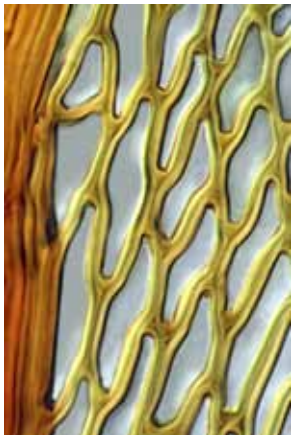
**cells:** 21–30 × 10–12 μm, rhombic-hexagonal, thick-walled, smooth

**capsule:** 2–3 mm, ovate-pyriform, narrow-necked, nodding; seta 10–20 mm; peristome bryoid, cilia absent or reduced; spores 22–30 μm in diam.

**note:** *Bryum argenteum* differs in having a silvery leaf tip



vegetative shoot, leaf outline, leaf apex, and margin midleaf  
 0.5 mm, 0.1 mm, 10 μm, 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Bryum harriottii* capsules (dry)

1 mm

continued next page

**Bryum mucronatum** Mitt.

**form:** tufts or turves of erect, branched, comose, radiculose stems, to 14 mm  
**habitat:** soil over rock, alpine, 1000–1800 m

**leaf:** size: 2–3 × 1 mm (upper comose leaves)

*shape:* ovate to oblong-ovate

*tip:* acute, ± mucronate

*base:* basal cells rectangular, hyaline

*costa:* percurrent to shortly excurrent in a mucro

*border:* 2–3 rows of elongate, firm-walled cells

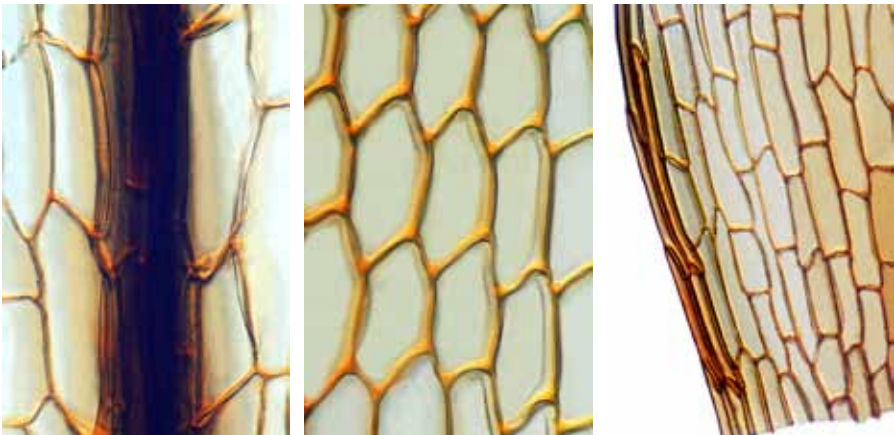
*margin:* entire, plane above, recurved below

*cells:* 70–90 × 20–30 μm, rectangular to hexagonal, thin-walled, smooth

**capsule:** 3–5 mm, pyriform, long-necked, ± horizontal, long-exserted, red-brown; seta 15–30 mm; operculum apiculate; peristome double; exostome teeth yellowish; endostome segments perforate; cilia 2–3; spores 21–30 μm in diam.

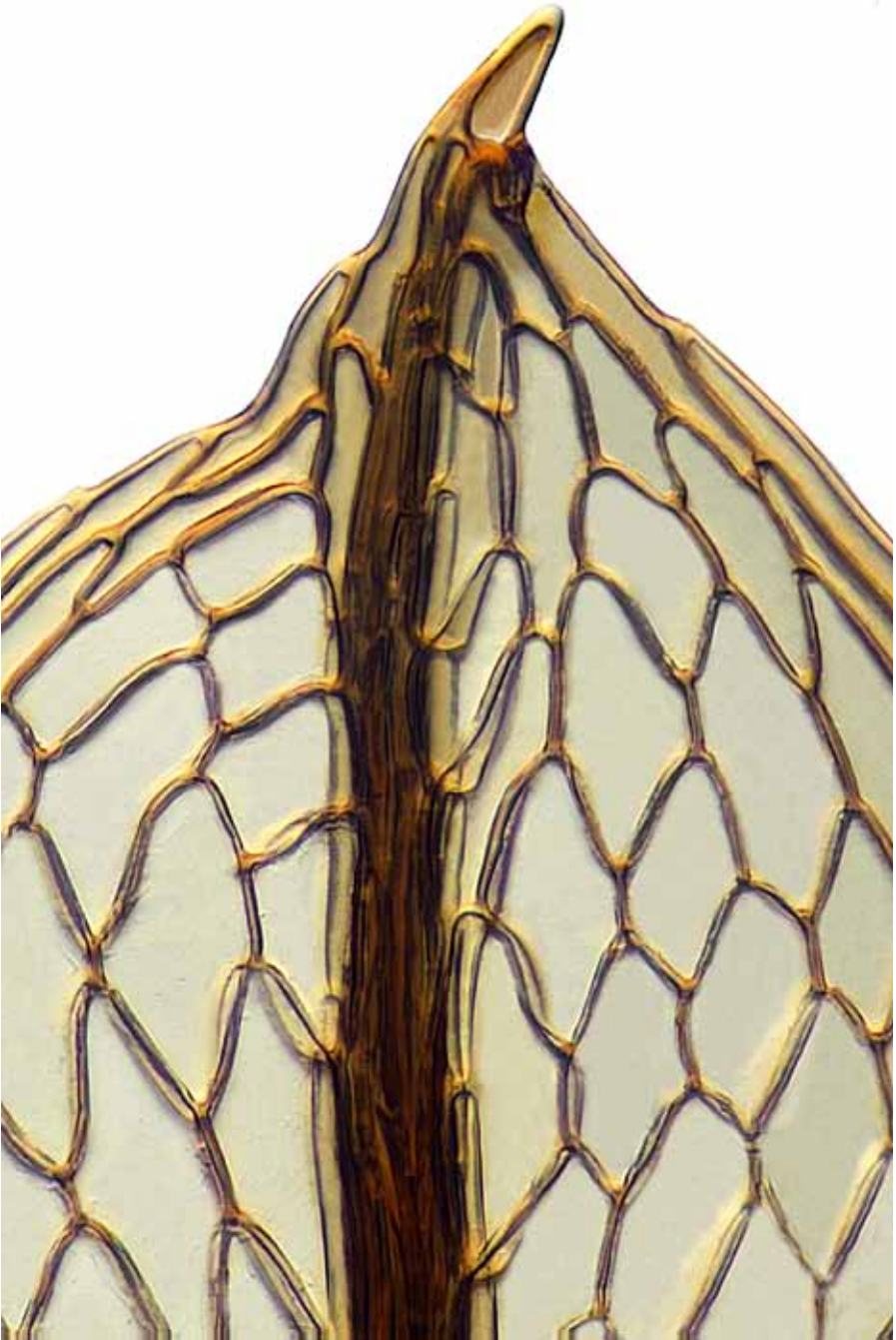


fertile shoot (dry), capsule (dry), leaf outline, leaf apex, and margin midleaf  
 5 mm, 1 mm, 0.5 mm, 50 μm, 50 μm



costa at midleaf, cells at midleaf, and leaf basal angle  
 50 μm, 50 μm, 50 μm

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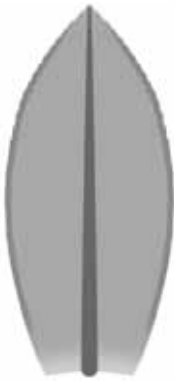


*Bryum mucronatum* leaf apex  
10  $\mu\text{m}$

Key\* to the New Zealand species of *Gemmabryum* (14)

- 1 Cells in the upper third of the lamina angled away from the costa at 20–45°; lower lamina cells rectangular; transition from upper to lower cells gradual; asexual gemmae usually lacking ..... 2
- 1: Cells in the upper third of the lamina not angled away from the costa; lower lamina cells subquadrate to short-rectangular; transition from upper to lower cells abrupt; asexual gemmae usually present (rhizoidal or stem tubers or axillary bulbils) ..... 4
- 2(1) Stems taller than 20 mm; costa percurrent; leaf apex obtuse to broadly acute ..... ● *Gemmabryum laevigatum*
- 2: Stems shorter than 20 mm; costa excurrent as a short stout point; leaf apex acute ..... 3
- 3(2): At least the lower half of the leaf bordered, weakly concave; leaves equidistant on the stem; plants often encrusted with carbonates ..... ● *Gemmabryum clavatum*
- 3: Leaf not bordered, strongly concave; leaves in imbricate comal tufts on the stem; plants not encrusted with carbonates ..... ● *Gemmabryum crassum*
- 4(1): Rhizoidal tubers present ..... 5
- 4: Rhizoidal tubers lacking ..... 11
- 5(4) Leaves strongly imbricate when moist ..... ● *Gemmabryum australe*
- 5: Leaves erect-spreading when moist ..... 6
- 6(5): Tubers mostly < 100  $\mu\text{m}$  long ..... ● *Gemmabryum sauteri*
- 6: Tubers mostly > 120  $\mu\text{m}$  long ..... 7
- 7(6): Leaves bordered; plants usually tinted red ..... ● *Gemmabryum rubens*
- 7: Leaves not bordered; plants green, brown, or golden ..... 8
- 8(7): Tuber cells distinctly protuberant ..... ● *Gemmabryum chrysonuron*
- 8: Tuber cells not protuberant ..... 9
- 9(8): Tubers golden-yellow ..... *Gemmabryum tenuisetum*
- 9: Tubers red, red-purple, or red-brown ..... 10
- 10 Rhizoids yellowish to brown ..... ● *Gemmabryum radiculosum*
- 10: Rhizoids deep violet or purple, rarely reddish ..... ● *Gemmabryum ruderale*
- 11(4): Bulbils in axils of upper leaves of sterile stems ..... 12
- 11: Bulbils lacking ..... 13
- 12(11) Leaves ovate-lanceolate; capsule neck gradually tapered to the seta ..... ● *Gemmabryum dichotomum*
- 12: Leaves lanceolate to triangular; capsule neck abruptly contracted to the seta ..... ● *Gemmabryum coronatum*
- 13(11): Leaves comose, 2–3 mm long; costa thin; border 3–5 rows of firm-walled cells that fuse with the acumen at the leaf tip; lamina cells 45–60  $\times$  12–15  $\mu\text{m}$  ..... ● *Gemmabryum caespiticium*
- 13: Leaves not comose, 0.4–1.0 mm long; costa stout; border weak, with cells slightly narrower than other lamina cells; lamina cells 30–40  $\times$  2–4  $\mu\text{m}$  ..... ● *Gemmabryum preissianum*

\* based on Spence, JR; Ramsay, HP (2006): *Bryaceae. Flora of Australia* 51, 288



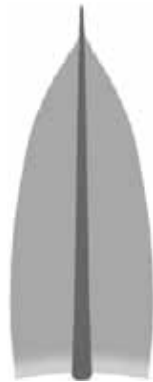
*Gemmabryum  
laevigatum*



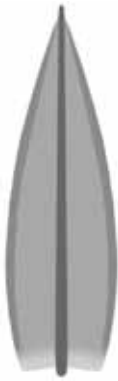
*Gemmabryum  
dichotomum*



*Gemmabryum  
clavatum*



*Gemmabryum  
rubens*



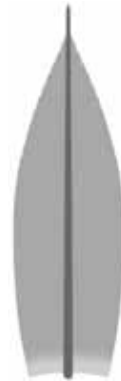
*Gemmabryum  
crassum*



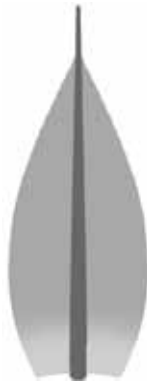
*Gemmabryum  
australe*



*Gemmabryum  
sauteri*



*Gemmabryum  
chrysoneuron*



*Gemmabryum  
coronatum*



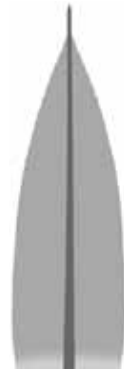
*Gemmabryum  
caespiticium*



*Gemmabryum  
radiculosum*



*Gemmabryum  
ruderale*



*Gemmabryum  
tenuisetum*



*Gemmabryum  
preissianum*

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*Gemmabryum* sp. male shoots  
1 mm

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**Gemmabryum australe** (Hampe) J.R.Spence & H.P.Ramsay

**form:** densely tufted, erect, ± branched, imbricate stems, 10–20 mm tall  
**habitat:** silty soil in open stony river beds

**leaf:** size: 1.5 mm

*shape:* ovate-lanceolate

*tip:* narrowly acuminate

*base:* basal cells short-oblong to subquadrate; alar cells not differentiated

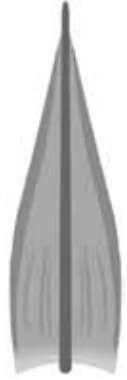
*costa:* excurrent in a weakly denticulate arista

*border:* weak, 1–2 rows of long, narrow cells

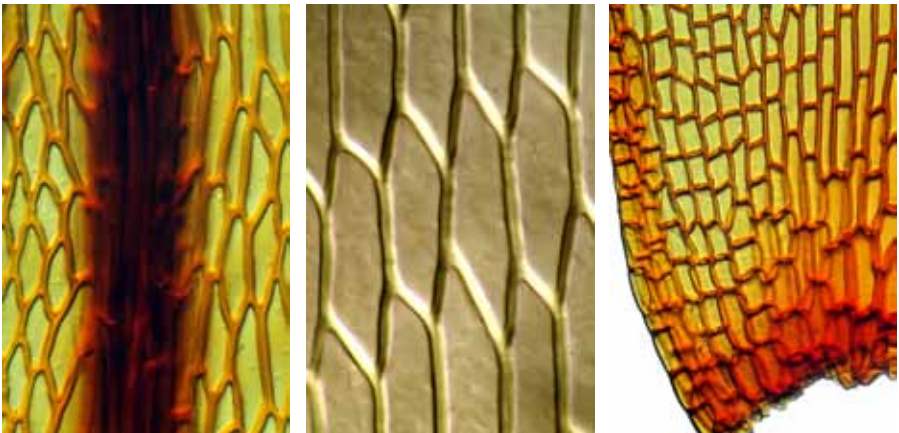
*margin:* entire, revolute throughout

*cells:* 25–35 × 6–12 μm, rhombic-hexagonal, firm-walled, smooth

**capsule:** 2–2.5 mm, pyriform or oval, pendent, long-exserted, purple-brown; seta 15–25 mm, slender, flexuose, purplish; operculum apiculate, deep purple, glossy; peristome double, exostome teeth orange-yellow, hyaline-bordered, endostome segments perforate, cilia 2–3; spores 7–8 μm in diam., smooth



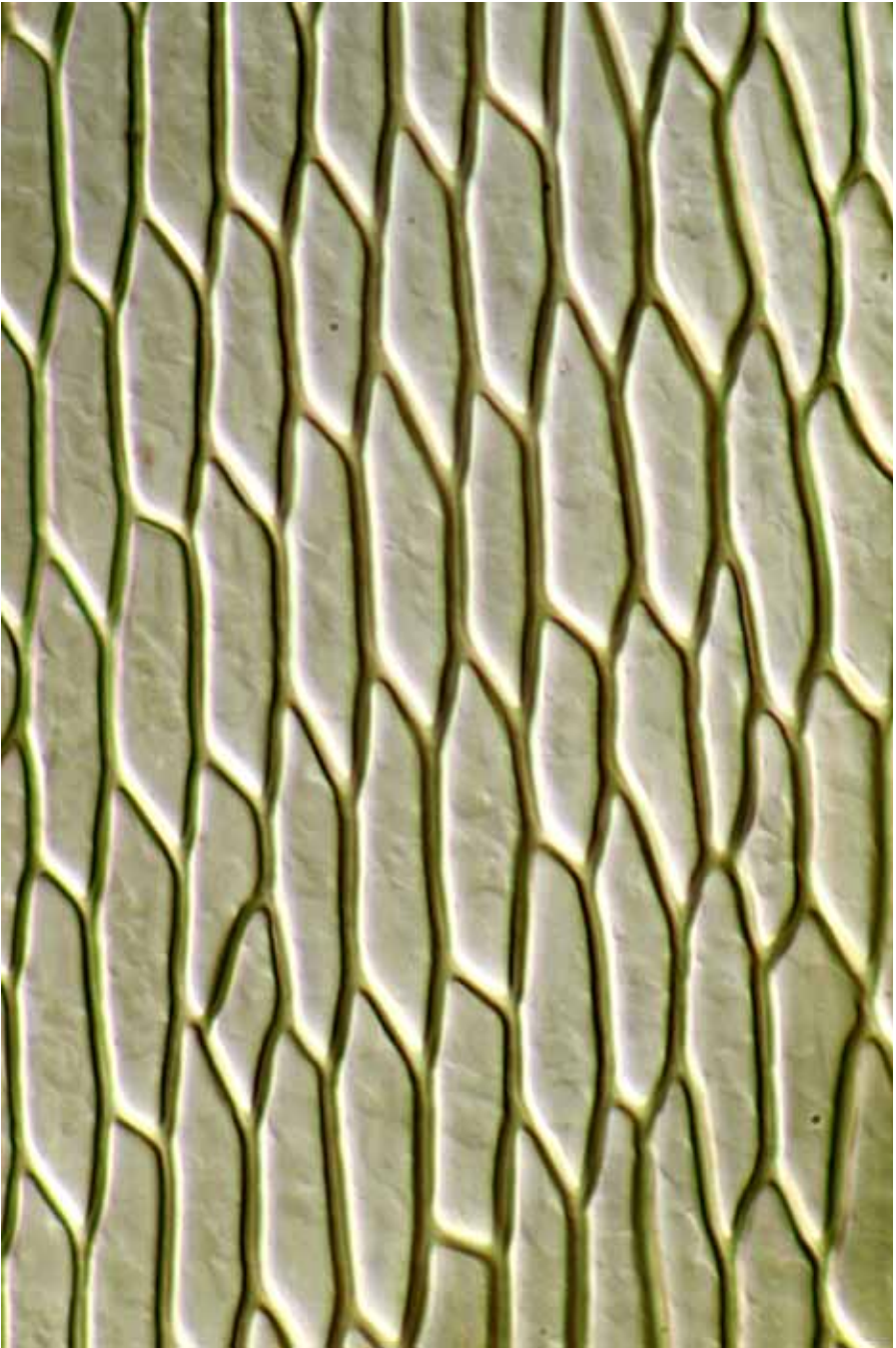
vegetative shoots (dry) (2), leaf outline, leaf apex (2), and revolute margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 50 μm, ■ 50 μm, ■ 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page





*Gemmabryum australe* cells midleaf  
10  $\mu\text{m}$

continued next page

**Gemmabryum caespiticium** (Hedw.) J.R.Spence

**form:** tufts of simple, erect, comose, radiculose, red stems, to 8 mm, the leaves yellow-green, glossy

**habitat:** soil of tussockland, riverbeds, lawns, or disturbed sites, to 950 m

**leaf:** size: 1.5–2.8 mm

*shape:* oblong to ovate-lanceolate

*tip:* long-acuminate

*base:* not decurrent; alar cells inflated, thin-walled, red-pigmented

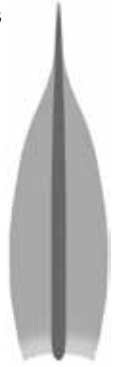
*costa:* reddish at base; excurrent in the acumen

*border:* 3–5 rows of elongate, firm-walled cells that fuse with the acumen cells

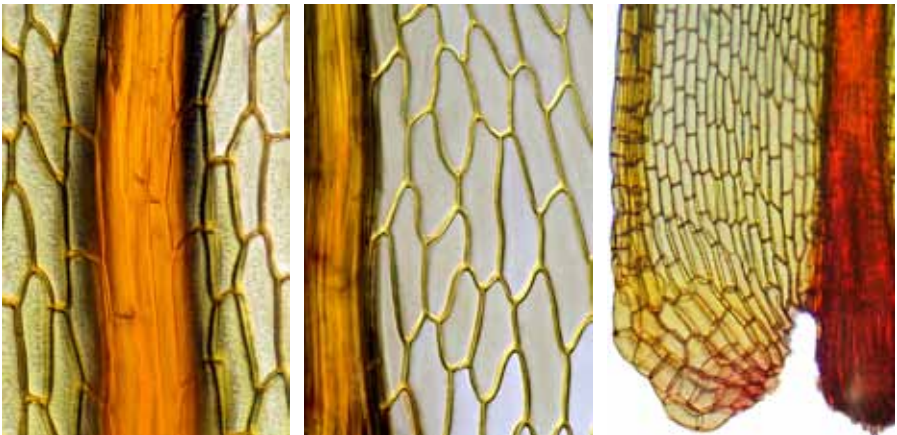
*margin:* entire below, minutely denticulate above, ± recurved

*cells:* 45–60 × 12–15 μm, rhombic-hexagonal, firm-walled, smooth

**capsule:** 2–3 mm, clavate, short-necked, pendent, long-exserted, reddish; seta 20–45 mm; operculum conic, apiculate; peristome double; exostome teeth yellow; endostome segments perforate; cilia 2–3; spores 9–16 μm in diam.



vegetative shoot (dry), leaf outline, leaf apex, leaf subapex, and margin midleaf  
 1 mm, 0.5 mm, 50 μm, 50 μm, 10 μm



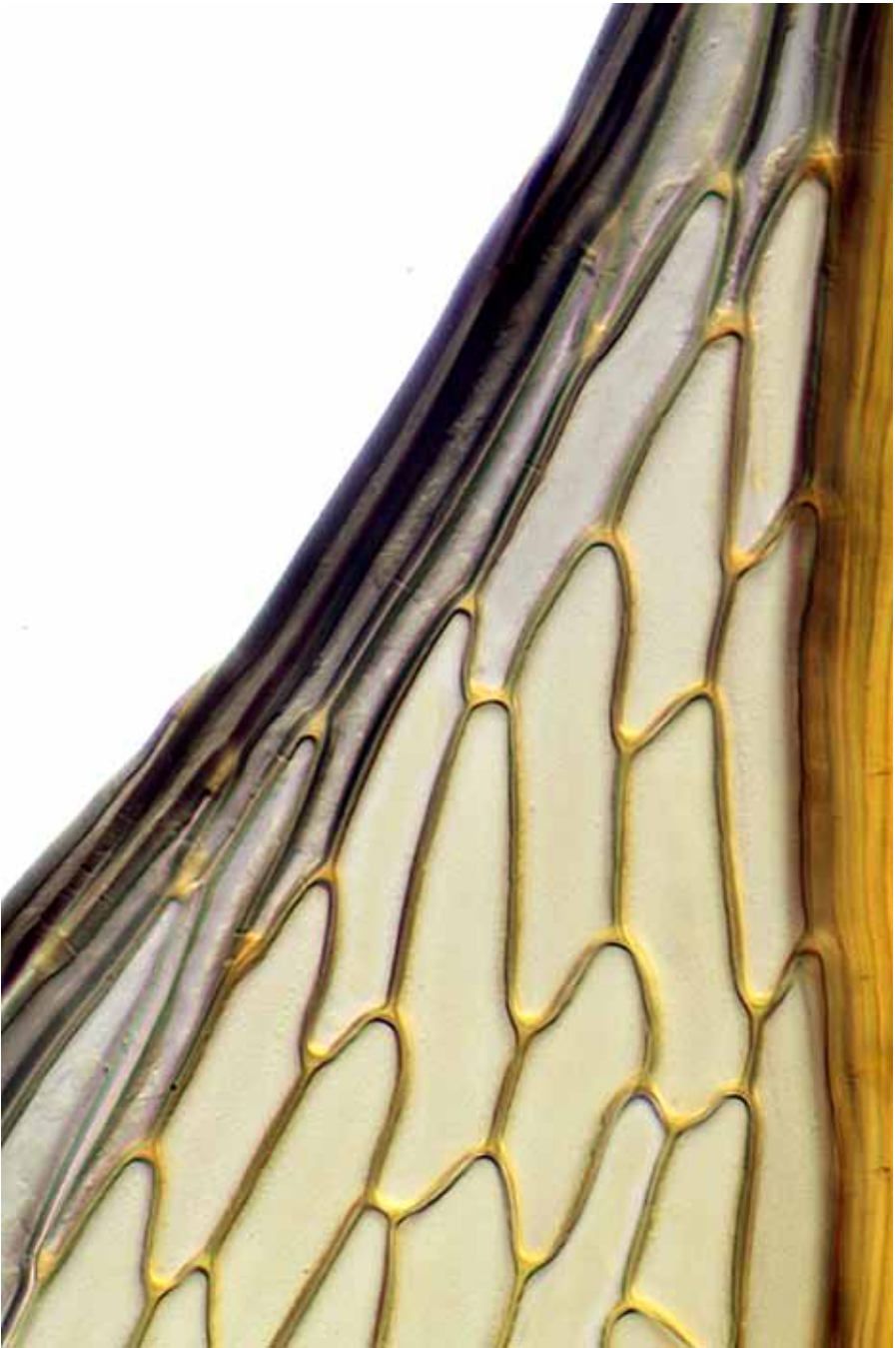
costa midleaf, juxtacostal cells midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

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*Bryum caespiticium* vegetative shoots (dry)  
1 mm

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*Bryum caespiticium* margin of upper leaf  
10  $\mu\text{m}$

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**Gemmabryum chryseuron** (Müll.Hal.) J.R.Spence & H.P.Ramsay

**form:** tufts of erect, yellowish, red-tinged, glossy stems, 5–15 mm; tubers red, > 500  $\mu\text{m}$  long, with bulging cells

**habitat:** soil or soil over rock, often coastal

**leaf:** size: 1.0–1.5 mm

*shape:* ovate-lanceolate to narrowly lanceolate

*tip:* acute to acuminate

*base:* juxtacostal basal cells short-rectangular, marginal cells quadrate

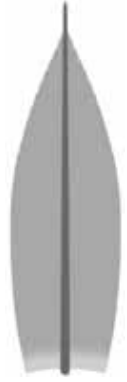
*costa:* strong, long-excurrent in a cusp, yellow

*border:* absent or weak, 1–2 rows of long, narrow cells

*margin:* entire below, finely serrulate above, plane to revolute below

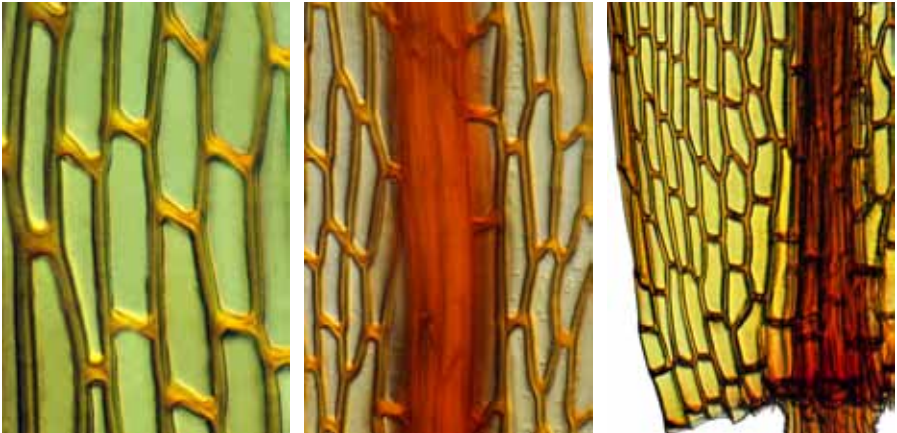
*cells:* 40–60  $\times$  10–15  $\mu\text{m}$ , rhombic, firm-walled, smooth

**capsule:** 2–3 mm, clavate, pendent, exserted, red-brown; seta 15–40 mm, purple-red; operculum apiculate; peristome double, exostome teeth hyaline-bordered, endostome basal membrane tall, segments gaping, cilia 2; spores 10–13  $\mu\text{m}$  in diam., smooth



vegetative shoot (dry), leaf outline, leaf apex, and margin midleaf

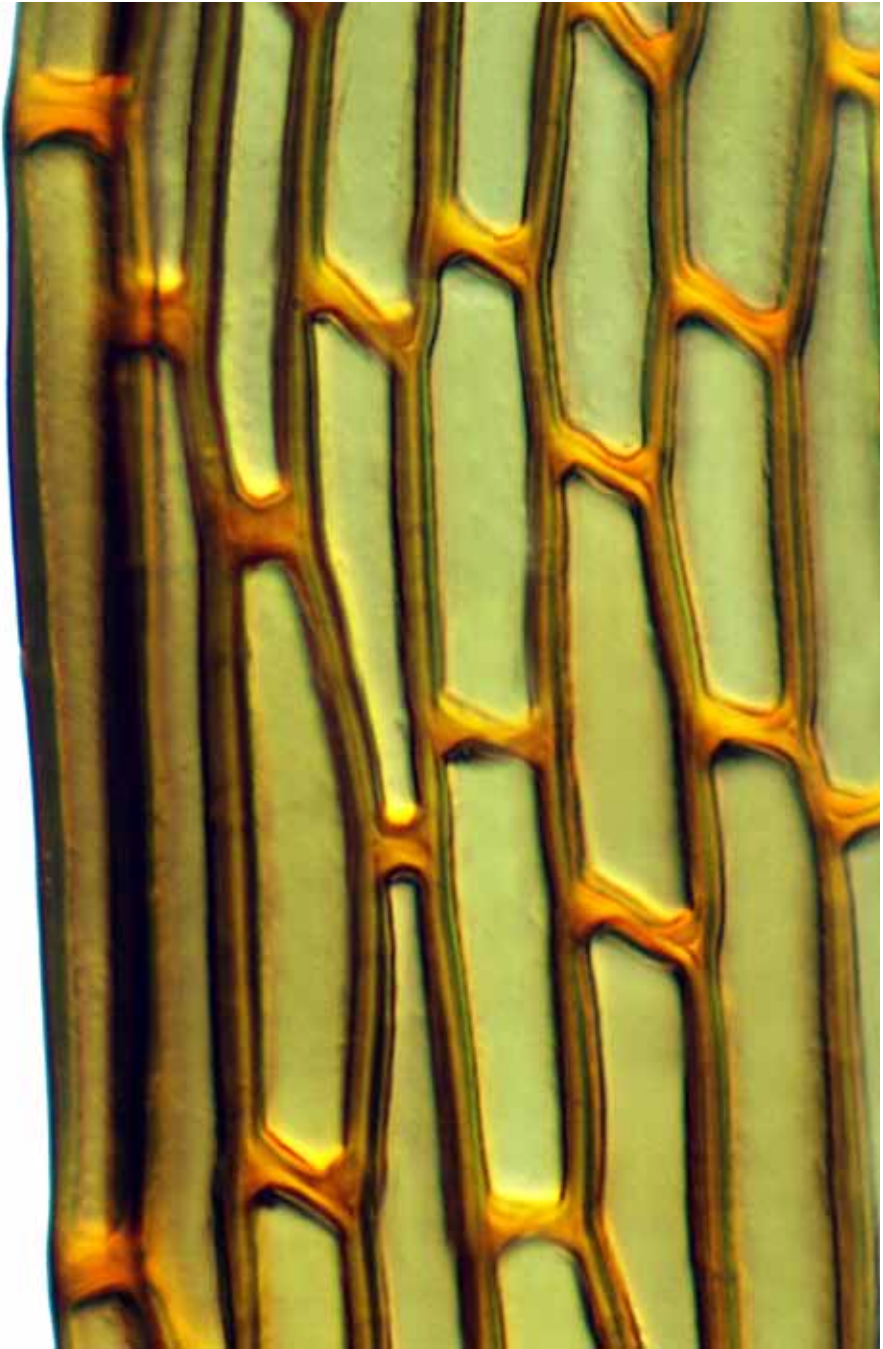
1 mm, 0.1 mm, 100  $\mu\text{m}$ , 10  $\mu\text{m}$



cells at midleaf, costa at midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Gemmabryum chryseurum* margin midleaf  
10  $\mu\text{m}$

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**Gemmabryum clavatum** (Schimp.) J.R.Spence & H.P.Ramsay

**form:** cushions or tufts of erect, branched, tomentose, red-tinged stems, 10 mm; tubers globose, red-brown, 75–150  $\mu\text{m}$  long

**habitat:** soil or rock in open,  $\pm$  wet sites, with other mosses, to 1220 m

**leaf:** size: 1.0–2.0  $\times$  0.5–0.9 mm

*shape:* oblong-lanceolate,  $\pm$  concave

*tip:* acute, cuspidate

*base:* basal cells quadrate

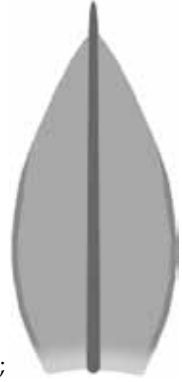
*costa:* shortly excurrent as a rigid reddish or brownish cusp

*border:* 1–3 midleaf rows of narrow, incrassate,  $\pm$  pigmented cells

*margin:* entire, plane

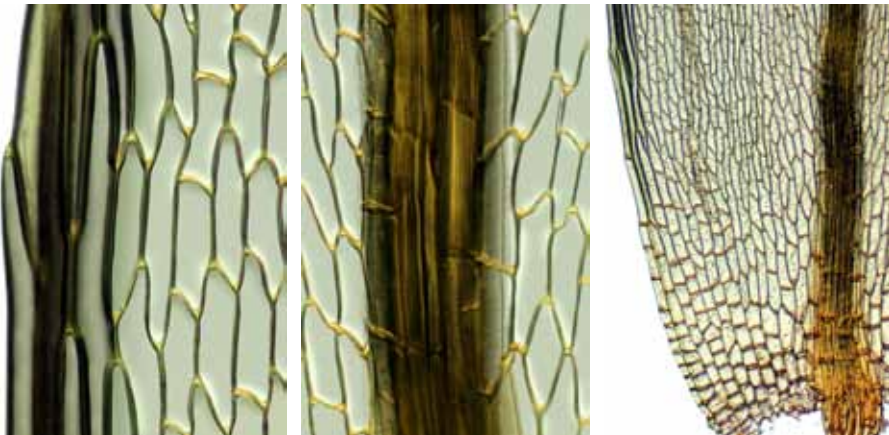
*cells:* 27–45  $\times$  9–12  $\mu\text{m}$ , oblong-hexagonal, firm-walled, smooth

**capsule:** 2–4 mm, elongate-clavate, subpendent, curved, apophysate, exserted, red-purple; seta 10–20(–40) mm; operculum conic; peristome double, endostome cilia variable from rudimentary to fully developed; spores 12–27  $\mu\text{m}$  in diam.



vegetative shoots (dry) (2), capsule (dry), leaf outline, and leaf apex

1 mm, 1 mm, 0.5 mm, 0.5 mm, 50  $\mu\text{m}$



margin at midleaf, costa at midleaf, and leaf basal angle

50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 100  $\mu\text{m}$

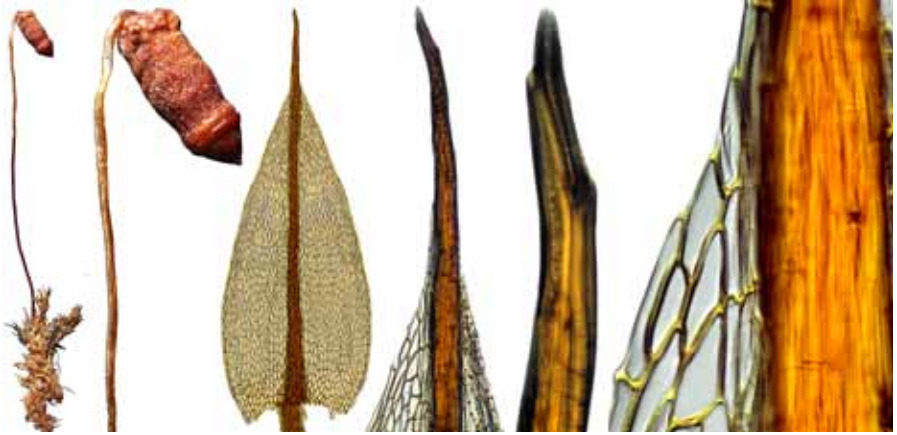
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*Gemmabryum clavatum* margin midleaf  
10  $\mu$ m

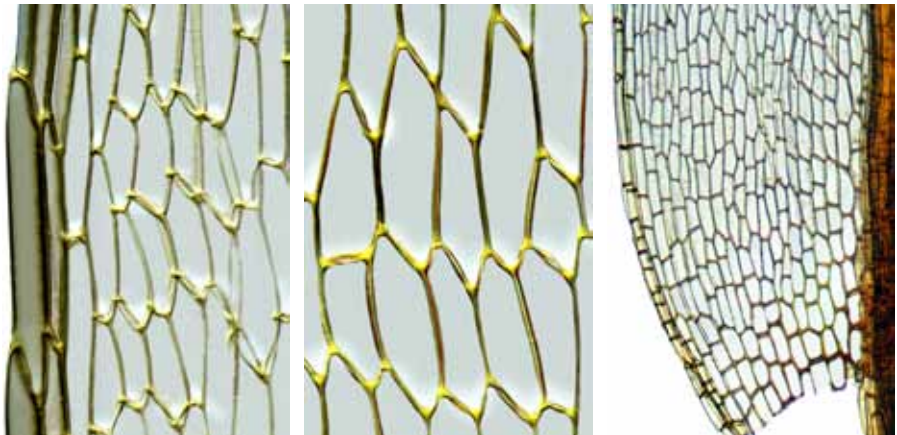
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**Gemmabryum coronatum** (Schwägr.) J.R.Spence & H.P.Ramsay**form:** curves of erect, sparsely branched, radiculose stems, 5–15 mm**habitat:** soil, lignum, or rock in open, disturbed or burnt sites, to 500 m**leaf:** size: 0.6–1.5 × 0.4–0.6 mm*shape:* oblong to ovate-lanceolate, ± concave*tip:* acute to acuminate, ending in a nearly smooth hair-point*base:* not decurrent; basal cells ± quadrate; leafy bulbils in axils*costa:* excurrent in the cusp*border:* weak, 2–4 rows of narrow, dark cells*margin:* entire to weakly serrulate above, recurved in the lower half*cells:* 30–60 × 8–12 μm, ± rhombic, firm-walled, smooth**capsule:** 1.6–1.8 mm, oblong, cernuous to pendent, exserted, reddish brown, the neck wider than the urn, warty when dry; seta 8–14 mm, reddish brown; operculum domed, minutely apiculate; peristome double, exostome teeth 500 μm tall, orange-red below, hyaline above, endostome segments perforate, cilia 2–3; spores 8–10 μm in diam.

fertile shoot (dry), capsule (dry), leaf outline, leaf apex (2), and margin midleaf

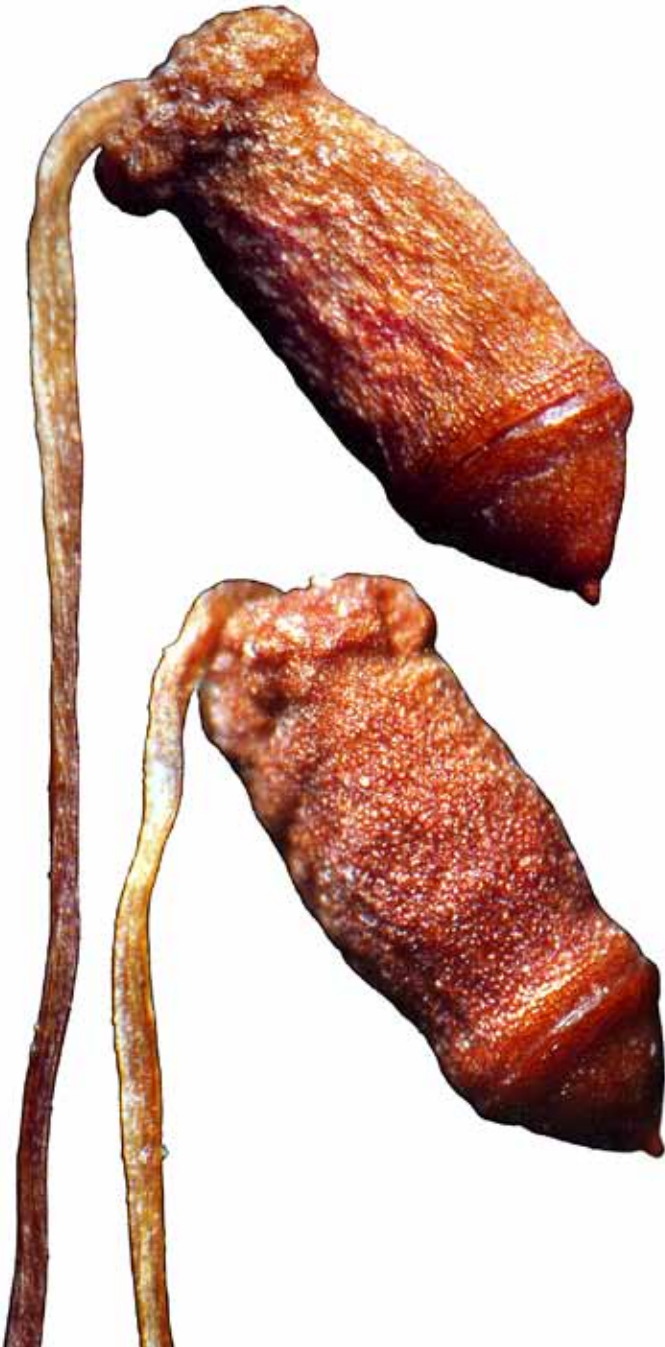
1 mm, 1 mm, 0.5 mm, 50 μm, 10 μm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

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*Gemmabryum coronatum* capsules (dry) with coronate necks and apiculate opercula  
— 0.1 mm

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**Gemmabryum crassum** (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay

**form:** turves of erect, comose stems, to 20 mm, red-tomentose below

**habitat:** sand or rock in exposed sites, wet or dry

**leaf:** size: 2.0–2.5 × 0.6–0.8 mm

*shape:* oblong-ovate, strongly concave

*tip:* acute or cuspidate

*base:* basal cells longer than the other lamina cells

*costa:* stout, prominent abaxially, excurrent in the cusp

*border:* weak, 5 rows of linear cells

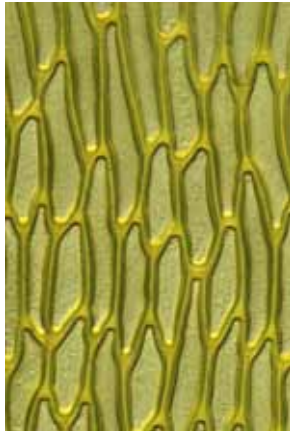
*margin:* ± denticulate, narrowly revolute from base to nearly the apex

*cells:* 25–60 × 12–20 μm, ± rhombic with round ends, firm-walled, smooth

**capsule:** to 2 mm, oblong to clavate, horizontal to pendent, exerted, brown, short-necked, wide-mouthed when empty; seta 15–25 mm, curved just below capsule; operculum apiculate; peristome double, exostome teeth orange-red, endostome segments white from a tall basal membrane, split; cilia 1–3; spores 8–10 μm in diam.

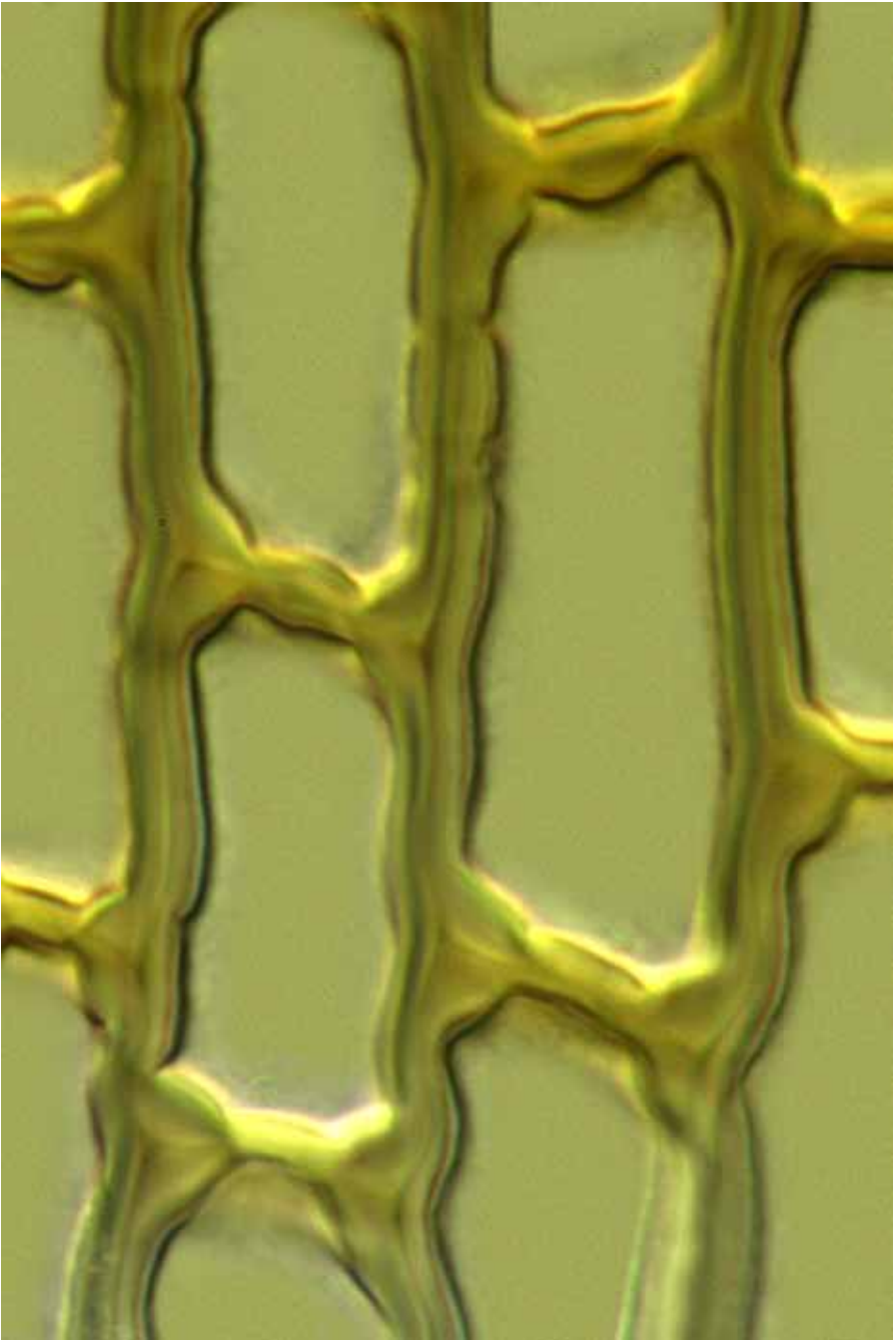


vegetative shoot (dry), leaf outline, leaf apex, mature capsule (dry), and apical margin  
 ■ 1 mm, ■ 0.1 mm, ■ 50 μm, ■ 1 mm, ■ 10 μm



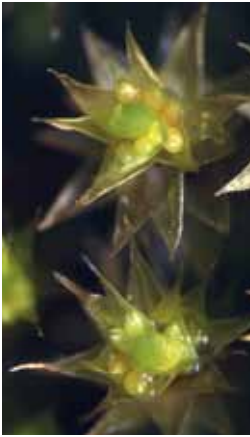
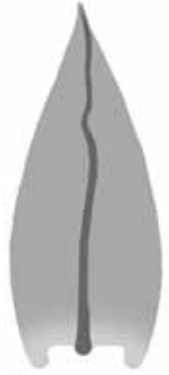
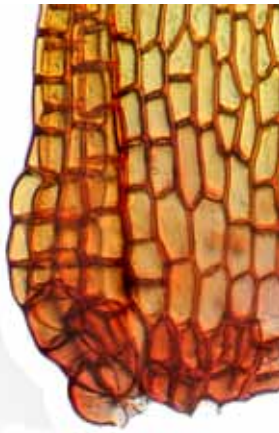
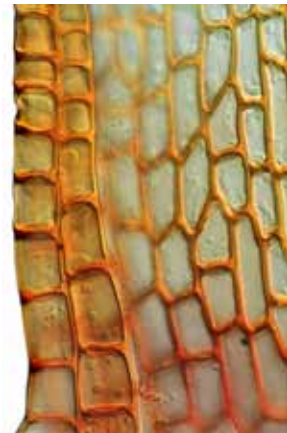
recurved midleaf margin, cells at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

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*Gemmabryum crassum* porose basal leaf cells  
— 10  $\mu\text{m}$

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**Gemmabryum dichotomum** (Hedw.) J.R.Spence & H.P.Ramsay**form:** turves of erect, comose, branched, radiculose stems, 5(–20) mmtall, rhizoids reddish, with numerous axillary gemmae to 430  $\mu\text{m}$  long**habitat:** soil of roadcuttings, dunes, or rarely rock, often urban, to 730 m**leaf:** size: comal leaves 0.7–1.6  $\times$  0.3–0.7 mm*shape:* ovate-lanceolate,  $\pm$  concave*tip:* acute*base:* basal cells short, oblong*costa:*  $\pm$  sinuose, percurrent to long-excurrent in a rigid point*border:* weak, 2–4 rows of long, narrow cells*margin:* entire, plane to  $\pm$  revolute below*cells:* 30–60  $\times$  10–15  $\mu\text{m}$ ,  $\pm$  rhombic, firm-walled, smooth**capsule:** 1.5–2.5 mm, obovoid, horizontal to pendent, dark, strangulate at maturity, the neck shrunk; annulus of 3–4 rows of cells; seta 6–10 mm,  $\pm$  flexuose, reddish; operculum conic, glossy; peristome double, endostome pale yellow; spores 15–18  $\mu\text{m}$  in diam.axillary propagules, shoot (dry), mature capsule (dry), leaf outline, and leaf apex  
 0.5 mm,  1 mm,  1 mm.  0.1 mm,  50  $\mu\text{m}$ recurved margin near leaf base, leaf basal angle, and bud-like axillary propagule  
 10  $\mu\text{m}$ ,  10  $\mu\text{m}$ ,  50  $\mu\text{m}$ 

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**Gemmabryum laevigatum** (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay

**form:** curves of erect, ± branched, radiculose stems, 10–40(–100) mm

**habitat:** damp soil or rock in boggy lake and creek margins, to 2300 m

**leaf:** size: 1.6–2.8 mm

*shape:* oblong-elliptic to elliptic

*tip:* broadly acute to obtuse, ± cucullate

*base:* alar cells ± quadrate

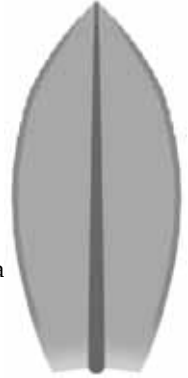
*costa:* percurrent to shortly excurrent

*border:* 1–5 rows of narrow cells below

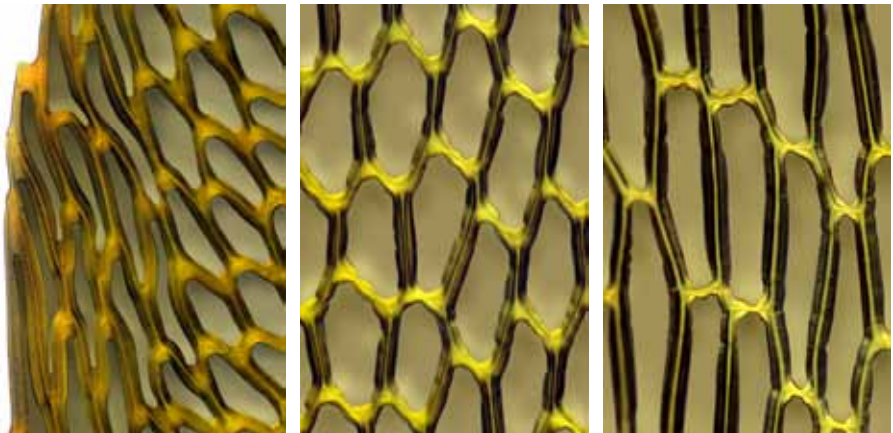
*margin:* entire below, serrulate near the apex, plane to recurved below

*cells:* 25–50 × 12–25 μm, ± rhombic, incrassate, ± porose, smooth

**capsule:** 2.5–3.5 mm, obovoid-cylindric, ± pendent, exserted, brown; seta to 30 mm; operculum apiculate; peristome double, the exostome teeth hyaline-margined, endostome segments widely split, cilia 2–3; spores 12–18 μm in diam.

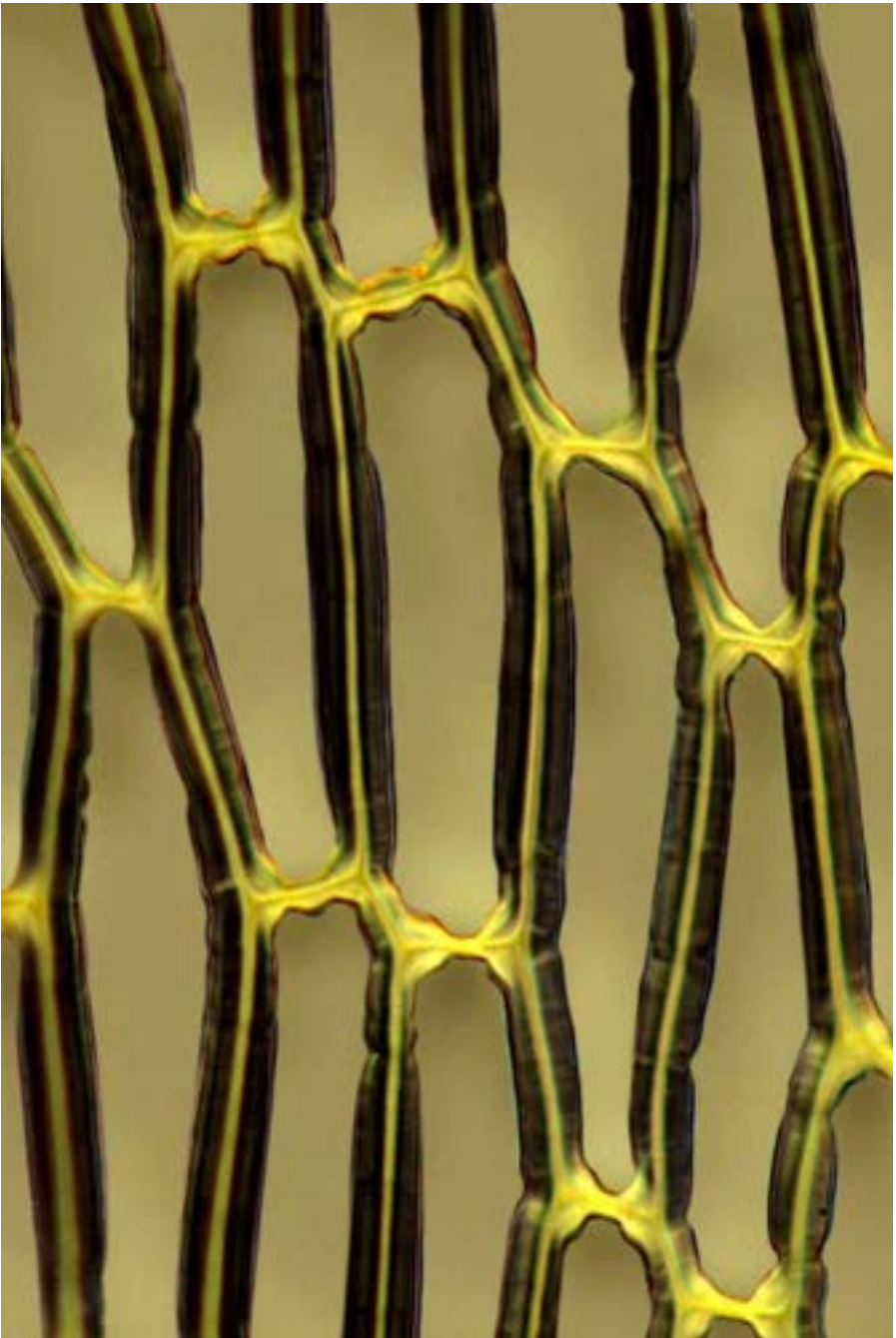


vegetative shoot (2, dry on left), papillose rhizoid, and leaf outline and apex  
 5 mm, 5 mm, 10 μm, 0.1 mm, 50 μm



margin at midleaf, cells at midleaf, and cells in lower leaf  
 10 μm, 10 μm, 10 μm

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*Gemmabryum laevigatum* cells toward leaf base  
10  $\mu\text{m}$

continued next page

**Gemmabryum preissianum** (Hampe) J.R.Spence & H.P.Ramsay  
formerly *Brachymenium preissianum* (Hampe) A.Jaeger

**form:** turves of erect, sparsely radiculose, yellow-green stems, 4 mm

**habitat:** calcareous rock or clayey soil, to 350 m

**leaf:** size: 0.7–0.8 × 0.3 mm

*shape:* lanceolate from a wide base, concave

*tip:* acute, aristate

*base:* basal cells quadrate

*costa:* excurrent in a stout arista, yellow-brown

*border:* weak, 1–2 rows of cells narrower and longer than the blade cells

*margin:* entire, plane

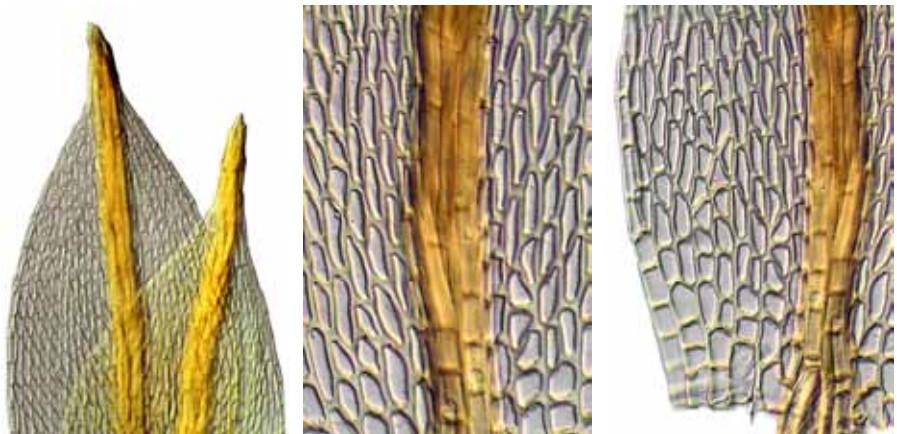
*cells:* 20–40 × 6–9 μm, rhombic-hexagonal, firm-walled, smooth

**capsule:** 2–2.5 mm, oblong-ovoid, with a narrow mouth and distinct neck; seta to 10 mm, flexuose; operculum high-conic; peristome double, exostome teeth 16, yellow above; spores 9–12 μm in diam., smooth



fertile shoot, leaf outline, and leaf apex (2)

1 mm, 100 μm, 20 μm, 20 μm



leaf apices, costa at midleaf, and leaf basal angle

50 μm, 50 μm, 50 μm

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*Gemmabryum preissianum* capsule (moist)  
1 mm

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**Gemmabryum radiculosum** (Brid.) J.R.Spence & H.P.Ramsay

**form:** tufts of erect, radiculose stems, 3–10 mm, tubers globose, red-brown, 100–200  $\mu\text{m}$  long

**habitat:** calcareous soil, limestone, or mortar, coastal and low inland sites

**leaf:** size: 1.0  $\times$  0.3 mm

*shape:* ovate-lanceolate

*tip:* acute

*base:* not decurrent; basal cells  $\pm$  quadrate

*costa:* strong, excurrent, yellow or red in old leaves

*border:* none or weak, 1–2 rows of long, narrow cells

*margin:* entire below, weakly denticulate above, recurved below

*cells:* 30–45  $\times$  8–10  $\mu\text{m}$ , rhombic, firm-walled, smooth

**capsule:** 2–3 mm, narrowly ellipsoid, nodding, long-exserted, brown; seta 10–20 mm, reddish; operculum low-conic; peristome double, exostome teeth yellow or brown; endostome basal membrane tall, and the segments perforate, cilia 2–3; spores 9–12  $\mu\text{m}$  in diam.



fertile and vegetative shoots (dry), leaf outline, capsule, leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 0.5 mm, 1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



cells at midleaf, costa at midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

**Gemmabryum rubens** (Mitt.) J.R.Spence & H.P.Ramsay

**form:** tufts of erect, radiculose, ± reddish stems, 10–20 mm, globose tubers abundant, to 300 μm long

**habitat:** disturbed soil, soil over concrete, or pasture, to 60 m

**leaf:** size: 1.5–2.4 × 0.5 mm

*shape:* ovate-lanceolate to subtriangular, abruptly tapering to an acumen

*tip:* long, slender, weakly denticulate acumen

*base:* basal cells ± rectangular

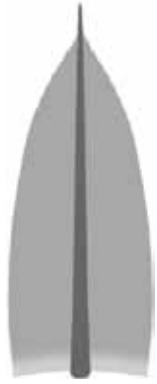
*costa:* wide below, slender above, excurrent in acumen

*border:* 2–4 rows of long, narrow, thick-walled, pigmented cells

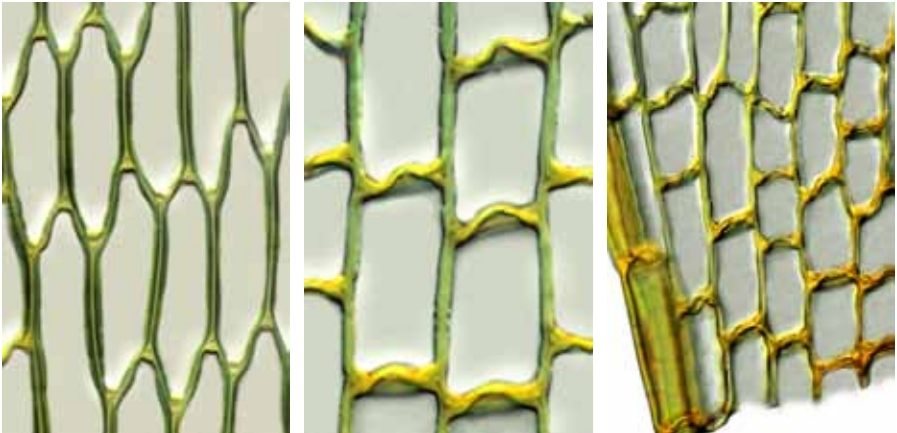
*margin:* entire below, denticulate above, plane above, recurved below

*cells:* 70–105 × 14–18 μm, fusiform-rhombic, thin-walled, smooth

**capsule:** capsules not seen in New Zealand; 2–3 mm, clavate to pyriform, pendent, exserted, brown; seta 20 mm, reddish brown; operculum low-conic; peristome double, exostome teeth yellow-brown, endostome segments perforate, cilia 2–3

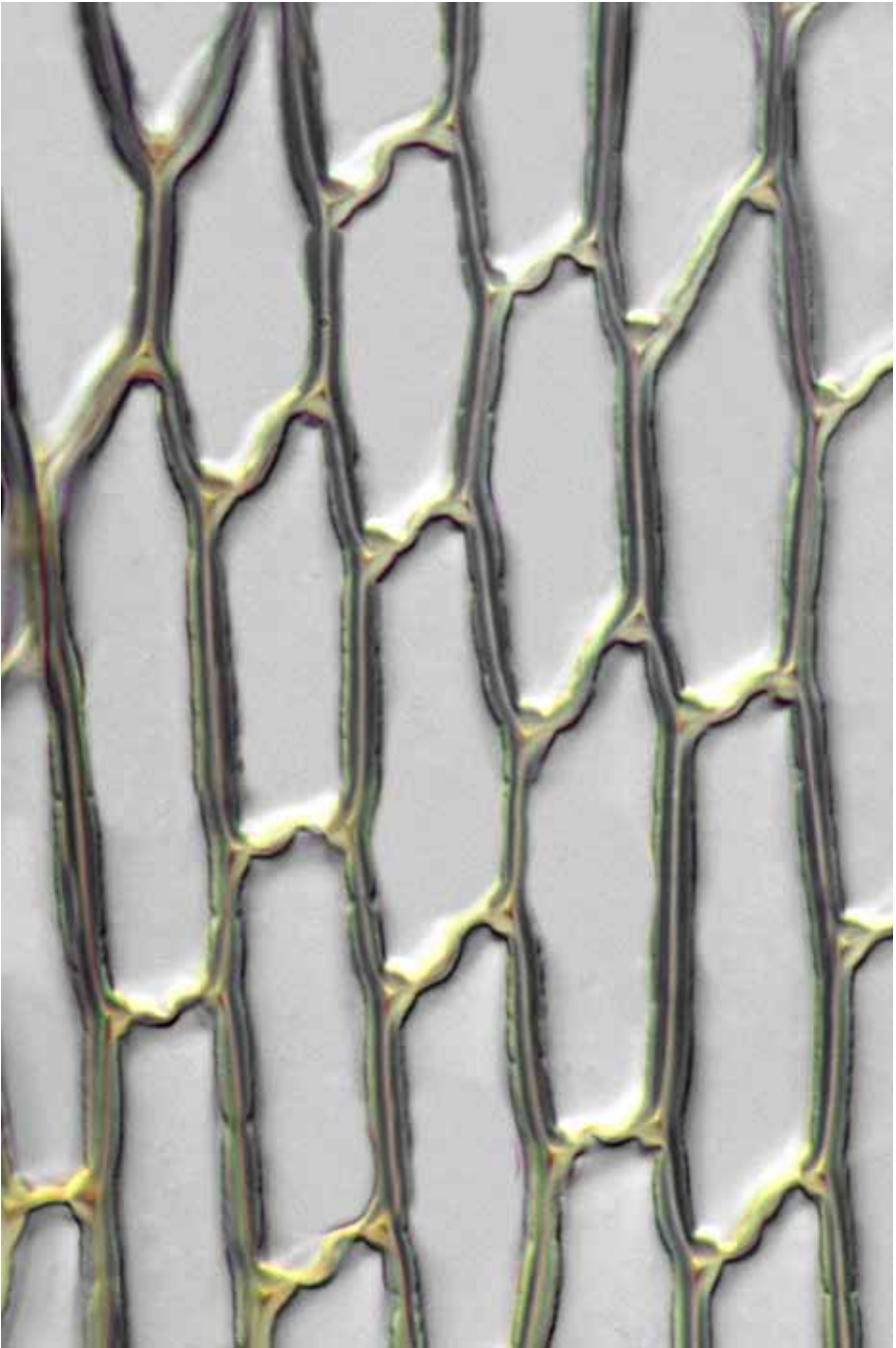


vegetative shoot (dry), leaf outline, leaf apex, tip of acumen, and margin midleaf  
 1 mm, 0.5 mm, 50 μm, 50 μm, 10 μm



cells at midleaf, cells in lower leaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Gemmabryum rubens* porose cells lower leaf  
10  $\mu\text{m}$

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**Gemmabryum ruderale** (Crundw. & Nyholm) J.R.Spence & H.P.Ramsay

**form:** tufted, erect, stems, 5–8 mm; rhizoids violet and papillose; tubers red, ± spherical, 125–250 μm long, orange

**habitat:** soil, basic or mildly acidic, disturbed sites such as earthen banks, roadsides, agricultural fields, and coastal sand dunes

**leaf:** size: 0.7–1.3 × 0.2–0.5 mm

**shape:** ovate- or elliptic-lanceolate

**tip:** acute

**base:** not decurrent; basal cells quadrate to short-rectangular

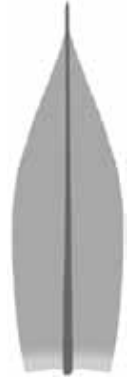
**costa:** excurrent in a stout point

**border:** weak, 2–3 rows of cells longer and narrower than nearby cells

**margin:** entire below, finely denticulate above, plane

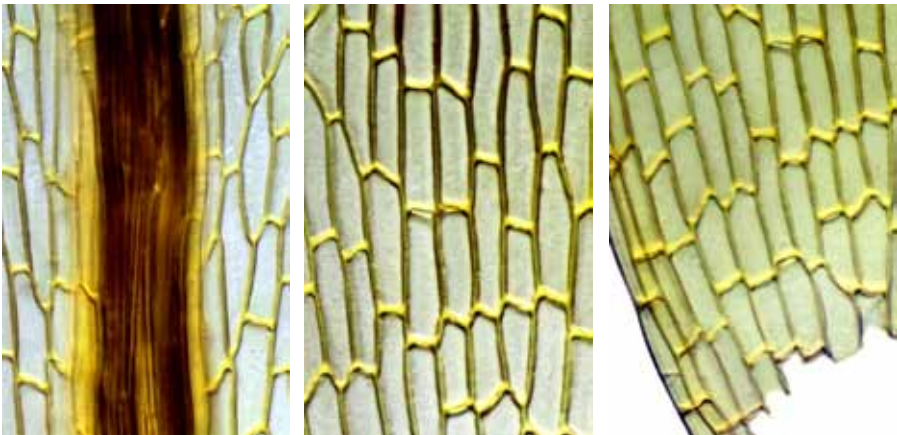
**cells:** 40–60 × 10 μm, rhombic, firm-walled, smooth

**capsule:** to 2.3 mm, rare; urn pyriform, pendent; seta 10–20 mm; operculum mammillate; peristome bryoid, teeth fused at the base up to the mouth of the urn; spores 9–11 μm in diam.



vegetative shoots (dry) (2), leaf outline, leaf apex, margin midleaf

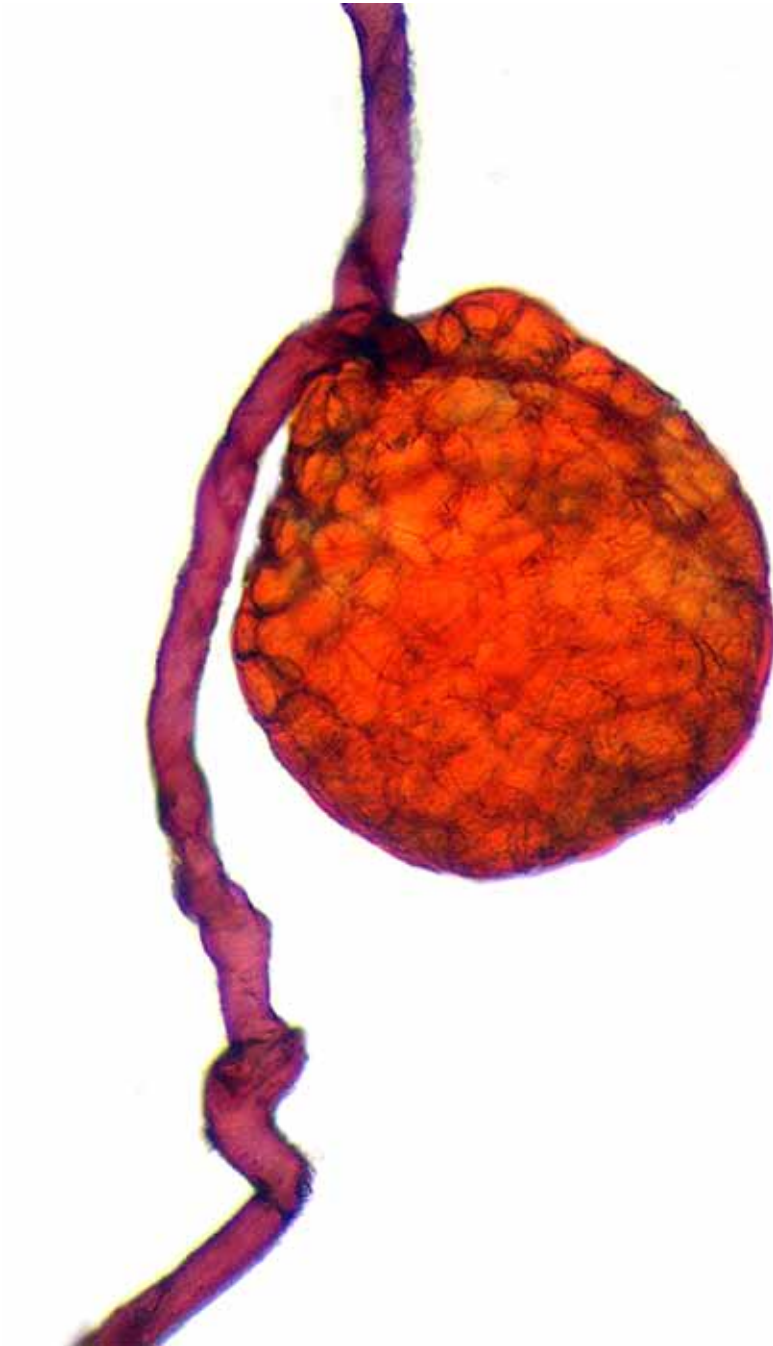
1 mm, 1 mm, 1 mm, 50 μm, 10 μm



costa midleaf, cells midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm

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*Gemmabryum ruderale* underground tuber  
100  $\mu\text{m}$

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**Gemmabryum sauteri** (Bruch & Schimp.) J.R.Spence & H.P.Ramsay

**form:** tufts of erect, ± branched, radiculose stems, to 15 mm, rhizoidal tubers reddish, 60–140 μm long

**habitat:** soil or soil over rock on roadsides and stream banks

**leaf:** size: 1.0–1.8 × 0.5–0.7 mm

*shape:* ovate- or elliptic-lanceolate

*tip:* acute

*base:* basal cells ± rectangular, not pigmented

*costa:* stout, excurrent

*border:* 2–5 rows of cells narrower than the other lamina cells

*margin:* entire below, denticulate above, plane above, recurved below

*cells:* 20–70 × 10–12 μm, rhombic, firm-walled, smooth

**capsule:** 1.5–3.0 mm, narrowly pyriform, inclined to nodding, exserted, red-brown; seta 10–20 mm, red; operculum low-conic; peristome double, exostome teeth yellow to brown; endostome basal membrane tall, segments perforate, cilia 2–3; spores 14–20 μm in diam.

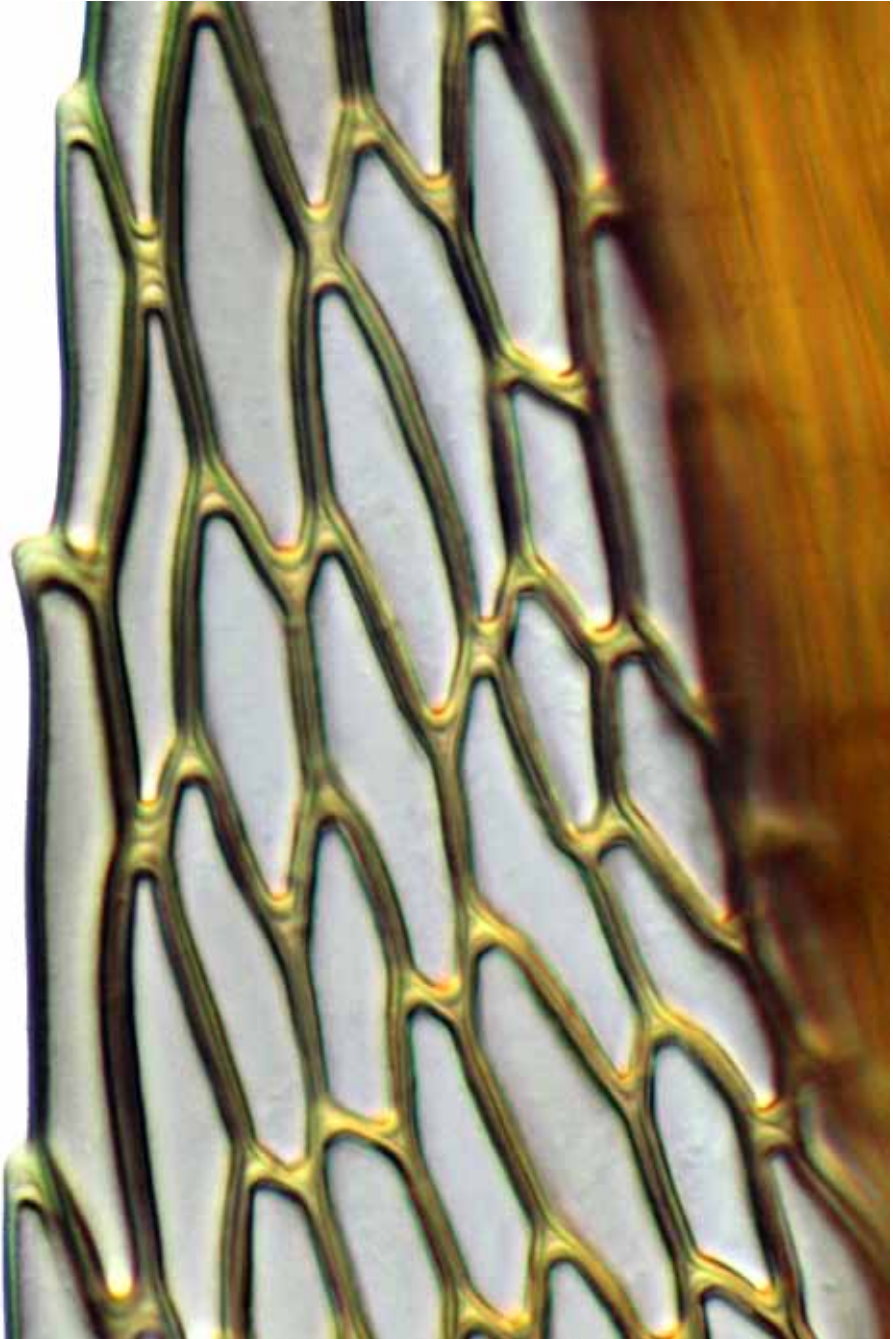


vegetative shoots (dry) (2), leaf outline, rhizoidal tuber, and leaf subapex and apex  
 1 mm, 1 mm, 0.1 mm, 10 μm, 50 μm, 50 μm



margin of upper leaf, costa in midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Gemmabryum sauteri* margin upper leaf  
10  $\mu$ m

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**Plagiobryum novae-seelandiae** Broth.

**form:** tufts or mats of soft, erect, radiculose branched stems, 3–6 mm, the branches julaceous, red- and silver-tinged

**habitat:** damp soil over calcareous rock, in forest or grassland, to 1650 m

**leaf:** size: stem leaves 0.5–0.7 mm, leaves of innovations smaller

*shape:* oblong to lingulate, cochleariform

*tip:* obtuse or rounded

*base:* basal cells rectangular, thin-walled

*costa:* thin, failing below the apex

*border:* not differentiated

*margin:* entire, plane

*cells:* 45–75 × 21–30 μm, rhombic to rectangular, thin-walled, smooth

**capsule:** 5–6 mm, clavate-pyriform, pendent, necked, ± asymmetric, gibbous, mouth small, orange; seta 10–17 mm, pale red, curved; operculum mammillate; peristome double, exostome teeth shorter than endostome, cross-striate below; spores 27–33 μm, reniform



vegetative shoots (dry), fertile shoot, leaf outline, and leaf apex  
 1 mm, 1 mm, 0.1 mm, 50 μm

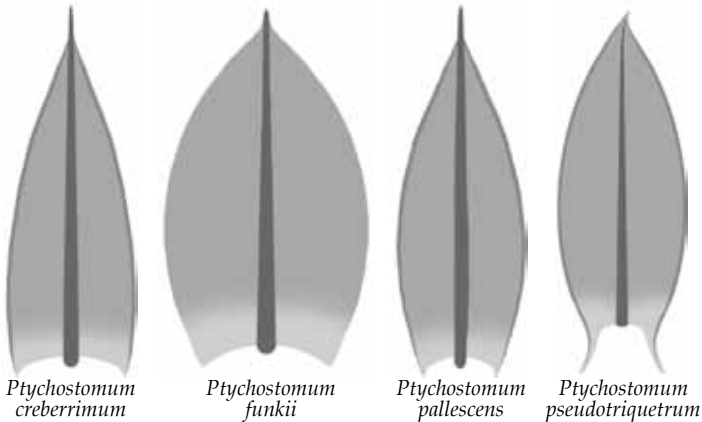


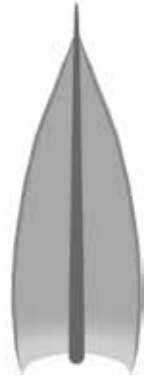
margin at midleaf, costa at midleaf, and leaf base cells  
 50 μm, 50 μm, 50 μm

Key\* to the New Zealand species of *Ptychostomum* (4)

- 1 Leaves strongly imbricate ..... ● ***Ptychostomum funkii***  
 1: Leaves not strongly imbricate ..... 2
- 2(1:) Leaves equidistant on the stem, decurrent; lamina cells incrassate; upper margin denticulate ..... ● ***Ptychostomum pseudotriquetrum***  
 2: Leaves densely comose on the stem, not decurrent; lamina cells thin-walled; upper margin usually entire or finely serrulate ..... 3
- 3(2:) Synoicous; leaf border distinct ..... ● ***Ptychostomum creberrimum***  
 3: Dioicous or autoicous; leaf border weak to nearly absent ..... ● ***Ptychostomum pallescens***

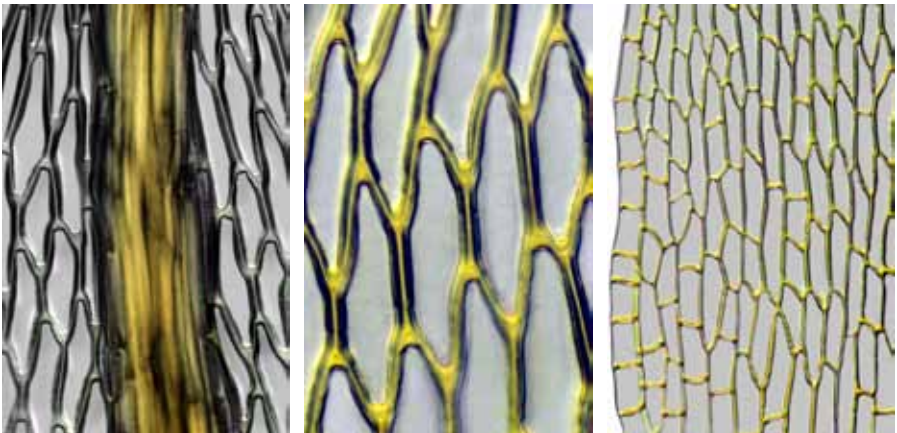
\* based partly on Spence, JR; Ramsay, HP (2006): *Bryaceae. Flora of Australia* 51, 324.



**Ptychostomum creberrimum** (Taylor) J.R.Spence & H.P.Ramsay**form:** curves of erect, branched, tomentose, comose stems, 10–30 mm**habitat:** sandy soil or basic rock and rock crevices, to 610 m**leaf:** size: 1.3–2.3 mm*shape:* ovate-lanceolate*tip:* acuminate, ending in a denticulate awn*base:* not decurrent; basal cells long-rectangular, thin-walled*costa:* strong, excurrent in the awn*border:* 3–5 rows of linear, thick-walled cells reaching to the apex*margin:* entire below, denticulate near apex, strongly recurved to near apex*cells:* 40–70 × 10–15 μm, rhombic-hexagonal in midleaf, firm-walled, smooth, ± porose**capsule:** 2.5–3.0 mm, oblong-cylindric, pendent, necked, exserted; seta 25–35 mm, slender; peristome well-developed; operculum apiculate; endostome segments with long perforations; cilia 2; spores 10–24 μm in diam.

fertile and vegetative shoots (dry), leaf outline, leaf apex (2), and border midleaf

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page

**Ptychostomum funkii** (Schwäger.) J.R.Spence

**form:** gregarious, erect, light green stems, 7 mm, julaceous (sterile)  
**habitat:** naturally disturbed sites such as gravelly streamsides

**leaf:** size: 0.8–1.2 mm

*shape:* ovate, concave

*tip:* acute

*base:* alar cells none; basal cells short-rectangular, thin-walled

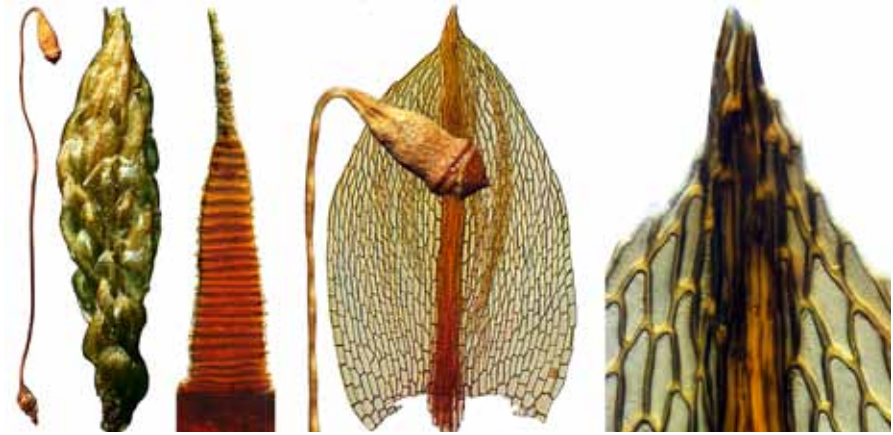
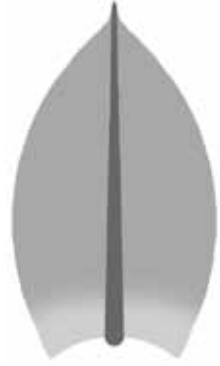
*costa:* shortly excurrent as a stout cusp

*border:* weak, 1–3 rows of ± elongate cells

*margin:* entire, plane

*cells:* 45–55 × 12–15 μm, rhombic-hexagonal, thin-walled, smooth

**capsule:** 2.5–3 mm, pyriform, necked, pendent, long-exserted, brown; seta to 40 mm, reddish; operculum apiculate; peristome double; exostome teeth narrowly lanceolate, papillose above; endostome segments perforate, as long as the exostome teeth; spores 12–15 μm in diam.



fertile and vegetative shoots (dry), exostome tooth, capsule, leaf outline, and leaf apex  
 5 mm, 0.5 mm, 100 μm, 0.5 mm, 0.1 mm, 10 μm



margin at midleaf, costa at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page

***Ptychostomum pallescens*** (Schwägr.) J.R.Spence  
formerly *Bryum pallescens* Schwägr.

**form:** cushions or turves of branched, radiculose, erect, comose stems, 15 mm

**habitat:** soil or in rock crevices, montane grassland, to 1630 m

**leaf:** size: 1.4–2.4 × 0.8 mm

*shape:* oblong-ovate, concave

*tip:* acute or acuminate, cuspidate

*base:* basal cells ± rectangular, longer than other lamina cells

*costa:* excurrent in the cusp

*border:* 1–2 rows of elongate, firm-walled cells

*margin:* entire below, denticulate above, recurved at margins

*cells:* 40–60 × 12–18 μm, rhombic-hexagonal, thin-walled, smooth

**capsule:** 1.8–2.5 mm, pyriform, necked, symmetric, inclined to pendent, exserted, brown; seta 15–30 mm; peristome double, exostome teeth reddish, endostome segments long-perforate, cilia 2; spores 21–24 μm in diam.



vegetative shoots (dry) (2), leaf outline, apex (2), and recurved margin (abaxial view)

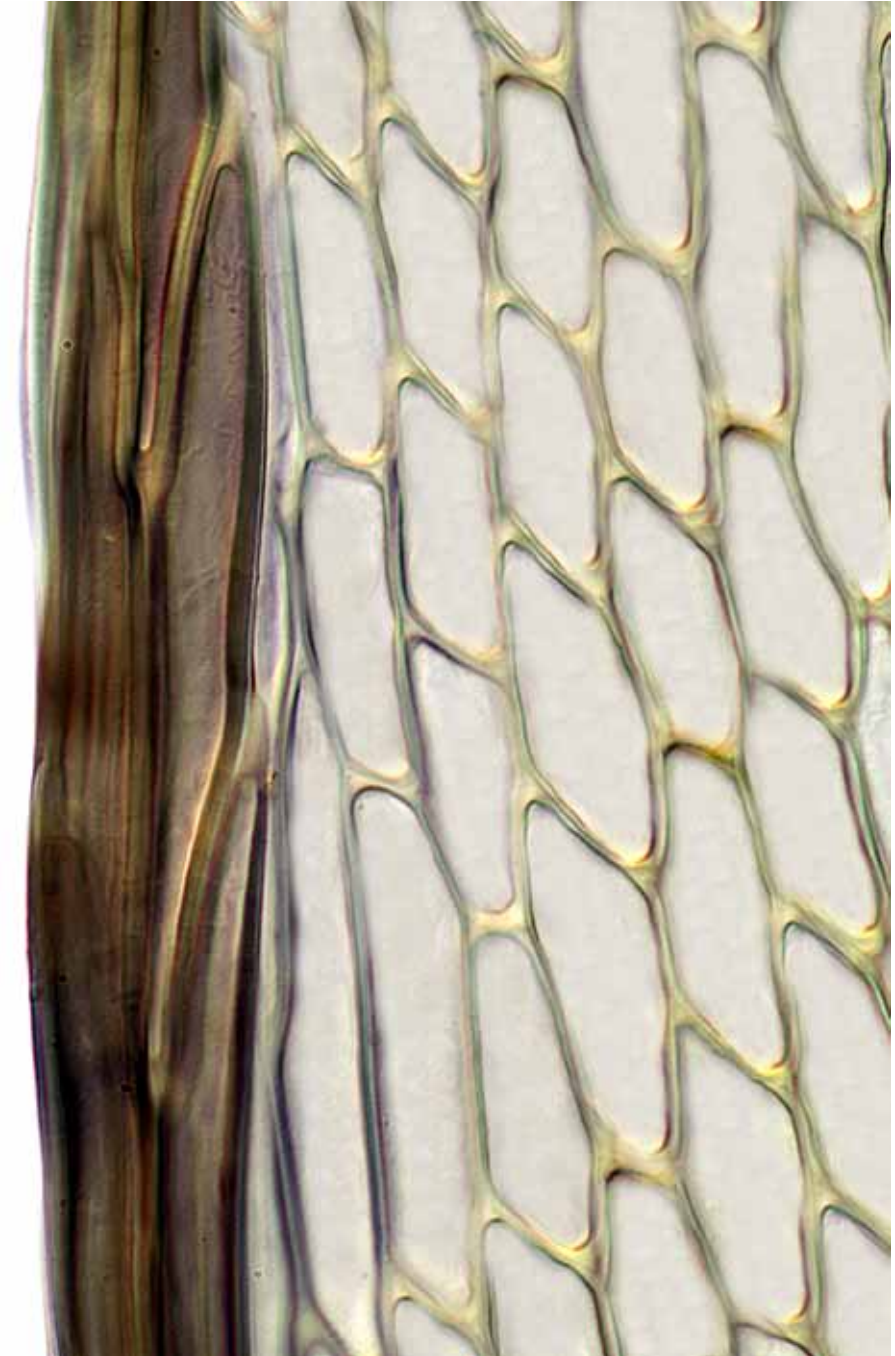
1 mm (2), 1 mm, 50 μm, 10 μm, 10 μm



cells at midleaf, costa at midleaf (adaxial view), and leaf basal angle

10 μm, 10 μm, 50 μm

continued next page



*Ptychostomum pallescens* recurved margin, abaxial surface  
10  $\mu$ m

continued next page

**Ptychostomum pseudotriquetrum** (Hedw.) J.R.Spence & H.P.Ramsay

**form:** tufts of robust, erect, tomentose, sparsely forked, red-tinged stems, 10–50 mm tall

**habitat:** wet soil or rock in mineral-rich swamps, seeps, ponds, to 2000 m

**leaf:** size: 1.5–3.0 × 0.9–1.4 mm

*shape:* ovate-lanceolate to elliptic

*tip:* acute to cuspidate or acuminate

*base:* narrowly decurrent; basal cells coloured, subquadrate near the margin

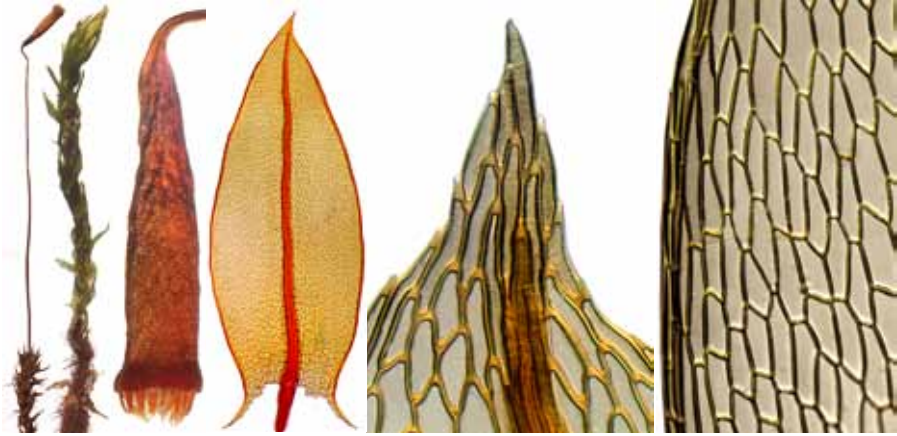
*costa:* strong, red below, percurrent or excurrent in a short cusp

*border:* 5 rows of thick-walled, linear cells (200–250 μm long)

*margin:* entire below, denticulate above, plane above, recurved ± throughout

**capsule:** 3–4 mm, pyriform, straight, necked, inclined to pendent; seta 25–50 mm; peristome bryoid, endostome segments perforate, cilia 2–3, filiform; spores 15–18 μm in diam.

**note:** both widespread and common



shoots (dry) (2) and capsule (dry), leaf outline, leaf apex, and margin midleaf  
 ■ 5 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm

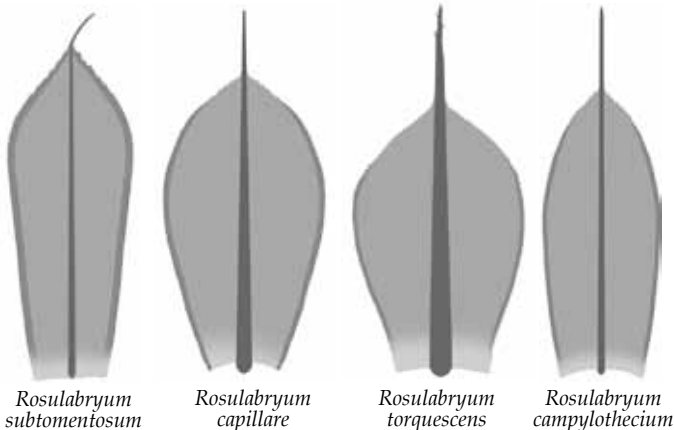
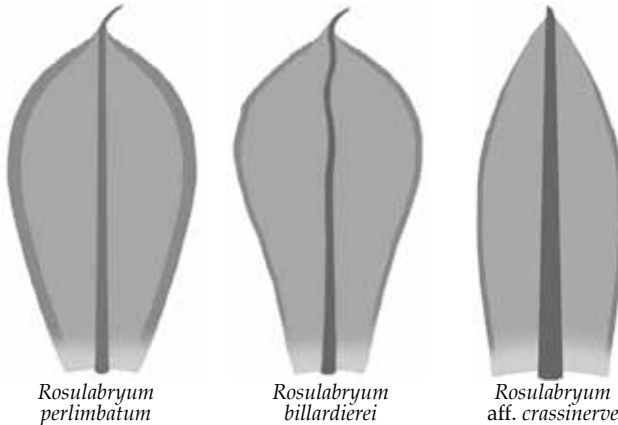


cells at midleaf, costa at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

Key\* to the New Zealand species of *Rosulabryum* (7)

- 1 Papillose filamentous brood-bodies in the leaf axils .. ● *aff. Rosulabryum crassinerve*  
 1: No brood-bodies in the leaf axils ..... 2
- 2(1): Excurrent costa an eighth or less of the length of the lamina ..... 3  
 2: Excurrent costa more than a fifth of the length of the lamina ..... 4
- 3(2) Seta straight ..... ● *Rosulabryum billardierei*  
 3: Seta usually hooked below the capsule ..... 4
- 3(2) Upper to middle lamina cells incrassate ..... ● *Rosulabryum perlimbatum*  
 3: Upper to middle lamina cells thin- to firm-walled ● *Rosulabryum subtomentosum*
- 3(2): Tubers bright orange or crimson ..... ● *Rosulabryum torquescens*  
 3: Tubers red-brown ..... 4
- 4(3): Most leaves < 3 mm long; tubers mostly < 300 µm wide ● *Rosulabryum capillare*  
 4: At least some leaves 4–10 mm long; tubers mostly > 500 µm wide .....  
 ..... ● *Rosulabryum campylothecium*

\* based partly on Spence, JR; Ramsay, HP (2006): *Bryaceae. Flora of Australia* 51, 332.



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**Rosulabryum billardierei** (Schwägr.) J.R.Spence

**form:** curves of erect, sparsely branched stems, 10–50 mm tall, yellow-green above, radiculose below; gemmoid tubers 500–1000  $\mu\text{m}$  long

**habitat:** rock, soil, or coastal sand in dunes or forest, to 400 m

**leaf:** size: 1.5–5 mm

*shape:* obovate

*tip:*  $\pm$  cuspidate

*base:* lower cells rectangular, thin-walled, nodulose

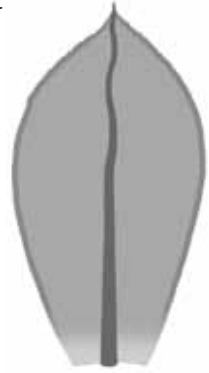
*costa:* excurrent in the cusp

*border:* 1–5 rows of narrow, elongate, incrassate cells

*margin:* sharply toothed above, plane above, recurved below

*cells:* 40–80  $\times$  12–20  $\mu\text{m}$ , rhombic-hexagonal, firm-walled, smooth,  $\pm$  porose

**capsule:** 2.0–3.5 mm, oblong-cylindric, necked, pendent, exserted; seta 20–35 mm, cygneous; peristome bryoid; spores 11–18  $\mu\text{m}$  in diam.

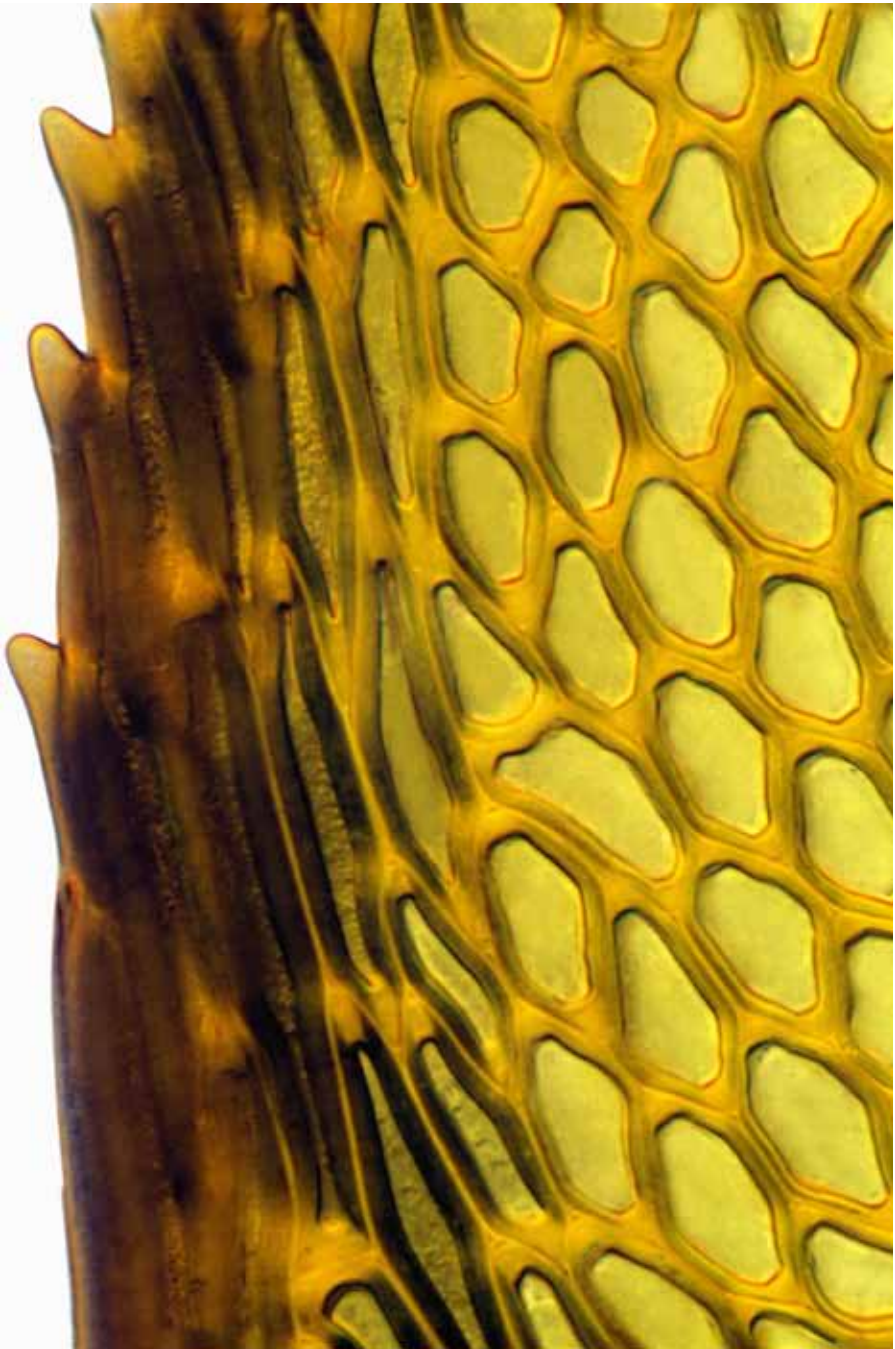


vegetative shoot (dry) (2), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 50  $\mu\text{m}$



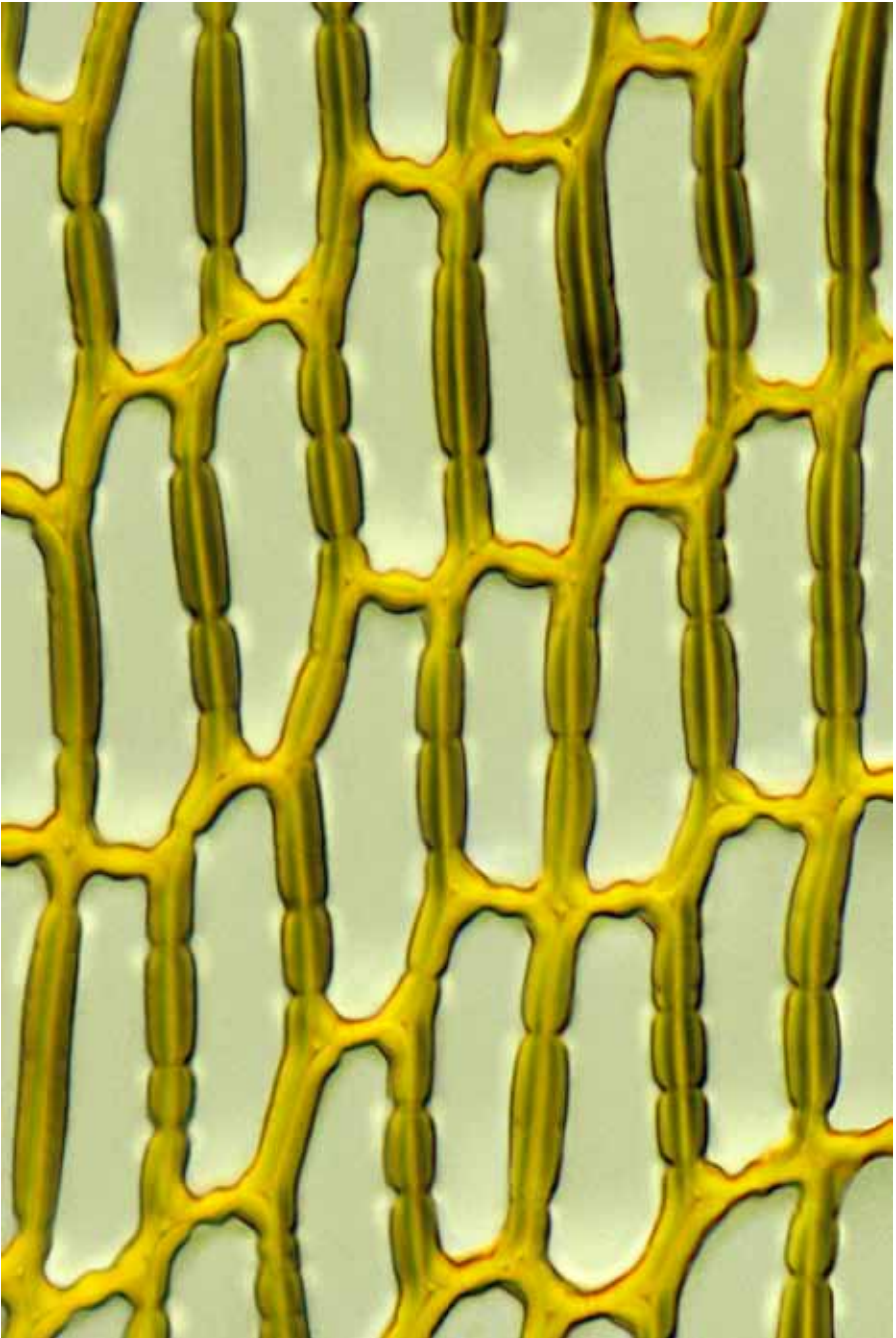
margin at midleaf, cells at midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 100  $\mu\text{m}$

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*Rosulabryum billardieri* margin midleaf  
10  $\mu\text{m}$

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*Rosulabryum billardieri* cells midleaf  
10  $\mu\text{m}$

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**Rosulabryum campylothecium** (Taylor) J.R.Spence

**form:** tufts of erect, comose 10–25 mm stems, ± red-tomentose below, lacking tubers, the leaves closely imbricate, comose, golden green

**habitat:** coastal sand, or soil over rock, in dunes and scrub, to to 400 m

**leaf:** size: 2–3.2 × 0.8–1.3 mm

*shape:* ovate to obovate, concave

*tip:* acute, ending in a long hyaline awn

*base:* basal cells rectangular

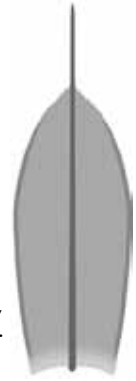
*costa:* long-excurrent in a denticulate, hyaline awn

*border:* weak, 1–2 rows of elongate cells

*margin:* entire below, denticulate above, plane above, recurved in lower 3/4

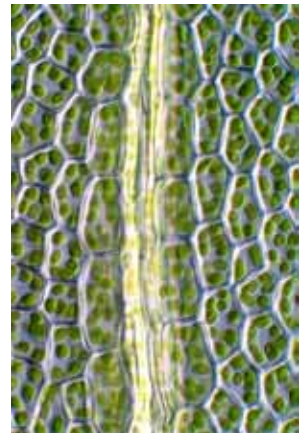
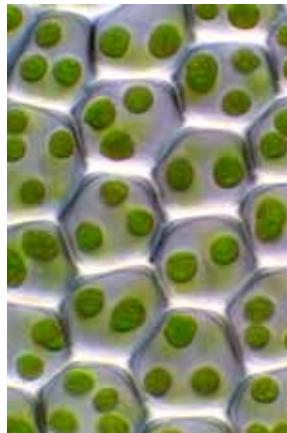
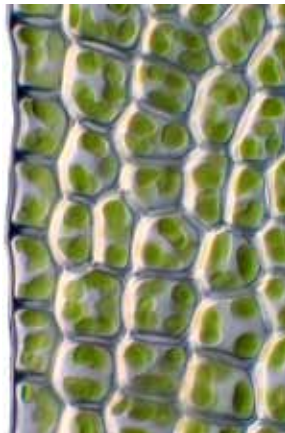
*cells:* 30–45 × 12–15 μm, hexagonal, firm-walled, smooth

**capsule:** 2.8–3.5 mm, oblong-cylindric, necked, pendent, ± curved, exserted, brown; seta 17–20 mm; operculum mammillose; spores 16–20 μm in diam.



habit on disused waterpipe, leaf outline and apex, and base of hair-point

■ 5 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, cells at midleaf, and costa at midleaf

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page

**Rosulabryum capillare** (Hedw.) J.R.Spence

**form:** curves of erect, comose, branched stems, 7–12 mm, tomentose below, the leaves dark green, matt; rhizoidal tubers gemmoid, 180–360  $\mu\text{m}$  long  
**habitat:** soil, sand, rock, concrete, logs, and bark in shaded sites, to 1220 m

**leaf:** size: 3.5  $\times$  1.5 mm

*shape:* elliptic to spatulate, spirally twisted around the stem when dry

*tip:* tapering to a long, denticulate awn

*base:* not decurrent, not pigmented; basal cells  $\pm$  rectangular

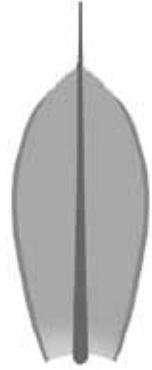
*costa:* excurrent in the arista

*border:* 2–4 rows of narrow, firm- to thick-walled cells

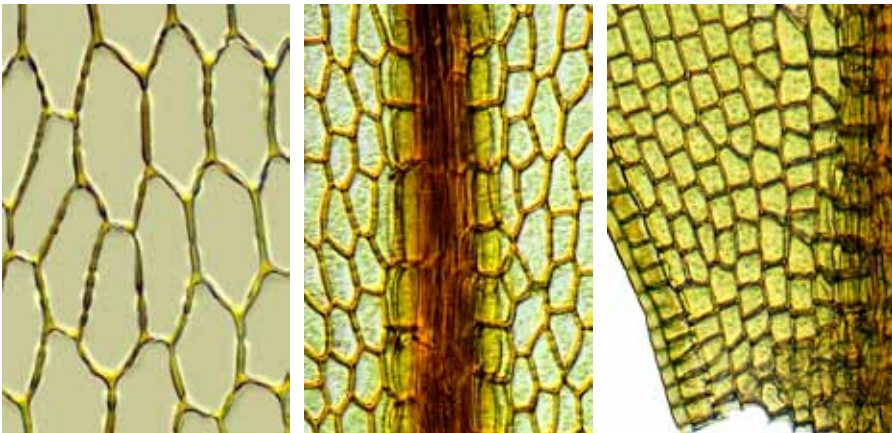
*margin:* entire below, serrulate to serrate above, recurved to near the apex

*cells:* 50–60  $\times$  18  $\mu\text{m}$ , hexagonal-rhombic, thin-walled, smooth

**capsule:** 3–5 mm, clavate-cylindric, pendent, exserted, brown; seta 20–55 mm, red; operculum apiculate; peristome double, the exostome teeth yellow with a hyaline border; spores 11–14  $\mu\text{m}$  in diam., smooth

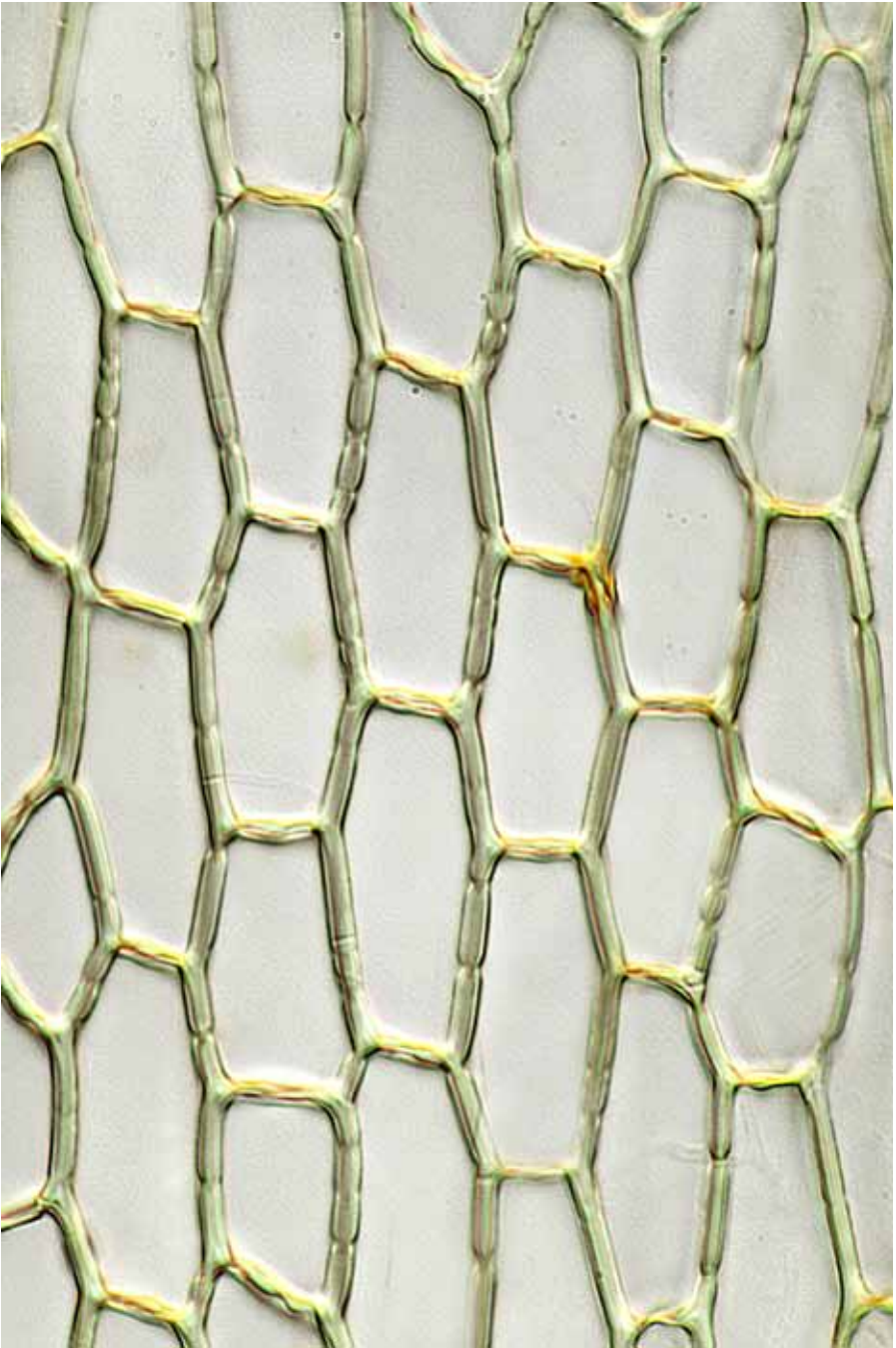


vegetative shoot (dry), leaf outline, capsule (dry), leaf apex, and margin midleaf  
 1 mm, 1 mm, 1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



cells at midleaf, costa at midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Rosulabryum capillare* leaf cells  
10  $\mu\text{m}$

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**Rosulabryum** aff. **crassinerve** Hook.f. & Wils.

**form:** turves of erect, branched, radiculose stems, the leaves  $\pm$  rosulate, with abundant long-filamentous, papillose brood bodies in leaf axils

**habitat:** soil-covered rock in shady, damp sites

**leaf:** size: 1.5–2.0 mm

*shape:* narrowly ovate, concave

*tip:* acute

*base:* basal cells rectangular,  $30\text{--}80 \times 15\text{--}30 \mu\text{m}$ ,  $\pm$  porose

*costa:* strong, shortly excurrent in a thick mucro

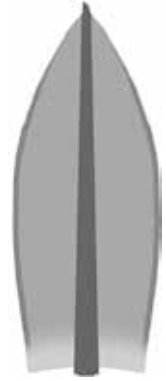
*border:* weak, 1–2 rows of long, narrow cells

*margin:* entire below, serrulate above, narrowly recurved below

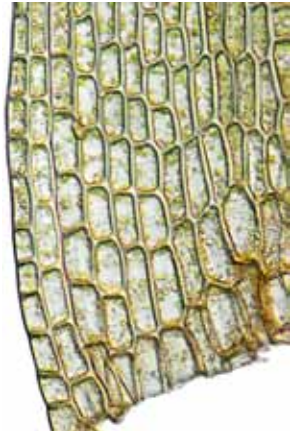
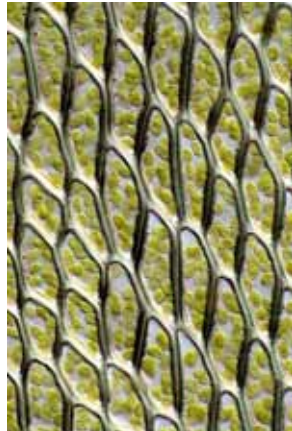
*cells:*  $30\text{--}60 \times 15\text{--}30 \mu\text{m}$ , rhombic-hexagonal, firm-walled, smooth

**capsule:** 2–4 mm,  $\pm$  cylindrical, inclined to nodding, long-exserted; seta 15–25 mm, red

**notes:** underground tubers orange, to 1.1 mm in diam.; axillary brood-bodies filiform, coarsely papillose, red-brown, terminal cell  $\pm$  hyaline



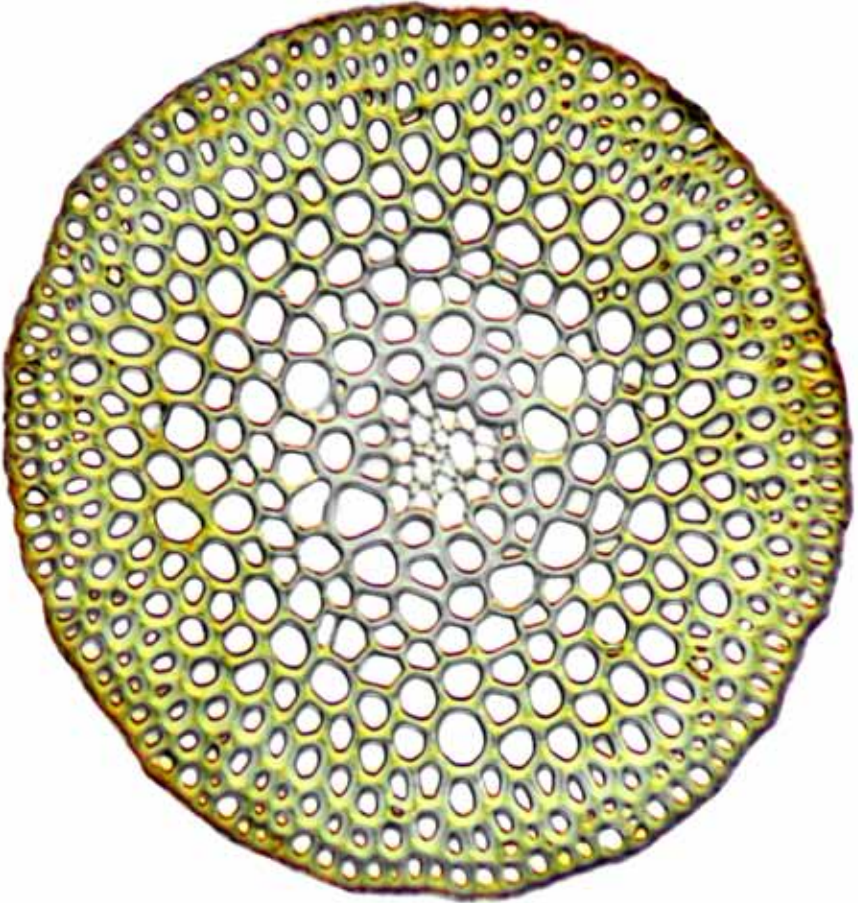
fertile shoot (moist), capsule, vegetative shoot (moist), brood-body, leaf outline and apex  
 5 mm, 5 mm, 1 mm, 50  $\mu\text{m}$ , 0.5 mm, 50  $\mu\text{m}$



margin midleaf, cells midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

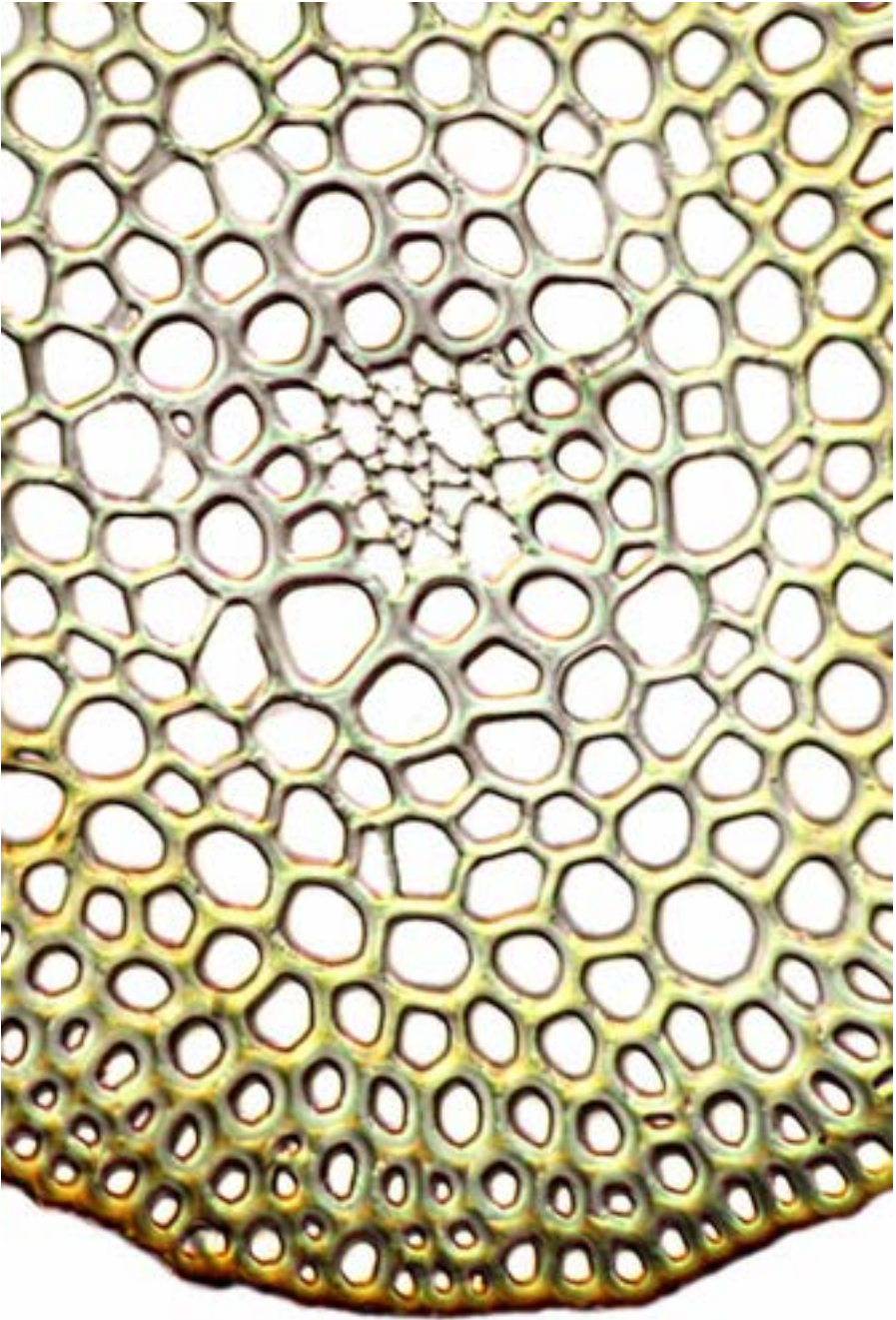
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*Rosulabryum* aff. *crassinerve* seta cross-section  
50  $\mu$ m

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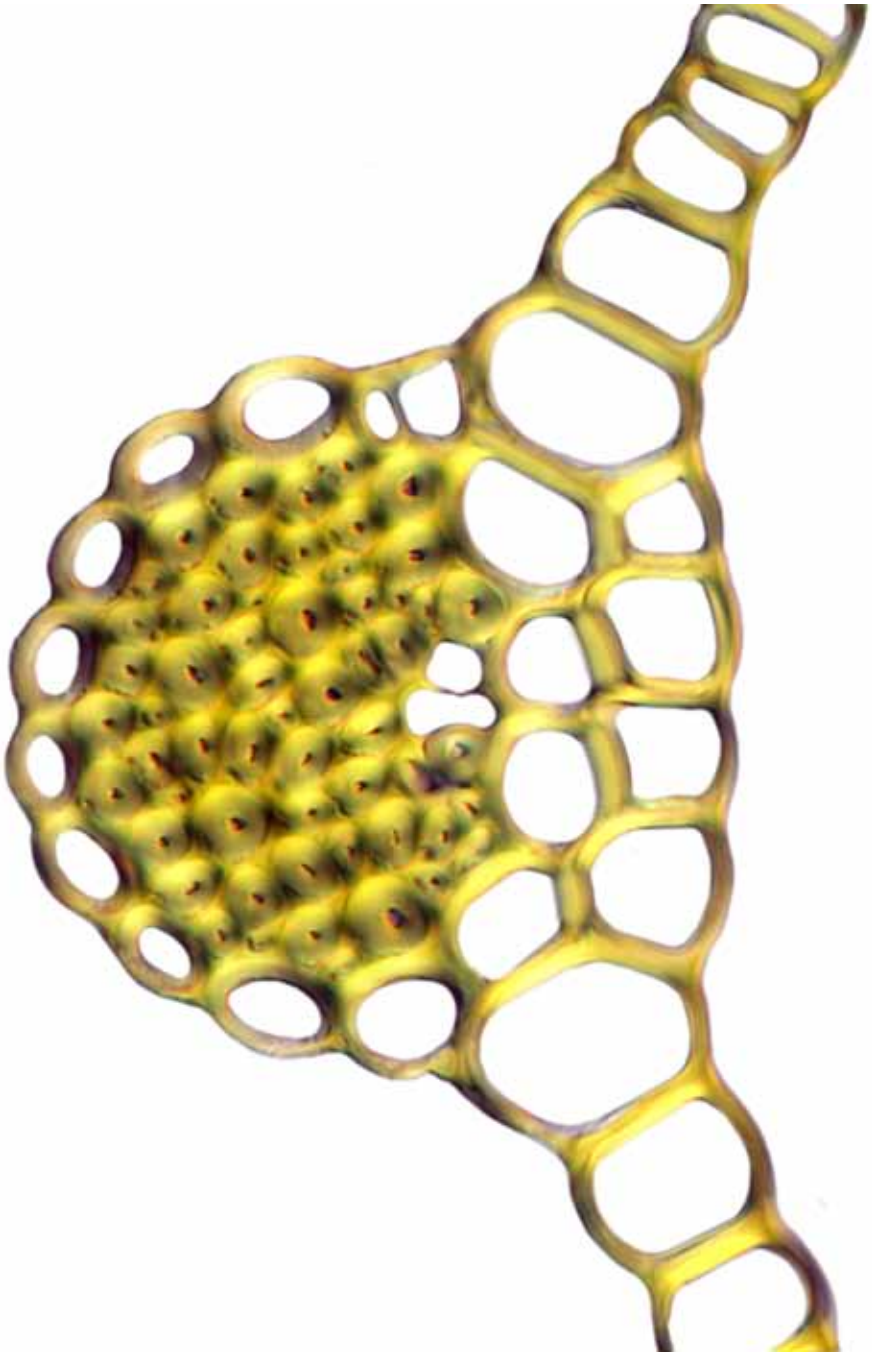
*Rosulabryum* cf. *crassinerve* seta cross-section detail  
10  $\mu$ m

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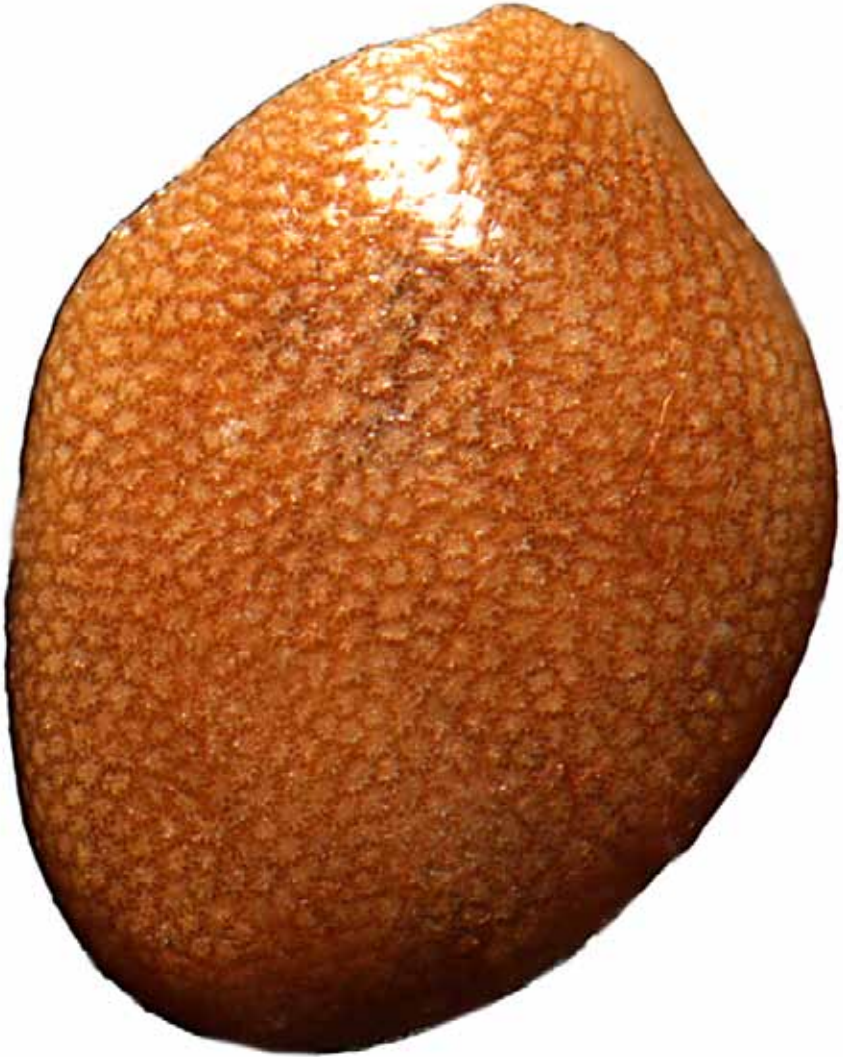
*Rosulabryum cf. crassinerve* leaf xs showing narrowly recurved margin, prominent costa  
50  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Rosulabryum* cf. *crassinerve* leaf cross-section  
10  $\mu\text{m}$

continued next page



*Rosulabryum* cf. *crassinerve* tuber  
100  $\mu$ m

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**Rosulabryum perlimbatum** (Cardot) Ochyra

**form:** curves of erect, ± branched, comose, red-radiculose stems, 15–20 mm  
**habitat:** mostly lowland, peatlands and herbfields, to 1020 m

**leaf:** size: 2.5–4.5 × 1–1.3 mm

**shape:** obovate to spatulate

**tip:** acute, with short, narrow, denticulate cusp

**base:** alar cells not differentiated; basal cells broadly rectangular

**costa:** excurrent or fusing with borders at the apex

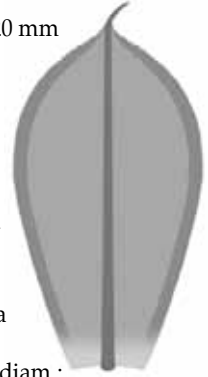
**border:** 6–12 rows of pale, elongate, thick-walled cells

**margin:** entire below, denticulate above, plane above, recurved below

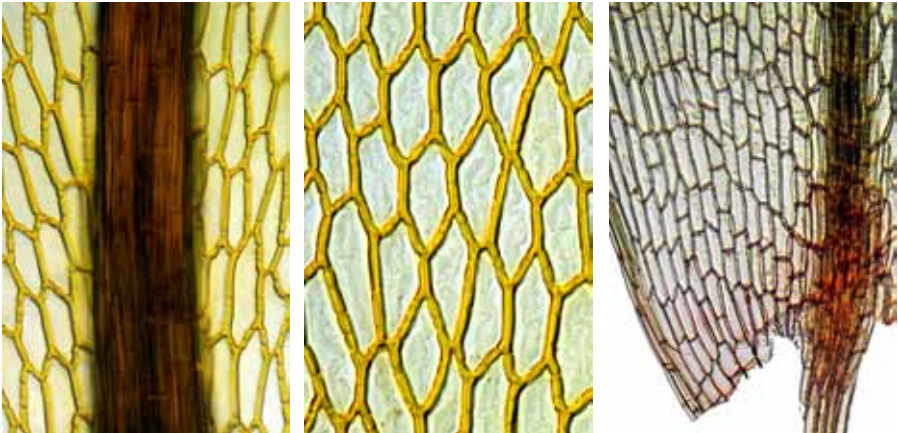
**cells:** 40–60 × 12–16 μm, rhombic-hexagonal, firm-walled, porose

**capsule:** 2.5–4.5 mm long, clavate-cylindric, pendent, long-exserted, brown, large-mouthed, contracted below the mouth when dry; seta 7–15 mm long, hooked near tip

**notes:** rhizoidal tubers common, orange to red, ± globose, to 0.3 mm diam.; differs from *R. billardierei* in having a wider border and a hooked seta



vegetative shoot (dry), leaf outline, leaf apex, and bordered margin midleaf  
 1 mm, 1 mm, 50 μm, 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

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*Rosulabryum perlimbatum* wide leaf border (limbidium) near apex.  
10  $\mu$ m

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**Rosulabryum subtomentosum** (Hampe) J.R.Spence

**form:** tufted, sparingly branched stems, green to yellow-green, to 35 mm tall, comose, denuded and radiculose below, stacked innovations often arising from the perichaetia; gemmoid tubers 500–1000  $\mu\text{m}$

**habitat:** soil, sand, rock, or rotting logs in forest or scrub, coastal to inland

**leaf:** size: 3.7–7  $\times$  1.2–1.7 mm

*shape:* obovate to spatulate, twisted around the leaf axis when dry

*tip:* a narrow,  $\pm$  curved, smooth, sharp-tipped awn

*base:* lower cells rectangular, thin- to firm-walled, porose

*costa:* moderately to long-excurrent

*border:* 4–8 rows of narrow, elongate, incrassate cells

*margin:* sharply toothed above, plane above, recurved below

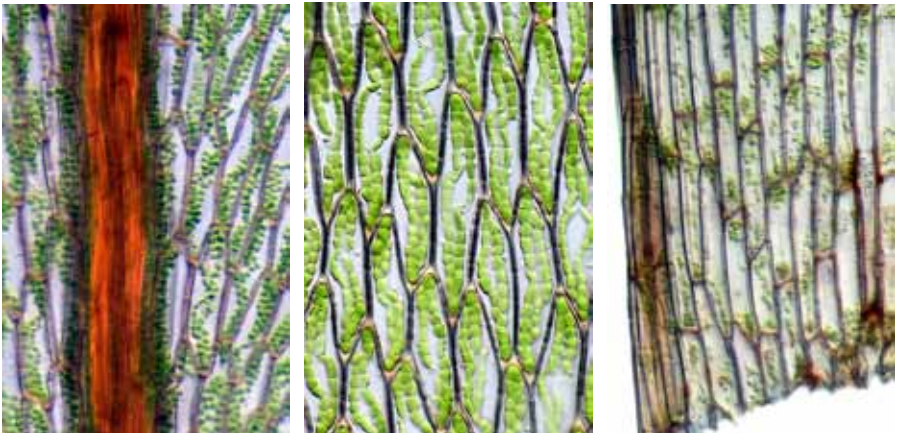
*cells:* 40–80  $\times$  12–20  $\mu\text{m}$ , rhombic-hexagonal, firm-walled, porose, smooth

**capsule:** 3–6 mm, oblong-cylindric, strongly necked, horizontal to cernuous,  $\pm$  curved, exserted; setae multiple, 20–50 mm, red; peristome bryoid; spores 12–18  $\mu\text{m}$  in diam., finely papillose



vegetative shoot (dry), leaf outline, apex and cusp, and serrate and bordered margin

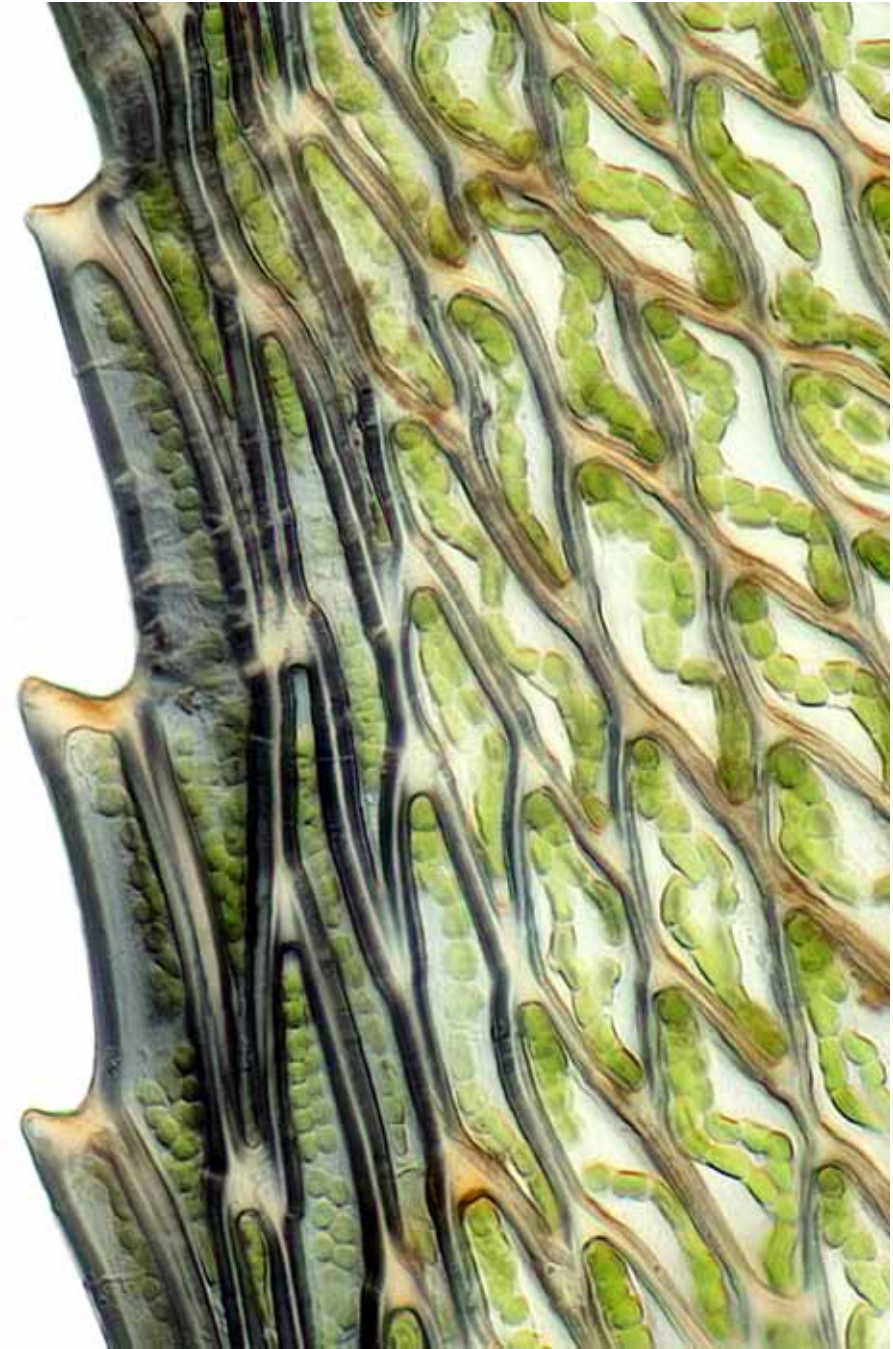
1 mm, 1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$



costa, lamina cells, and leaf basal angle

50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Rosulabryum subtomentosum* serrate and bordered margin  
10  $\mu\text{m}$

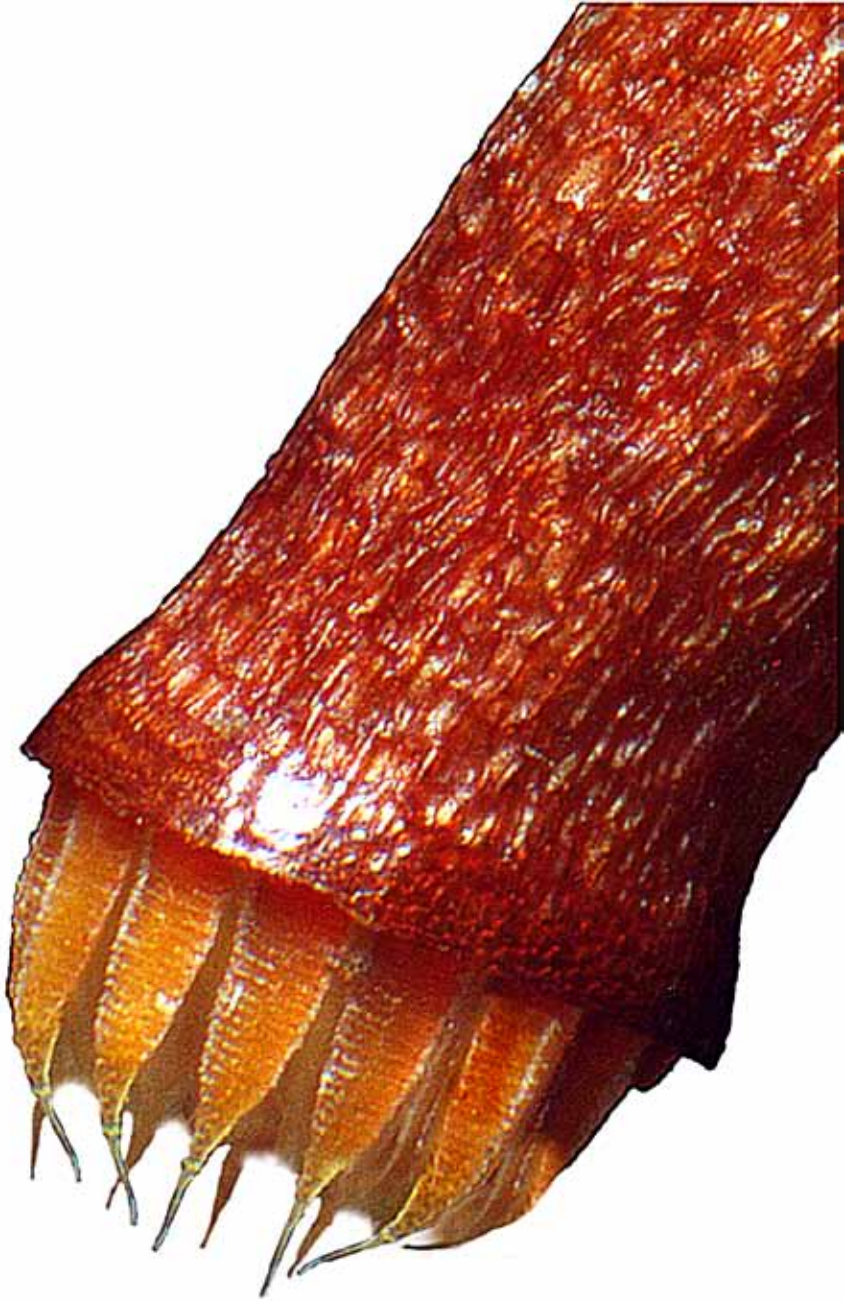
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*Rosulabryum subtomentosum* lamina cells  
10  $\mu\text{m}$

continued next page



*Rosulabryum subtomentosum* peristome  
50  $\mu\text{m}$

**Rosulabryum torquescens** (Bruch ex De Notaris) J.R.Spence

**form:** tufted, soft, radiculose stems, 10–25 mm tall, the leaves dark to reddish green, not glossy, rhizoidal gemmae 75–255 mm long

**habitat:** soil, soil over rock, or rotting wood

**leaf:** size:  $3 \times 1.5$  mm

*shape:* obovate to spatulate,  $\pm$  concave

*tip:* short-acuminate, abruptly aristate

*base:* basal cell shorter and more rectangular than the blade cells

*costa:* long-excurrent in a flexuose arista

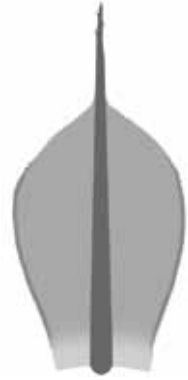
*border:* several rows of thick-walled, linear, incrassate cells

*margin:* entire below, serrulate above, recurved to midleaf

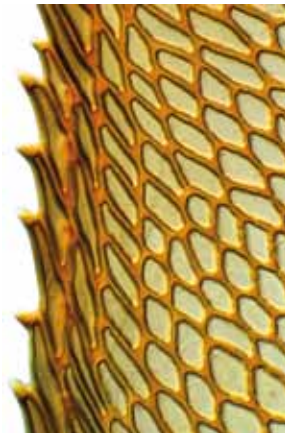
*cells:*  $50\text{--}80 \times 10\text{--}20$   $\mu\text{m}$ , rhombic, firm-walled, smooth

**capsule:** 3–6 mm, pyriform to cylindric, horizontal to pendent, long-necked; seta 20–35 mm, straight, often several per stem; peristome bryoid, endostome segments apiculate; spores 11–15  $\mu\text{m}$

**note:** highly variable



vegetative habit (moist), shoot (dry), leaf outline, hair-point, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 0.25 mm, ■ 100  $\mu\text{m}$ , ■ 100  $\mu\text{m}$



border in upper leaf, costa at midleaf, and recurved margin at midleaf  
 ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

***Epipterygium opararens*** Fife & A.J.Shaw

**form:** loosely tufted, erect, unbranched stems, to 15 mm tall, strongly complanate, the leaves distichous, lustrous with a metallic sheen

**habitat:** moist or wet shaded soil, lowland

**leaf:** size: 1.5–2.1 × 0.7–0.9 mm; dorsal leaves smaller  
*shape:* ± asymmetric, broadly elliptic from a narrow base

*tip:* broadly acute

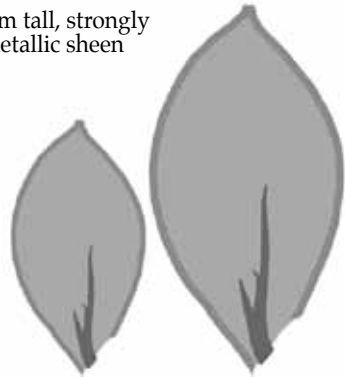
*base:* basal cells little differentiated

*costa:* reaching to two-thirds up the blade

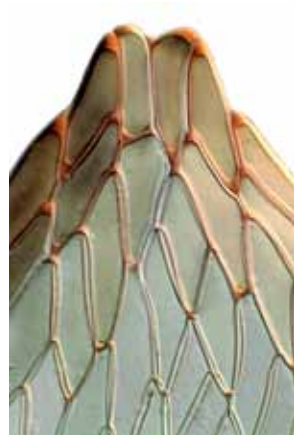
*border:* 1–2 rows of dark, firm-walled cells

*margin:* entire to slightly crenulate, plane  
*cells:* 90–200 × 20–30 μm, linear, thin-walled, smooth

**capsule:** capsules not seen in New Zealand



dorsal leaf



vegetative habit, leaf outline, and leaf apex

■ 1 mm, ■ 0.5 mm, ■ 10 μm



margin at midleaf, cells at midleaf, and costa terminus

■ 10 μm, ■ 10 μm, ■ 10 μm

**Ochiobryum blandum** (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay

**form:** densely tufted, branched, erect stems, 10–60 mm tall, radiculose, pinkish below, the leaves glossy, lurid green

**habitat:** moist soil or rock, especially in splash-zones near streams

**leaf:** size: 1–3 mm

*shape:* ovate to oblong, concave, ± complanate

*tip:* obtuse to broadly acute

*base:* basal cells shorter than the other laminal cells, ± pigmented

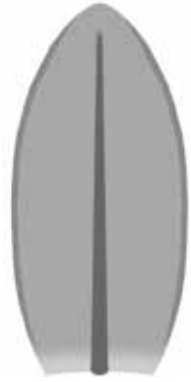
*costa:* subpercurrent to shortly excurrent

*border:* 3–4 rows of narrow, thick-walled cells

*margin:* entire, plane

*cells:* 50–120 × 5–16 μm, narrowly elongate, firm-walled, smooth

**capsule:** 3–4 mm, pyriform with tapered neck, suberect to inclined, dark brown; seta 20–45 mm, slender, flexuose, reddish; peristome bryoid, exostome and endostome well-developed, cilia appendiculate; spores 10–18 μm in diam., smooth



fertile shoot and capsule (moist) (3), leaf outline, and leaf apex

■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 mm



margin in upper leaf, costa in midleaf, and leaf basal angle

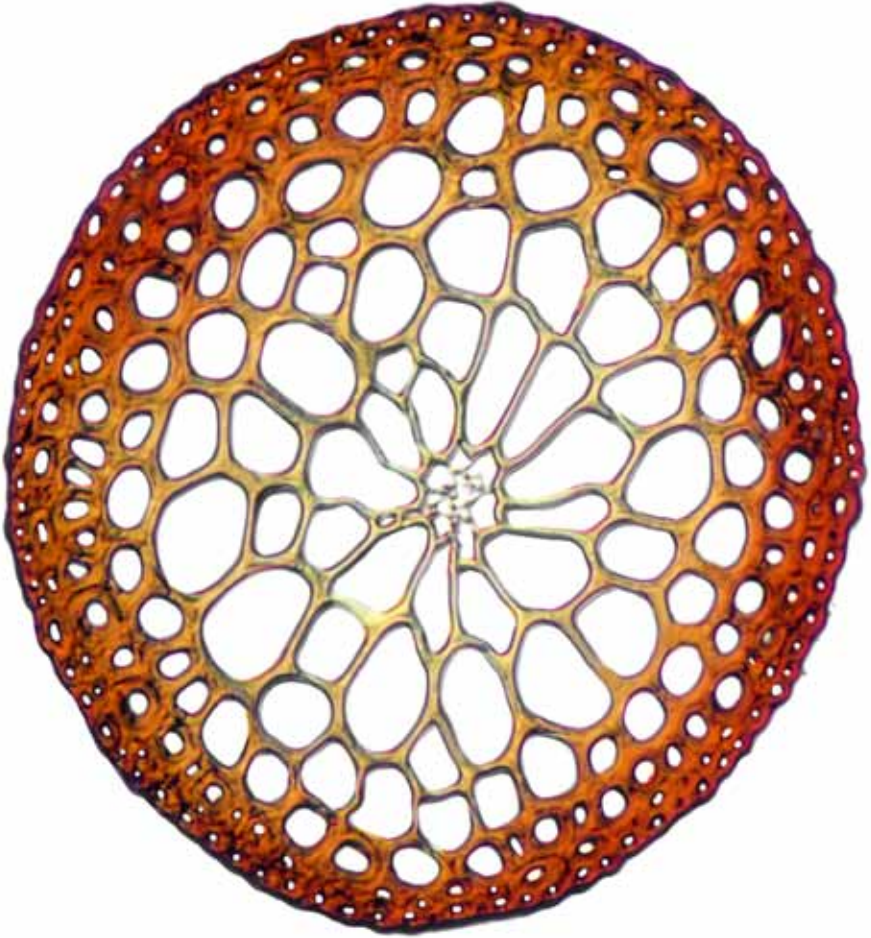
■ 10 mm, ■ 10 μm, ■ 10 μm

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*Ochiobryum blandum* vegetative habit  
— 1 mm

continued next page



*Ochiobryum blandum* seta cross-section  
— 10  $\mu\text{m}$

**Plagiomnium novae-zelandiae** (Colenso) T.J.Kop.

**form:** tufts or mats of erect or decumbent, complanate stems, to 50 mm long, tomentose, appearing 2-ranked  
**habitat:** damp, shaded soil, humus, or rotting logs, rarely rock, stream or lake margins, to 1000 m

**leaf:** size: 5.5–7.0 × 3–4 mm

*shape:* broadly elliptic-oblong from a narrow insertion

*tip:* rounded or refuse, shortly mucronate, ± undulate

*base:* decurrent; basal cells not differentiated

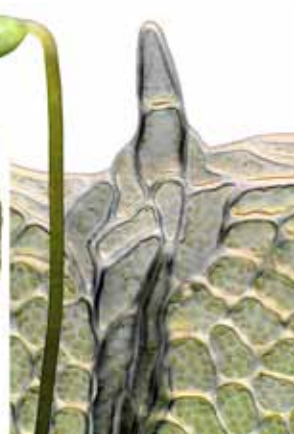
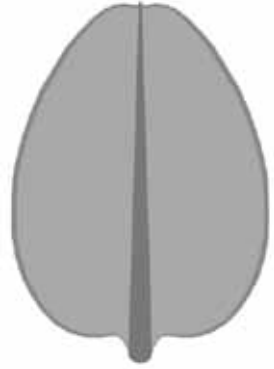
*costa:* wide at the base, percurrent, confluent with the border

*border:* 3–4 rows of elongate cells

*margin:* obscurely denticulate, plane

*cells:* 30 μm, rounded-hexagonal, thin-walled, smooth

**capsule:** 3–3.5 mm, ovate or oblong, horizontal to pendent, pale, glaucous, mouth wide, red; seta 20–30 mm, often aggregated; peristome bryoid; spores to 32 μm in diam.



vegetative habit, leaf outline, immature capsule, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 50 μm



border at midleaf, cells at midleaf, and costa at midleaf  
 ■ 50 μm, ■ 50 μm, ■ 50 μm

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*Plagomnium novae-zelandiae* vegetative habit  
■ 1 mm

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*Plagiomnium novae-zelandiae* vegetative shoot  
1 mm

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*Plagiomnium novae-zelandiae* immature capsules  
1 mm

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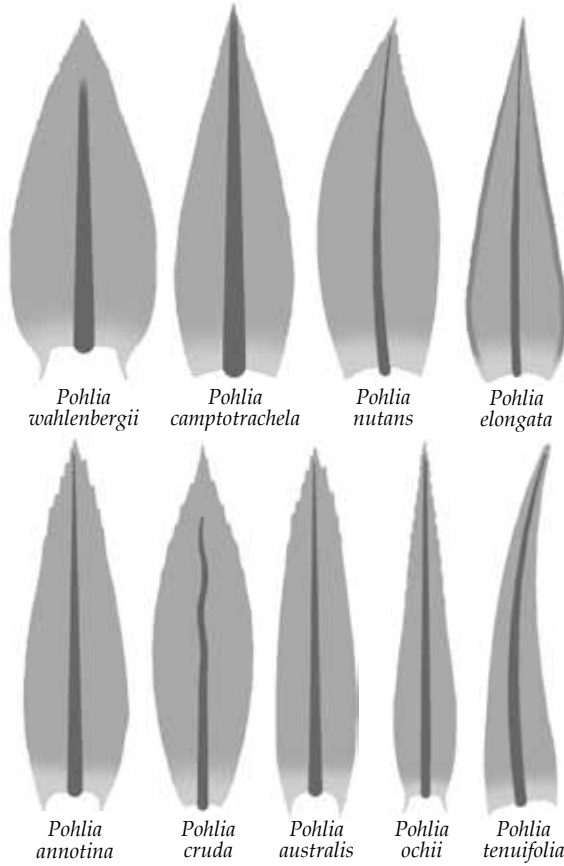


*Plagiomnium novae-zelandiae* leaf border  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Pohlia* (9)**

- 1 Plants with axillary gemmae ..... 2  
 1: Plants without axillary gemmae ..... 5
- 2(1) Plants glossy; gemmae > 500  $\mu\text{m}$  long, with 1–2 leaf primordia ..... ● ***Pohlia ochii***  
 2: Plants dull; gemmae < 400  $\mu\text{m}$  long, with 3–9 leaf primordia ..... 3
- 3(2): Leaves 1.5–2.0 mm long, strongly decurrent; gemmae oblong ..... 4  
 3: Leaves 0.8–1.4 mm long, not or only weakly decurrent; gemmae spherical .....  
 ..... ● ***Pohlia camptotrachela***
- 4(3) Gemmae orange; midleaf cells mostly < 100  $\mu\text{m}$  long; plants usually fertile .....  
 ..... ● ***Pohlia annotina***  
 4: Gemmae green or brown; midleaf cells mostly > 100  $\mu\text{m}$  long; plants never fertile .....  
 ..... ● ***Pohlia australis***
- 5(1): Gametophytes < 5 mm tall; lower leaves linear-lanceolate ..... ● ***Pohlia tenuifolia***  
 5: Gametophytes 8–50 mm tall; leaves lanceolate to ovate-lanceolate ..... 6
- 6(5): Plants whitish green; leaf cells 10–18  $\mu\text{m}$  wide ..... ● ***Pohlia wahlenbergii***  
 6: Plants green; leaf cells 6–10  $\mu\text{m}$  wide ..... 7
- 7(6): Leaves with a metallic sheen; leaf cells thin-walled, rhombic to linear-rhombic .....  
 ..... ● ***Pohlia cruda***  
 7: Leaves without a metallic sheen; leaf cells firm-walled, elongate-hexagonal ..... 8
- 8(7): Capsule neck at least as long as the urn; endostome segments narrowly perforate  
 along the keels; cilia absent or rudimentary ..... ● ***Pohlia elongata***  
 8: Capsule neck shorter than the urn; endostome segments broadly perforate along the  
 keels; cilia long and nodulose ..... ● ***Pohlia nutans***

\* based on Shaw, AJ (2006): A revision of the moss genus *Pohlia* Hedw. (Mniaceae) in Australia. *Systematic Botany* 31, 249, and Shaw, AJ; Fife, AJ (1985): *Pohlia australis* sp. nov. (Musci) from New Zealand with notes on some other austral *Pohlias*. *New Zealand Journal of Botany* 23, 186.



***Pohlia annotina*** (Hedw.) Lindb.

**form:** loose tufts of erect, simple stems, reddish below, bearing in the leaf axils brood bodies with 3–4 leaf primordia

**habitat:** soil on roadbanks, tracks, ditches, and other disturbed sites

**leaf:** size: 1.2–2 mm long

**shape:** narrowly lanceolate, decurrent, erect-spreading wet or dry

**tip:** acuminate

**base:** alar cells not differentiated

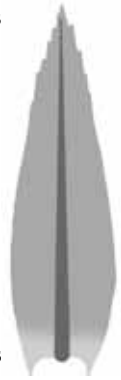
**costa:** percurrent to subpercurrent

**border:** not differentiated

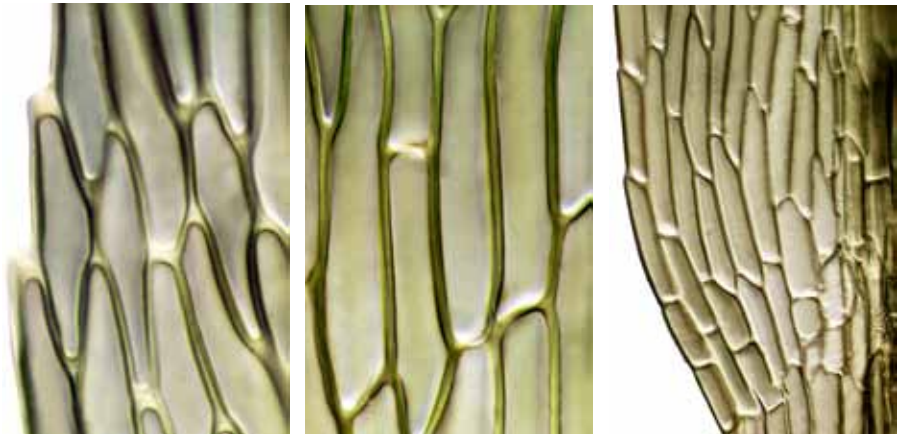
**margin:** serrulate at the apex, plane above, weakly reflexed when dry

**cells:** 60–95 × 9–12 μm, long-rhombic, thin-walled, smooth

**capsule:** 2.5–3 mm, long-pyriform, the neck as long as the urn, horizontal to pendent, brown at maturity; operculum convex; seta 18–35 mm, reddish, flexuose; annulus revoluble; endostome segments perforate, cilia 2–4; spores 18–22 μm in diam., finely papillose



vegetative shoots (wet) (2), leaf outline, leaf apex and subapex showing costa terminus  
 1 mm, 1 mm, 1 mm, 10 μm, 10 μm



serrulate margin midleaf, lamina cells, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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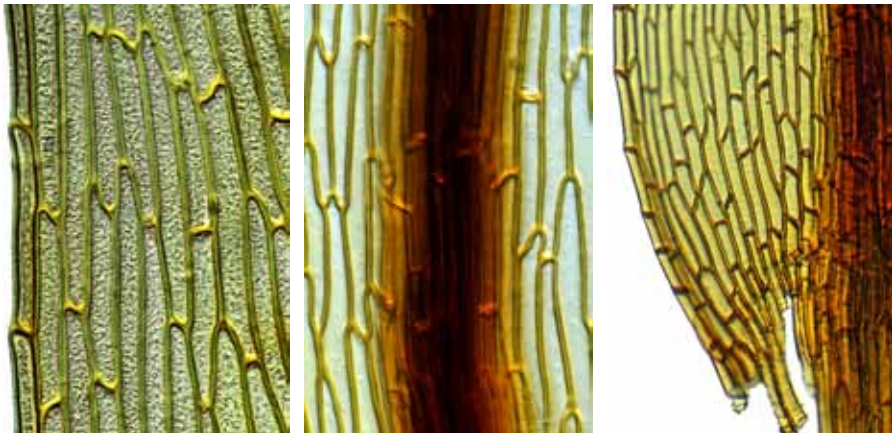


*Pohlia annotina* vegetative shoot with axillary propagules, brood body whole-mounts  
1 mm, 10  $\mu$ m



***Pohlia australis*** Shaw & Fife**form:** loose tufts of simple, slender, erect, red stems, to 10 mm tall**habitat:** damp soil of roadside verges and other  $\pm$  exposed, disturbed sites**leaf:** size: 1.4–2.0  $\times$  0.3–0.4 mm*shape:* lanceolate*tip:* narrowly acute*base:* long-decurrent, alar region not differentiated*costa:* subpercurrent*border:* not differentiated*margin:* entire below, serrulate near the apex, plane to widely recurved*cells:* 100–150  $\times$  8–11  $\mu\text{m}$ , linear-rhombic, thin- to firm-walled, smooth**capsule:** not known**notes:** gemmae 3–8 in the upper leaf axils, ovate-oblong, 200–380  $\times$  200  $\mu\text{m}$ , with 4–9 leaf primordia, yellow-green to yellow-brown, darkening with age

vegetative shoot (dry), leaf outline, leaf apex, and axillary gemma with leaf primordia  
 1 mm, 5 mm, 0.5 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$



margin at midleaf, costa at midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

***Pohlia camptotrachela*** (Renauld & Cardot) Brotherus

**form:** small tufts of erect stems, 5–20 mm tall, often with 10–25 bulbils per upper leaf axil,  $80\text{--}140 \times 80\text{--}120 \mu\text{m}$

**habitat:** damp, bare soil in fields or along tracks and around pools

**leaf length:**  $2.0 \times 0.45 \text{ mm}$

**shape:** narrowly lanceolate

**tip:** acuminate

**base:** not differentiated

**nerve:** failing near the apex

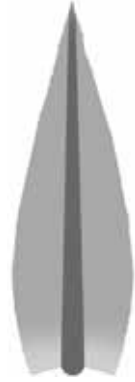
**border:** not differentiated

**margin:** serrulate above, entire below, plane

**cells:**  $80\text{--}100 \times 5\text{--}7 \mu\text{m}$  (shorter above), linear, thin-walled, smooth

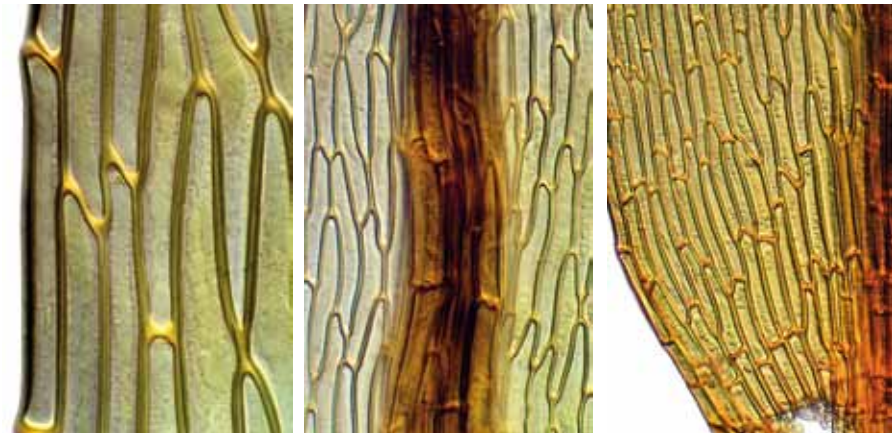
**capsule:** to 3 mm, oblong, cernuous to pendent; seta 20–25 mm; capsules uncommon; peristome bryoid, endostome cilia reduced or absent

**note:** a pioneer of damp, bare soil, especially along streambanks



bulbiferous shoots (dry) (3), leaf outline, leaf apex, and axillary bulbils

■ 1 mm (3), ■ 0.1 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



margin at midleaf, costa at midleaf, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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**Pohlia cruda** (Hedw.) Lindb.

**form:** tufted, simple or forked stems, 10–50 mm tall, red-radiculose below, the leaves opalescent, glossy

**habitat:** soil or humus, often in rock crevices or soil under overhanging banks

**leaf:** size: 2–4 × 0.5–1.0 mm

*shape:* elliptic to ovate-lanceolate, ± decurrent, reddish below

*tip:* gradually acuminate

*base:* not differentiated

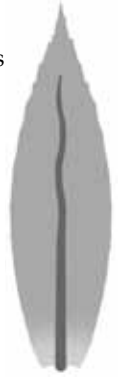
*costa:* failing well below the apex, ± flexuose above, reddish below

*border:* not differentiated

*margin:* distantly serrulate above, plane to narrowly reflexed

*cells:* 85–120 × 8.5–12 μm, linear, thin-walled, smooth

**capsule:** 2.5–4 mm, oblong-cylindric, neck up to half the length of the urn, horizontal to pendent, stoma superficial; seta 10–35 mm, flexuose, orange; operculum convex-conic, blunt or umbonate; peristome bryoid, exostome and endostome equal length; spores 13–24 μm in diam.



vegetative shoots (2), leaf outlines (2), and leaf apex

1 mm, 0.5 mm, 0.5 mm (2), 10 μm



margin at midleaf, cells at midleaf, and costa at midleaf

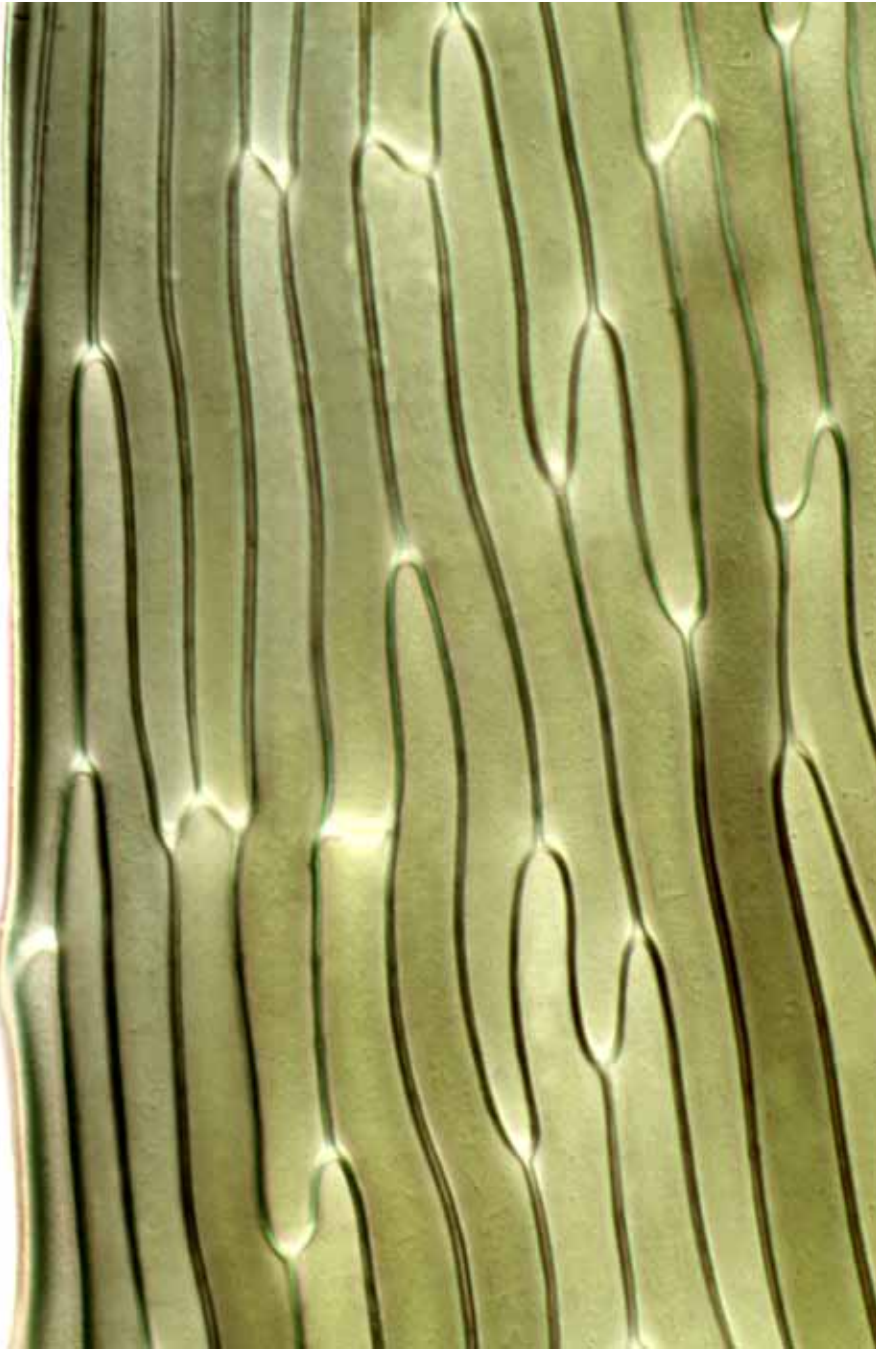
10 μm, 10 μm, 10 μm

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*Pohlia cruda* leaf apex  
10  $\mu\text{m}$

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*Pohlia cruda* margin midleaf  
10  $\mu\text{m}$

continued next page

***Pohlia elongata* Hedw.**

**form:** loosely tufted, erect, simple stems, 3–12 mm tall, the leaves dull green  
**habitat:** soil, rotting logs, and tree bases to high elevations

**leaf:** size: 0.8–1.7 × 0.3–0.6 mm

**shape:** ovate-lanceolate to linear-lanceolate, stiff when dry

**tip:** acuminate

**base:** ± decurrent, basal cells short-rectangular

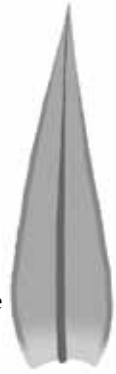
**costa:** failing 1–4 cells below the apex

**border:** not differentiated

**margin:** entire below, serrulate above, recurved in the upper stem leaves

**cells:** upper cells 40–90 × 7–10 μm, linear, firm-walled, smooth

**capsule:** to 6.5 mm, cylindric, long-necked, erect to nodding, exserted, light brown; annulus revolvable; seta 20–30 mm; peristome double, the endostome segments keeled and narrowly perforate; operculum high-conic; stomata superficial; spores 16–23 μm in diam., papillose



fertile shoots (dry) (3), capsule (dry) (2), leaf outline, leaf apex, and margin midleaf

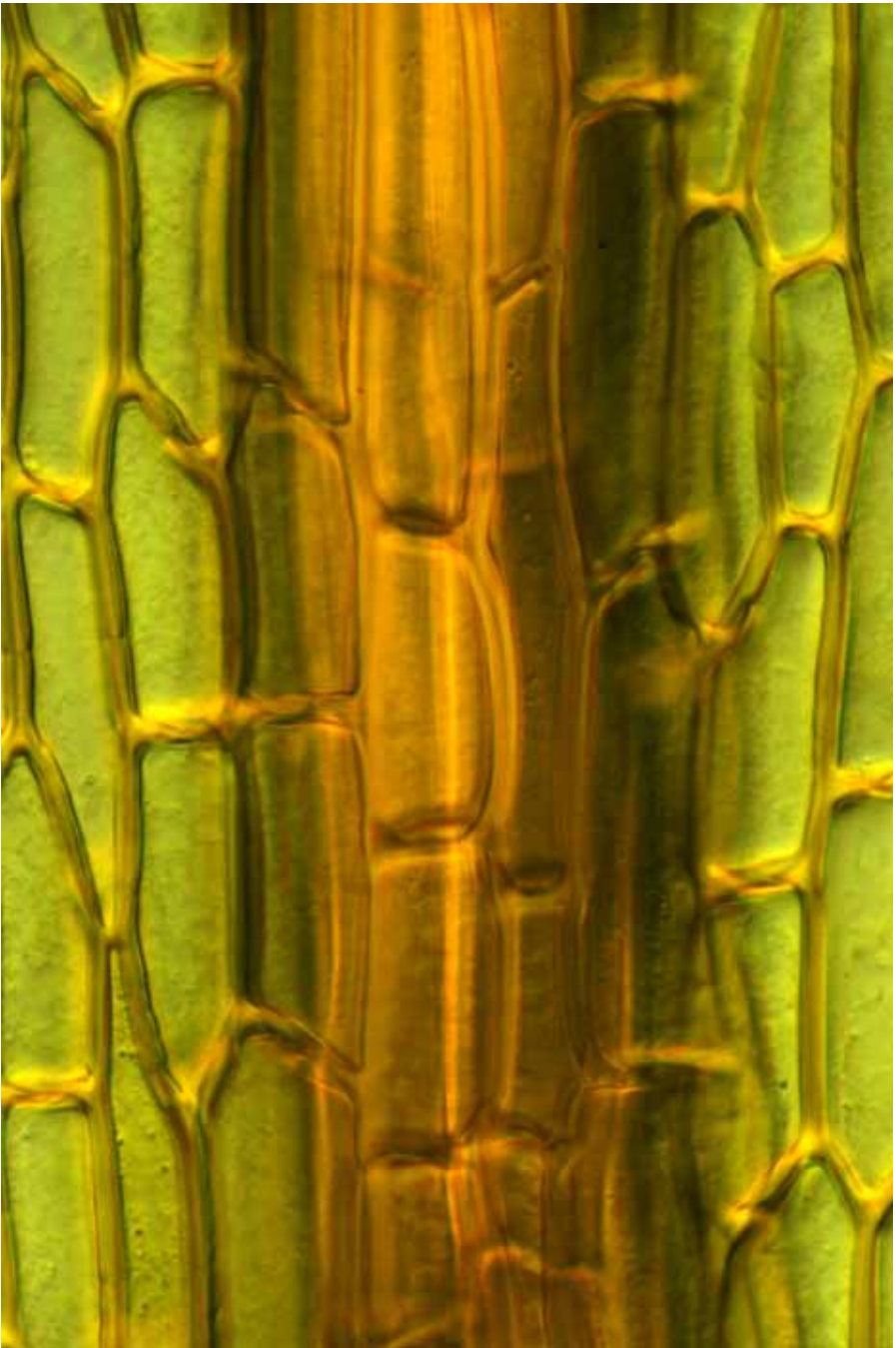
5 mm, 1 mm, 1 mm, 1 mm, 0.1 mm, 50 μm, 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

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*Pohlia elongata* costa midleaf  
10  $\mu$ m

continued next page

**Pohlia nutans** (Hedw.) Lindb.

**form:** tufted, erect, unbranched stems, 10–40 mm tall, the upper leaves crowded and larger

**habitat:** soil, rotting wood, and old peat hummocks in open or closed forest

**leaf:** size: 2–3(–4) mm

*shape:* lanceolate

*tip:* acuminate

*base:* not differentiated

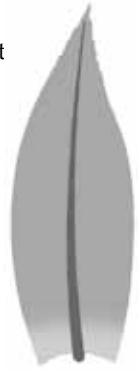
*costa:* strong below, subpercurrent

*border:* not differentiated

*margin:* entire below, denticulate near the apex, plane to reflexed

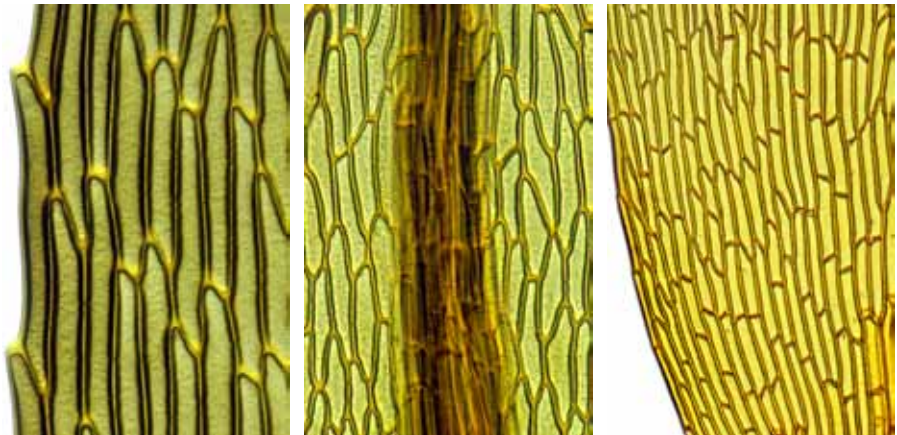
*cells:* 40–110 × 9–12 μm, linear to narrowly rhombic, firm-walled, smooth

**capsule:** 2.5–4 mm, narrowly pyriform, necked, horizontal to pendent, exerted, orange; seta 15–45 mm, flexuose, orange; peristome double, endostome cilia 2–3, segments perforate or gaping; operculum conic, rounded to bluntly apiculate; spores 16–21 μm in diam.



vegetative shoots (dry) (3), capsule (moist), leaf outline, and leaf apex

1 mm (2), 1 mm, 1 mm, 1 mm, 50 μm



margin midleaf, costa upper leaf, and leaf basal angle

10 μm, 10 μm, 50 μm

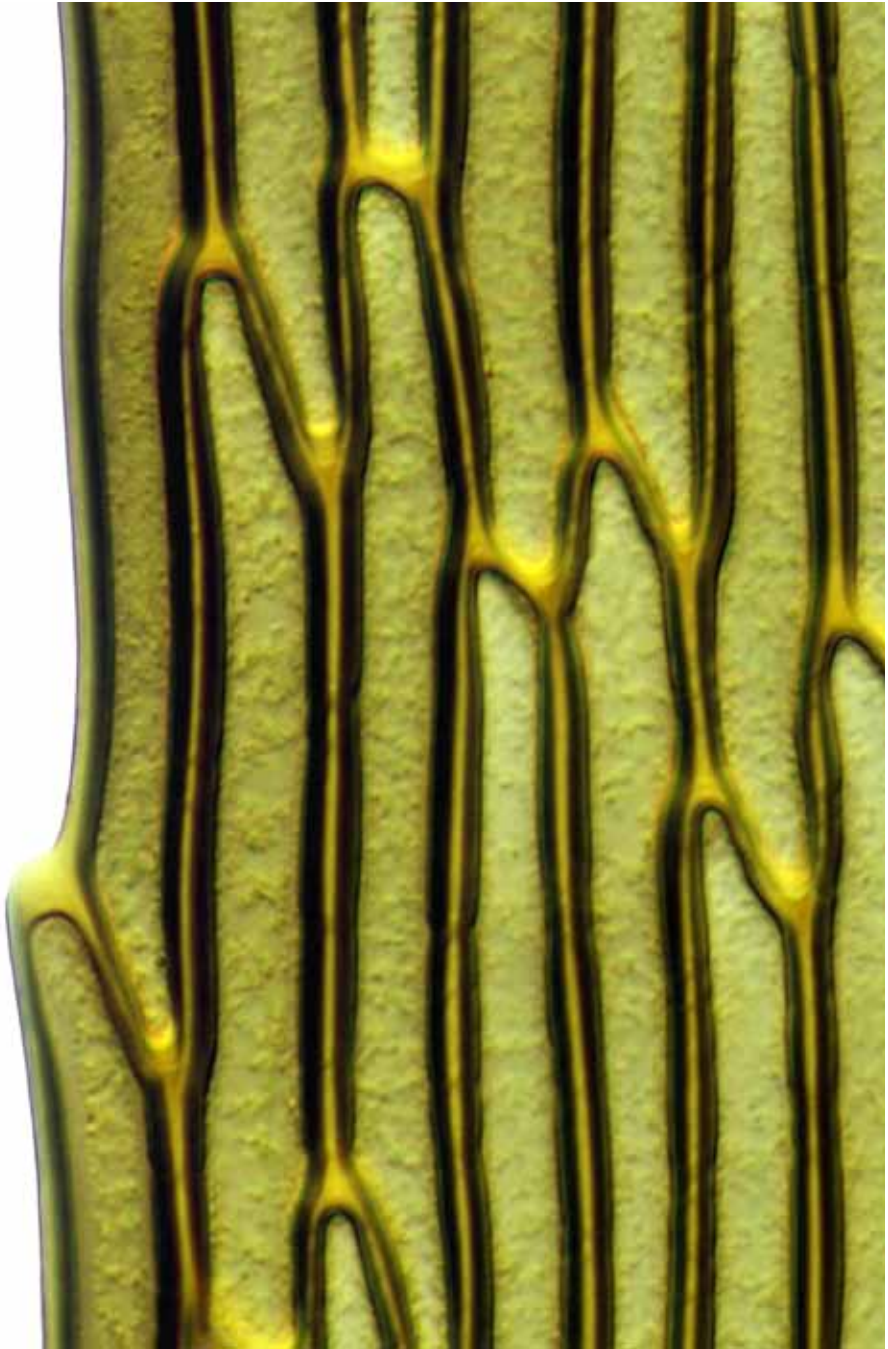
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*Pohlia nutans* immature capsules  
1 mm

continued next page



*Pohlia nutans* margin midleaf  
10  $\mu$ m

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**Pohli ochii** Vitt

**form:** slender shoots in tufts, light or yellow-green, dull or lustrous, 7–18 mm tall  
**habitat:** on dripping-wet, protected cliff faces

**leaf:** size: 2.1–3.4 mm

*shape:* narrowly lanceolate to linear-lanceolate

*tip:* attenuate to long-acuminate, twisted (torquate) when dry

*base:* undifferentiated, narrowly decurrent

*costa:* slender, ending several cells below the apex

*border:* not differentiated

*margin:* reflexed, serrulate from midleaf to the apex, subentire below

*cells:* upper cells elongate, thin-walled,  $105\text{--}260 \times 7\text{--}11 \mu\text{m}$ ; basal cells shorter

**capsule:** capsules not known

**note:** twisted, vermicular propagula common in upper leaf axils,  $130\text{--}300 \mu\text{m}$  long, with 1–3 primordia



vegetative shoots (dry) (4), leaf outline, and torquate leaf apex

5 mm, 5 mm, 5 mm, 1 mm, 1 mm, 50  $\mu\text{m}$



subapex and margin, vermicular gemmae, and leaf basal angle

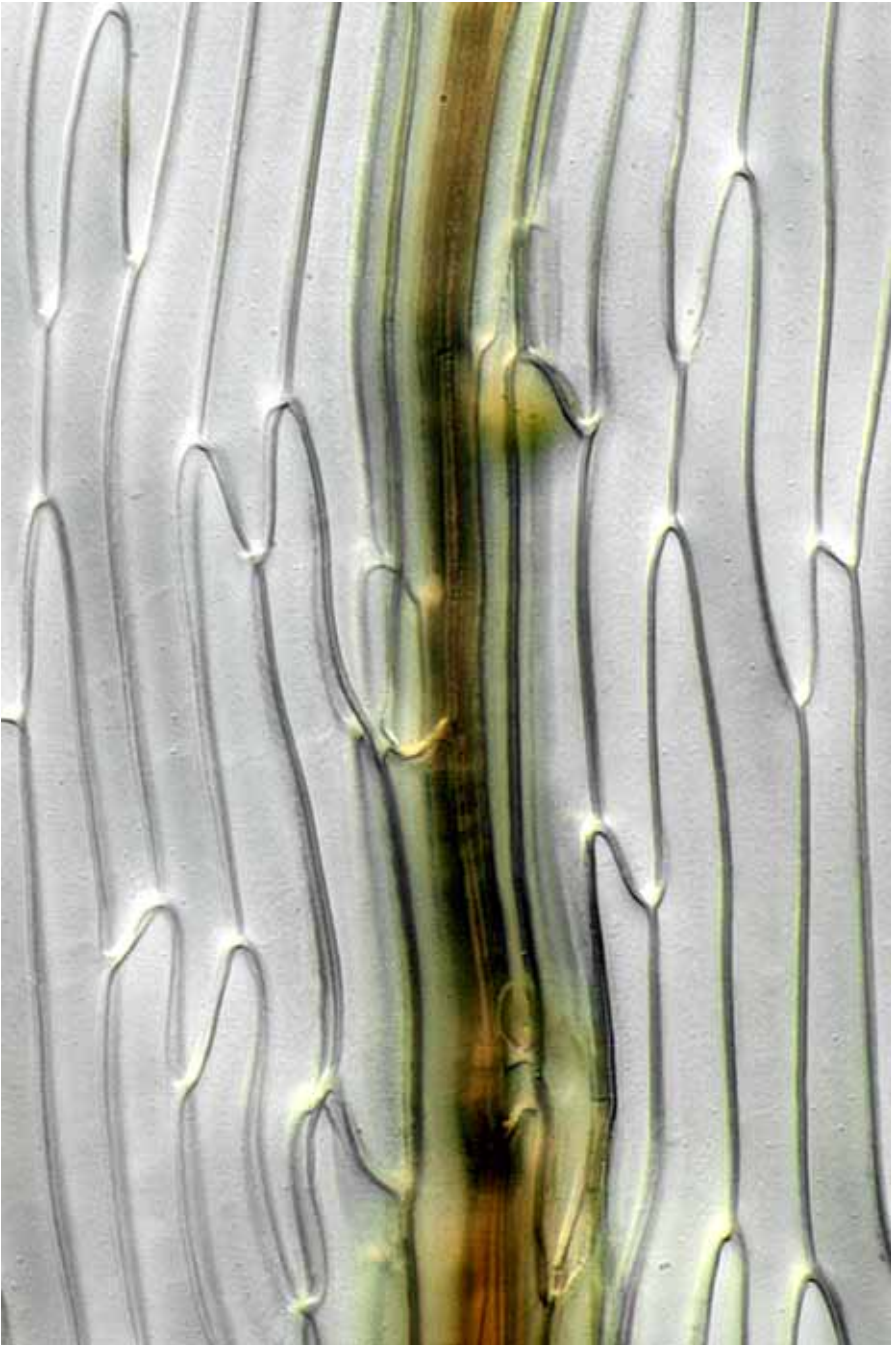
50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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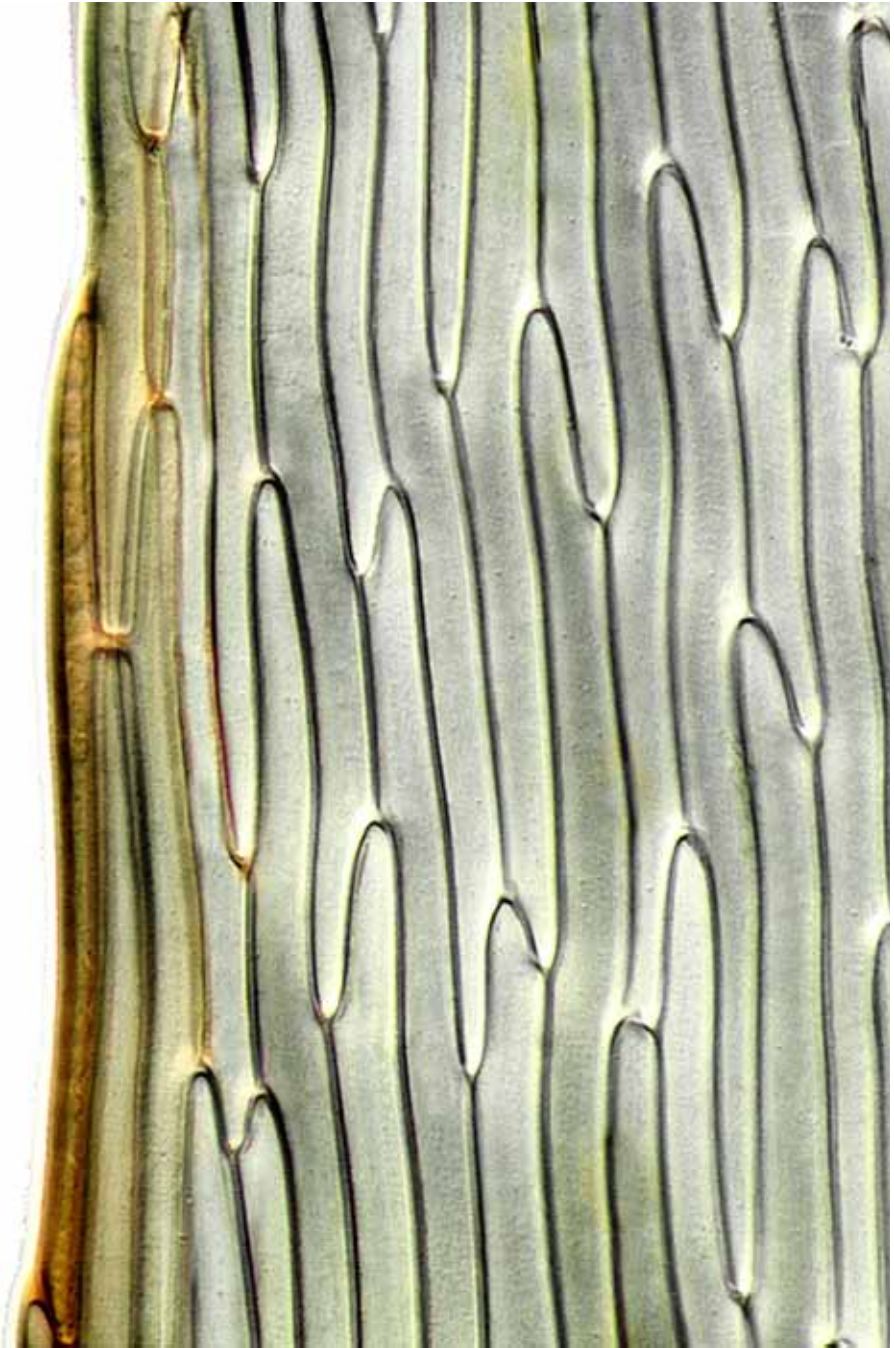
*Pohlia ochii* vegetative shoot (dry), and twisted (torquate) leaf apex  
1 mm (left), 50  $\mu$ m (right)

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*Pohlia ochii* costa upper leaf  
10  $\mu\text{m}$

continued next page



*Pohlia ochii* margin upper leaf  
10  $\mu\text{m}$

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***Pohlia tenuifolia*** (A.Jaeger) Broth.

**form:** tufted or loosely gregarious, erect, simple, slender stems, 3–10 mm tall, the leaves yellowish brown

**habitat:** soil

**leaf:** size: 1–2 mm

*shape:* narrowly linear-lanceolate to triangular, ± curved

*tip:* acuminate, rounded at the tip

*base:* not differentiated

*costa:* percurrent

*border:* not differentiated

*margin:* entire, plane to narrowly recurved

*cells:* 70–100 × 10 μm, linear-rhombic, firm-walled, smooth

**capsule:** 1–1.5 mm, narrowly oval or oblong, inclined to pendent, brown; seta 10–20 mm, flexuose, reddish; operculum conic; peristome bryoid, the exostome teeth 16, subulate with numerous lamellae, endostome cilia from rudimentary to long; spores 14–16 μm, smooth



vegetative shoot (dry and moist), leaf outline, and leaf apex (2)

1 mm,

0.5 mm,

0.1 mm,

50 μm,

50 μm



margin midleaf, costa midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page

***Pohlia wahlenbergii*** (Weber & D.Mohr) Andrews *in* Grout

**form:** loosely tufted or matted, erect, unbranched stems 10–50 mm tall, the leaves pale green

**habitat:** wet soil and humus of springs, meadows, and fens, to 2000 m

**leaf:** size: 1.0–2.5 × 0.3–1.0 mm

**shape:** ovate to ovate-lanceolate, concave

**tip:** acute to obtuse

**base:** alar cells undifferentiated, base narrowly decurrent

**costa:** failing well below the apex, reddish

**border:** not differentiated

**margin:** serrulate toward the apex, plane or nearly so

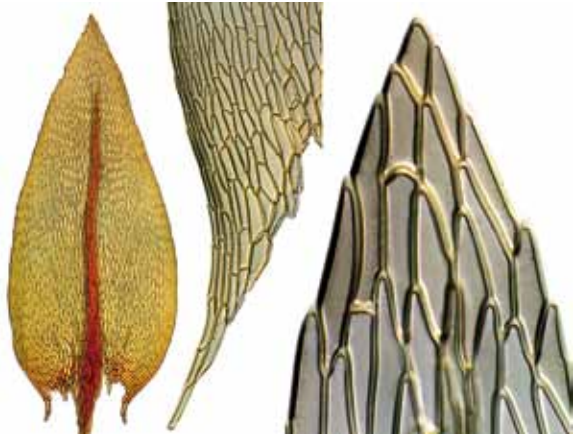
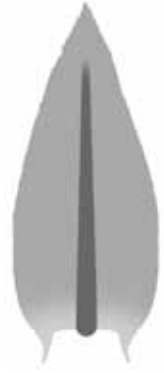
**cells:** 80–140 × 13–20 μm, long-rhombic, thin-walled, smooth

**capsule:** 1–2 mm, ovoid, short-necked, pendent, light to dark brown;

seta 10–20 mm; operculum high-conic; annulus none; peristome

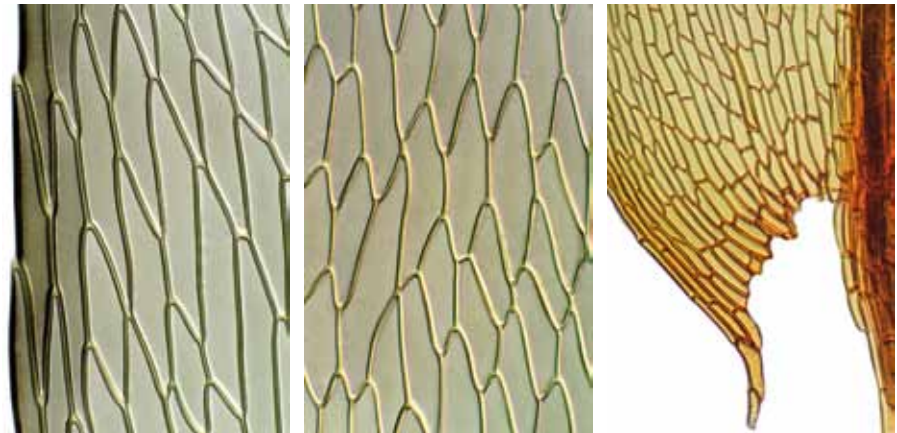
bryoid; spores 14–18 μm in diam.

**note:** nearly cosmopolitan



vegetative shoots (dry), leaf outline, leaf decurrency, and leaf apex

■ 1 mm, ■ 0.1 mm, ■ 50 μm, ■ 10 μm



margin midleaf, cells midleaf, and leaf basal angle showing decurrency

■ 10 μm, ■ 10 μm, ■ 50 μm

continued next page





*Pohlia wahlenbergii* margin midleaf  
10  $\mu\text{m}$

**Schizymerium bryoides** Hook.

**form:** tufted or scattered, radiculose, irregularly branched stems, to 20 mm tall, the leaves dull yellow, glossy

**habitat:** soil or rock

**leaf:** size: 0.8–2 × 0.2–0.5 mm

**shape:** lanceolate to oblong-lanceolate

**tip:** acute to acuminate

**base:** not differentiated

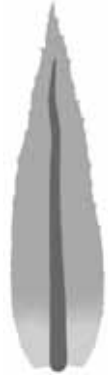
**costa:** gradually tapering, failing below the apex

**border:** not differentiated

**margin:** ± denticulate above, plane

**cells:** 120 × 6–8 μm, linear-rhombic, firm-walled, smooth

**capsule:** 2.5–3.5 mm, pyriform to clavate, ± asymmetric, inclined to suberect, wide-mouthed when old; seta 10–30 mm, slender, flexuose, reddish; operculum low-conic, mammillate; exostome absent, endostome processes 16 from a low membrane; spores 16–20 μm in diam, pale brown, smooth



vegetative shoots (dry) (3), leaf outline, and leaf apex (2)

1 mm (2), 1 mm, 0.25 mm, 50 μm, 10 μm



margin midleaf, cells midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

**Key\* to the New Zealand species of *Leptostomum* (2)**

- 1 Hair-point not branched; cells 12–18  $\mu\text{m}$ , incrassate; seta usually 15–55 mm long ..... ● ***Leptostomum inclinans***
- 1: Hair-point branched; cells 20–30  $\mu\text{m}$ , thin-walled; seta usually 10–15 mm long ..... ● ***Leptostomum macrocarpum***

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 238.



**Leptostomum inclinans** R.Br.

**form:** erect, simple or forked, matted tomentose stems, in dense cushions, 10–40 mm tall, the leaves pale green to yellow-brown

**habitat:** bark or rarely rock in montane forest

**leaf:** size: 2.5–3 (not including the arista) × 0.6–0.7 mm

**shape:** oblong to ovate-oblong

**tip:** widely acute to obtuse

**base:** basal cells slightly larger than the blade cells

**costa:** stout below, yellow, excurrent in a long, fine, smooth, flexuose arista

**border:** not differentiated

**margin:** entire to ± denticulate toward the apex, reflexed, ± undulate

**cells:** 12–18 μm, isodiametric, incrassate, smooth

**capsule:** 3.5 mm, cylindric, long-necked, narrow-mouthed, inclined to erect, brown above, reddish below; seta 15–55 mm, slender, flexuose; operculum short-conic; calyptra cucullate, fugacious; peristome rudimentary

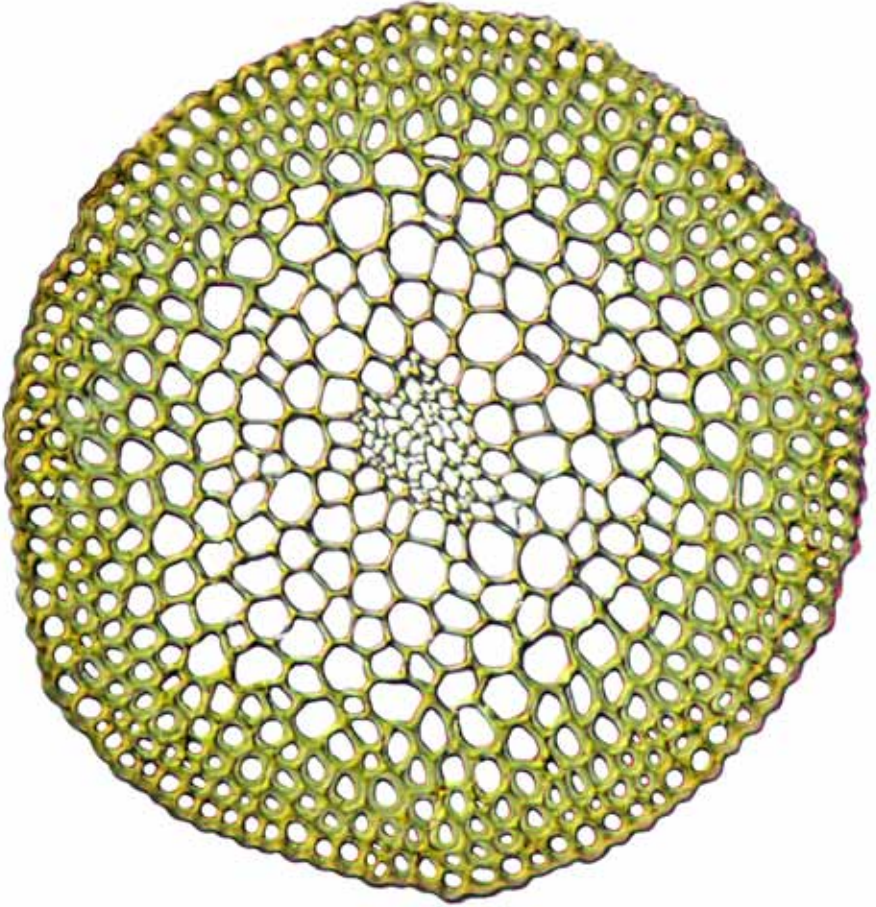


fertile habit, vegetative shoot (moist), leaf outline, leaf apex, and immature capsules (2)  
 5 mm, 1 mm, 1 mm, 0.5 mm, 1 mm (2)



margin midleaf, base of arista, and leaf basal angle  
 10 μm, 10 μm, 100 μm

continued next page



*Leptostomum inclinans* seta cross-section  
10  $\mu\text{m}$

continued next page



*Leptostomum inclinans* margin midleaf  
10  $\mu$ m

continued next page

**Leptostomum macrocarpum** (Hedw.) Bach.Pyl.

**form:** densely tufted, erect, heavily red-tomentose stems, 8–20 mm tall  
**habitat:** bark, rock, or rarely soil in lowland to montane forest

**leaf:** size: 2.3–3.0 mm (excluding the hair-point)

*shape:* ovate to obovate-oblong

*tip:* obtuse

*base:* basal cells short-oblong

*costa:* excurrent in a branched hair-point

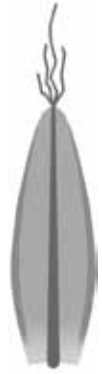
*border:* not differentiated

*margin:* entire, revolute from near base to tip

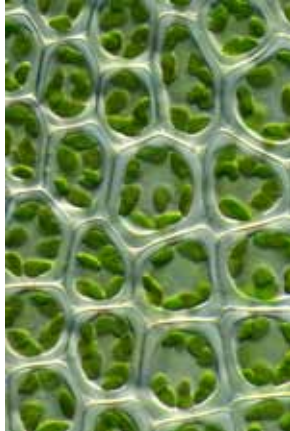
*cells:* 20–30  $\mu\text{m}$ , subquadrate to wide-hexagonal, thick-walled, smooth

**capsule:** 3–4.5 mm, ovate-oblong, erect, exserted, pale brown; seta 10–15(–45) mm, yellow to orange, flexuose; peristome rudimentary, only a low, papillose, membranous endostome; operculum high-conic; no annulus

**note:** differs from *Leptostomum inclinans* in having a branched hair-point and larger leaf cells

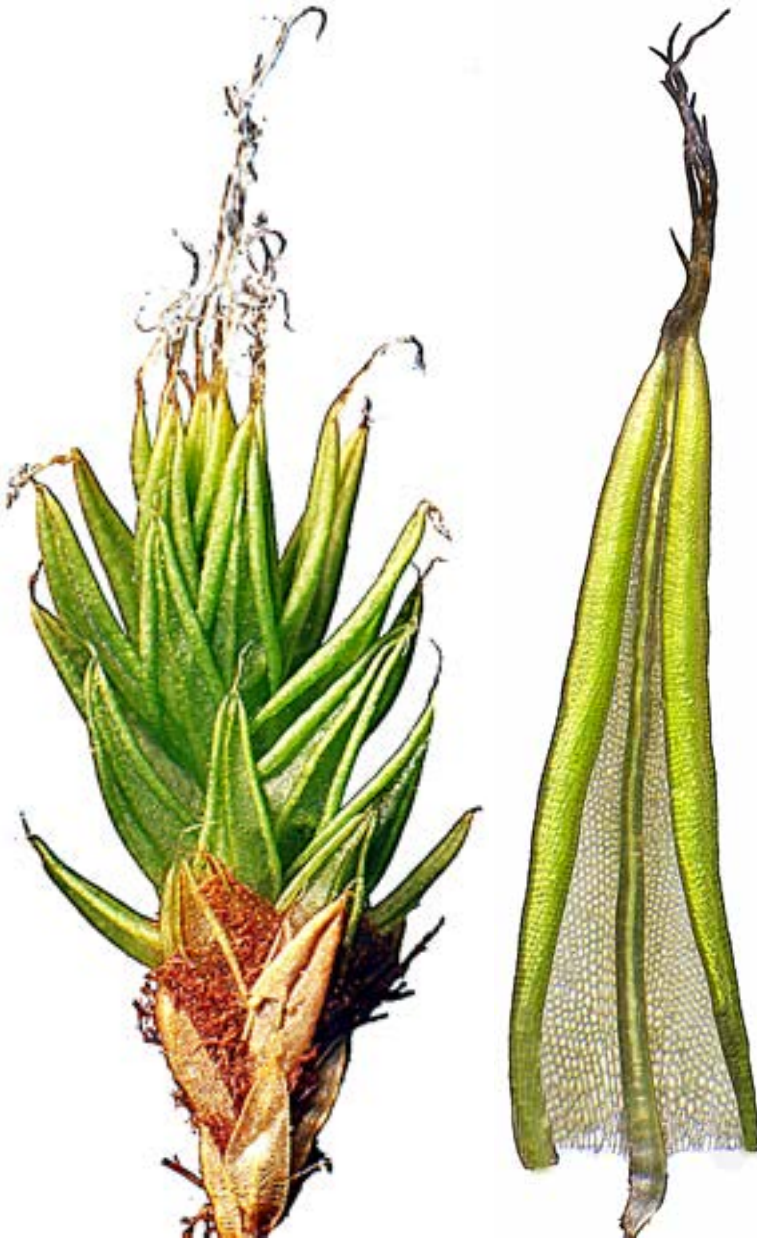


fertile shoots (male on left), capsules (with and without calyptra) (2), and leaf outline  
 ■ 1 mm, ■ 1 mm, ■ 1 mm (2), ■ 1 mm



leaf apex, hair-point, cells lower leaf (fresh), and leaf basal angle  
 ■ 100  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 100  $\mu\text{m}$

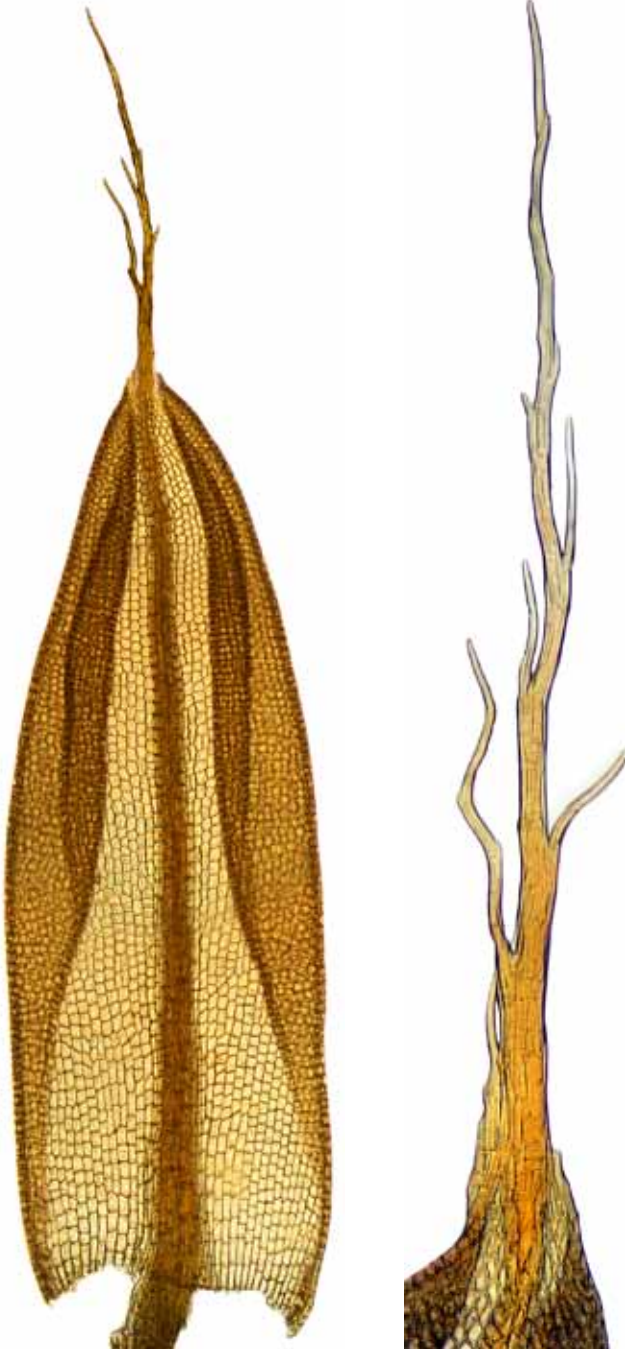
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*Leptostomum macrocarpum* vegetative shoot and leaf (abaxial surface) (moist)  
1 mm, 1 mm

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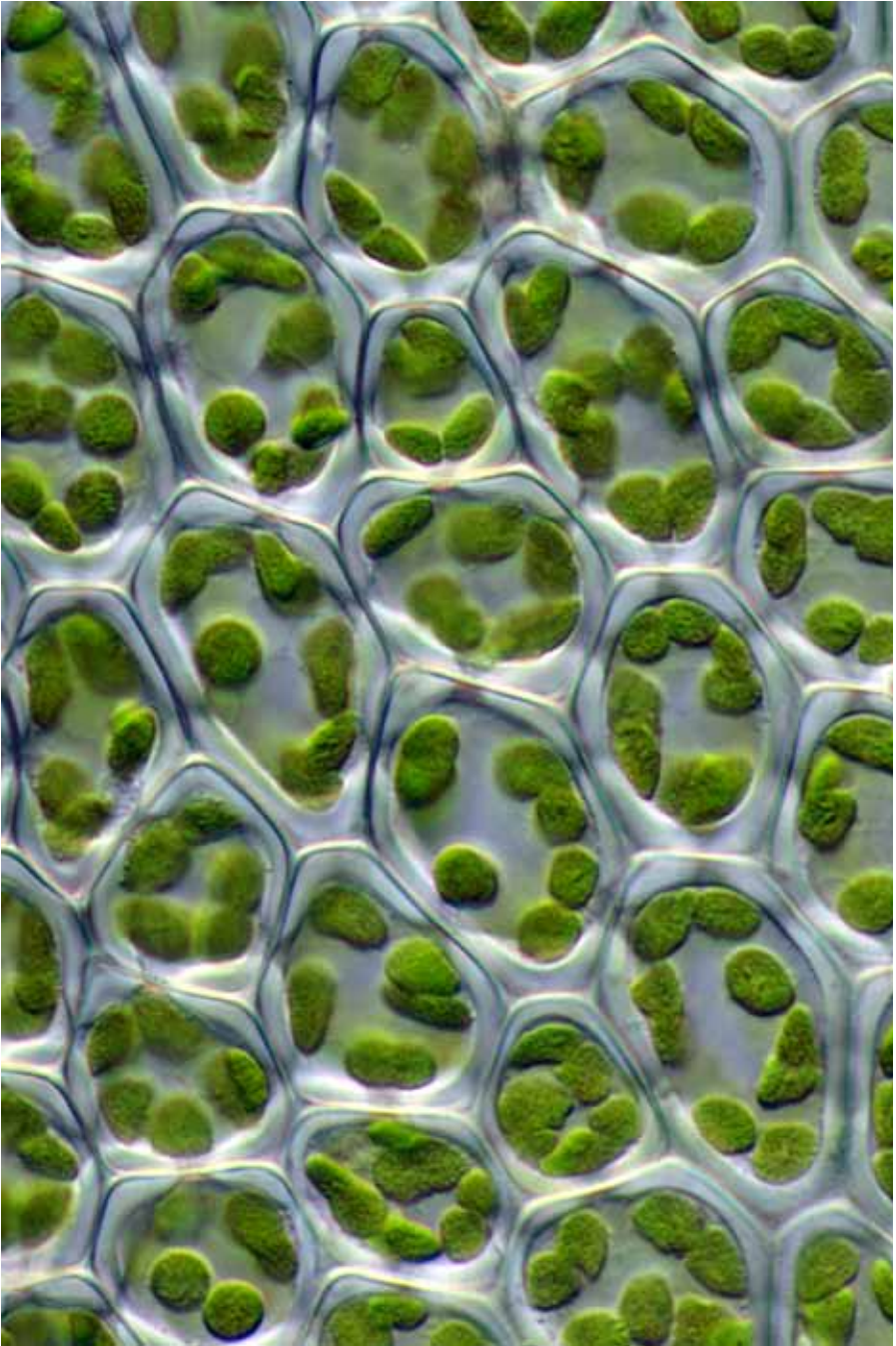


*Leptostomum macrocarpum* leaf outline and hair-point detail (cleared)

0.5 mm,

0.1 mm

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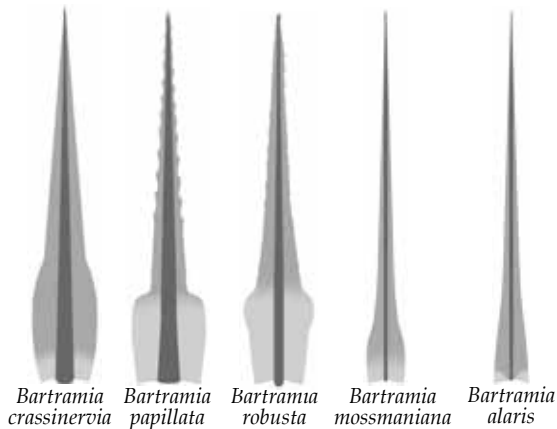


*Leptostomum macrocarpum* cells lower leaf (fresh)  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Bartramia* (5)**

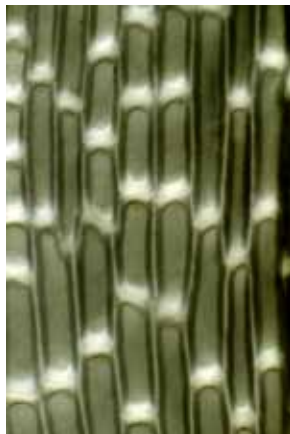
- 1 Angle cells forming a distinct alar group ..... ***Bartramia alaris***  
 1: Angle cells not differentiated ..... 2
- 2(1:) Upper cells elongate and obscure; leaf base strongly sheathing ..... 3  
 2: Upper cells isodiametric and clear; leaf base only weakly sheathing ..... 4
- 3(2) Capsule gymnostomous, erect..... ● ***Bartramia robusta***  
 3: Capsule peristomate, inclined..... ● ***Bartramia papillata***
- 4(2:) Stems 30–100 mm tall; seta 2–8 mm long..... ● ***Bartramia mossmaniana***  
 4: Stems 6–7 mm tall; seta 10 mm long ..... ● ***Bartramia crassinervia***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 301.



**Bartramia crassinervia** Mitt.**form:** tufted, branched stems to 7 mm tall, glaucous green**habitat:** montane beech forest, 800–1100 m**leaf:** *size:* to 2 mm long*shape:* lanceolate, spreading when moist*tip:* acuminate, subula serrulate toward apex*base:* weakly sheathing from a narrowly ovate base*costa:* strong, 1/3 of width of leaf base, excurrent, toothed on back and apex*border:* not differentiated*margin:* serrulate above, recurved*cells:*  $7 \times 11 \mu\text{m}$ , upper  $\pm$  quadrate, lower elongate, firm-walled, smooth to weakly papillose**capsule:**  $1.5 \times 0.8 \text{ mm}$ , when young subglobose, when mature short-cylindric, asymmetric, and strongly ridged, rust-red; seta to 10 mm, red; operculum convex, apiculate; peristome teeth narrow, reddish**note:** a rare New Zealand endemic

vegetative shoot (moist), mature capsule (dry), leaf, apex, subapex, and upper margin  
 1 mm, 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



costa and recurved margin, cells near leaf base, and leaf basal angle  
 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page



*Bartramia crassinervis* habit (dry)  
10 mm

**Bartramia mossmaniana** Müll.Hal.

**form:** robust, loosely tufted, soft, sparingly branched stems, 30–100 mm tall, tomentose below

**habitat:** bark, soil, or rock crevices in damp forest to high elevation

**leaf:** size: 5–9 × 0.6–1.0 mm

**shape:** suddenly contracted to a linear subula from a wide base

**tip:** long-tapering

**base:** semi-sheathing

**costa:** excurrent in a sharply denticulate point, ± serrulate at the back

**border:** not differentiated

**margin:** doubly serrate above, narrowly recurved or thickened

**cells:** 8–15 μm, ± isodiametric, incrassate, mammillose, sheath cells linear

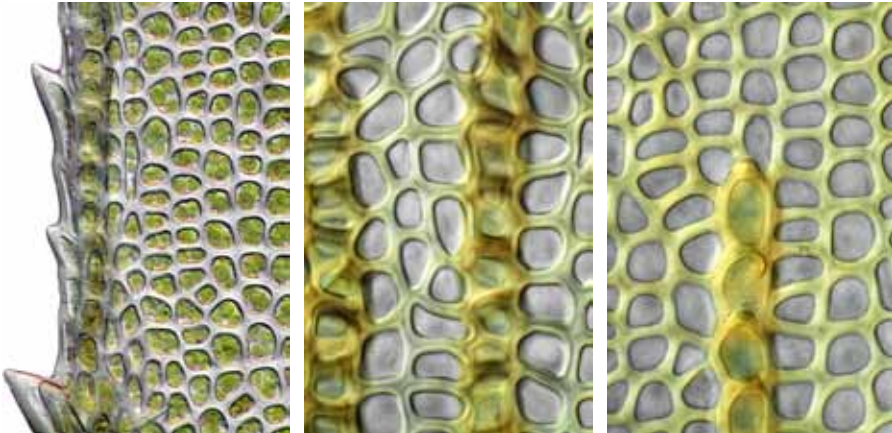
**capsule:** 1–2 mm, oval-oblong to subglobose, ± curved and furrowed when dry; seta 2–5 mm, often paired

**note:** resembles *Polytrichadelphus magellanicus*, but differs in having a double peristome and non-lamellate leaves



fertile shoot (2), mature capsule (dry), leaf outline, leaf apex, and subapex

5 mm, 5 mm, 1 mm, 1 mm, 10 μm, 10 μm



toothed subula margin and cells midleaf (2)

10 μm, 10 μm, 10 μm



*Bartramia mossmaniana* vegetative shoot (moist) and peristome (top view) (dry)  
■ 1 mm (shoot), ■ 0.5 mm (peristome)

continued next page

**Bartramia papillata** Hook.f. & Wilson

**form:** tufted, erect, heavily tomentose stems, 10–30 mm tall, the leaves yellowish brown or green

**habitat:** soil or rock

**leaf:** size: 3.5–8 mm

*shape:* setaceous from a wide semi-sheathing base

*tip:* acute

*base:* cells of silvery basal sheath hyaline, smooth, thin-walled

*costa:* percurrent or excurrent, ill-defined

*border:* not differentiated

*margin:* serrulate above, plane or slightly reflexed, ± bistratose

*cells:* 16–30  $\mu\text{m}$  long, rectangular, firm-walled, papillose

**capsule:** 1–3 mm, subglobose slightly asymmetrical, oblong to subglobose, erect to inclined, furrowed or wrinkled when dry; seta 3–20 mm, orange; operculum conic; peristome double, exostome teeth 16, red, endostome cilia reduced; spores 18–24  $\mu\text{m}$



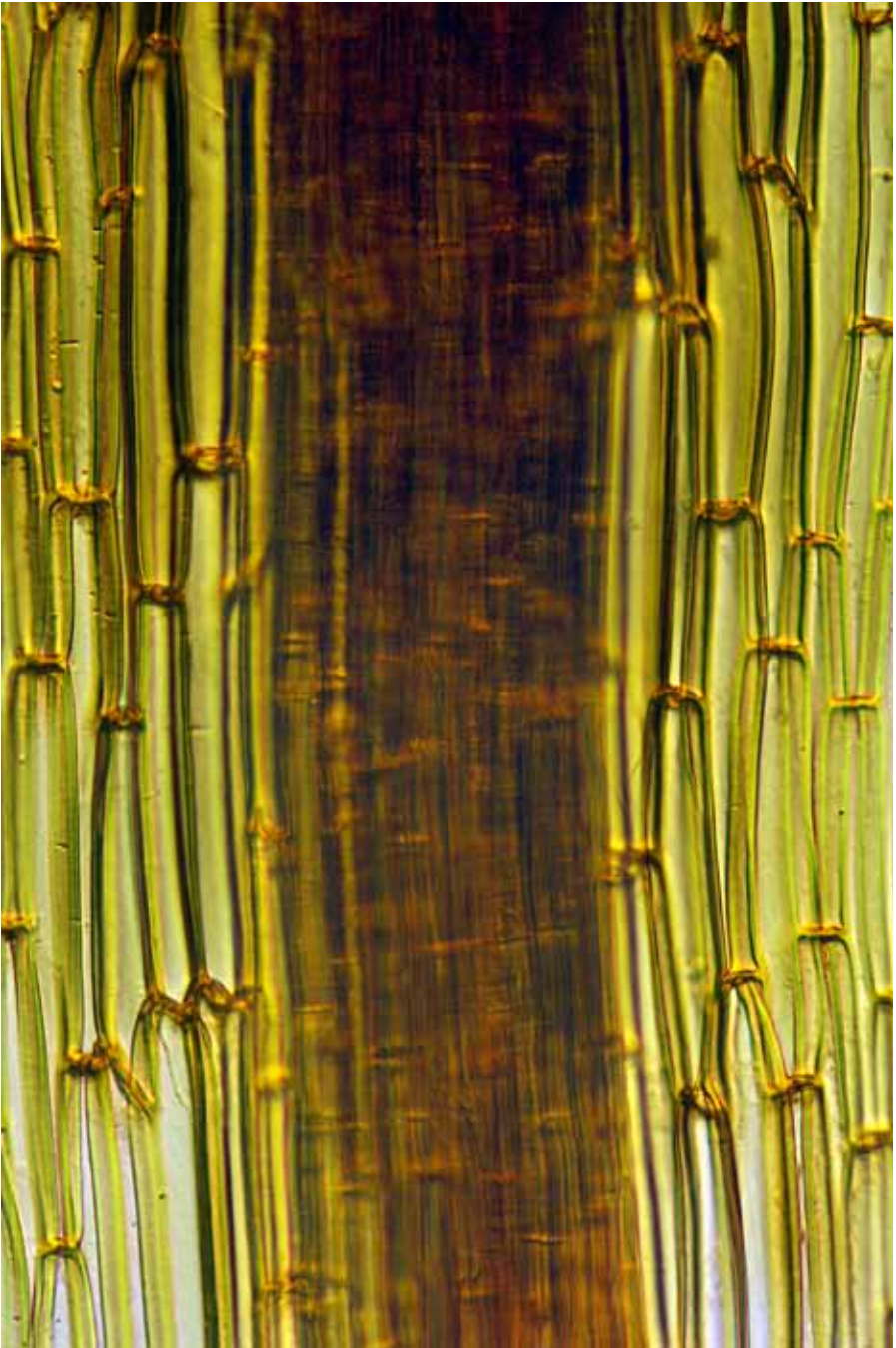
fertile shoot, capsules (2), hyaline sheathing leaf bases, leaf outline, and leaf apex (2)  
 ■ 1 mm, ■ 1 mm (2), ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$



shoulder of sheath, subula margin, and costa near base  
 ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

continued next page





*Bartramia papillata* costa near leaf base  
10  $\mu\text{m}$

continued next page

**Bartramia robusta** Hook.f. & Wilson

**form:** loosely caespitose, densely rhizomatose stems, to 30 mm tall, the leaves yellow-green

**habitat:** soil or rock in montane to alpine herbfields, to 1500 m

**leaf:** size: 3.5–6.3 × 0.5–1.0 mm

**shape:** narrowly triangular atop an obtuse, sheathing, hyaline base

**tip:** acute

**base:** basal cells long-rectangular, 190 × 30 μm, thin-walled

**costa:** strong, prominent abaxially, percurrent

**border:** not differentiated

**margin:** entire below, denticulate above (teeth single or double), plane

**cells:** 38 × 8 μm, rectangular, firm-walled, ± prorate

**capsule:** 2 × 1 mm, subglobose, ± erect, sulcate when dry; seta 10–30 mm;

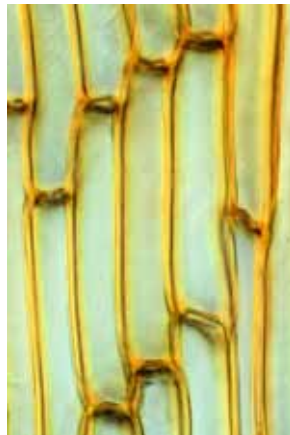
peristome double, exostome teeth orange, endostome segments rudimentary;

spores reniform, brown, 35–50 μm in diam., coarsely verrucose



fertile habit, cushion (cutaway view), leaf outline, and leaf apex

1 mm, 1 mm, 1 mm, 10 μm



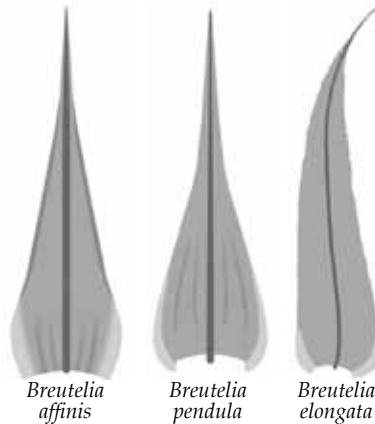
leaf shoulder, leaf basal cells, and immature capsule with calyptra

50 μm, 10 μm, 0.5 mm

**Key\* to the New Zealand species of *Breutelia* (3)**

- 1 Leaves subsecund; stems densely foliate..... ● ***Breutelia elongata***  
 1: Leaves radially arranged; stem loosely foliate .....2  
 2(1:) Leaf plicate at only the base; alar cells in 6–12 rows, firm-walled .....  
 ..... ● ***Breutelia affinis***  
 2: Leaf plicate above; alar cells in 3–6 rows, thin-walled ..... ● ***Breutelia pendula***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 308.



**Breutelia affinis** (Hook.) Mitt.

**form:** densely matted, erect, heavily tomentose, ± simple stems, to 70 mm tall  
**habitat:** rock or soil in moist sites, to montane elevations

**leaf:** size: 1.7–3.8 × 0.4–0.9 mm

**shape:** ovate-lanceolate to oblong-lanceolate, plicate at the base

**tip:** long-acuminate

**base:** basal patch plus many rows of subquadrate alar cells to 1/3 up blade

**costa:** short- to long-excurrent

**border:** not differentiated

**margin:** denticulate above, entire below, recurved midleaf and below

**cells:** 6–40 × 2–6 μm, irregular, firm-walled, ± papillose

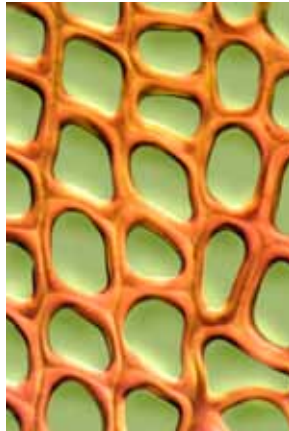
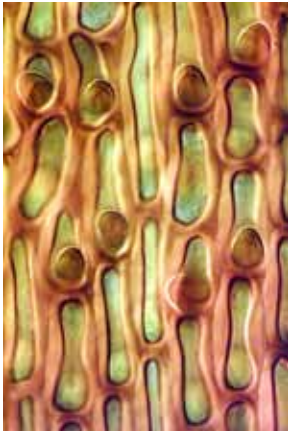
**capsule:** 2 mm, cylindric, inclined to horizontal, deeply ribbed when dry; seta to 25 mm; peristome double, exostome teeth 16, endostome cilia rudimentary; spores 24–34 μm

**note:** differs from other species of *Breutelia* in having large numbers of subquadrate alar cells reaching 1/3 up the leaf blade



male shoots (2), leaf outline, leaf apex (2), and margin midleaf

5 mm, 1 mm, 0.1 mm, 10 μm, 10 μm, 10 μm



cells midleaf, alar cells, and leaf basal angle showing plications

10 μm, 10 μm, 100 μm

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*Breutelia affinis* habit  
1 mm

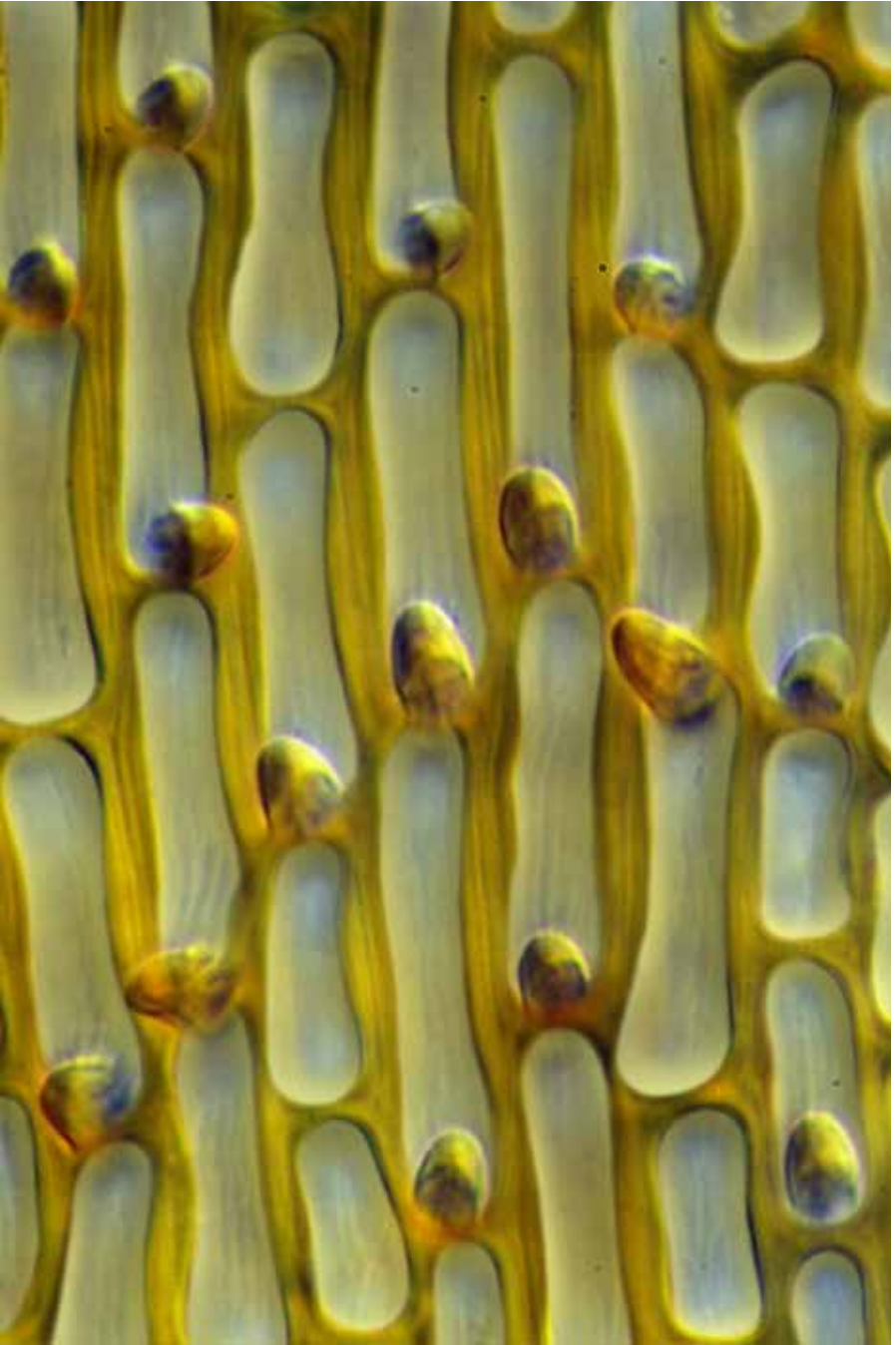
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*Breutelia affinis* vegetative shoots (dry)

5 mm

continued next page



*Breutelia affinis* cells midleaf  
10  $\mu\text{m}$

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**Breutelia elongata** (Hook.f. & Wilson) Mitt.

**form:** tufted, erect, ± simple stems, to 80 mm long, the leaves secund, golden  
**habitat:** moist soil or occasionally rock, lowland to montane

**leaf:** size: 5–7 mm

*shape:* ovate-lanceolate, strongly plicate throughout

*tip:* acuminate, ending in a filiform hair-point

*base:* 6–8 rows of short, pigmented cells

*costa:* percurrent to shortly excurrent in a slender point

*border:* not differentiated

*margin:* distantly denticulate, plane

*cells:* 30–55 μm, narrowly linear, incrassate, papillose at the distal end

**capsule:** 5 mm, ovate-oblong, erect, ± gibbous, sulcate when dry; seta 20–60 mm; spores 20–22 μm in diam.

**note:** differs from *Breutelia pendula* in having thicker-walled porose cells, a narrower leaf base and costa, more strongly plicate leaves, and a shorter and wider alar region



vegetative shoots (dry) (2), capsule, leaf plications, leaf outline, and leaf apex  
 ■ 5 mm, ■ 1 mm, ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 10 mm



leaf margin, midleaf cells, and alar region of leaf base  
 ■ 10 μm, ■ 10 μm, ■ 100 μm

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**Breutelia pendula** (Sm.) Mitt.

**form:** robust mats of ± simple, densely tomentose stems, to 140 mm long  
**habitat:** soil or rock in moist sites, usually at higher elevations

**leaf:** size: 2.5–4.0 × 0.8–1.3 mm

**shape:** ovate-lanceolate from a sheathing base, plicate throughout

**tip:** finely acuminate

**base:** alar region 3–6 rows of pellucid cells forming a distinct group

**costa:** excurrent in a slender, ± flexuose, ± hyaline point

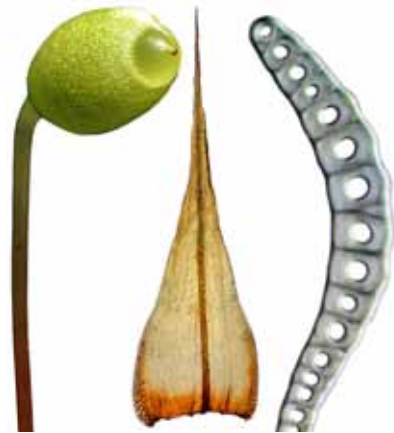
**border:** not differentiated

**margin:** serrulate above, ± recurved toward the base

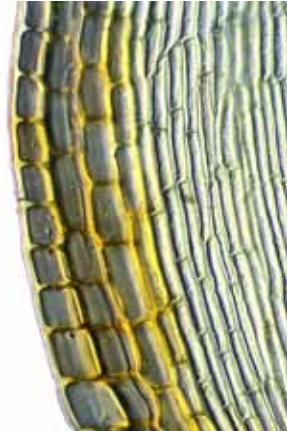
**cells:** 15–50 μm long, linear to rectangular, firm-walled, smooth

**capsule:** 2.5–4 mm, ovoid-oblong, ± gibbous, inclined to horizontal, grooved when dry; seta 20–50 mm; peristome double, endostome cilia rudimentary; spores 20–22 μm

**notes:** can form large, deep mats on rock faces; differs from *Breutelia elongata* in having a wide leaf base and costa and less strongly plicate leaves



habit, tomentose shoot base, immature capsule, leaf outline, and margin cross-section  
 10 mm, 1 mm, 1 mm, 0.5 mm, 10 μm



cells midleaf, alar region, alar region xs, and whole leaf xs  
 10 μm, 50 μm, 50 μm, 100 μm

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*Breutelia pendula* vegetative habit (moist)  
10 mm

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*Breutelia pendula* perigonium ("male flower") in top view  
1 mm

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*Breutelia pendula* mature capsule and peristome  
— 0.1 mm

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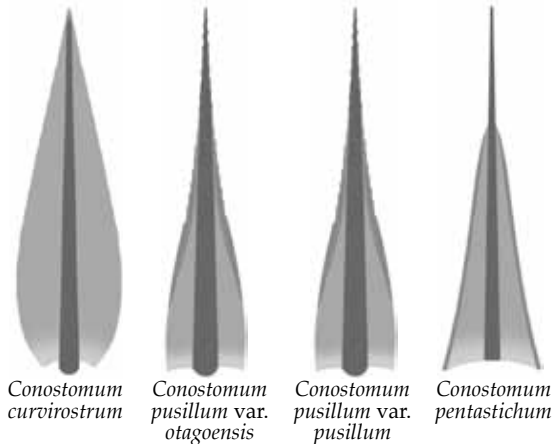


*Breutelia pendula* leaf cross-section  
10  $\mu\text{m}$

**Key\* to the New Zealand species and varieties of *Conostomum* (4)**

- 1 Peristome present; seta > 9 mm ..... 2  
 1: Peristome absent; seta < 6 mm ..... 3
- 2(1) Costa narrow, distinct, and in xs without multistratose wings; capsule < 2.5 mm ..... ● ***Conostomum pentastichum***  
 2: Costa wide, indistinct, and in xs with multistratose wings; capsule > 2.5 mm ..... ● ***Conostomum pusillum* var. *pusillum***
- 3(1:) Costa long-excurrent; capsule erect, globose, not sulcate ..... ● ***Conostomum curvirostrum***  
 3: Costa percurrent or only short-excurrent; capsule inclined to horizontal, ellipsoidal, sulcate ..... ● ***Conostomum pusillum* var. *otagoensis***

\* based partly on Fife, AJ (1998): A synopsis of the New Zealand representatives of *Conostomum* (Musci: Bartramiaceae). *New Zealand Journal of Botany* 36, 606.



**Conostomum curvirostrum** (Mitt.) Mitt.

**form:** erect, short-branched, tomentose stems, 2–4 mm tall, tufted or in cushions, the leaves green to reddish brown

**habitat:** soil at high elevation

**leaf:** size: 0.5–0.9 × 0.1–0.2 mm

*shape:* lanceolate to triangular-lanceolate

*tip:* acuminate

*base:* basal cells oblong-rectangular, smooth; alar cells little differentiated

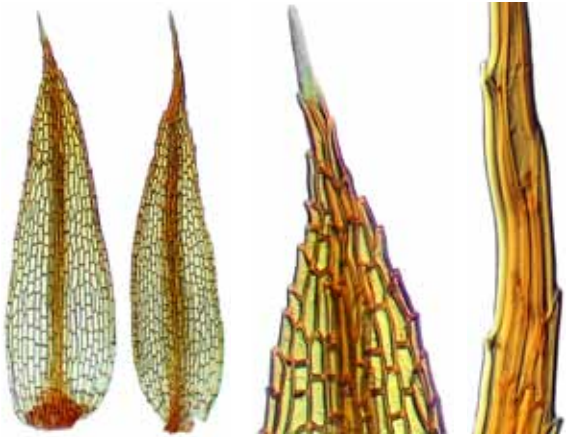
*costa:* excurrent in a hyaline hair-point, prorate

*border:* not differentiated

*margin:* entire, plane or variably recurved

*cells:* 20–55 × 10–12 μm, rectangular, thin-walled, smooth to prorate

**capsule:** 1–1.3 mm, globose, erect, wrinkled or furrowed when dry; seta 2–7 mm; peristome absent; spores globose, ovoid, or reniform, densely warted, 36–50 μm in diam.



empty capsules, leaf outlines (2), leaf apex, and hair-point  
 1 mm, 0.1 mm (2), 50 μm, 5 μm



subapex (prorate costa), costa in upper leaf, and leaf basal angle showing base of costa  
 50 μm, 10 μm, 10 μm

continued next page

**Conostomum pentastichum** (Brid.) Lindb.

**form:** densely tufted, tomentose, branched stems, to 20 mm tall, the leaves distinctly five-ranked and glaucous

**habitat:** damp soil or rock at high altitude

**leaf:** size: 1–2 × 0.3–0.5 mm

*shape:* narrowly triangular, the surface prorate

*tip:* acuminate

*base:* undifferentiated

*costa:* wide at the base, indistinct, long-excurrent in a hair-point, prorate

*border:* absent

*margin:* prorate, narrowly recurved

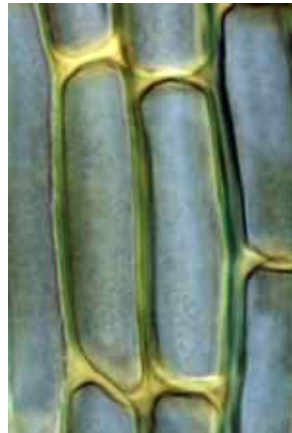
*cells:* 35–60 × 10 μm, linear, firm-walled, smooth to prorate

**capsule:** 1.5–3.5 mm, globose to ovoid, inclined to ceruuous, sulcate when dry; seta 1–3.5 mm; peristome single, exostome teeth red, the tips fused; spores reniform, to 60 μm long

**note:** readily identified by its 5-ranked leaves



habit, pentastichous shoots (2), leaf outline and subapex, and recurved margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 100 μm, ■ 10 μm



prorate midleaf surface, basal leaf cells, and immature capsules  
 ■ 10 μm, ■ 10 μm, ■ 1 mm

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*Conostomum pentastichum* mature capsule  
1 mm

continued next page

**Conostomum pusillum** var. **otagoensis** Fife

**form:** tufted, erect, sparsely branched stems with leaves in five rows, 5–20 mm  
**habitat:** damp, exposed soil or rock at high altitude

**leaf:** size: 0.8–1.8 mm

*shape:* lanceolate to narrowly triangular, little altered when dry

*tip:* acuminate

*base:* alar cells not differentiated

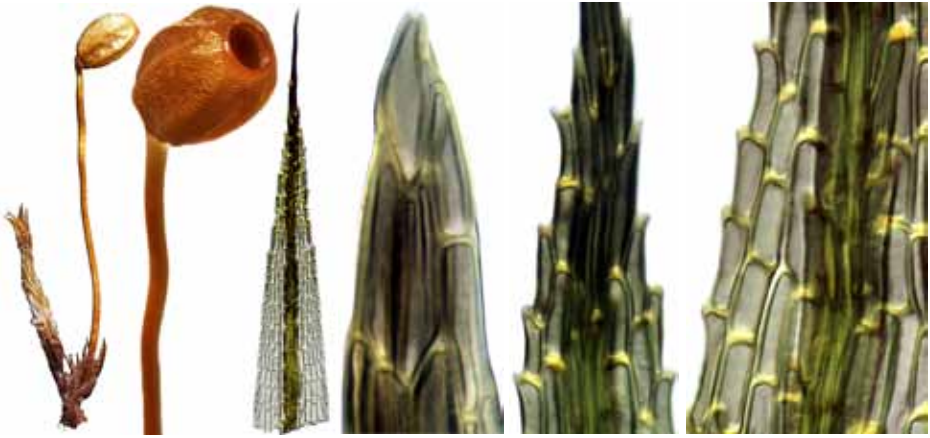
*costa:* excurrent in a ± hyaline, denticulate arista

*border:* not differentiated

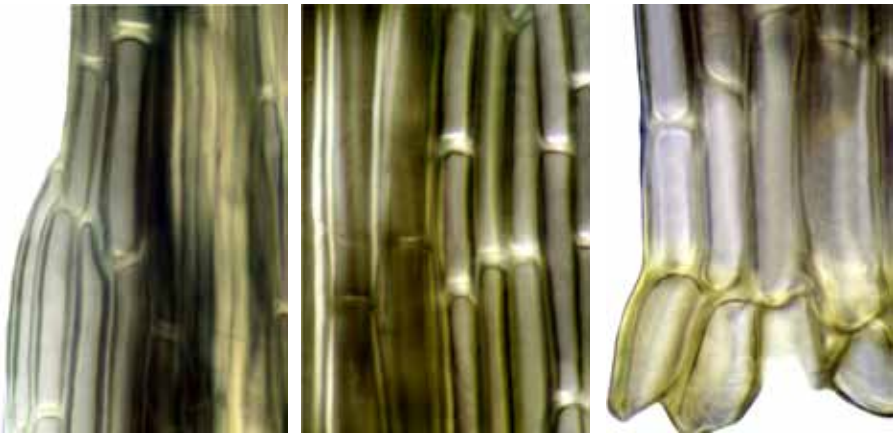
*margin:* entire to denticulate, plane to narrowly incurved

*cells:* 40–70 × 10 μm, rhombic-rectangular, firm-walled, smooth or nearly so

**capsule:** 1.3–2 mm long, subglobose, inclined to horizontal, ribbed when dry,  
 brown; seta 5–20 mm long, orange, ± flexuose; peristome none



fertile shoot (dry), mature capsule, leaf outline, apex and subapex, and upper margin  
 1 mm, 1 mm, 0.5 mm, 10 μm, 50 μm, 10 μm



margin at midleaf, juxtacostal cells near base, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page



*Conostomum pusillum* var. *otagoensis* mature capsule  
0.5 mm

**Conostomum pusillum** Hook.f. & Wilson var. **pusillum**

**form:** gregarious, branched, ± tomentose, erect stems, to 6 mm tall  
**habitat:** soil at subalpine and alpine elevations

**leaf:** size: 0.7–2.0 mm

*shape:* triangular to linear-lanceolate, unistratose, little altered when dry

*tip:* acuminate, ending in a hair-point

*base:* basal cells longer than the other laminal cells

*costa:* occupying about half the leaf width below, excurrent, prorate above

*border:* not differentiated

*margin:* entire below, denticulate above, narrowly recurved

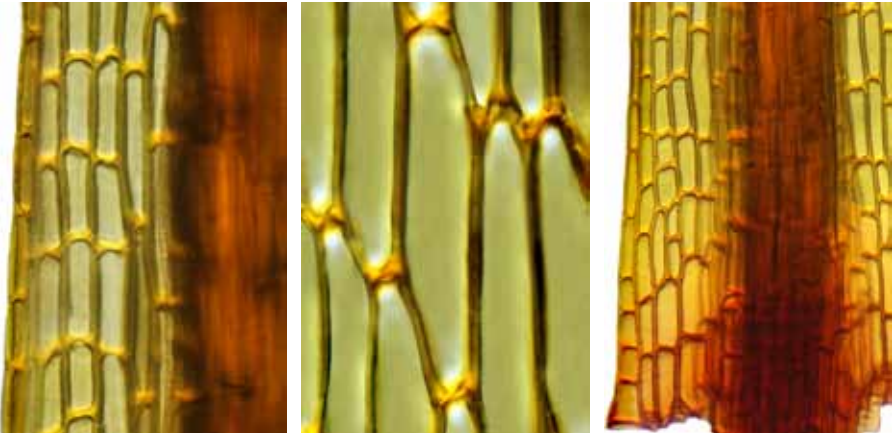
*cells:* 25–60 × 6–10 μm, rectangular, firm-walled, prorate above

**capsule:** 1.3–2 mm, globose to ovoid, slightly asymmetric, erect to inclined, exerted, brown, ± sulcate when dry; seta 9–20 mm, orange, flexuose; operculum curved-rostrate; peristome single, exostome teeth red, joined at their tips; spores globose, ovoid, or reniform, to about 60 μm in diam.



fertile shoot (dry) (2), leaf outline, leaf apex (2), and maturing capsules

5 mm, 1 mm, 0.1 mm, 10 μm, 10 μm, 0.5 mm (2)



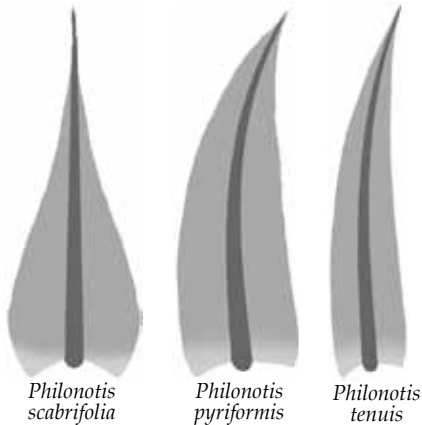
margin midleaf, juxtacostal cells in lower leaf, and leaf basal angle

10 μm, 10 μm, 10 μm

**Key\* to the New Zealand species of *Philonotis* (3)**

- 1 Plants glaucous..... ● ***Philonotis scabrifolia***  
 1: Plants not glaucous..... 2
- 2(1:) Stems 10–40 mm tall; costa long-excurrent; margin ± recurved.....  
 ..... ● ***Philonotis tenuis***  
 2: Stems 40–80 mm tall; costa short-excurrent; margin plane... ● ***Philonotis pyriformis***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 310.



**Philonotis pyriformis** (R.Br.bis) Wijk & Margrad.

**form:** loosely tufted, radiculose stems, ± branched by innovations in whorls, 20–200 mm tall, the leaves ± falcate-secund

**habitat:** rock in constantly wet sites, lowland to montane elevations

**leaf:** size: 1.5–2.3 × 0.4–0.8 mm

*shape:* triangular to lanceolate, ± falcate

*tip:* attenuate

*base:* basal angle cells are shorter than the blade cells

*costa:* short-excurrent, denticulose-papillose above on the back

*border:* not differentiated

*margin:* serrulate, plane

*cells:* 20–30 × 6–12 μm, oblong to rectangular, firm-walled, prorulose

**capsule:** 2.5–3 mm, ovate, horizontal, asymmetric, ± gibbous, mouth small, oblique, striate when dry; seta 30–50 mm, flexuose, reddish; peristome double, endostome with cilia; spores 20–24 μm in diam., papillose



vegetative shoots (moist on far left), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



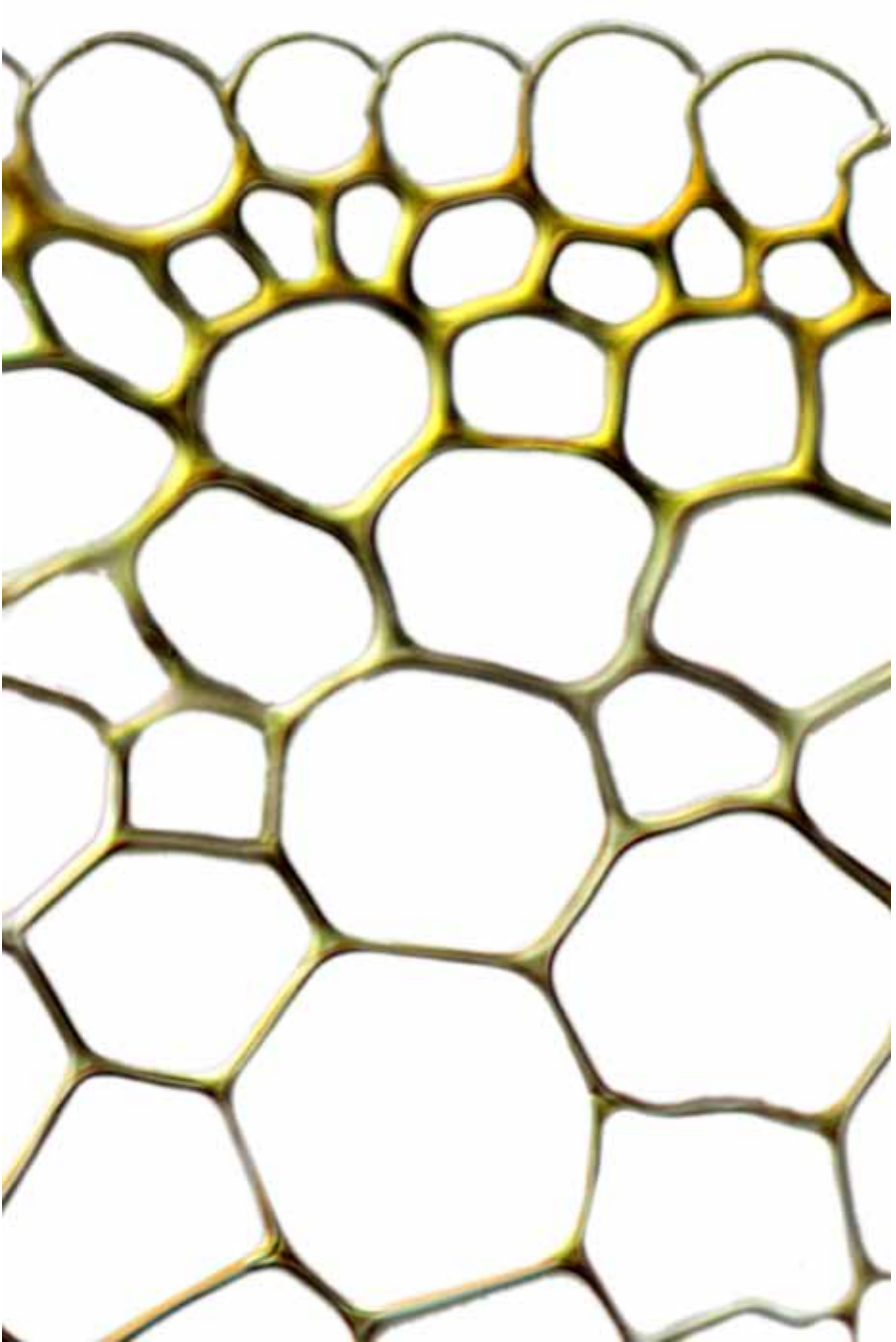
cells midleaf, costa near leaf base, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm



*Philonotis pyriformis* vegetative shoot (moist)  
1 mm (left), 1 mm (right)

continued next page



*Philonotis pyriformis* stem cross-section showing hyaloderm  
10  $\mu\text{m}$

continued next page





*Philonotis pyriformis* leaf and costa cross-section (partially diagrammatic)  
10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

**Philonotis scabrifolia** (Hook.f. & Wilson) Braithw.

**form:** tufted, erect, radiculose stems, to 20 mm tall, the upper branches whorled, the leaves distinctly glaucous

**habitat:** soil, moist to wet, at montane elevations

**leaf:** size: stem leaves 1.5–2.0 × 0.5–0.7 mm; branch leaves smaller

**shape:** lanceolate to ovate-lanceolate

**tip:** acuminate

**base:** basal cells shorter than the blade cells

**costa:** excurrent

**border:** not differentiated

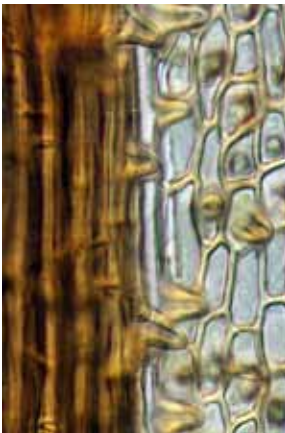
**margin:** denticulate, slightly recurved toward the apex

**cells:** 10–26 × 8–10 μm, short-rectangular to subquadrate, firm-walled, unipapillose

**capsule:** 2 × 1 mm, ovoid, arcuate, inclined to horizontal, sulcate; seta 15–20 mm; operculum convex, umbonate; peristome double; spores 30–34 μm in diam., reniform, papillose



habit showing perigonia, perigonal shoot, leaf outline, leaf apex, and mature capsule  
 ■ 5 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 0.5 mm



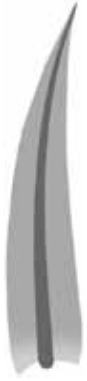
costa midleaf, vegetative shoots, and paraphyses  
 ■ 10 μm, ■ 1 mm, ■ 50 μm

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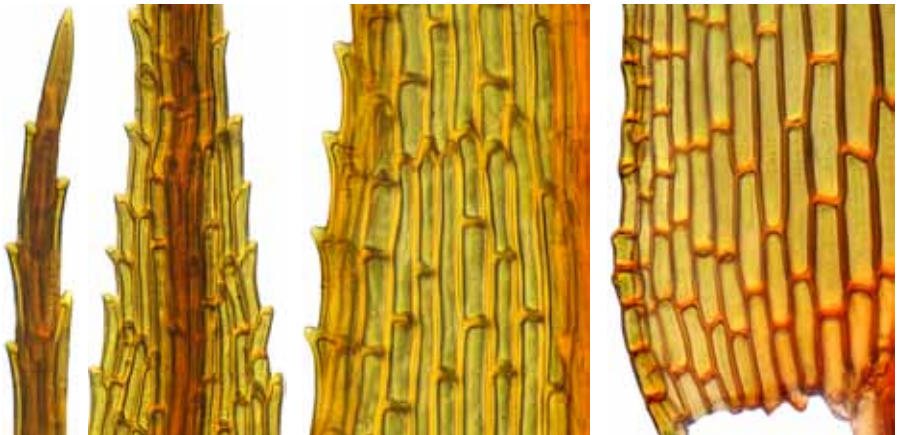


*Philonotis scabrifolia* perigonal shoot  
1 mm

continued next page

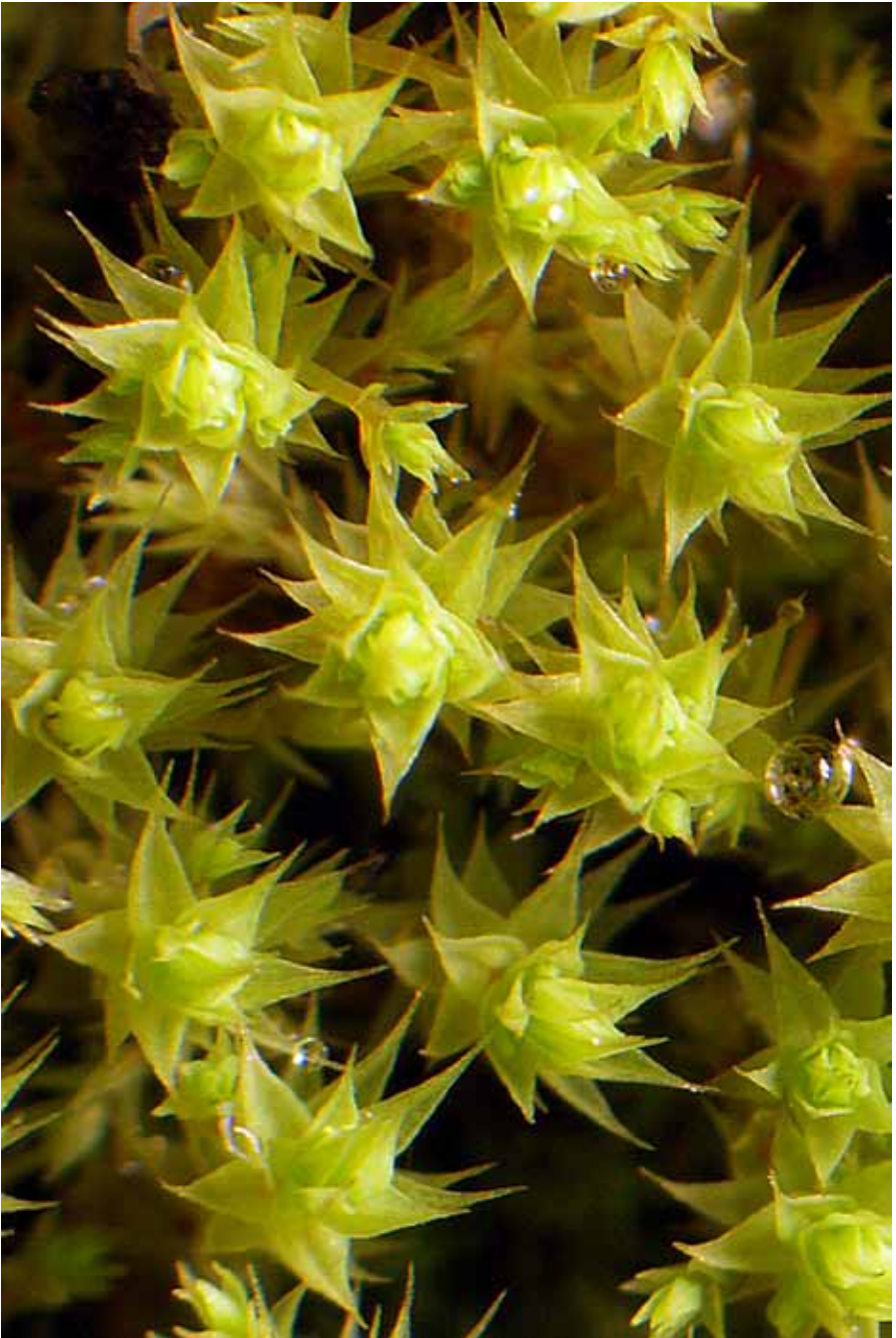
**Philonotis tenuis** (Taylor) Reichardt**form:** densely tufted, simple stems, 10–40 mm tall, ± with subfloral innovations**habitat:** damp rock and soil, lowland to montane elevation**leaf:** *size:* 0.8–1.8 × 0.3–0.7 mm, water-repellent (hydrophobic), tomentose below  
*shape:* narrowly triangular, ± falcate*tip:* attenuate*base:* the basal cells are shorter and broader than the blade cells*costa:* percurrent to long-excurrent in an arista, denticulate on the back above*border:* not differentiated*margin:* denticulate, ± reflexed*cells:* 20–30 × 5–15 μm, oblong, firm-walled, distally prorulose**capsule:** 1.3–2.7 mm, subglobose, cernuous to horizontal, sulcate (16-ribbed)  
when dry; seta 10–25 mm; peristome double, endostome cilia rudimentary;  
spores 20–24 μm in diam., brown**note:** highly variable—the leaf can range from straight to falcate, the costa from percurrent to long-excurrent, and the margin from weakly to strongly reflexed

vegetative shoots (moist on left), capsules, leaf outlines (2), and propagule (surculus)  
 ■ 1 mm, ■ 1 mm, ■ 1 mm (2), ■ 0.5 mm (2), ■ 50 μm



leaf apex and subapex, margin midleaf, and leaf basal angle  
 ■ 10 μm (2), ■ 10 μm, ■ 10 μm

continued next page



*Philonotis tenuis* habit  
1 mm

continued next page



*Philonotis tenuis* costa cross-section  
10  $\mu\text{m}$



*Philonotis tenuis* leaf margin cross-section  
10  $\mu\text{m}$

**Plagiopus oederiana** (Sw.) H.A.Crum & L.E.Anderson

**form:** tufted, erect, tomentose stems, 20–100 mm tall, triangular in xs, the leaves dull green to yellow-brown

**habitat:** moist shaded cliffs and boulders, usually calcareous

**leaf:** size: 2–3.5 mm

*shape:* narrowly lanceolate

*tip:* acuminate

*base:* basal cells not differentiated

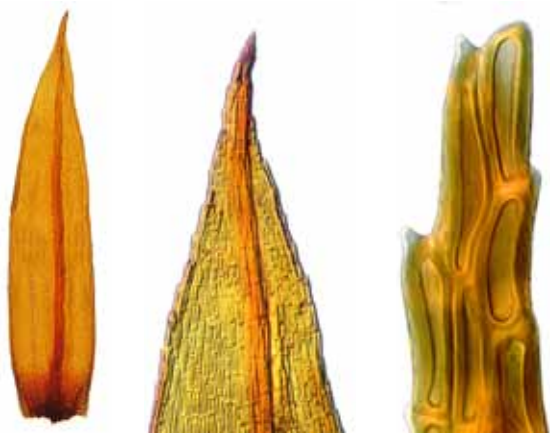
*costa:* percurrent to shortly excurrent, ± serrulate on the back above

*border:* not differentiated

*margin:* entire, revolute nearly to the apex

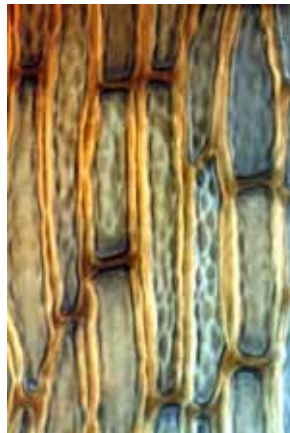
*cells:*  $9 \times 5 \mu\text{m}$ , subquadrate to short-rectangular, firm-walled, striolate

**capsule:** 1–2 mm, globose, inclined to horizontal, furrowed when dry; seta 7–18 mm, ± flexuose, smooth; operculum low-convex; peristome double, exostome teeth golden to reddish, endostome pale brown; spores 20–26  $\mu\text{m}$  in diam., brown, coarsely papillose



vegetative habit (dry), leaf outline, and leaf apex (2)

■ 1 mm, ■ 0.5 mm, ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



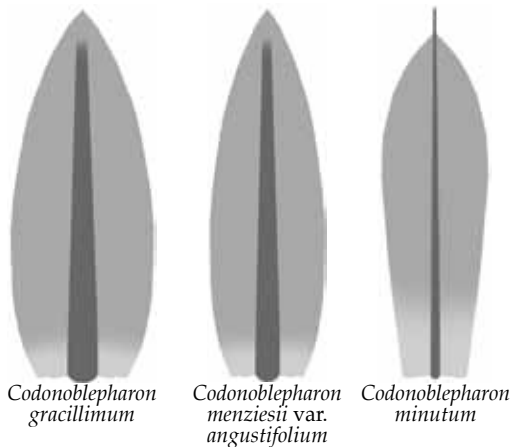
margin midleaf, striolate leaf cells, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Key\* to the New Zealand species of *Codonoblepharon* (3)**

- 1 Costa excurrent; cells in stem xs all thin-walled ..... ● ***Codonoblepharon minutum***  
 1: Costa failing below the apex; at least some cells in stem xs thick-walled ..... 2
- 2(1:) Leaves < 0.6 mm; stems filiform..... ● ***Codonoblepharon gracillimum***  
 2: Leaves > 1.2 mm; stems not filiform .....  
 ..... ● ***Codonoblepharon menziesii* var. *angustifolium***

\* based on Lewinsky-Haapasaari, J; Ramsay, HP (2006): *Zygodon. Flora of Australia* 51, 238, and Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 199.





**Codonoblepharon gracillimum** (Broth. ex M.Fleisch.) Matcham & O'Shea

**form:** densely tufted, rhizomatous, erect, branched stems, to 7 mm tall

**habitat:** bark in partially shaded lowland forest

**leaf:** size: 0.3–0.6 × 0.1–0.2 mm

*shape:* ± lanceolate; gemmae clustered on stalks in axils

*tip:* acute

*base:* basal marginal cells quadrate

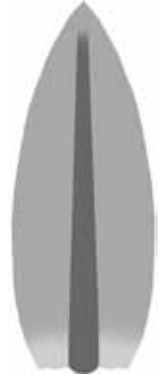
*costa:* failing below the apex

*border:* not differentiated

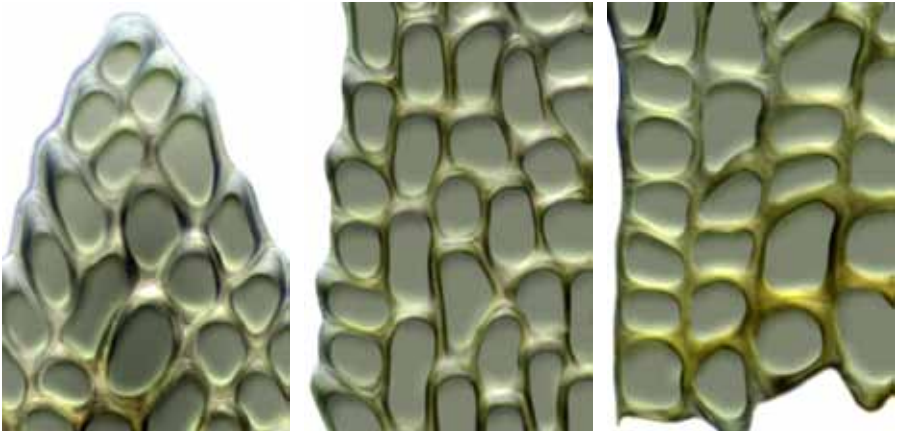
*margin:* entire below, ± crenulate near apex, plane

*cells:* 6–12 × 6–9 μm, rounded-quadrate to rhombic, firm-walled, smooth

**capsule:** 1.0–1.2 mm, cylindric, long-necked, ribbed when dry, erect, long-exserted, pale to reddish brown; seta 3–5 mm; peristome double, exostome teeth pale yellow to hyaline, 8 pairs, reflexed when dry, endostome segments hyaline, up to 3/4 the length of the exostome teeth; spores 12–14 μm in diam., finely papillose



vegetative and fertile shoots (dry) (3), capsule (dry), gemma, leaf outline, and leaf apex  
 0.5 mm (3), 0.5 mm, 10 μm, 0.1 mm, 10 μm



apex detail, margin midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page

**Codonoblepharon menziesii** var. **angustifolium** (Broth. ex M.Fleisch.) Matcham & O'Shea

**form:** dense tufts of erect,  $\pm$  radiculose, branched stems, 10–20 mm, the leaves olive-green, gemmoid brood bodies 7–8-celled, short-filamentous

**habitat:** basic rock, concrete, bark, rotting logs, or tree trunks, to 1350 m

**leaf:** size: 1–2  $\times$  0.3–0.6 mm; filiform to clavate gemmae at base

**shape:** lanceolate to ovate-lanceolate, distally keeled,  $\pm$  undulate and twisted around the stem when dry

**tip:** acute to obtuse,  $\pm$  cucullate

**base:** basal cells hyaline, firm-walled, rhombic to rectangular

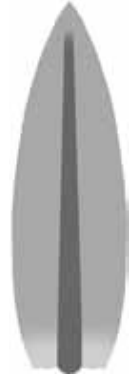
**costa:** strong and wide below, reaching nearly to the apex

**border:** absent

**margin:** entire, revolute to above midleaf

**cells:** 8–13  $\mu$ m, quadrate to rhombic, in oblique rows, thick-walled, smooth

**capsule:** 1.5–2.0 mm, ovoid to pyriform or cylindric, deeply 8-ribbed when dry, seta to 6 mm; calyptra smooth; operculum red-bordered, short-rostrate; peristome double, exostome teeth 8, double, papillose, endostome of 16 narrow processes; spores 15–18  $\mu$ m in diam., smooth



shoot (wet), capsule (young, mature), leaf outline, leaf apex, and gemma whole-mount  
 1 mm, 0.5 mm, 0.5 mm, 0.1 mm, 10  $\mu$ m, 10  $\mu$ m



margin midleaf, costa lower leaf, and leaf basal angle  
 10  $\mu$ m, 10  $\mu$ m, 50  $\mu$ m

continued next page



*Codonoblepharon menziesii* var. *angustifolium* vegetative shoot (moist)

1 mm

continued next page



*Codonoblepharon menziesii* var. *angustifolium* immature (moist) and mature (dry) capsules  
0.5 mm

continued next page

**Codonoblepharon minutum** (Müll.Hal. & Hampe) Matcham & O'Shea

**form:** dense tufts of simple, radiculose, erect stems, 1–3 mm, the leaves olive-green; gemmae clustered in leaf axils, clavate, 4–8-celled, 50–120  $\mu\text{m}$  long

**habitat:** bark, lignum, limestone, and concrete, coastal and inland to 160 m

**leaf:** size: 0.8–1.5 mm

*shape:* oblong- to elliptic-lanceolate

*tip:* apiculate

*base:* basal cells rectangular

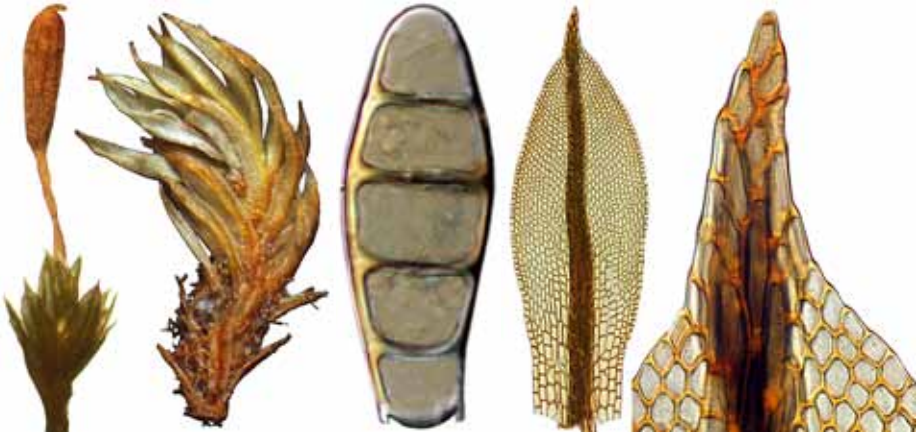
*costa:* excurrent in the apiculus

*border:* not differentiated

*margin:* entire, plane to  $\pm$  reflexed below

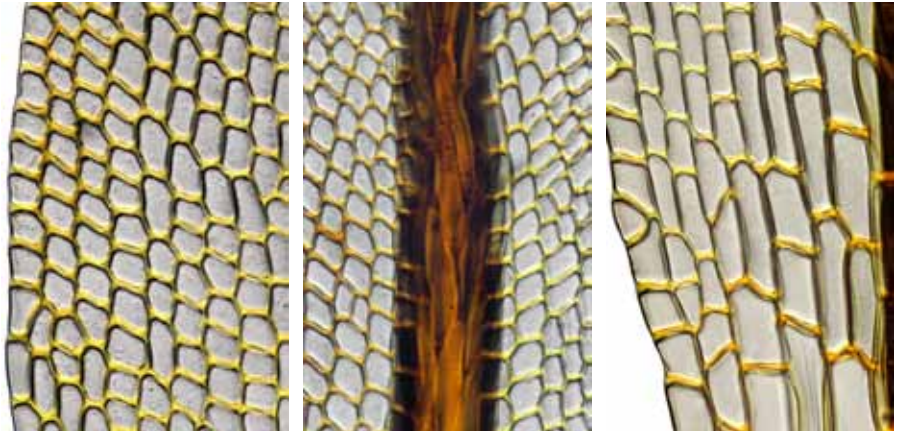
*cells:* 8–12  $\times$  6–9  $\mu\text{m}$ , quadrate to rhombic, firm-walled, smooth

**capsule:** 1.0–1.5 mm, pyriform to ovoid, 8-ribbed when dry; seta 1.5–3.0 mm; calyptra smooth; stomata superficial; peristome double, exostome teeth in 8 pairs, reflexed when dry; endostome segments 8, sometimes alternating with 8 rudimentary segments; spores 15–20  $\mu\text{m}$  in diam.



shoots and capsule, axillary propagule, leaf outline, and leaf apex

1 mm, 0.5 mm, 10  $\mu\text{m}$ , 0.1 mm, 10  $\mu\text{m}$



margin midleaf, costa midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

**Leratia obtusifolia** (Hook.) Goffinet

**form:** tufts of branched stems, 5–10 mm, dull, radiculose below, the leaves olive-green or brownish above, brown to blackish below

**habitat:** bark, exposed roots, rotting logs, and less commonly rock, to 760 m

**leaf:** size: 0.6–1.0 × 0.2–0.3 mm

**shape:** ligulate to ovate-oblong, keeled, gemmae in axils

**tip:** obtuse to rounded

**base:** not decurrent; a few smooth, rectangular cells in the basal angles

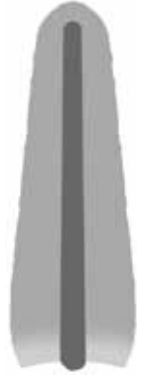
**costa:** ending below the apex, covered adaxially by lamina cells

**border:** not differentiated

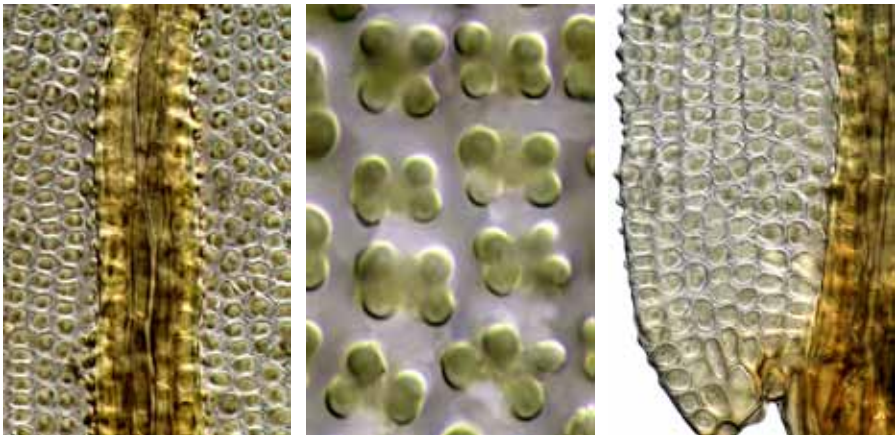
**margin:** crenulate from projecting papillae, ± recurved to revolute below

**cells:** 9–12 μm, isodiametric to oval, firm-walled, 4–5-papillose, bulging

**capsule:** 1–1.5 mm, 8-grooved when dry, cylindric to obovoid; seta 2–4 mm; operculum obliquely rostrate; calyptra prorulose; peristome double, exostome teeth in 8 pairs, reflexed when dry; endostome segments 8 or 16, white; spores 12–15 μm in diam., finely papillose



shoots (dry) (2), mature capsule (dry), leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 0.5 mm, 0.1 mm, 50 μm, 10 μm



costa midleaf, papillae, and leaf basal angle

50 μm, 10 μm, 50 μm

**Macrocoma tenuis** (Hook. & Grev.) Vitt subsp. **tenuis**

**form:** matted, tangled, dull, brownish, creeping stems, the secondary stems suberect, slender, ± julaceous when dry, 5–15 mm long

**habitat:** bark and branches on forest margins and in scrub, to 1200 m

**leaf:** size: 1.0–1.3 × 0.2–0.5 mm

*shape:* lanceolate, concave

*tip:* bluntly acute to obtuse

*base:* basal cells somewhat larger, mammillose, and elongated near the costa

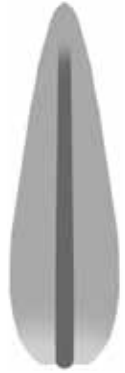
*costa:* failing below the apex to percurrent

*border:* not differentiated

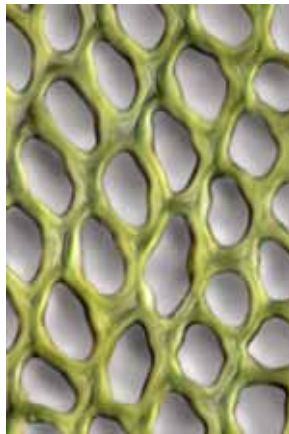
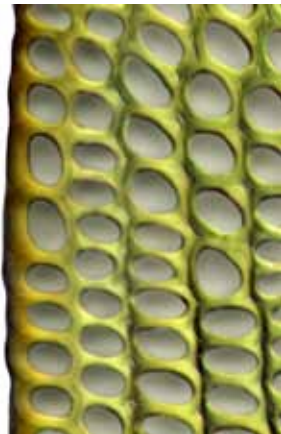
*margin:* entire, plane to ± recurved

*cells:* 6–10 μm, isodiametric, firm-walled, bulging or mammillose

**capsule:** 1.5–2 mm, cylindric-ellipsoid, erect, deeply 8-plicate at the mouth when dry, stomata superficial; seta 3–6 mm; operculum rostrate; calyptra densely hairy; peristome double, endostome reduced to a low papillose membrane; spores to 40 μm in diam.



emerging capsules (moist), mature capsules (dry), leaf outline, leaf xs, and leaf apex  
 1 mm, 1 mm, 0.25 mm, 10 μm, 50 μm



margin midleaf, cells midleaf, and costa midleaf  
 10 μm, 10 μm, 50 μm

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*Macrocoma tenuis* emerging calyptra-covered sporophytes (moist)

1 mm

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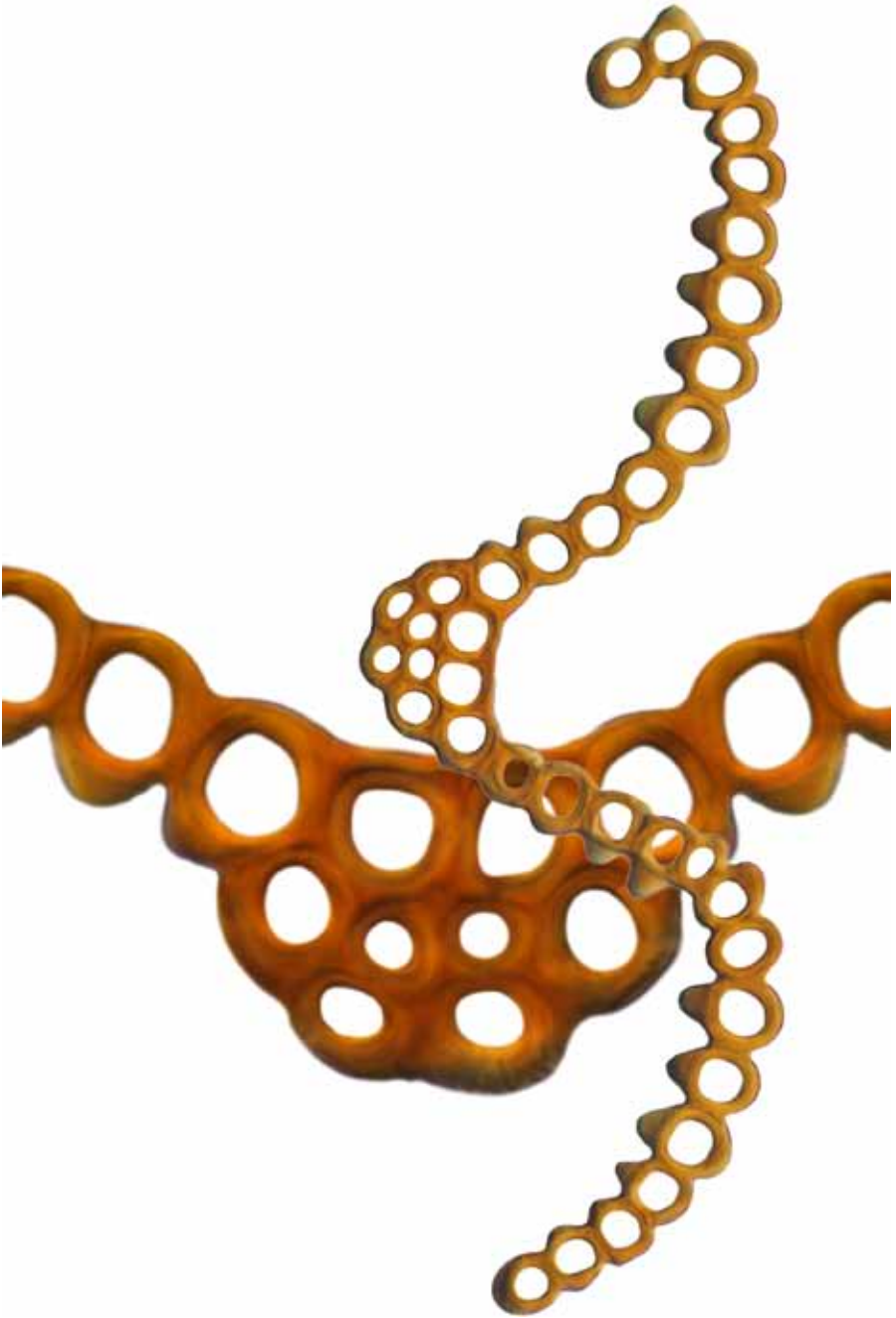




*Macrocoma tenuis* emerging calyptra-covered sporophytes (dry)

1 mm

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*Macrocoma tenuis* leaf cross-sections

10  $\mu\text{m}$  (whole leaf), 10  $\mu\text{m}$  (costa)

**Key\* to the New Zealand species of *Macromitrium* (14)** (see next page for another key)

- 1 Upper leaf cells papillose or strongly bulging..... 2  
 1: Upper leaf cells smooth or only slightly bulging ..... 9
- 2(1) Branches ending in brush-like tufts; mature leaves muticous and retuse .....  
 ..... ● ***Macromitrium helmsii***  
 2: Branches not ending in tufts; mature leaves sometimes muticous but not retuse ..... 3
- 3(2): Leaves lanceolate; perichaetial leaves much longer than the vegetative leaves and strongly sheathing ..... ● ***Macromitrium gracile***  
 3: Leaves ligulate to oblong; perichaetial leaves no longer than the vegetative leaves and only weakly sheathing ..... 4
- 4(3): All leaf cells about as long as wide; seta papillose; calyptra hairs papillose.....  
 ..... ● ***Macromitrium angulatum***  
 4: Some leaf cells at least three times as long as wide; seta smooth; calyptra hairs naked or smooth, not papillose ..... 5
- 5(4): Upper leaf margin crenulate-bulging..... 6  
 5: Upper leaf margin entire or papillose ..... 7
- 6(5) Peristome reduced to a low basal membrane; capsule rim 8-plicate.....  
 ..... ● ***Macromitrium ligulaefolium***  
 6: Peristome of 16 erect teeth; capsule rim not plicate ..... ● ***Macromitrium ligulare***
- 7(5): Costa failing below the apex; not peristomate; calyptra lacerate but not plicate .....  
 ..... ● ***Macromitrium grossirete***  
 7: Costa percurrent or excurrent as a mucro or cusp; peristomate; calyptra plicate ..... 8
- 8(7): Interior basal cells to 16  $\mu\text{m}$  long, the lumen rounded to elliptic.....  
 ..... ● ***Macromitrium brevicaula***  
 8: Interior basal cells to 40  $\mu\text{m}$  long, the lumen elongate ... ● ***Macromitrium prorepens***
- 9(1): Branches ending in brush-like tufts; mature leaves muticous and retuse .....  
 ..... ● ***Macromitrium retusum***  
 9: Branches not ending in brush-like tufts; mature leaves not muticous, not retuse ..... 10
- 10(9:): Leaf cells just above insertion up to 15  $\mu\text{m}$  long; plant restricted to Chatham Islands.....  
 ..... ● ***Macromitrium ramsayae***  
 10: Leaf cells just above insertion up to 40  $\mu\text{m}$  long; plant widespread ..... 11
- 11(10:): Leaves  $\pm$  straight; spores anisoporous, 16–42  $\mu\text{m}$  in diam.....  
 ..... ● ***Macromitrium orthophyllum***  
 11: Leaves strongly twisted-curved; spores isoporous, 25–65  $\mu\text{m}$  in diam. .... 12
- 12(11:): Costa with two stereid bands; peristome double . ● ***Macromitrium longirostre***  
 12: Costa with only one stereid band; peristome single (exostome only)..... 13
- 13(12:): Leaves 1.5–2.5 mm long; midleaf cell lumina strongly curved to sigmoid.....  
 ..... ● ***Macromitrium longipes***  
 13: Leaves 1.0–1.5 mm long; midleaf cell lumina straight to only slightly curved.....  
 ..... ● ***Macromitrium microstomum***

\* based on Vitt, DH (1983): The New Zealand species of *Macromitrium*. *Journal of the Hattori Botanical Laboratory* 54, 6.

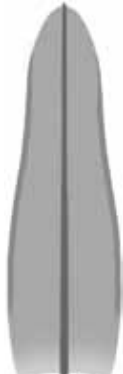
Key\* to the New Zealand species of *Macromitrium* (14)

- 1 Surface of midleaf cells smooth ..... 2  
 1: Surface of midleaf cells papillose ..... 7
- 2(1) Dry branch leaves twisted along their own length; seta twist sinistrorse; peristome single (exostome only) ..... 3  
 2: Dry branch leaves wound around the stem; seta twist dextrorse; peristome double.. 5
- 3(2) Lumina of basal cells curved or sinuose ..... ● ***Macromitrium longipes***  
 3: Lumina of basal cells ± straight ..... 4
- 4(3): Costa xs homogeneous ..... ● ***Macromitrium orthophyllum***  
 4: Costa xs guide cells and an abaxial stereid band .... ● ***Macromitrium microstomum***
- 5(2): Branching penicillate; branch leaves muticous and retuse, the costa excurrent .....  
 ..... ● ***Macromitrium retusum***  
 5: Branching simple; branch leaves not fragile, the costa subpercurrent to percurrent .. 6
- 6(5): Branch leaves unistratose throughout ..... ● ***Macromitrium ramsayae***  
 6: Branch leaves partly bistratose ..... ● ***Macromitrium longirostre***
- 7(1): Midleaf cells 1–2-papillose (low) ..... 8  
 7: Midleaf cells 1–2-papillose (tall or branched) or pluri- to multipapillose ..... 10
- 8(7) Seta papillose; calyptra densely hairy ..... ● ***Macromitrium angulatum***  
 8: Seta smooth; calyptra glabrous ..... 9
- 9(8): Peristome reduced to a low basal membrane; capsule rim 8-plicate .....  
 ..... ● ***Macromitrium ligulaefolium***  
 9: Peristome of 16 erect teeth; capsule rim not plicate ..... ● ***Macromitrium ligulare***
- 10(7:): Upper cells 1–2-papillose (tall or branched) ..... 11  
 10: Upper cells pluri- to multipapillose ..... 12
- 11(10) Branch leaf wound around the stem when dry ..... ● ***Macromitrium prorepens***  
 11: Branch leaf twisted along its own length when dry ..... ● ***Macromitrium grossirete***
- 12(10): Branch leaves fragile (muticous) ..... 13  
 12: Branch leaves not fragile ..... ● ***Macromitrium brevicaulis***
- 13(12) Branch leaves muticous and retuse ..... ● ***Macromitrium helmsii***  
 13: Branch leaves muticous but not retuse ..... ● ***Macromitrium gracile***

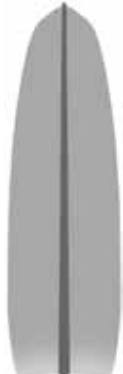
\* based on a key generated by DELTA from a 26-character database of New Zealand *Macromitrium* species, plus (for couplet 9) Vitt, DH (1983): The New Zealand species of *Macromitrium*. *Journal of the Hattori Botanical Laboratory* 54, 6.



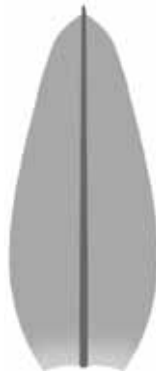
*Macromitrium gracile*



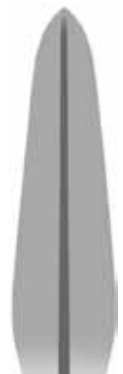
*Macromitrium prorepens*



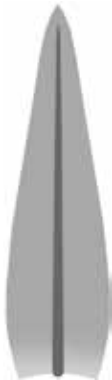
*Macromitrium brevicaule*



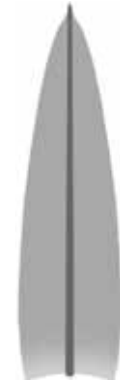
*Macromitrium angulatum*



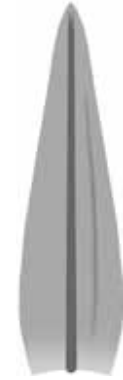
*Macromitrium ramsayae*



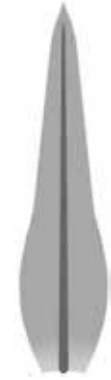
*Macromitrium longipes*



*Macromitrium orthophyllum*



*Macromitrium microstomum*



*Macromitrium grossirete*



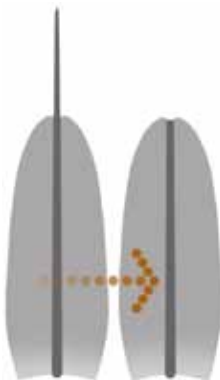
*Macromitrium longirostre*



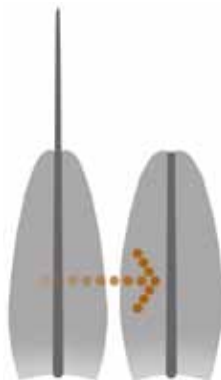
*Macromitrium ligulare*



*Macromitrium ligulaefolium*



*Macromitrium retusum*



*Macromitrium helmsii*

**Macromitrium angulatum** Mitt.

**form:** primary stems creeping; secondary stems erect, branching, to 13 mm long, the leaves dull olive-green

**habitat:** bark in *Nothofagus* forest

**leaf:** size: 0.9–1.5 mm

**shape:** oblong to ovate-lanceolate; reaction in KOH deep red

**tip:** broadly acute, ending in a stout mucro

**base:** little differentiated

**costa:** excurrent in the mucro

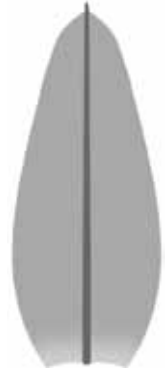
**border:** not differentiated

**margin:** entire below, crenulate-papillose above, plane

**cells:** 8–12  $\mu\text{m}$ , rounded-quadrate, firm-walled, bulging-unipapillose

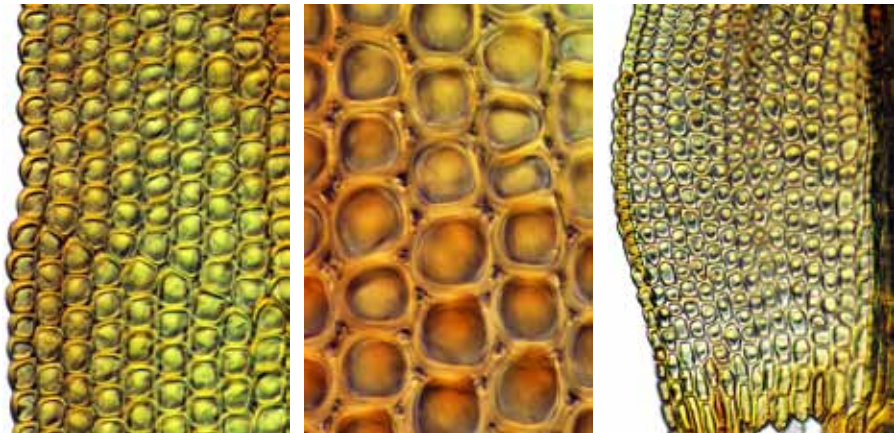
**capsule:** 1.4–1.6 mm, ovate, erect, exserted, dark brown; seta 2.3–3 mm, strongly papillose; peristome none; operculum erect-beaked; calyptra lacerate, mitrate, plicate, densely hairy below

**note:** known from only a single collection near Wellington



fertile shoot and capsule with calyptra (dry), leaf outline, and leaf apex (2)

5 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$



margin midleaf, cells midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

**Macromitrium brevicaule** (Besch.) Broth.

**form:** mats of creeping stems, the branches regular, simple, short, and erect, 3–7 mm tall; leaves spirally twisted when dry

**habitat:** bark and rock in the salt-spray zone, Auckland and north

**leaf:** size: stem leaves 0.8–1.2 mm long, branch leaves 1.0–1.8 mm long

**shape:** stem leaves ovate-lanceolate, branch leaves oblong-ligulate, keeled

**tip:** stem leaves acute to obtuse, branch leaves obtuse, often mucronate

**base:** basal marginal cells  $10\text{--}24 \times 5\text{--}10 \mu\text{m}$ ; juxtacostal cells  $9\text{--}18 \times 3\text{--}6 \mu\text{m}$

**costa:** strong, prominent, glossy, excurrent in the mucro or failing just below

**border:** not differentiated above, indistinct below

**margin:** entire below, slightly crenulate above, plane

**cells:**  $6\text{--}12 \mu\text{m}$ , rounded to quadrate, firm-walled, pluripapillose, bulging

**capsule:** 1.3–1.7 mm, oval, erect, exserted, reddish, narrow-mouthed, 8-ribbed; seta 3–5 mm, reddish; calyptra mitrate, fringed, faintly plicate, naked to sparsely hairy; operculum erect-beaked; peristome single, an exostome of 16 teeth; spores  $13\text{--}34 \mu\text{m}$  in diam.

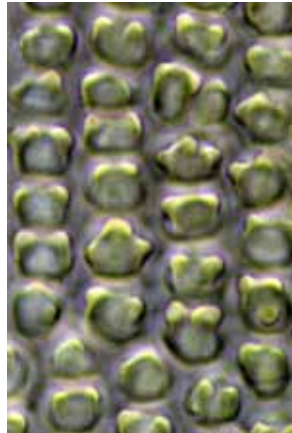


branch leaf



vegetative shoot (dry), capsule (dry), calyptra (dry), leaf outline, mucronate leaf apex

1 mm, 0.5 mm, 0.1 mm, 0.1 mm, 10  $\mu\text{m}$



margin midleaf, surface papillae midleaf, and margin near leaf base

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

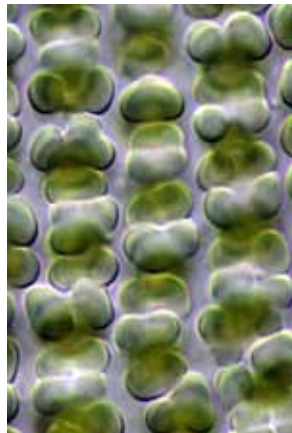
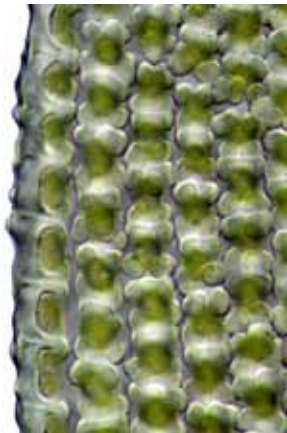
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**Macromitrium gracile** (Hook.) Schwägr.**form:** matted, creeping, dull, wiry, mostly simple stems, 20–40 mm**habitat:** bark or rarely rock, scrub and montane forests, to 1000 m**leaf: size:** stem leaves 0.8–1.0 mm, branch leaves 1.8–2.8 mm**shape:** stem leaves ovate-lanceolate, branch leaves lanceolate, ovate base**tip:** branch leaves narrowed to a bistratose subula, often broken off**base:** lower cells incrassate, with  $\pm$  sinuose lumina,  $20\text{--}50 \times 8\text{--}10 \mu\text{m}$ **costa:**  $\pm$  excurrent in the subula or failing just below**border:** not differentiated**margin:** papillose-crenulate, plane above  $\pm$  reflexed below on one side**cells:**  $6\text{--}10 \mu\text{m}$ , isodiametric, mostly incrassate, multipapillose (low)**capsule:** 1.0–2.2 mm, ovoid, plicate,  $\pm$  narrowed near the mouth when dry; seta 2.5–7.0 mm,  $\pm$  flexuose; calyptra golden, glossy, naked or with a few hairs, mitrate, strongly plicate, 3–5-lacerate; operculum long-rostrate, erect; peristome single, exostome teeth 16, pale, papillose; spores  $16\text{--}40 \mu\text{m}$  in diam., anisoporous

branch leaf



vegetative shoots (2), capsule with calyptra, leaf outline, and leaf apex

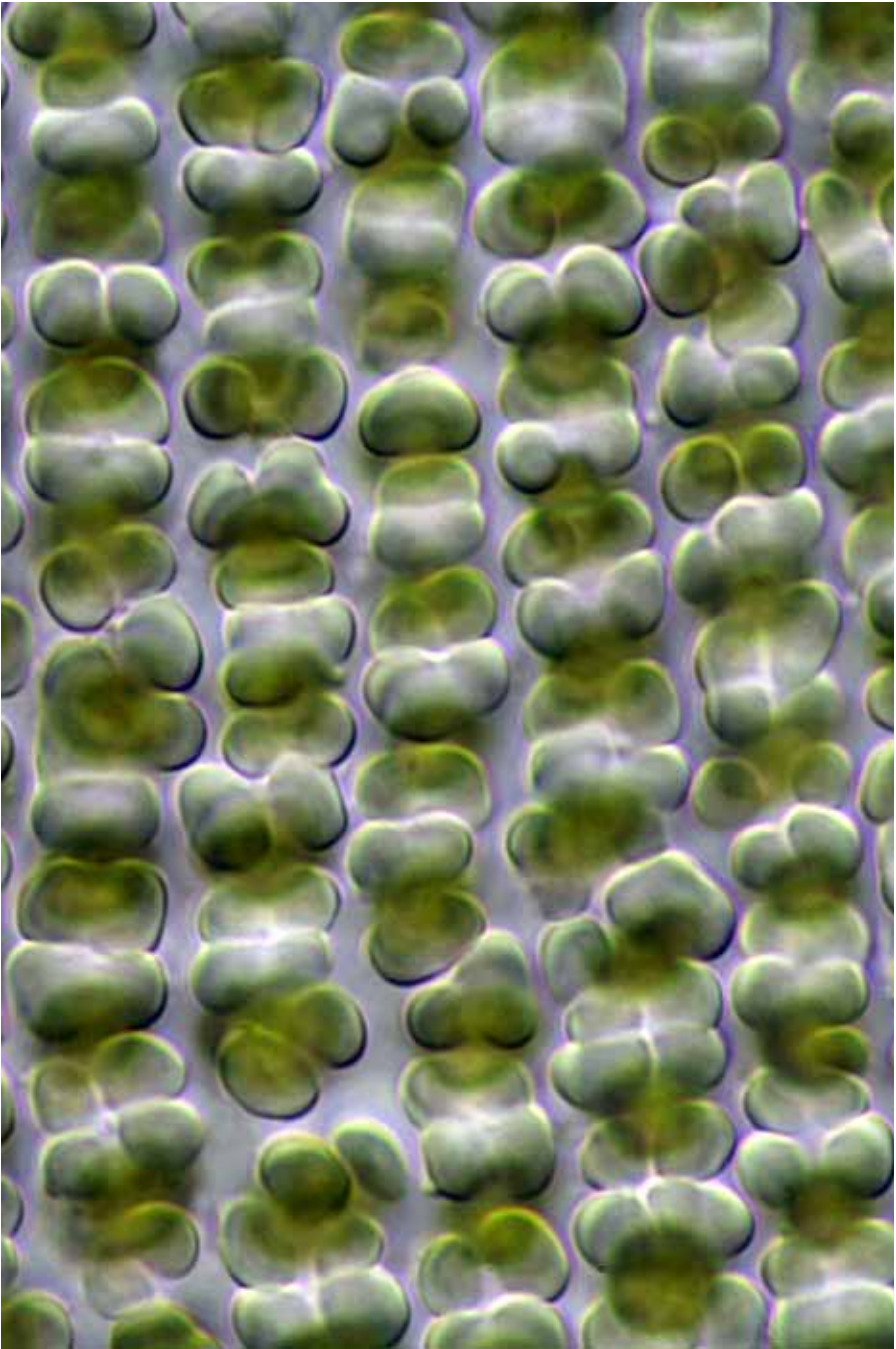
■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$ 

margin upper leaf, papillose cells in upper leaf, and margin of lower leaf

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ 

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*Macromitrium gracile* leaf surface papillae  
10  $\mu\text{m}$

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**Macromitrium grossirete** Müll.Hal.

**form:** primary stems matted, creeping; secondary stems erect, sparsely branched, to 10 mm tall, the leaves yellow- to olive-green

**habitat:** tree bark in high-montane forest, mostly South Island, to 1200 m

**leaf:** size: branch leaves 2.5–4.5 mm

*shape:* stem lanceolate, branch ligulate-lanceolate, ± twisted when dry

*tip:* stem leaves acuminate, branch leaves ± cuspidate

*base:* basal cells  $20\text{--}40 \times 11\text{--}16 \mu\text{m}$ , rectangular, the lumina nodose

*costa:* ending a few cells below the apex

*border:* not differentiated

*margin:* subentire to crenulate, broadly reflexed on one side

*cells:* upper cells  $10\text{--}16 \mu\text{m}$ , isodiametric-rounded, firm-walled, unipapillose

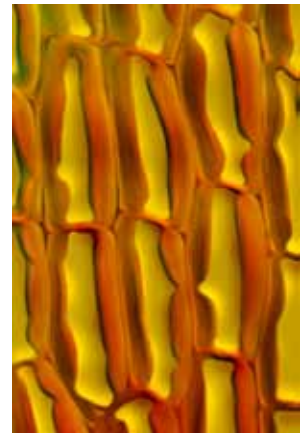
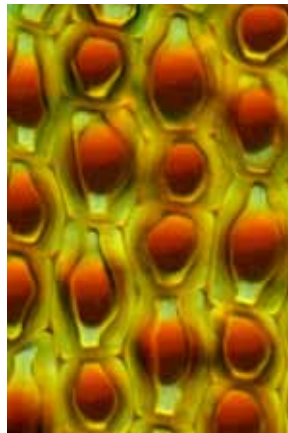
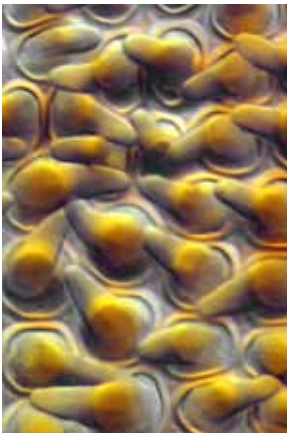
**capsule:** 1.5–2 mm, oblong-elliptic, erect to horizontal, exserted, light brown, furrowed and reddened at the mouth; seta 2.5–4.5 mm, erect to flexuose, twisted when dry; peristome none; operculum beaked; calyptra mitrate, 1–3-slits below, hairy; spores  $18\text{--}40 \mu\text{m}$  in diam., anisosporous



branch leaf

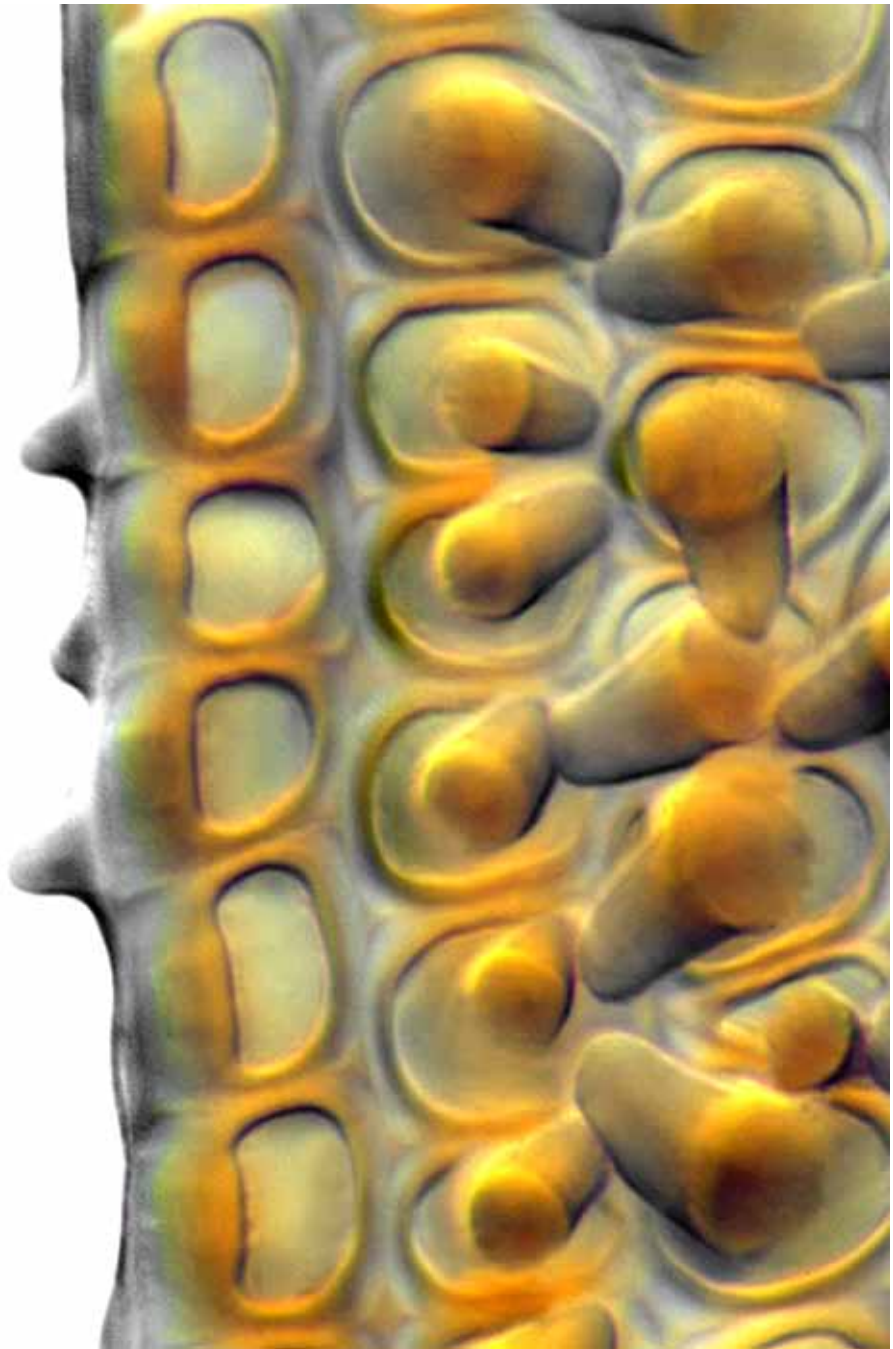


fertile shoot (dry), calyptra, mature capsule, leaf outline, leaf apex, and margin midleaf  
 5 mm, 1 mm (2), 1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



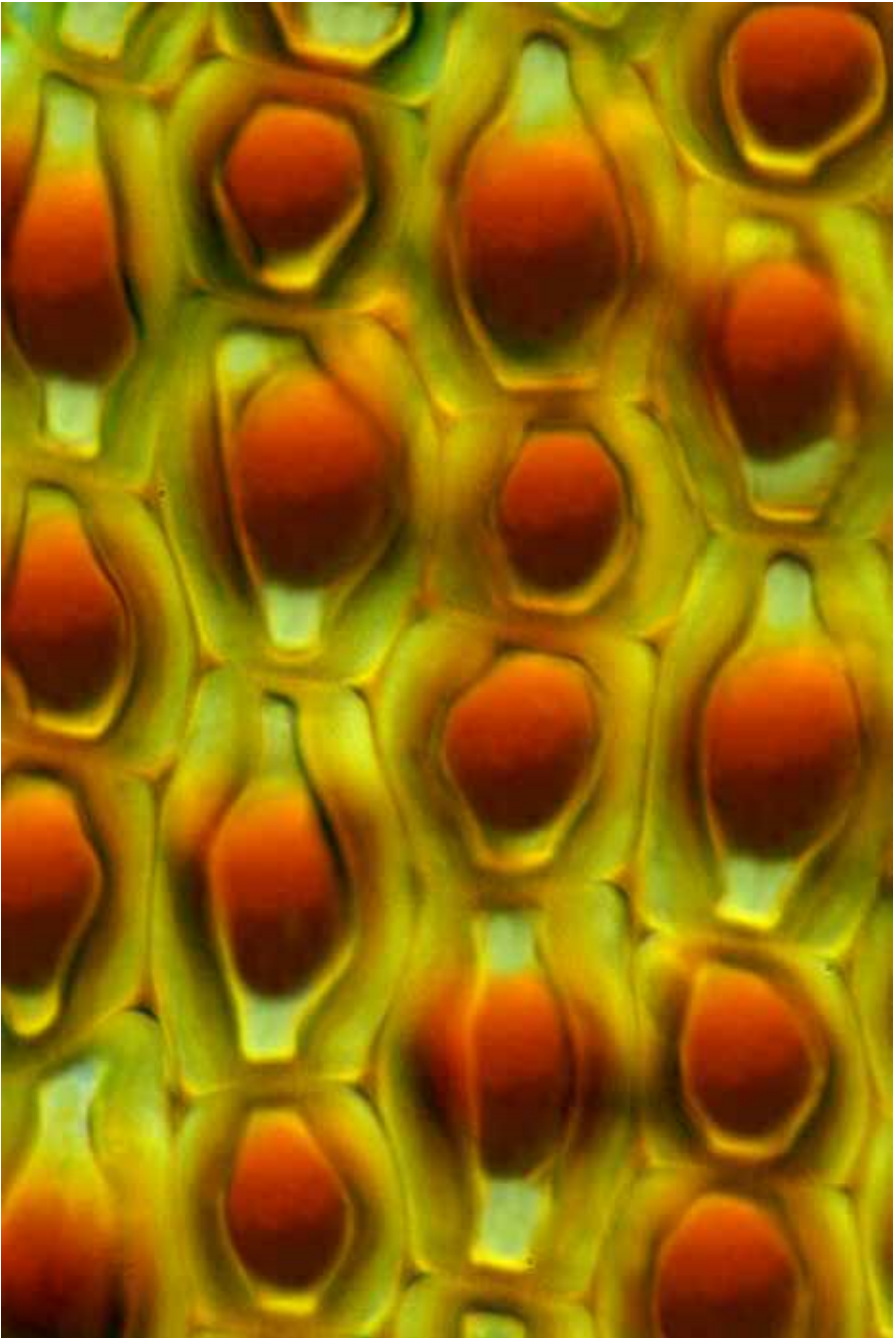
unipapillose cells midleaf, transition cells in lower leaf, and cells near leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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*Macromitrium grossirete* margin midleaf  
10  $\mu$ m

continued next page



*Macromitrium grossirete* transition cells in lower leaf  
10  $\mu$ m

continued next page

**Macromitrium helmisii** Paris

**form:** loose spreading mats of olive-green, creeping primary stems with erect, regularly spaced penicillate branches to 25 mm long, the leaves dull olive-green to yellow-brown

**habitat:** bark in lowland podocarp-hardwood forest, to 760 m

**leaf:** size: 1.2–2.5 mm

**shape:** stem lanceolate-acuminate, branch ligulate to oblong

**tip:** obtuse to retuse, ending in a deciduous, linear, flexuose arista

**base:** basal cells long-rectangular to linear,  $20\text{--}40 \times 5\text{--}10 \mu\text{m}$

**costa:** excurrent into the arista

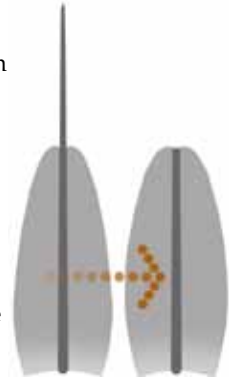
**border:** not differentiated

**margin:** entire, plane to weakly curved on one side

**cells:**  $5\text{--}9 \mu\text{m}$ , rounded-quadrate, thick-walled, low-multipapillose

**capsule:** not seen in New Zealand

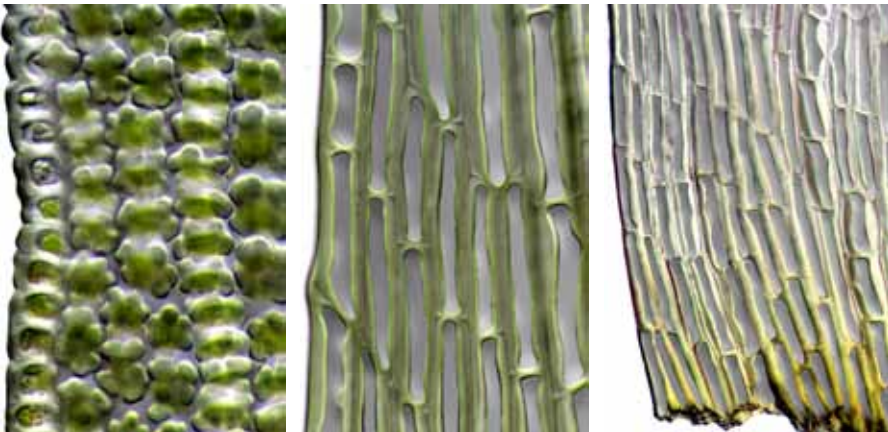
**note:** differs from *Macromitrium retusum* in having papillose cells



branch leaf



vegetative shoots with aristae (moist), arista, arista tip, leaf outline, and retuse leaf apex  
 5 mm (2), 1 mm, 100  $\mu\text{m}$ , 100  $\mu\text{m}$ , 0.5 mm, 50  $\mu\text{m}$



margin and papillae midleaf, margin near leaf base, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

**Macromitrium ligulaefolium** Broth.

**form:** creeping primary stems, with closely spaced, short, squarrose branches, 5–10 mm tall, the leaves dull to glossy olive-green to brown

**habitat:** bark of tree trunks, and rock, to 520 m

**leaf:** *size:* stem leaves 1.3–1.5 mm, branch leaves 1.5–3.0 mm

*shape:* stem leaves ovate-lanceolate, branch leaves  $\pm$  ligulate, strongly keeled

*tip:* variable,  $\pm$  acute-apiculate

*base:* basal cells rectangular, unevenly thick-walled

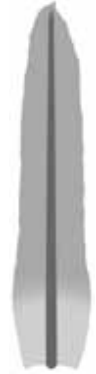
*costa:* ending below or at the apex, or excurrent in an apiculus

*border:* one row of smaller cells

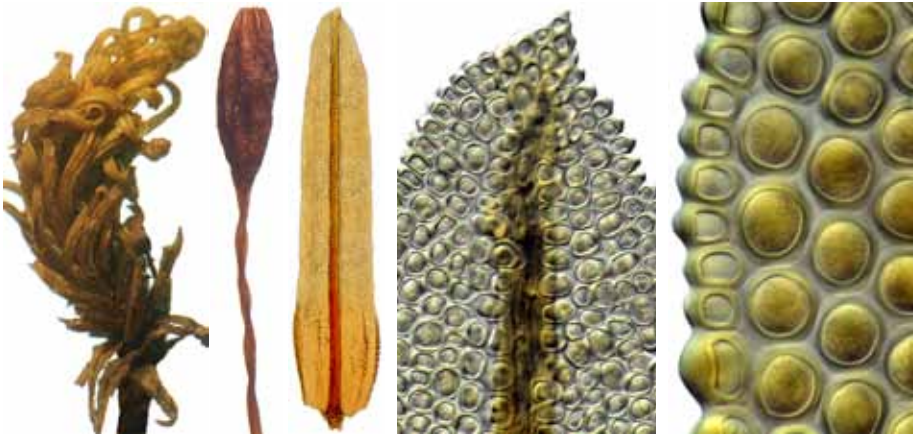
*margin:* minutely crenulate above, entire below, plane to reflexed

*cells:* 8–12  $\mu\text{m}$ , rounded, thick-walled, strongly bulging, 1–4-papillose

**capsule:** 1.5 mm, narrowly ovoid to ellipsoid, erect, rim 8-plicate, narrow-mouthed, brown; seta 5–6 mm; operculum erect-rostrate; calyptra weakly plicate, 1–5-laciniate; peristome none or single, exostome a low membrane, endostome none; spores 15–25  $\mu\text{m}$  in diam.

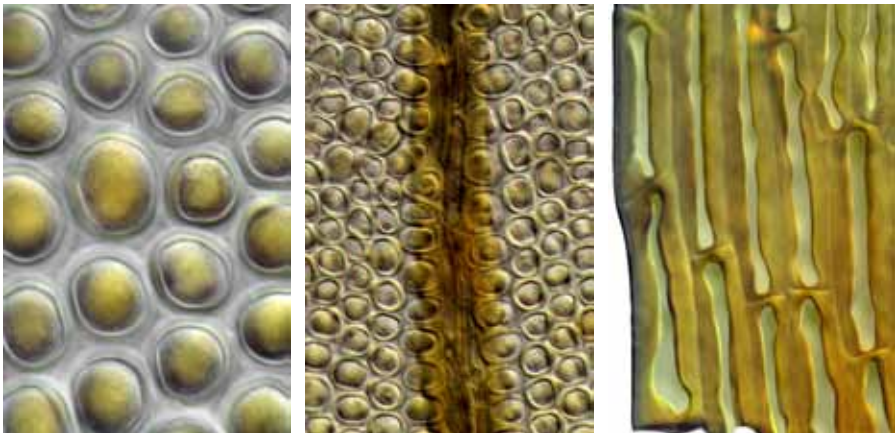


branch leaf



shoot and capsule (dry), leaf outline, leaf apex, and margin midleaf

1 mm, 0.5 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



cells midleaf, costa midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

**Macromitrium ligulare** Mitt.

**form:** mats of creeping primary stems, the branches regular, short, and erect, 12–17 mm, the leaves dull, olive-green to yellow-green

**habitat:** bark of tree trunks and branches in lowland podocarp forest, to 900 m

**leaf:** size: stem leaves 1.0–1.3 mm long; branch leaves 1.5–2.5 mm long

*shape:* stem leaves lanceolate, branch leaves ± ligulate, strongly keeled

*tip:* stem leaves acute or acuminate, branch leaves obtuse, apiculus one-celled

*base:* inner cells  $14\text{--}30 \times 9 \mu\text{m}$ , short-rectangular, thick-walled, porose, smooth

*costa:* prominent, glossy, smooth, failing a few cells below the apex

*border:* not differentiated

*margin:* entire below, crenulate above, plane to ± reflexed below

*cells:* 9–15  $\mu\text{m}$ , rounded-quadrate, thick-walled, 1–4-papillose

**capsule:** 1.5–2.0 mm, oblong to cylindrical, erect, exserted, light tan; seta 2–8 mm;

stomata superficial; operculum erect-beaked; calyptra weakly plicate, entire

with 1–3 long slits, smooth, naked; peristome single, exostome of 16 teeth;

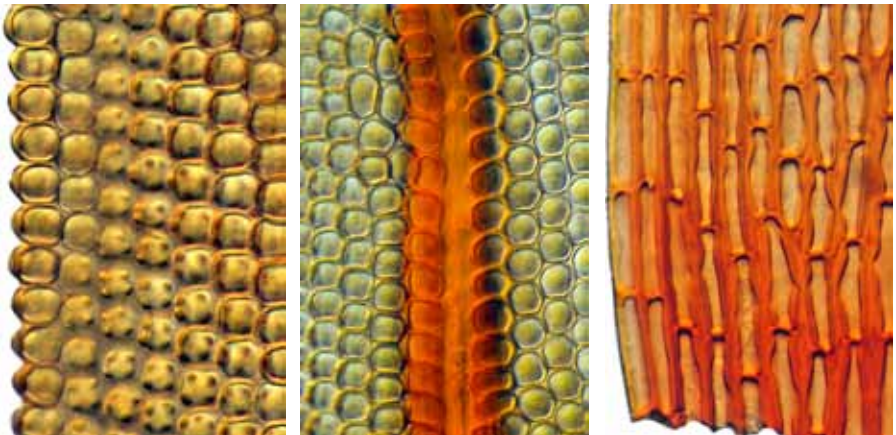
spores 14–34  $\mu\text{m}$  in diam., anisoporous



branch leaf



fertile and vegetative shoots (dry) (3), paraphyses, leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 100  $\mu\text{m}$ , ■ 0.1 mm, ■ 10  $\mu\text{m}$



margin midleaf, costa midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Macromitrium ligulare* costa midleaf  
10  $\mu\text{m}$

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**Macromitrium longipes** (Hook.) Schwägr.

**form:** densely matted, golden, ± branched primary stems, with secondary branches 25(–50) mm tall, the leaves golden brown

**habitat:** bark or rarely rock, lowland to montane forest, to 1400 m

**leaf:** size: stem leaves 1.5–2.0 mm, branch leaves 1.5–3.0 mm

**shape:** stem ovate-lanceolate, branch ± ligulate, ± plicate on one side

**tip:** stem leaves ± subulate, branch leaves acute

**base:** cells of 1/3–2/3 incrassate, with semilunar to sinuose lumina

**costa:** failing just below the apex

**border:** not differentiated

**margin:** entire, widely recurved on one or both sides

**cells:** 7–9  $\mu\text{m}$ , isodiametric, incrassate, smooth, ± bulging

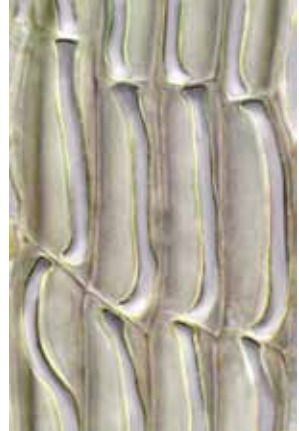
**capsule:** 1.5–2 mm, elliptic to cylindric, erect, narrowed and finely plicate at the mouth when dry; seta 15–25 mm; calyptra strongly plicate, deeply laciniate, to 5 mm; peristome of 16 pale lanceolate exostome teeth, endostome none; spores 26–66  $\mu\text{m}$  in diam., anisoporous



branch leaf



vegetative shoot (wet and dry), fertile shoot (dry), mature capsules (2), and calyptrae (3)  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 1 mm (2), ■ 1 mm (3)



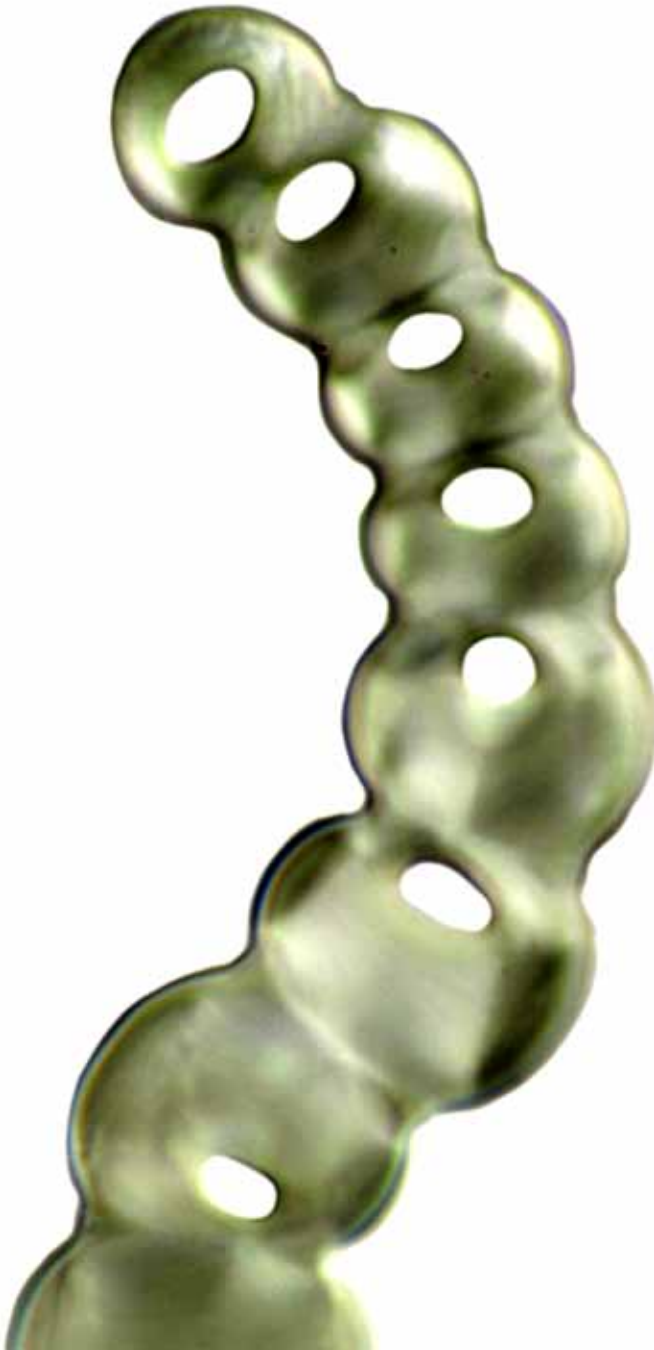
mature capsule (dry), leaf outline, leaf apex, and leaf basal cells  
 ■ 1 mm, ■ 0.5 mm, ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Macromitrium longipes* calyptrae  
1 mm

continued next page



*Macromitrium longipes* leaf margin cross-section  
10  $\mu$ m

continued next page

**Macromitrium longirostre** (Hook.) Schwägr.

**form:** matted, creeping primary stems, secondary stems erect, ± branched, to 35 mm long, the leaves olive-green above, chestnut brown below

**habitat:** exposed rock and bark in coastal Chatham Islands; tolerates salt spray

**leaf:** size: stem leaves 1.0–2.0 mm, branch leaves 1.6–4.0 mm

**shape:** stem leaves lanceolate, branch leaves lanceolate to oblong, ± bistratose in upper third, flexuose-twisted around the stem when dry, not fragile

**tip:** stem leaves acuminate, branch leaves acute to cuspidate

**base:** basal cells short-rectangular, their lumina slit-like and straight or nearly so

**costa:** keeled above, percurrent, subpercurrent, or rarely excurrent in a cusp

**border:** not differentiated

**margin:** entire, plane

**cells:** 10–15 × 8–10 μm, rounded-quadrate, thick-walled, smooth, bulging

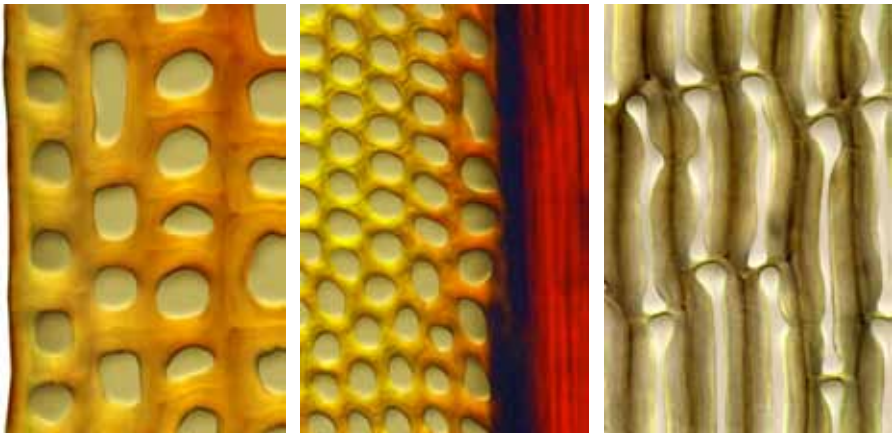
**capsule:** 1.5–3 mm, ovate to fusiform-cylindric, erect, exserted, brown; seta 5.5–11 mm; operculum long-beaked; calyptra lacerate, mitrate, plicate, naked; exostome teeth 16; endostome a low membrane; spores 20–40 μm in diam.

branch leaf



vegetative shoot (moist on left), leaf outline, leaf apex, and capsules (2)

1 mm, 1 mm, 1 mm, 10 μm, 1 mm (2)



margin lower leaf, cells and costa midleaf, and cells near leaf base

10 μm, 10 μm, 10 μm

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*Macromitrium longirostre* calyptra  
0.5 mm

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**Macromitrium microstomum** (Hook. & Grev.) Schwägr.

**form:** spreading mats of primary stems, the secondary branches 4–6(–15) mm, the leaves dull, olive-green

**habitat:** bark of small branches in forest canopy, to 1200 m

**leaf:** size: stem leaves 1.2–1.5 mm, branch leaves 1.2–2.0 mm

**shape:** stem ovate-lanceolate, branch  $\pm$  ligulate, with a wide plica on one side

**tip:** stem leaves acuminate-subulate, branch leaves acute, strongly keeled

**base:** basal cells narrowly linear, with a straight lumen

**costa:** excurrent to failing just below the apex

**border:** not differentiated

**margin:** entire, plane or else recurved on the same side as the plica

**cells:** upper cells 8–10  $\mu$ m, oval or isodiametric, rounded, incrassate, smooth;

midleaf cells 10–20  $\times$  8–10  $\mu$ m, smooth; basal cells 25–55  $\mu$ m long, smooth

**capsule:** 1.0–1.9 mm, ovoid to oblong, narrowed and 8-plicate at the mouth;

seta 4–18 mm, slender, flexuose; calyptra deeply lacerate, plicate, glabrous;

peristome exostome, teeth 16, irregular, blunt; spores 30–54  $\mu$ m in diam.



branch leaf



fertile shoot (moist), capsule, peristome tooth, shoot (dry), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 10  $\mu$ m, ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu$ m



costa upper leaf, upper leaf cells, and cells in leaf base

■ 10  $\mu$ m, ■ 10  $\mu$ m, ■ 10  $\mu$ m

continued next page

**Macromitrium orthophyllum** Mitt.

**form:** creeping prostrate primary stems, secondary branches to 30 mm, the leaves olive-green, lacking a red or brown tinge

**habitat:** bark in lowland to low-montane forest, mostly eastern, to 500 m

**leaf:** size: stem leaves 1.0–1.5 mm, branch leaves 2.0–3.3 mm

**shape:** stem leaves ovate, branch leaves ovate- to oblong-lanceolate

**tip:** stem leaves long-acuminate, ± reflexed, branch leaves acute, keeled below

**base:** basal cells  $29\text{--}90 \times 8\text{--}10 \mu\text{m}$ , lumina of juxtacostal cells slightly sigmoid

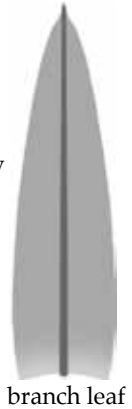
**costa:** percurrent to shortly excurrent

**border:** not differentiated

**margin:** entire, plane

**cells:** upper cells 5–8  $\mu\text{m}$ , rounded-quadrate, thick-walled, smooth

**capsule:** 2–3 mm, oblong-ovoid, erect, exserted, brown, 8-plicate above; mouth dark, narrowed, puckered; seta 6–13 mm; operculum long-rostrate, ± oblique; calyptra 2–3-lacerate, naked; peristome single, exostome only, of 16 whitish teeth; spores 16–42  $\mu\text{m}$  in diam., anisoporous

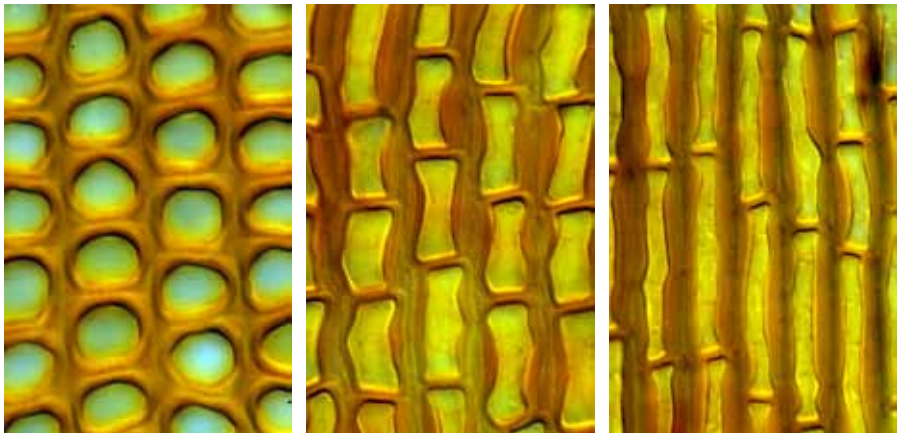


branch leaf



fertile and vegetative shoots (dry), leaf outline, leaf apex, and margin midleaf

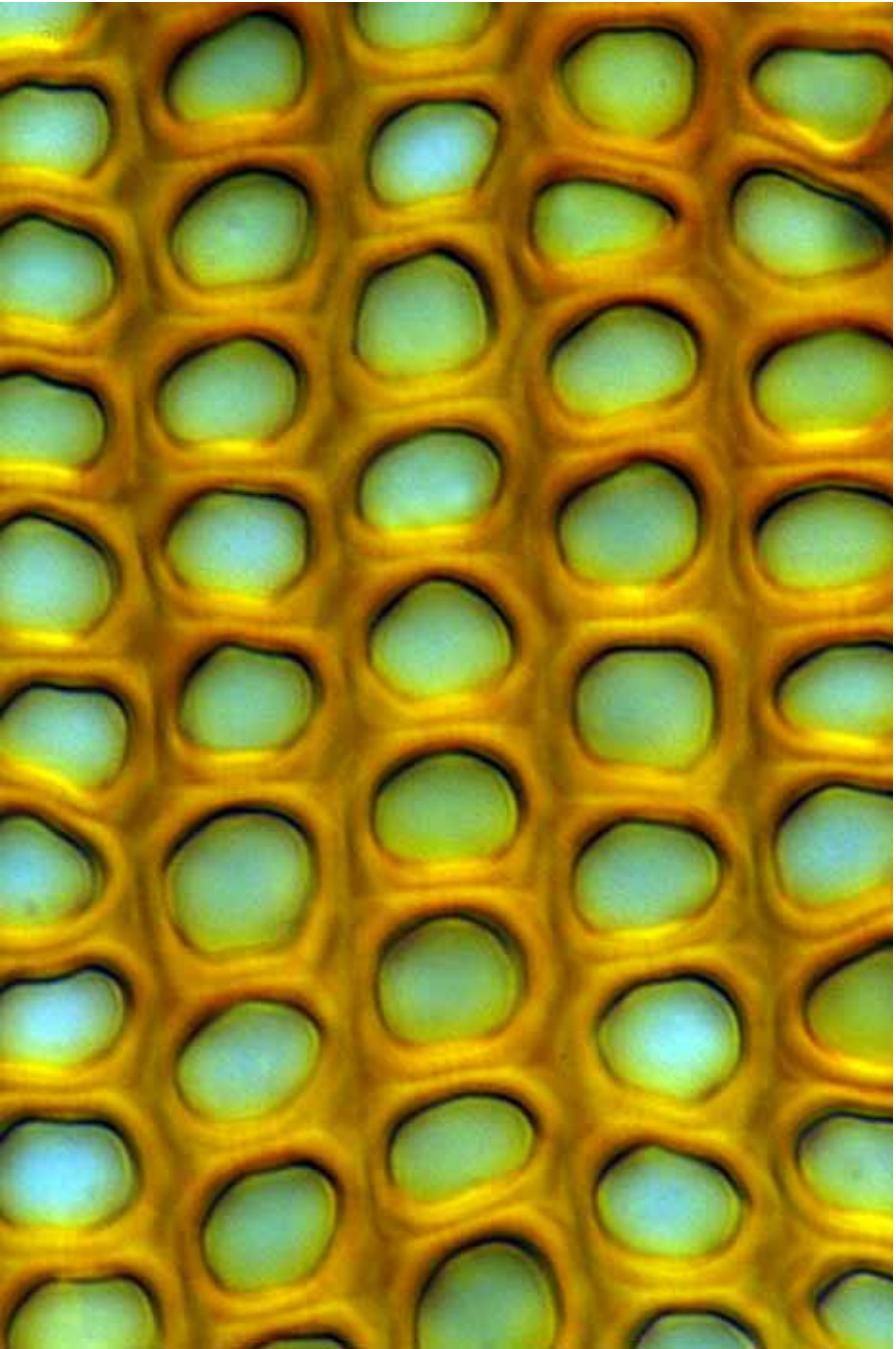
■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



upper leaf cells, midleaf cells, and lower leaf cells

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Macromitrium orthophyllum* upper leaf cells  
10  $\mu$ m

continued next page



**Macromitrium prorepens** (Hook.) Schwäger.

**form:** primary stems creeping; secondary branches to 20 mm, the leaves dull yellow-green to olive-green

**habitat:** bark in low elevation, high-rainfall forest, to 1150 m

**leaf:** size: stem leaves 1.0–1.5 mm, branch leaves 1.2–3.0 mm

**shape:** stem leaves ovate-lanceolate, branch leaves  $\pm$  ligulate, base wider

**tip:** stem and branch leaves obtuse, abruptly contracted to a stout apiculus

**base:** inner long-rectangular, to  $60\ \mu\text{m}$ ,  $\pm$  smooth, reaching  $1/3$  leaf length

**costa:** percurrent to excurrent in the apiculus

**border:** not differentiated

**margin:**  $\pm$  papillose, recurved to reflexed below

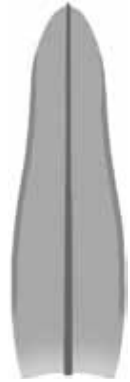
**cells:** midleaf 6–10  $\mu\text{m}$ , isodiametric-rounded, incrassate, 1–(2–4)-papillose

**capsule:** 0.8–1.8 mm, ovoid-oblong, erect to horizontal, 4-plicate below the

mouth; seta 2–9 mm, smooth; calyptra lacerate, plicate, sparsely hairy;

peristome single, exostome only, of 16 flexuose, pale, papillose teeth;

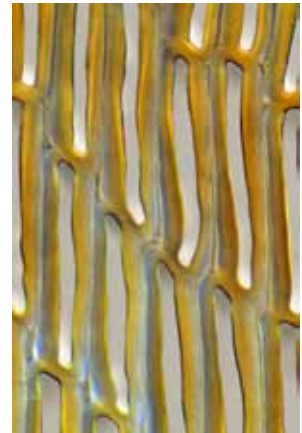
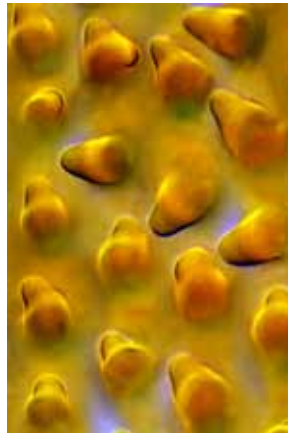
spores 16–44  $\mu\text{m}$  in diam., anisoporous



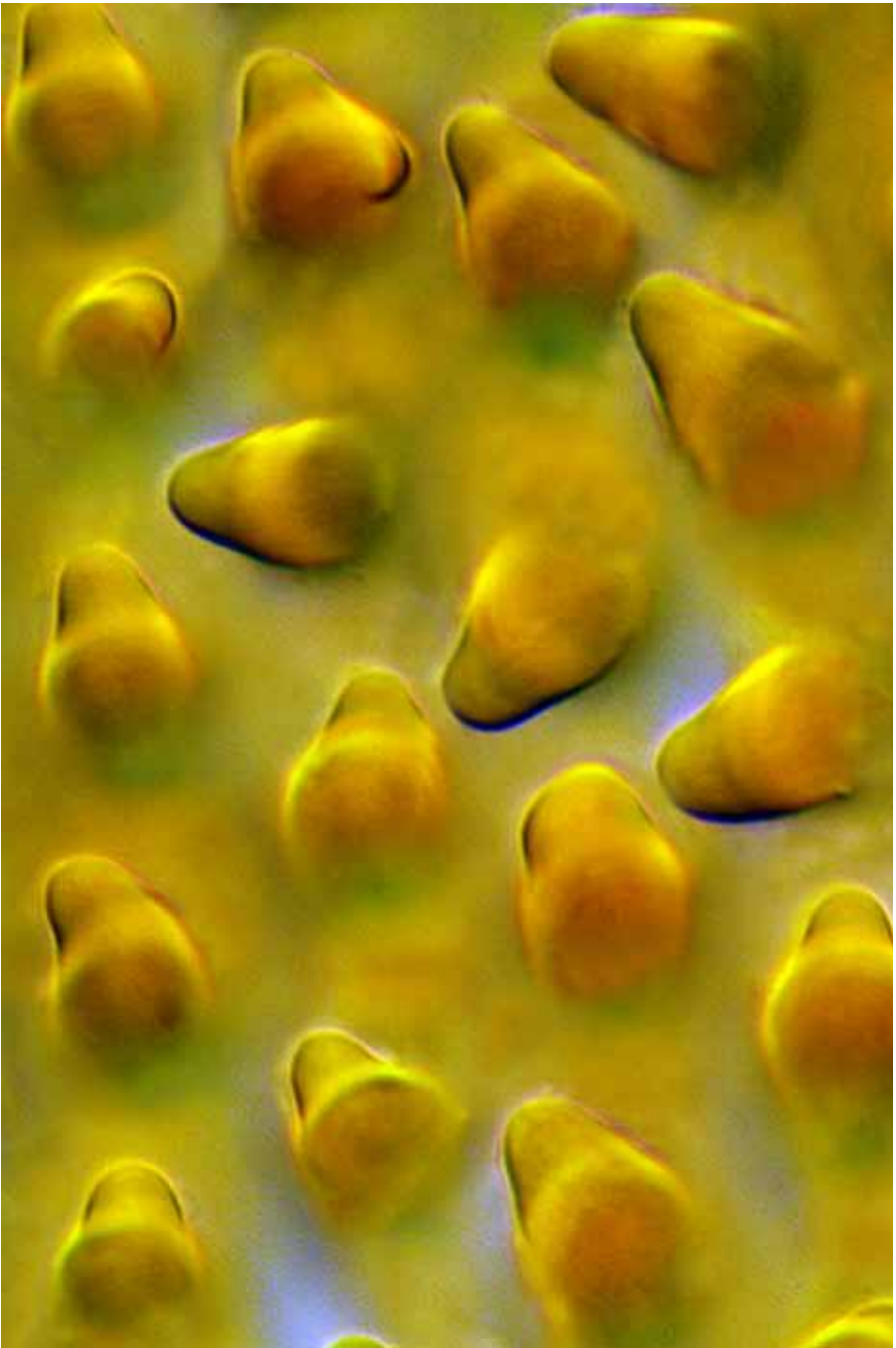
branch leaf



vegetative shoot, fertile shoot, capsule with calyptra, leaf outline, and leaf apex  
 5 mm, 1 mm, 1 mm, 0.1 mm, 10  $\mu\text{m}$



margin midleaf, papillae midleaf, and cells near leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



*Macromitrium prorepens* papillae midleaf  
10  $\mu\text{m}$

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*Macromitrium prorepens* leaf margin cross-section  
10  $\mu$ m

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*Macromitrium prorepens* leaf margin cross-section  
10  $\mu$ m

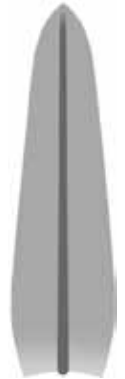
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**Macromitrium ramsayae** Vitt

**form:** matted, creeping primary stems, secondary branches up to 8 mm tall  
**habitat:** bark or rock in salt-spray areas of the Chatham Islands, to 250 m

**leaf:** *size:* stem leaves 1.0–1.5 mm, branch leaves 1.6–2.5 mm  
*shape:* stem: ovate-lanceolate; branch: oblong to lanceolate-oblong  
*tip:* stem leaves gradually acuminate, branch leaves bluntly cuspidate  
*base:* a few cells above the insertion 9–15(–20)  $\mu\text{m}$  long,  $\pm$  rectangular  
*costa:* broad below, prominent, ending in or just below the apex  
*border:* not differentiated  
*margin:* entire, broadly recurved to nearly the apex  
*cells:* 5–8  $\mu\text{m}$ , rounded-quadrate, in rows, thick-walled,  $\pm$  papillose

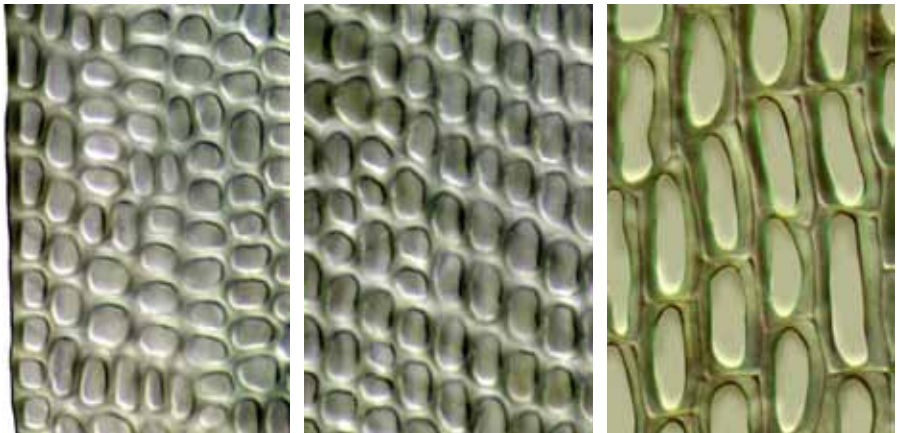
**capsule:** 1.2–2.3 mm, narrowly ovate to fusiform-cylindric, erect, exserted, slightly curved, brown; seta 2.5–4 mm, thick, smooth; calyptra mitrate, lacerate; operculum long-rostrate; peristome double, exostome of 16 blunt, papillose teeth, endostome a low papillose membrane 1–3 cells tall; spores 20–26  $\mu\text{m}$  in diam., papillose



branch leaf



vegetative and fertile shoots (dry), branch leaf outline, and branch leaf apex  
 1 mm, 1 mm, 0.5 mm, 10  $\mu\text{m}$



margin midleaf, cells midleaf, and cells just above leaf insertion  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Macromitrium ramsayae* vegetative shoots (dry)

1 mm

continued next page

**Macromitrium retusum** Hook.f. & Wilson

**form:** mats of creeping primary stems, secondary branches simple, penicillate, to 20 mm, the leaves golden green, glossy

**habitat:** bark and rock, ± coastal in the salt-spray zone, to 600 m

**leaf:** size: branch leaves 1.3–2.0 mm after arista is shed

**shape:** stem lanceolate-acuminate, branch oblong to ligulate

**tip:** ending in a deciduous arista; tip retuse after the arista is shed

**base:** basal cells rectangular,  $16\text{--}40 \times 7\text{--}10 \mu\text{m}$ ; lumina  $2\text{--}4 \mu\text{m}$  wide

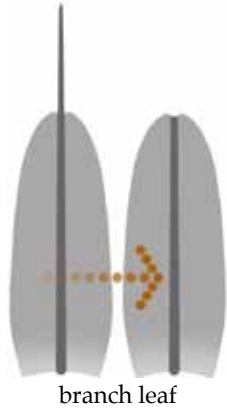
**costa:** excurrent as an arista 0.7–1.3 mm long

**border:** not differentiated

**margin:** entire, plane

**cells:**  $7\text{--}20 \mu\text{m}$ , rounded-quadrate, in rows, thick-walled, bulging

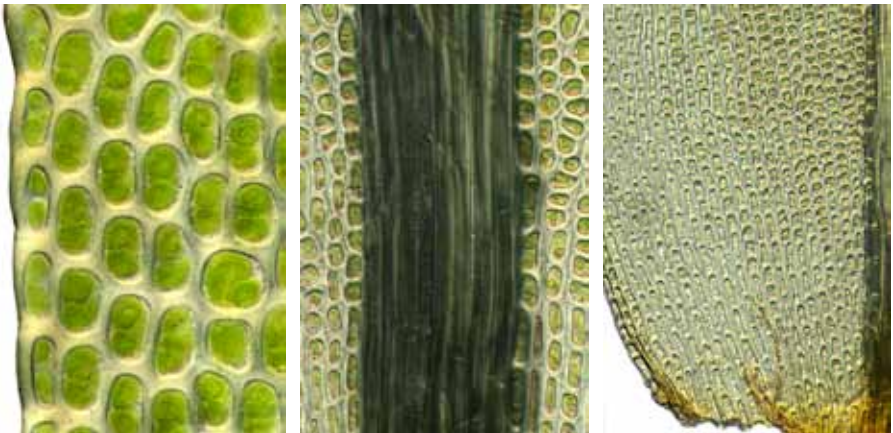
**capsule:** 2 mm, ovate to cylindrical, erect, exserted, brown; seta 4–7 mm; calyptra deeply lacerate, strongly plicate, mitrate, smooth; peristome double but appearing to be single, exostome teeth 16, warty, recurved when dry



branch leaf



vegetative shoot, branch with arista (dry), arista, arista tip, leaf outline, and retuse apex  
 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 0.1 mm, 50  $\mu\text{m}$



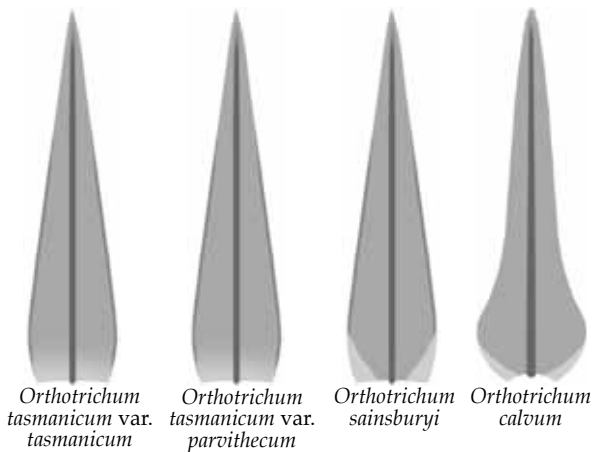
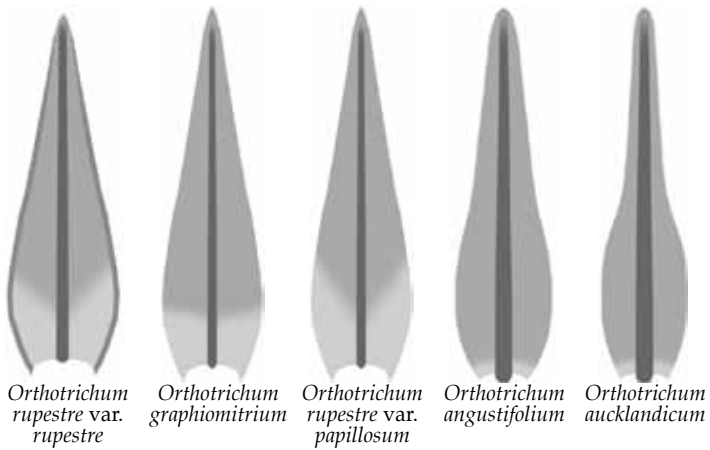
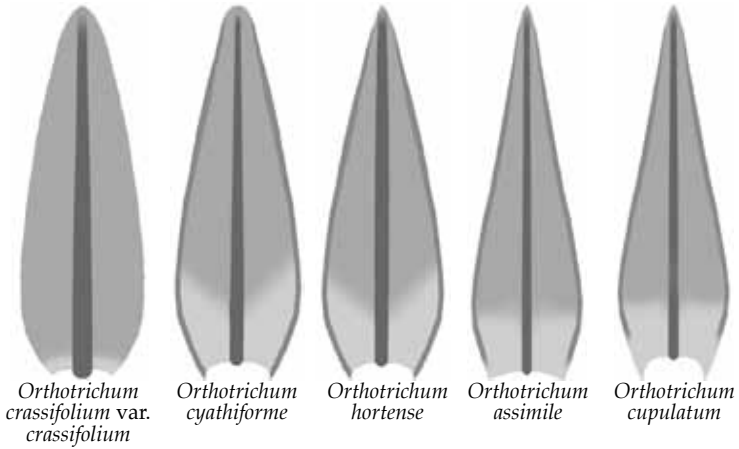
margin midleaf, costa midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

Key\* to the New Zealand species and varieties of *Orthotrichum* (14)

- 1 Leaf lamina bistratose at least distally; spores > 50  $\mu\text{m}$  in diam.....2  
 1: Leaf lamina unistratose throughout; spores < 40  $\mu\text{m}$  in diam.....4
- 2(1) Capsules emergent to exserted; leaves ovate to narrowly ovate-ligulate .....  
 ..... ● ***Orthotrichum crassifolium* subsp. *crassifolium***  
 2: Capsules immersed; leaves long-ligulate to ligulate-lanceolate from an ovate base.....3
- 3(2): Capsules ovate when dry; leaves narrowly lanceolate to broadly subulate from an  
 oblong-ovate base; restricted to Campbell Island.....● ***Orthotrichum angustifolium***  
 3: Capsules oblong when dry; leaves narrowly ligulate from an ovate base; restricted to  
 the Auckland Islands.....● ***Orthotrichum aucklandicum***
- 4(1): Capsule stomata immersed.....5  
 4: Capsule stomata superficial.....7
- 5(4) Calyptra smooth ..... ● ***Orthotrichum calvum***  
 5: Calyptra hairy.....6
- 6(5): Peristome with preperistome..... ● ***Orthotrichum cupulatum***  
 6: Peristome without preperistome ..... ● ***Orthotrichum assimile***
- 7(4): Capsule exserted.....8  
 7: Capsule immersed to emergent .....9
- 8(7) Capsules furrowed when dry; up to 7 mm of seta visible; 1(–2–3) capsules per peri-  
 chaetium..... ● ***Orthotrichum tasmanicum* var. *tasmanicum***  
 8: Capsules smooth when dry; seta not exposed; up to 10 capsules per perichaetium.....  
 ..... ● ***Orthotrichum tasmanicum* var. *parvithecum***
- 9(7): Leaves obtuse or rounded.....● ***Orthotrichum cyathiforme***  
 9: Leaves  $\pm$  acute.....10
- 10(9): Processes of inner peristome 16.....● ***Orthotrichum sainsburyi***  
 10: Processes of inner peristome 8 or lacking.....11
- 11(10): Processes of inner peristome lacking or rudimentary; plants mostly saxicolous 12  
 11: Processes of inner peristome present; plants corticolous.....13
- 12(11) Papillae of midleaf cells branched..... ● ***Orthotrichum rupestre* var. *rupestre***  
 12: Papillae of midleaf cells conic .....● ***Orthotrichum rupestre* var. *papillosum***
- 13(11): Stems 20–30 mm tall,  $\pm$  creeping; leaves gradually acuminate; processes broad.....  
 ..... ● ***Orthotrichum graphiomitrium***  
 13: Stems 8–15 mm tall, not creeping; leaves mostly acute; processes narrow .....  
 ..... ● ***Orthotrichum hortense***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 207, plus Lewinsky-Haapasaari, J; Ramsay, HP (2006): *Orthotrichum*. *Flora of Australia* 51, 219, and Lewinsky, J (1984): The genus *Orthotrichum* Hedw. (Musci) in Australasia, a taxonomic revision. *Journal of the Hattori Botanical Laboratory* 56, 369–460, and Vitt, DH (1976): A monograph of the genus *Muelleriella* Dusén. *Journal of the Hattori Botanical Laboratory* 40, 93.





**Orthotrichum assimile** Müll.Hal.

**form:** tufted erect stems, to 15 mm tall, not creeping, olive- or yellow-green above, dark below

**habitat:** usually bark, but sometimes rock, in humid sites to 1500 m elevation

**leaf:** size: 1.8–4.0 × 0.4–0.8 mm

**shape:** ovate-lanceolate to lanceolate, appressed and flexuose when dry

**tip:** acuminate to acute

**base:** basal cells rectangular, 15–90 × 10 μm, thin-walled, smooth, not porose

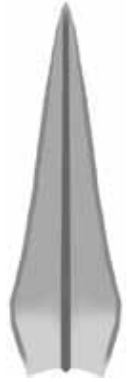
**costa:** failing below the apex

**border:** not differentiated

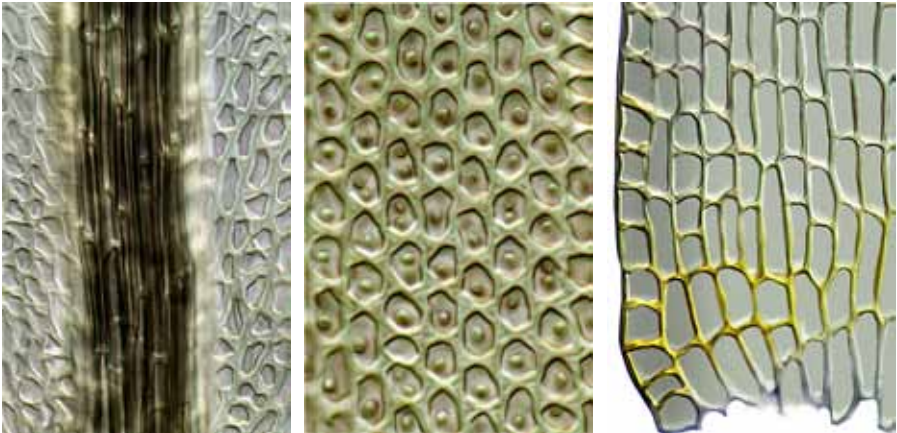
**margin:** entire, recurved on both sides

**cells:** 7–20 μm, isodiametric, thick-walled, 1(–2) low, simple-papillose

**capsule:** 1–2 mm, immersed to emergent, narrowly cylindrical, 8-ribbed and strangulate when dry, stomata immersed; calyptra split, plicate, long-pilose; exostome teeth 8, recurved when dry; endostome segments 8, narrow, well-developed; spores 6–20 μm in diam.



fertile shoot (immersed capsule), calyptra, leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 1 mm, 10 μm, 10 μm



costa (near base), midleaf laminal papillae, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page



*Orthotrichum assimile* cells near leaf base  
10  $\mu$ m

**Orthotrichum calvum** Hook.f. & Wilson

**form:** cushions of erect, radiculose, branched stems, 4–15 mm, olive-green

**habitat:** twig bark in scrub and forest margins, to 1000 m

**leaf:** size: 1.6–2.3 × 0.5–0.6 mm

*shape:* linear-lanceolate from an ovate base, concave

*tip:* bluntly acute to subobtusate

*base:* cells rectangular to linear, smooth, pellucid; transverse walls thickened

*costa:* failing below the apex, prominent abaxially

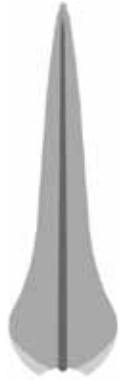
*border:* not differentiated

*margin:* entire, plane to ± recurved midleaf

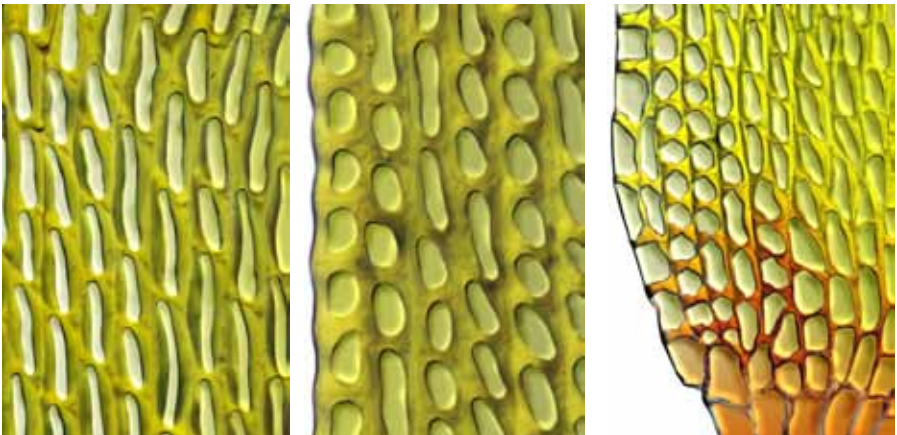
*cells:* 7–10 μm, rounded to irregularly 4–6-angled, ± incrassate, 1–2-papillose

**capsule:** 1.3 mm, widely oval or oblong, erect, exserted, brown, 8-ribbed; stomata immersed; seta 2–4 mm; calyptra pale below, dark at apex, smooth; exostome of 8 pairs of pale, lanceolate teeth, later deeply split; endostome 8–16 papillose processes; spores 20–24 μm in diam.

**note:** our only *Orthotrichum* with immersed stomata and a smooth calyptra



fertile shoot (moist), capsules, calyptra, operculum, leaf outline, and leaf apex  
 1 mm, 1 mm (3), 0.1 mm, 10 μm



cells lower leaf, margin below midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Orthotrichum calvum* capsules, calyptra, operculum, and exostome (dry)  
0.5 mm

continued next page



*Orthotrichum calvum* young and old capsules (dry)

0.5 mm

continued next page



*Orthotrichum calvum* exostome teeth (in KOH)  
50  $\mu$ m

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**Orthotrichum crassifolium** Hook.f. & Wils. var. **crassifolium**

**form:** erect, sparsely branched, brown to blackish stems, to 10 mm tall, in dense tufts or cushions

**habitat:** cliffs and coastal rock above high-tide mark, and inland to 130 m

**leaf:** size: 1.4–3.2 × 0.5–1.0 mm

**shape:** ligulate-lanceolate from a ± ovate base; ± bistratose above

**tip:** obtuse to acute

**base:** basal cells short-rectangular, 18–30 × 9 μm, longer near the costa

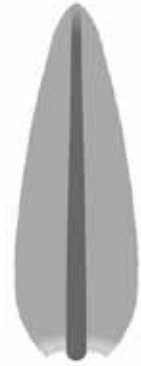
**costa:** stout, ending in or just below the apex

**border:** not differentiated

**margin:** entire, plane, 2–3-stratose

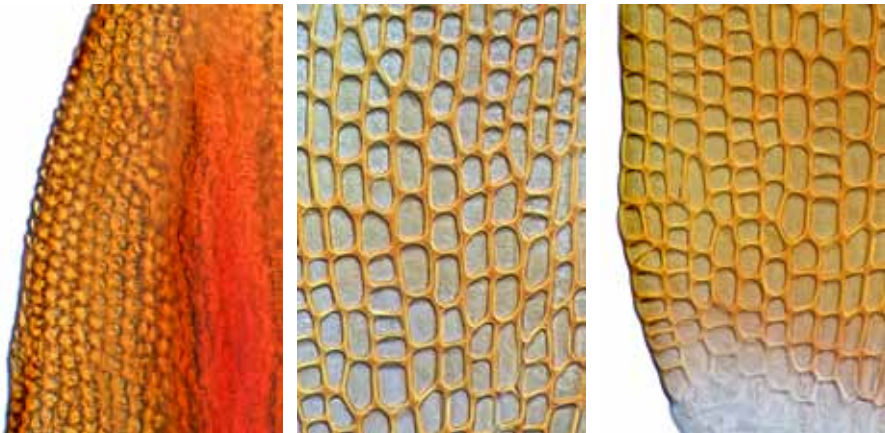
**cells:** 6–13 μm, rounded-rectangular, thick-walled, smooth to ± papillose

**capsule:** 1.0–1.8 mm, oblong-cylindric, erect, exserted, stomata immersed; seta 1–2.5 mm, curved; calyptra mitrate, naked; peristome single, the exostome teeth 16, papillose, recurved when dry; spores (30–)40–100 μm long, multicellular



fertile shoot, capsule, peristome tooth, leaf outline, and leaf apex

1 mm, 0.5 mm, 50 μm, 0.5 mm, 50 μm



margin upper leaf, cells midleaf, and leaf basal angle

50 μm, 10 μm, 10 μm

continued next page



**Orthotrichum cupulatum** Brid.

**form:** tufts or cushions of erect, ± branched stems, 12–20 mm, glaucous  
**habitat:** basic rock or walls, rarely on bark, in moist sites, to 2000 m

**leaf:** size: 2.3–3.2 × 0.5–1.0 mm

**shape:** lanceolate to ovate-lanceolate

**tip:** acute

**base:** decurrent, basal cells rectangular, 32–64 × 10–25 μm, smooth

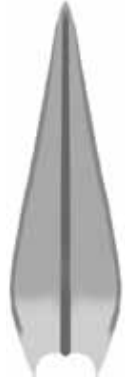
**costa:** reaching the apex

**border:** not differentiated

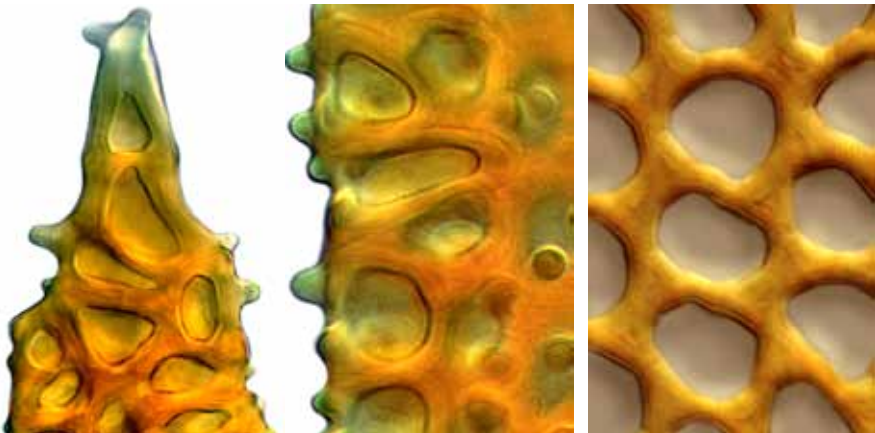
**margin:** entire, recurved on one side

**cells:** 8–13 μm, isodiametric, thick-walled, 2–3-papillose

**capsule:** 1.5 mm, ovoid-urceolate, constricted below the mouth when dry, 8 long and 8 short alternating ribs, immersed to emergent, stomata immersed; seta 0.6–2.0 mm; calyptra mitrate, split, plicate, papillose; peristome single or double, exostome teeth 16; spores 18–23 μm in diam.



fertile shoot (moist), calyptra, mature capsule (dry), leaf outline, and leaf apex  
 ■ 1 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 0.5 mm, ■ 10 μm



leaf apex, margin midleaf, and cells midleaf  
 ■ 10 μm, ■ 5 μm, ■ 5 μm

continued next page

**Orthotrichum graphiomitrium** Beckett

**form:** mats or tufts of erect, branched, radiculose, comose stems, 40 mm  
**habitat:** bark of shrubs and small trees in subalpine scrub, to 900 m

**leaf:** size: 2.6–4.1 × 0.7–1.3 mm

*shape:* ovate-lanceolate, little altered when dry

*tip:* gradually acuminate

*base:* transverse walls of basal angle cells thickened, pigmented

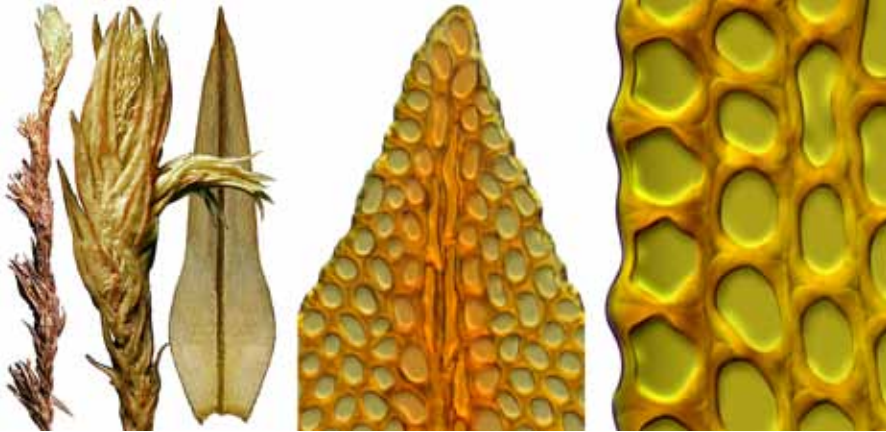
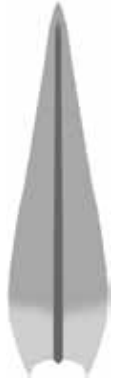
*costa:* orange to red, prominent abaxially, failing below the apex

*border:* not differentiated

*margin:* entire, plane to variably recurved

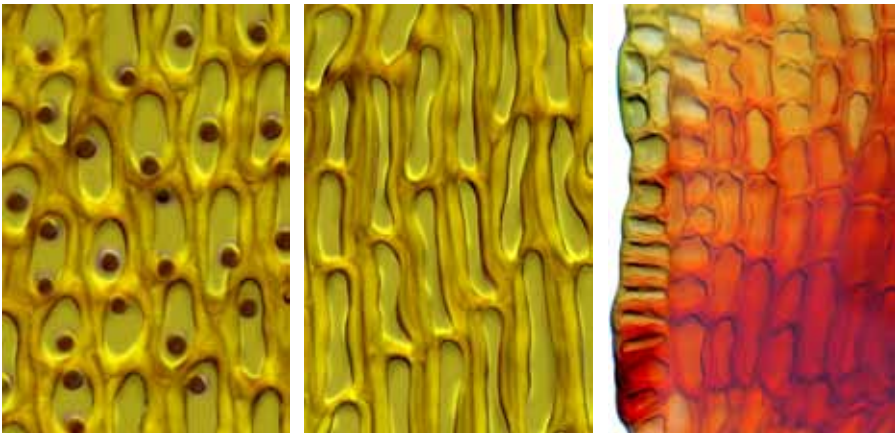
*cells:* 1.5–2 × 7–13 μm, subrotund to narrowly oval, incrassate, 1–3-papillose

**capsule:** 1.5–2 mm; broadly ovate, narrowed at the mouth, erect, immersed, appearing lateral, brown, stomata superficial; seta to 1 mm; exostome of 8 pairs of obtuse teeth, reflexed when dry; endostome of 8 processes almost equalling the teeth; calyptra plicate, densely hairy; operculum conico-rostellate, reddish at the base; spores globose, 18–32 μm in diam.



fertile shoot (dry) (2), leaf outline, leaf apex, and margin midleaf

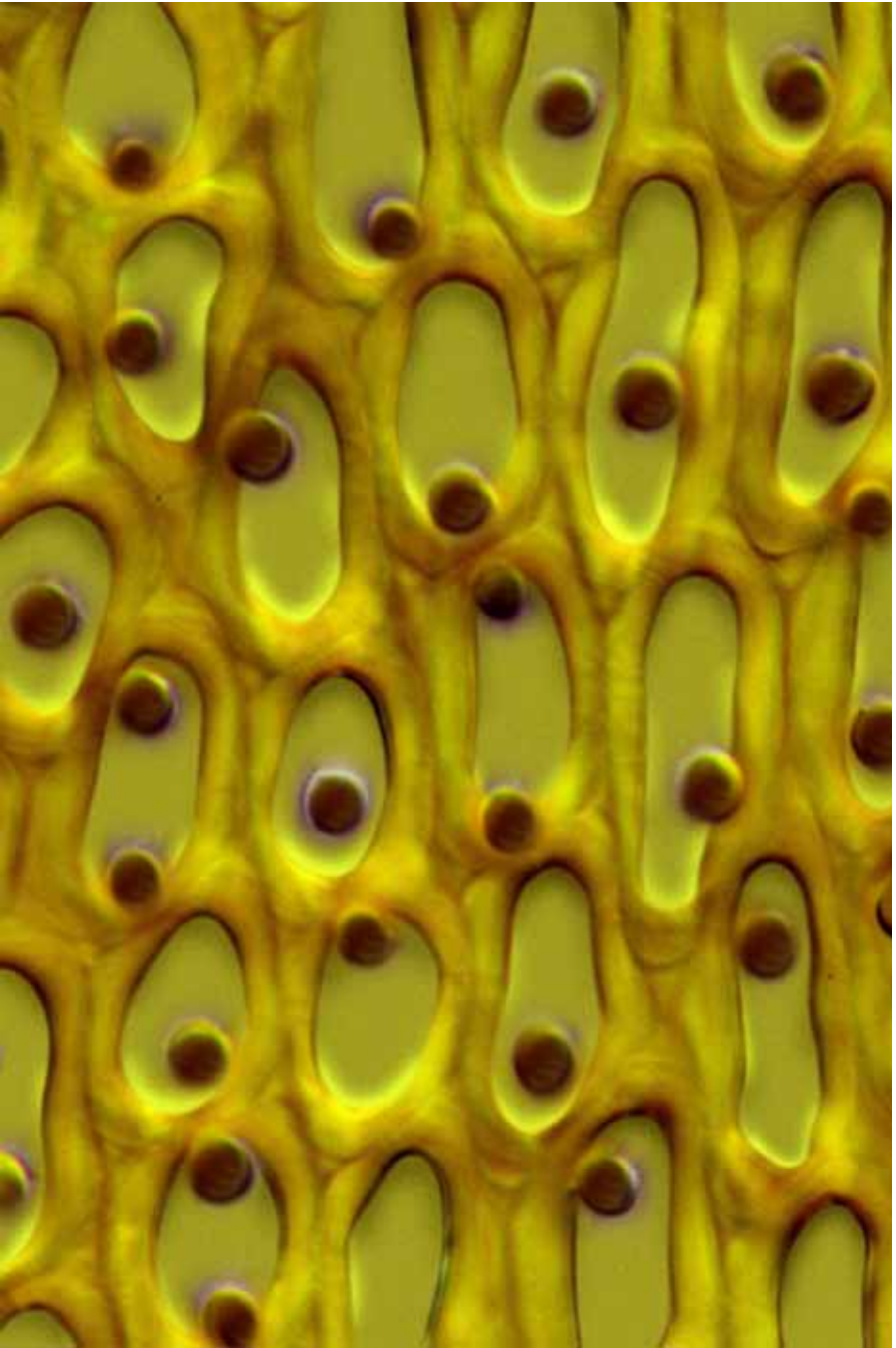
■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm, ■ 10 μm



papillose cells midleaf, cells near leaf base, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

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*Orthotrichum graphiomitrium* cells midleaf  
10  $\mu$ m

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**Orthotrichum hortense** Bosw.

**form:** tufts of erect, branched, often fertile stems, to 15 mm tall, dark below

**habitat:** mostly bark (often willow) but sometimes rock, often in humid sites

**leaf:** size: about 3 mm long

**shape:** ovate-lanceolate to oblong-lanceolate, concave, carinate below, spreading when moist, imbricate when dry but otherwise little altered

**tip:** acute, shortly acuminate, or subobtuse

**base:** basal cells  $\pm$  rectangular, thin-walled, smooth; marginal cells  $\pm$  quadrate

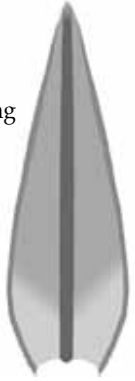
**costa:** percurrent or failing near the apex

**border:** not differentiated

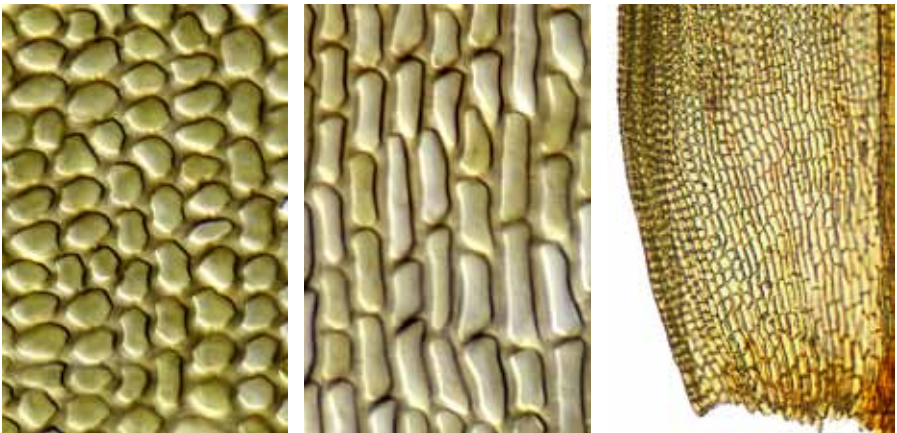
**margin:** entire, recurved or revolute almost to the apex on both sides

**cells:** 9–12  $\mu\text{m}$ ,  $\pm$  isodiametric, incrassate,  $\pm$  papillose

**capsule:** to 2 mm long, cylindrical, 8-ribbed, brown, strangulate when empty, immersed to emergent; stomata superficial; seta < 1 mm; operculum short-beaked; calyptra pilose above, plicate, pale below, apex dark red; exostome teeth 8, pale, reflexed when dry; spores 14–20  $\mu\text{m}$  in diam., brown, papillose



fertile shoot (dry), mature capsule (dry), leaf outline, apex, costa, and recurved margins  
 1 mm, 0.5 mm, 0.5 mm, 0.5 mm, 100  $\mu\text{m}$



lamina cells midleaf, cells near leaf base, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Orthotrichum hortense* fertile shoot (dry) and mature capsule (dry)  
1 mm, 0.1 mm

**Orthotrichum rupestre** Schleich. ex Schwägr. var. **rupestre**

**form:** tufts or mats of erect, ± curved, branched, radiculose stems, 15–60 mm, brownish, not glaucous when dry

**habitat:** non-calcareous rock or rarely smooth bark, in dryish sites, to 2300 m

**leaf:** size: 2–5 × 0.7–1.4 mm

**shape:** variable, lanceolate to broadly lanceolate, partially bistratose above

**tip:** acute to acuminate

**base:** transverse walls of basal cells thickened and porose

**costa:** ending in the apex

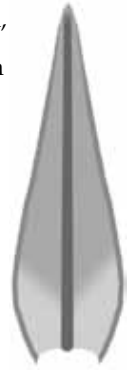
**border:** not differentiated

**margin:** entire, strongly recurved to near the apex

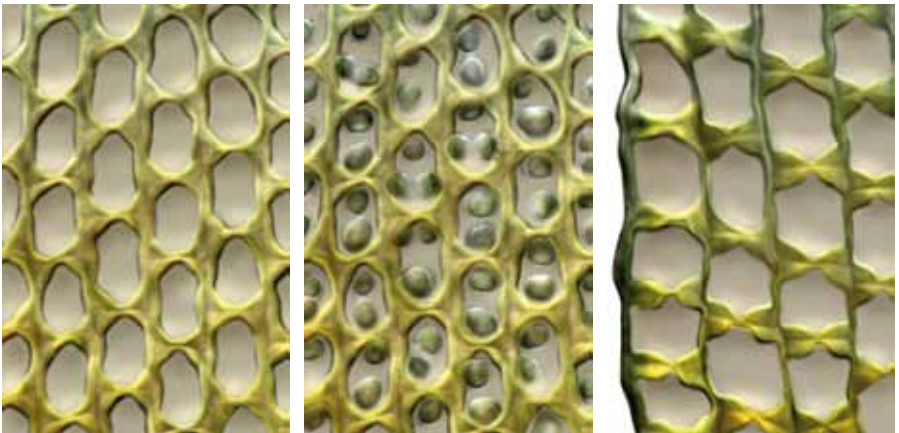
**cells:** 7–21 × 2–15 μm, rounded to ± elongate, thick-walled, 1–3-papillose

**capsule:** 1.5–3 mm, ellipsoid to ovoid, immersed to emergent, striate, not flared, stomata superficial; seta 0.8–2 mm; calyptra hairy; peristome teeth paired; spores 20–26 μm in diam.

**notes:** highly variable; cosmopolitan



fertile shoot (dry), mature capsule (dry), leaf outline, leaf apex, and upper leaf margin  
 1 mm, 0.5 mm, 0.5 mm, 50 μm, 10 μm

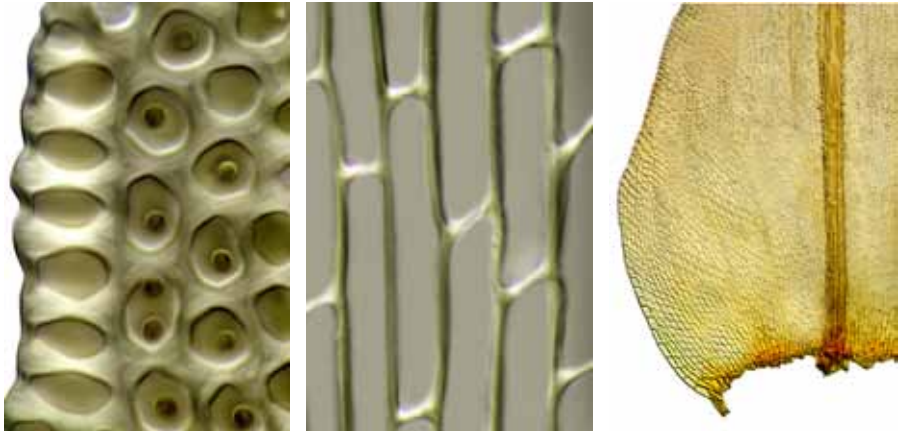


cells midleaf, leaf papillae, and margin near leaf base  
 10 μm, 10 μm, 10 μm

**Orthotrichum tasmanicum** var. **parvithecum** (R.Br.bis) Lewinsky**form:** loose tufts of erect stems to 30 mm tall, yellowish or olive-green**habitat:** bark or occasionally siliceous rock in humid sites to 2000 m elevation**leaf:** size: 2.5–3.7 × 0.6–0.9 mm, unistratose*shape:* ± lanceolate, crisped when dry*tip:* acuminate to acute*base:* basal cells rectangular, 50–70 × 8–15 μm, thin-walled, smooth*costa:* failing below the apex*border:* not differentiated*margin:* entire, ± undulate, recurved*cells:* 6 × 13 μm, rounded-isodiametric, thick-walled, 1(–2) papillate**capsule:** 1–2 mm, 2–3 per perichaetium, cylindric to short-ovoid, immersed to emergent, smooth, strangulate when dry; seta short; calyptra mitrate, ± pilose**notes:** differs from var. *tasmanicum* in having short setae and clustered and weakly ribbed capsules

fertile shoots, calyptra, leaf outline, and leaf apex (2)

1 mm, 0.5 mm, 1 mm, 10 μm, 10 μm



margin midleaf showing laminal papillae, cells near leaf base, and leaf basal angle

10 μm, 10 μm, 100 μm

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*Orthotrichum tasmanicum* var. *parvithecum* fertile shoots with clustered capsules (dry)

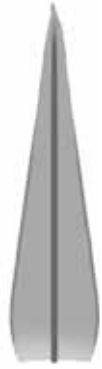
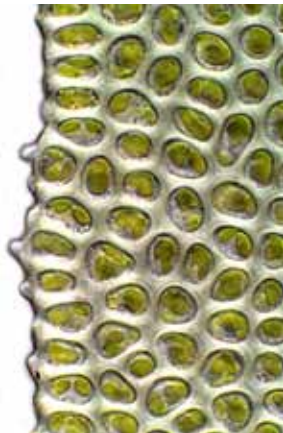
1 mm

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*Orthotrichum tasmanicum* var. *parvithecum* spores and reflexed exostome teeth  
0.1 mm

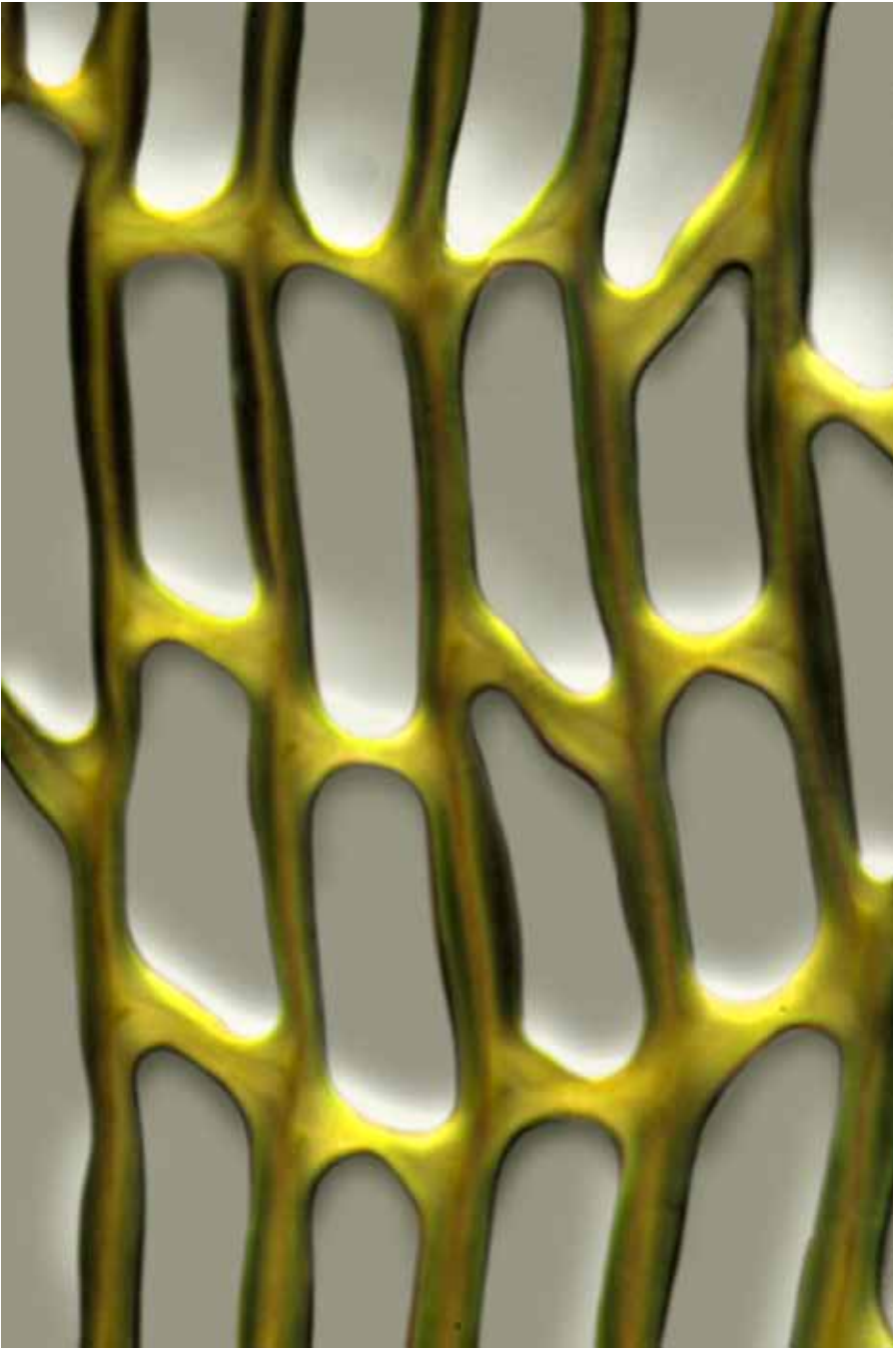
**Orthotrichum tasmanicum** Hook.f. & Wilson var. **tasmanicum****form:** tufts of erect, branched, radiculose stems, 10–30 mm, yellowish green**habitat:** bark or rarely non-calcareous rock, in damp sites, to 1650 m**leaf:** size: 2.4–3.5 × 0.7–0.8 mm*shape:* ± lanceolate*tip:* acute*base:* inner cells long, narrow, incrassate; outer cells quadrate, hyaline, transverse walls thickened*costa:* failing below the apex*border:* weak, hyaline toward the base*margin:* entire to denticulate above, recurved on both sides*cells:* 8–14 × 7–13 μm, isodiametric, incrassate, smooth to 1–2-papillose**capsule:** 1.5–2.5 mm, ovoid to cylindric, erect, long-exserted, pale brown, 8-grooved dry, stomata superficial; seta 4–7 mm; calyptra campanulate, usually hairy; peristome double, exostome teeth 8, recurved when dry, endostome segments 8, papillose; spores 18–32 μm in diam.fertile shoot, mature capsules (2), peristome teeth, leaf outline, and leaf apex  
 1 mm, 1 mm (2), 100 μm, 0.1 mm, 10 μmmargin midleaf, capsule stoma (superficial), and peristome  
 10 μm, 50 μm, 0.5 mm

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*Orthotrichum tasmanicum* var. *tasmanicum* fertile shoots (dry) and mature capsule (dry)  
1 mm, 1 mm

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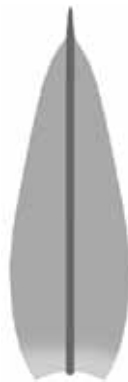


*Orthotrichum tasmanicum* var. *tasmanicum* cells of lower leaf  
10  $\mu$ m

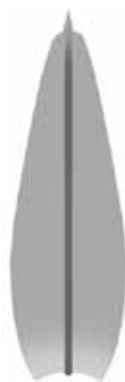
**Key\* to the New Zealand species of *Schlotheimia* (2)**

- 1 Branch leaf apex a stout cusp filled by the excurrent costa; upper margins weakly bordered by oblong (2–3:1) cells ..... ● ***Schlotheimia campbelliana***
- 1: Branch leaf apex a short and wide mucro of bistratose costal cells plus unistratose quadrate to elongate laminal cells; upper margins not bordered..... ● ***Schlotheimia knightii***

\* based on Vitt, DH (1989): The genus *Schlotheimia* (Orthotrichaceae: Bryopsida) in Australia and New Zealand. *Bryologist* 92, 283.



*Schlotheimia  
campbelliana*



*Schlotheimia  
knightii*

**Schlotheimia campbelliana** Müll.Hal.

**form:** spreading mats of creeping stems with erect, glossy branches to 10 mm long, densely red-tomentose below

**habitat:** on bark or rock, on Campbell, Stewart, and South Island, to 400 m

**leaf:** size: 2.0–2.6 × 0.7 mm

*shape:* oblong-lanceolate, spirally twisted when dry, keeled, ± rugose

*tip:* acuminate to acute, stoutly cuspidate, the cusp 0.5–1.0 mm long

*base:* basal cells 20–50 × 6–8 μm, curved, long-rectangular, incrassate, porose

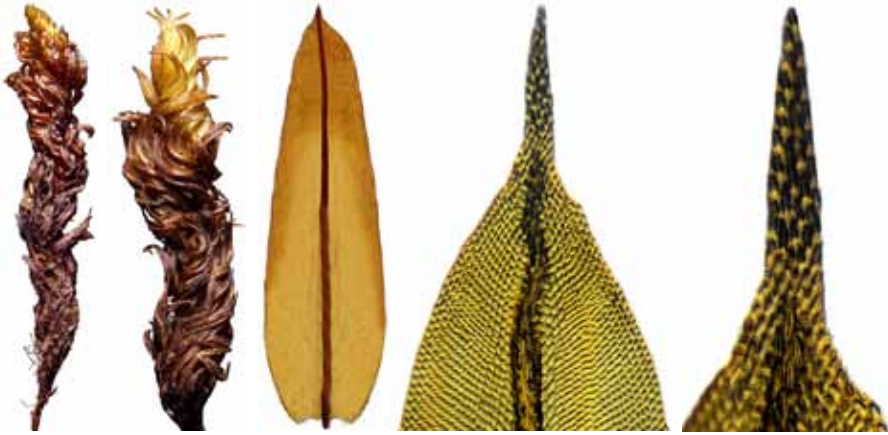
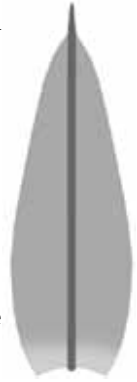
*costa:* strong, excurrent, filling the cusp

*border:* weak, 1–2 rows of cells 10–24 × 3–6 μm

*margin:* entire, plane above, plane to recurved below

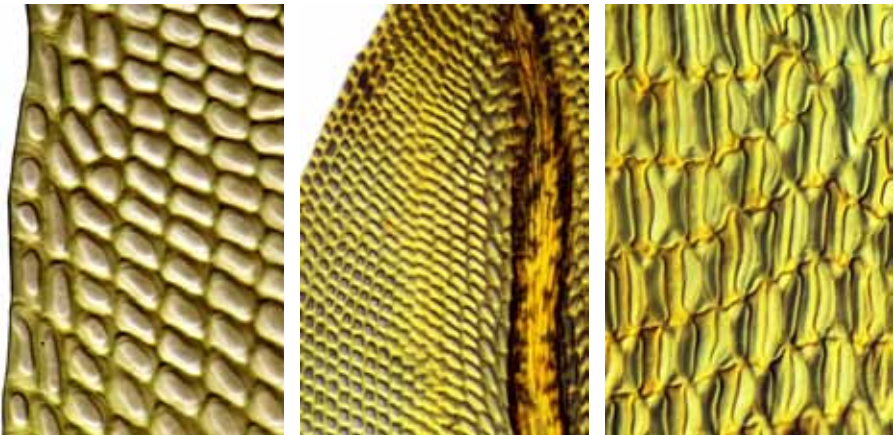
*cells:* midleaf 9–12 μm, oval-oblong, in oblique rows, incrassate, smooth

**capsule:** to 2 mm, ± cylindric, exserted, 8-ribbed; seta 6–8 mm long; calyptrae campanulate, dark above, 4–5-lobed below, naked, smooth; operculum long-rostrate; exostome teeth 16, orange, reflexed when dry; spores spherical, 20–36 μm in diam.



vegetative shoots (dry) (2), leaf outline, cuspidate leaf apex, and cusp

1 mm, 1 mm, 1 mm, 100 μm, 100 μm



midleaf margin, upper margin and costa, and cells near base

10 μm, 50 μm, 10 μm

continued next page



*Schlotheimia campbelliana* campanulate calyptrae  
1 mm

**Schlotheimia knightii** Müll.Hal.

**form:** cushions of creeping, glossy, red-brown stems, branches to 70 mm

**habitat:** bark, less commonly rock, in forest, to 1200 m

**leaf:** size: 1.5–2.5 mm

*shape:* oblong to ovate-oblong, keeled, ± rugose

*tip:* obtuse to acute, abruptly ending in a wide mucro of bistratose costal cells plus unistratose quadrate to elongate laminal cells

*base:* basal cells  $20\text{--}50 \times 6\text{--}8 \mu\text{m}$ , ± yellowish, thick-walled, porose, ± curved

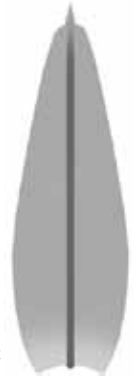
*costa:* failing below the mucro

*border:* some leaves with a weak border of elongate cells

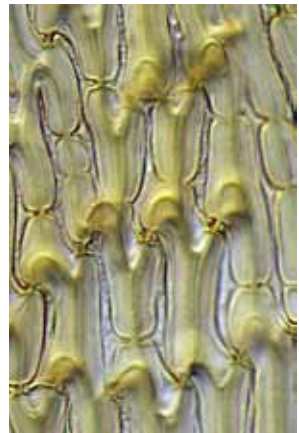
*margin:* entire, plane to recurved below

*cells:*  $10\text{--}20 \times 4\text{--}6 \mu\text{m}$ , oval to oblong, thick-walled, porose, ± papillose

**capsule:** 1.6–2.3 mm, erect to curved, cylindrical, inclined, exserted, 8-ribbed when dry, brown; seta 6–8 mm; calyptra not plicate or pilose, the lobes abruptly flared at the base; exostome teeth 16, orange, reflexed when dry; spores  $21\text{--}40 \mu\text{m}$  in diam.



vegetative shoot, capsules and calyptra (dry), leaf outline, and mucronate leaf apex  
 1 mm, 1 mm, 0.1 mm, 0.5 mm, 0.1 mm, 10  $\mu\text{m}$



margin midleaf, juxtacostal cells, and surface praeae at leaf base  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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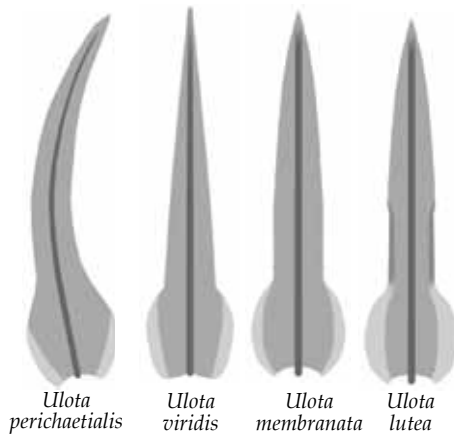


*Schlotheimia knightii* habit  
■ 1 mm

**Key\* to the New Zealand species of *Ulota* (4)**

- 1 Spores 70–90  $\mu\text{m}$  in diam., often multicellular; capsules pyriform ..... ● *Ulota membranata*  
 1: Spores 20–50  $\mu\text{m}$  in diam., unicellular; capsules not pyriform ..... 2
- 2(1:) Leaves < 2 mm long ..... ● *Ulota viridis*  
 2: Leaves > 2 mm long ..... 3
- 3(2:) Capsule exerted on seta 3–6 mm long ..... ● *Ulota lutea*  
 3: Capsule immersed on very short seta ..... ● *Ulota perichaetialis*

\* based on Ramsay, HP (2006): *Ulota*. *Flora of Australia* **51**, 229.



**Ulota lutea** (Hook.f. & Wilson) Mitt.**form:** tufts or cushions of erect,  $\pm$  unbranched, brownish stems, 10–25 mm**habitat:** bark of branches and twigs in humid forest, to 1300 m**leaf:** size: 1.0–2.5  $\times$  0.4–0.5 mm*shape:* linear-lanceolate from an ovate or elliptic base, crisped when dry*tip:* acute or shortly acuminate*base:* transverse walls of the outer 4–5 rows of basal cells strongly thickened;

inner basal cells thick-walled, sinuose

*costa:* vanishing below the apex*border:* not differentiated*margin:* entire, recurved on both sides for a short distance above the base*cells:* 9–12  $\mu\text{m}$ , irregularly rounded above, thick-walled, mammillose; basal

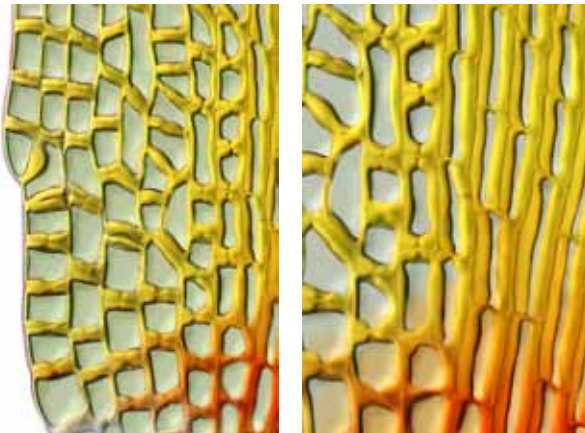
inner cells vermicular; basal outer cells quadrate

**capsule:** 1.5–2 mm, cylindric to oblong, long-necked, 8-ribbed when dry; seta

3–6 mm, yellow; operculum beaked; exostome teeth paired, cross-striate;

endostome segments 8; spores 39–42  $\mu\text{m}$  in diam., papillose

habit, fertile and vegetative shoots (dry), capsule, calyptra, leaf outline, and leaf apex  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$



leaf basal angle, outer and inner basal cells, and peristome  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 0.1 mm

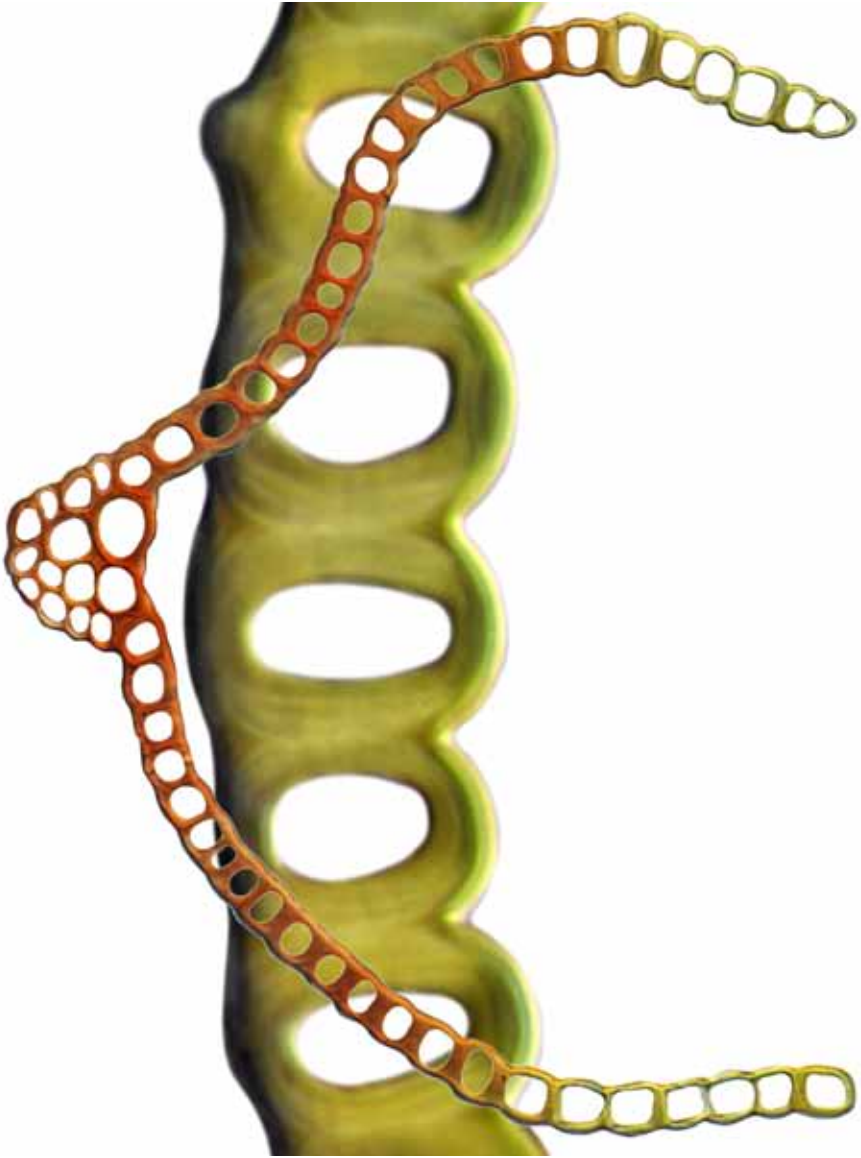


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*Uloa lutea* mature capsules showing opercula and peristomes  
0.1 mm

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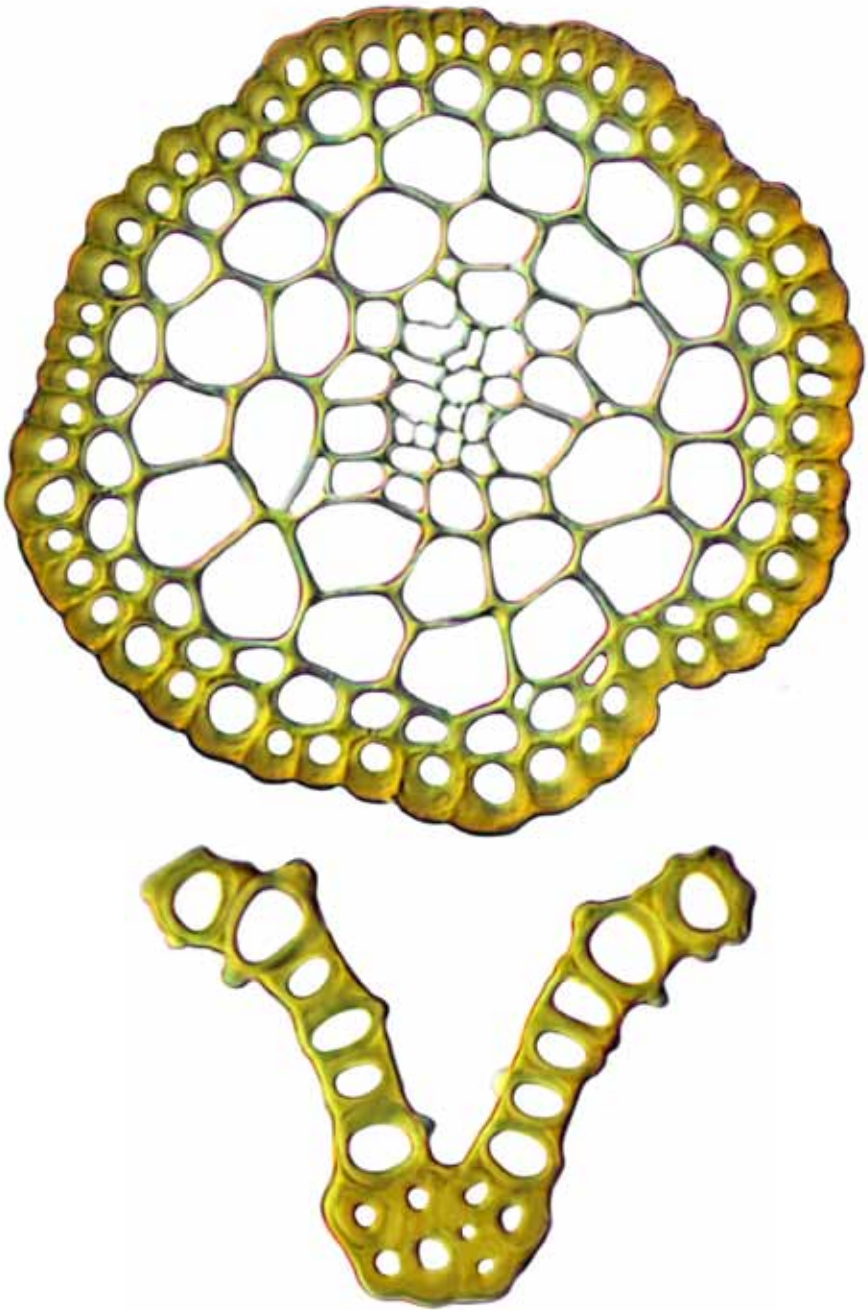


*Ullota lutea* leaf cross-sections

50  $\mu\text{m}$  (whole leaf, alar region),

10  $\mu\text{m}$  (detail)

continued next page



*Ullota lutea* seta and upper leaf cross-sections  
10  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)

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**Ulota membranata** Malta

**form:** tufts of erect stems, yellowish, dark below, branches to 15 mm

**habitat:** bark, mostly beech in wet montane forest, to 130 m

**leaf:** size: 1.6–2.1 × 0.4 mm long, not crisped when dry

**shape:** narrowly lanceolate from an ovate base

**tip:** acuminate

**base:** inner basal cells narrowly oval, thick-walled, reddish toward base

**costa:** failing below or in the apex

**border:** base only, 4–6 rows of cells transversely thickened

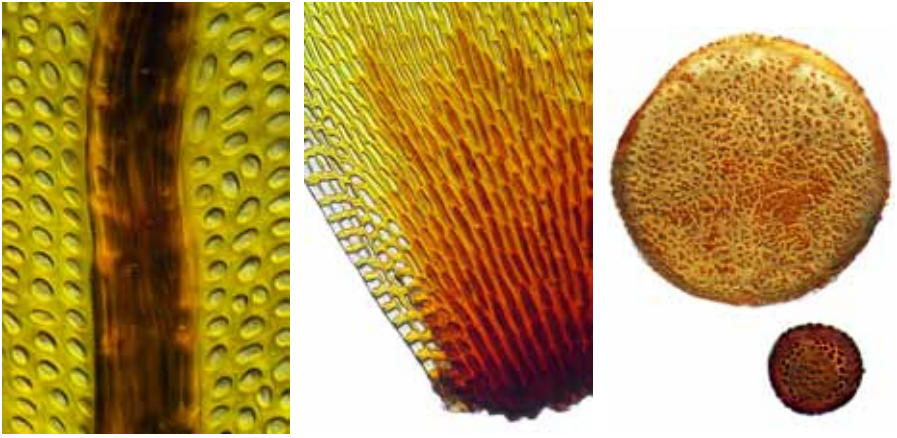
**margin:** entire, mostly plane but reflexed on both sides just above the base

**cells:** upper cells 8–12 μm, isodiametric, thick-walled, mammillose

**capsule:** 1.0–1.5 mm, ± pyriform, erect, exserted, brown, narrowed at the mouth, strongly 8-ribbed when dry; seta 3–4 mm, yellowish; calyptra campanulate, laciniated, hairy; exostome teeth 8, yellowish, with transverse bars and median zig-zag; endostome segments 16, irregular; spores multicellular, 70–120 μm in diam.



vegetative shoot (dry), capsules (dry) (2), leaf outline, leaf apex, and margin midleaf  
 0.5 mm, 0.5 mm (2), 0.5 mm, 50 μm, 10 μm



costa midleaf, leaf basal angle, and spore (alongside *Ulota lutea* spore)  
 10 μm, 50 μm, 50 μm

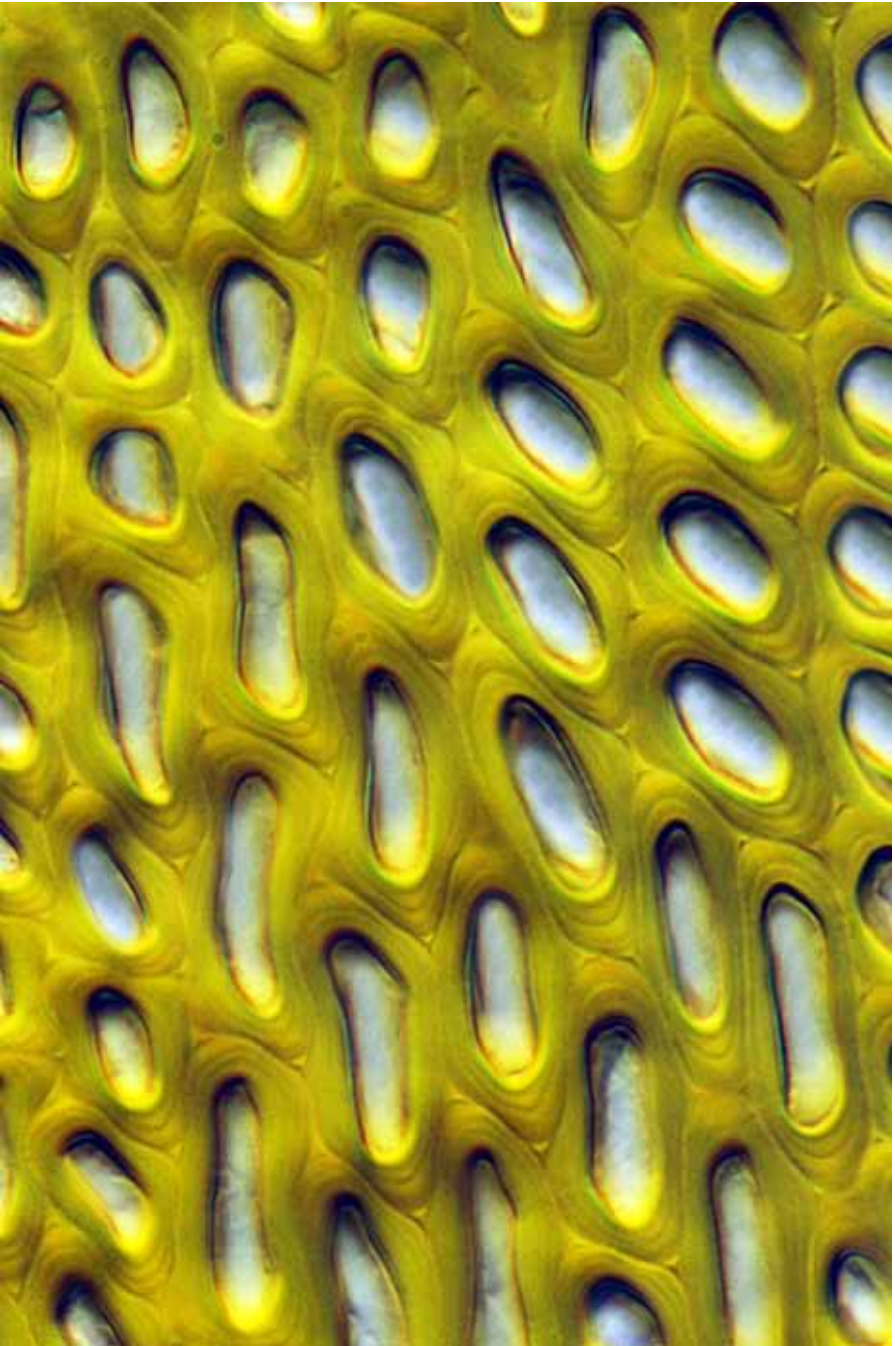
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*Ullota membranata* mature capsules (dry), showing recurved exostome teeth  
1 mm

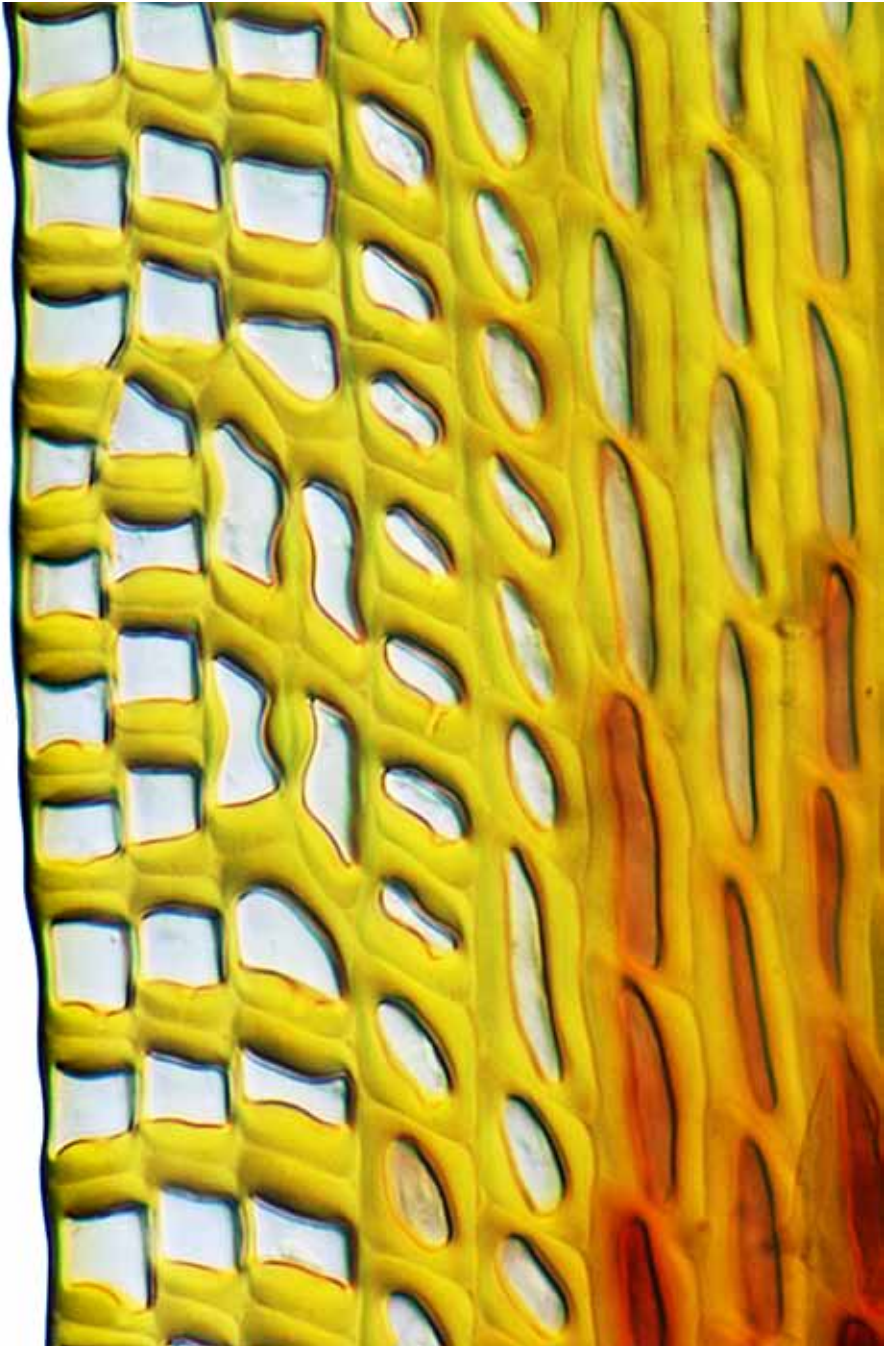
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*Ullota membranata* cells below midleaf  
10  $\mu\text{m}$

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*Ullota membranata* margin near leaf base  
10  $\mu\text{m}$

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**Ulota perichaetialis** (Sainsbury) Goffinet

**form:** tufts or cushions of creeping primary stems, secondary stems to 30 mm, branched, erect, yellow-brown above, dark brown and denuded below

**habitat:** bark in subalpine scrub and forest, to 1300 m

**leaf:** size: 2–3 × 0.4–0.5 mm

**shape:** narrowly lanceolate from an ovate base, ± curved, crisped when dry

**tip:** long-acuminate

**base:** transverse walls of the outer 3–6 rows of basal cells heavily thickened; inner basal cells elongate, thick-walled

**costa:** strong below, prominent abaxially, failing just below the apex

**border:** differentiated only in the leaf basal angles, 6–8 rows wide

**margin:** entire or nearly so, plane or recurved on one side

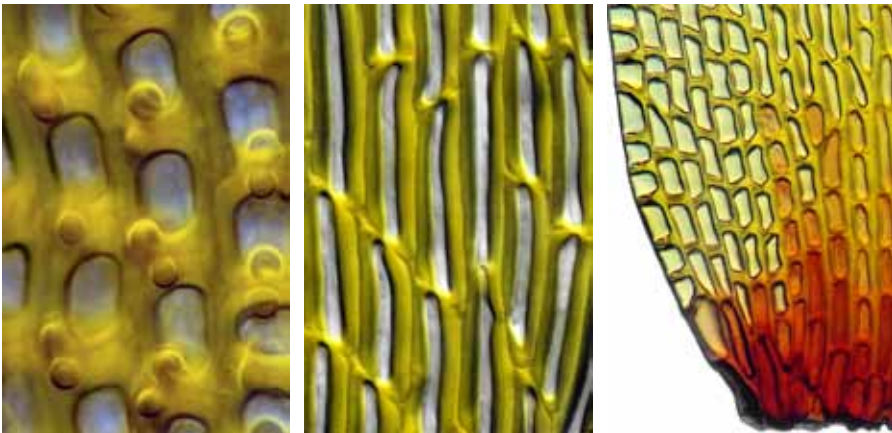
**cells:** upper 7–10 μm, isodiametric, thick-walled, mammillose

**capsule:** 2 mm, oval, erect, immersed, 8-ribbed when dry; seta 0.2 mm; calyptra campanulate, lacinate, hairy; operculum beak short, erect; peristome single, teeth 16, pale, papillose with median zig-zag; spores 40–50 μm in diam., green



fertile shoot (dry) (2), leaf outline, capsule (dry), leaf apex, and margin upper leaf

1 mm, 1 mm, 0.5 mm, 0.5 mm, 50 μm, 10 μm



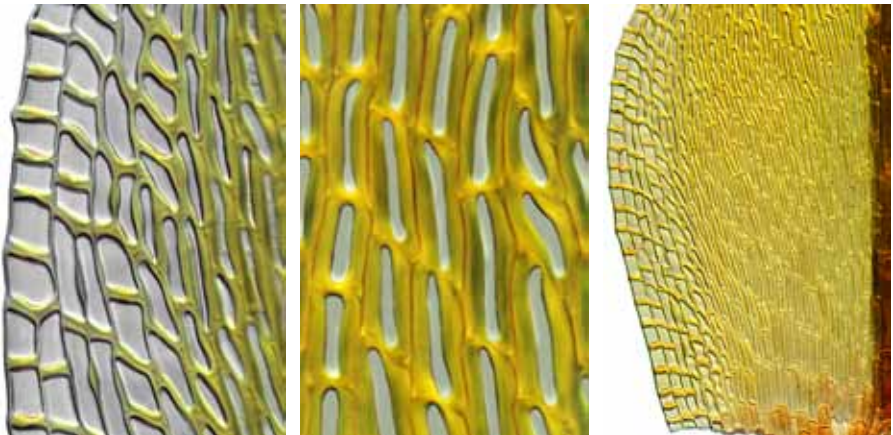
papillae upper leaf, cells of lower leaf, and leaf basal angle

10 μm, 10 μm, 50 μm

continued next page

**Ulota viridis** Venturi**form:** primary stems creeping; secondary branches erect, 8–13 mm**habitat:** tree bark (mostly beech) or rarely rock in montane forest, to 1400 m**leaf:** size: 1.5–2.1 mm*shape:* long-lanceolate from an ovate, pigmented base*tip:* acute*base:* basal marginal cells in 4–6 rows, hyaline, with thickened transverse walls*costa:* subpercurrent*border:* not differentiated*margin:* entire, plane except for recurving on both sides just above the base*cells:* upper cells 9–12  $\mu\text{m}$ , rounded-isodiametric, thick-walled, mammillose**capsule:** to 1.9 mm, oblong, short-necked, erect, exserted, light brown, 8-ribbed when dry; seta 3–4 mm, strongly twisted when dry; calyptra hairy; operculum yellow-rimmed, long-rostrate; exostome teeth paired, 8, not split, with median zig-zag; endostome processes filiform, smooth; spores 24–42  $\mu\text{m}$  in diam., coarsely papillose, green

vegetative shoot (dry), capsule (dry), leaf outline, leaf apex (2), and margin upper leaf  
 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



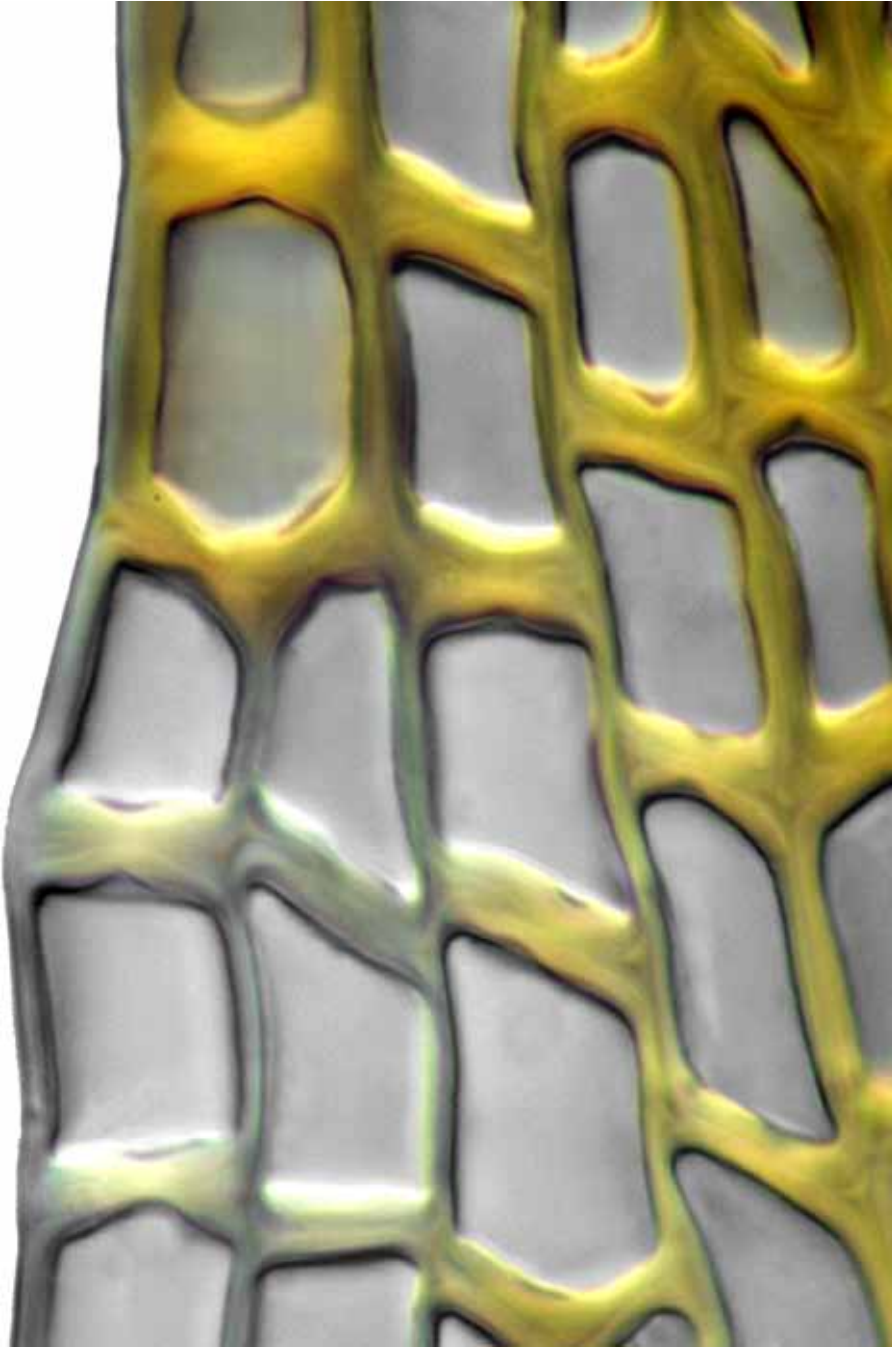
margin of lower leaf, central cells of leaf base, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Uloa viridis* coarsely pilose calyptra and mature capsule  
1 mm

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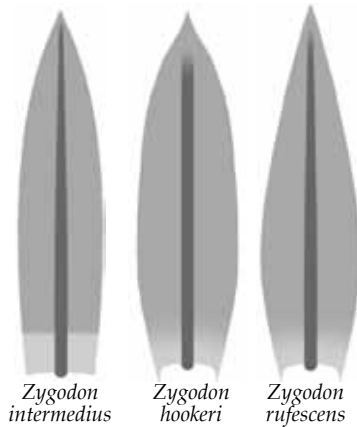
*Uloa viridis* margin of lower leaf  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Zygodon* (3)**

- 1 Leaves strongly squarrose when moist..... ● ***Zygodon rufescens***  
 1: Leaves recurved but not squarrose when moist..... 2

- 2(1): Apical teeth formed by only part of a cell; seta 2.5–10 mm long; capsules 1.0–1.5 mm long; spores 13–20  $\mu\text{m}$  in diam. .... ● ***Zygodon intermedius***  
 2: Apical teeth formed by entire cells; seta 10–15 mm long; capsules 1.5–2.0 mm long; spores 20–25  $\mu\text{m}$  in diam. .... ● ***Zygodon hookeri***

\* based on Lewinsky-Haapasaari, J; Ramsay, HP (2006): *Zygodon*. *Flora of Australia* 51, 238, and Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 199.



**Zygodon hookeri** Hampe

**form:** tufts or mats of radiculose stems, 10–30 mm, green to yellowish above, reddish brown below, glossy when dry, with axillary gemmae

**habitat:** bark, less often rock, usually in wettish habitats, 400–1000 m

**leaf:** size: 1.4–2.4 × 0.3–0.5 mm

*shape:* lanceolate to linear-lanceolate, keeled

*tip:* sharply acute

*base:* undifferentiated, slightly decurrent

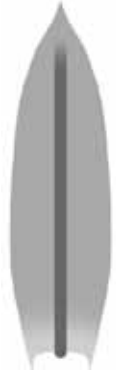
*costa:* ending below the apex

*border:* not differentiated

*margin:* entire to dentate, undulate, but plane at margins

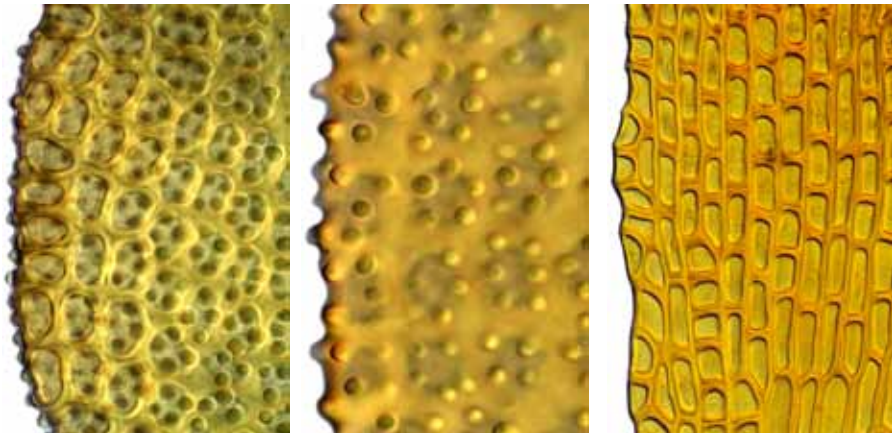
*cells:* 6–12.5 × 4.5–11.0 μm, isodiametric, thick-walled, 4–7-papillose

**capsule:** 1.5–2.2 mm, oblong or cylindric, exserted, erect, deeply 8-ribbed when dry; seta 5–20 mm; calyptra cucullate, naked, smooth; operculum obliquely long-rostrate; endostome only, segments 8, filiform, smooth, hyaline; spores 20–25 μm in diam., papillose



vegetative shoot (dry) (2), capsule, operculum, margin xs, leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10 μm, ■ 0.1 mm, ■ 10 μm

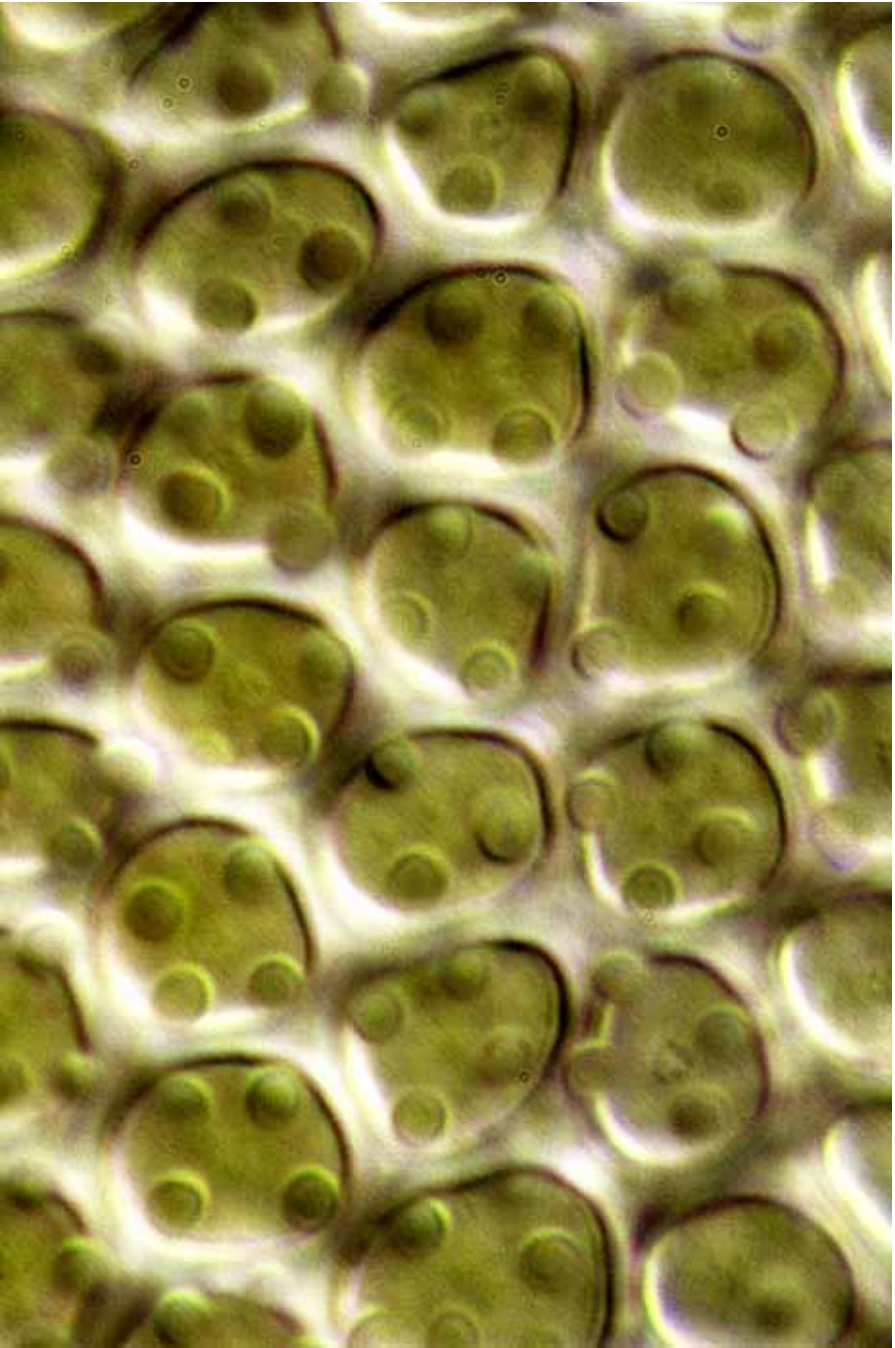


margin midleaf and surface papillae, and margin near leaf base

■ 10 μm, ■ 10 μm, ■ 10 μm

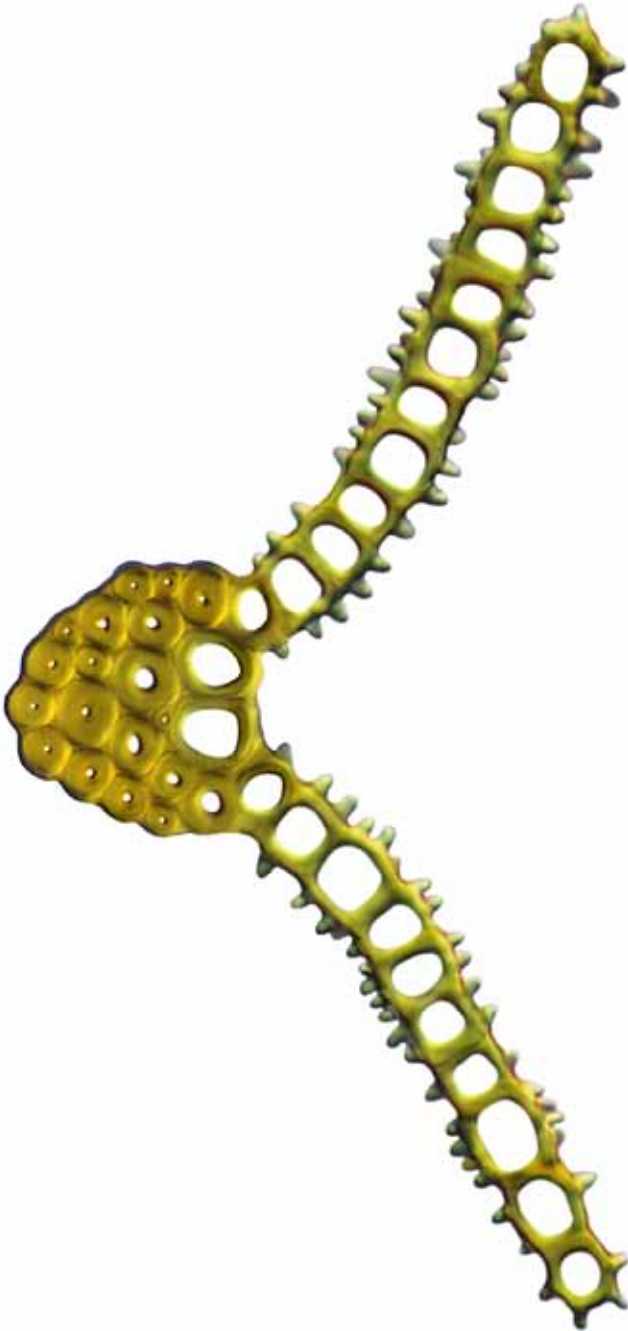
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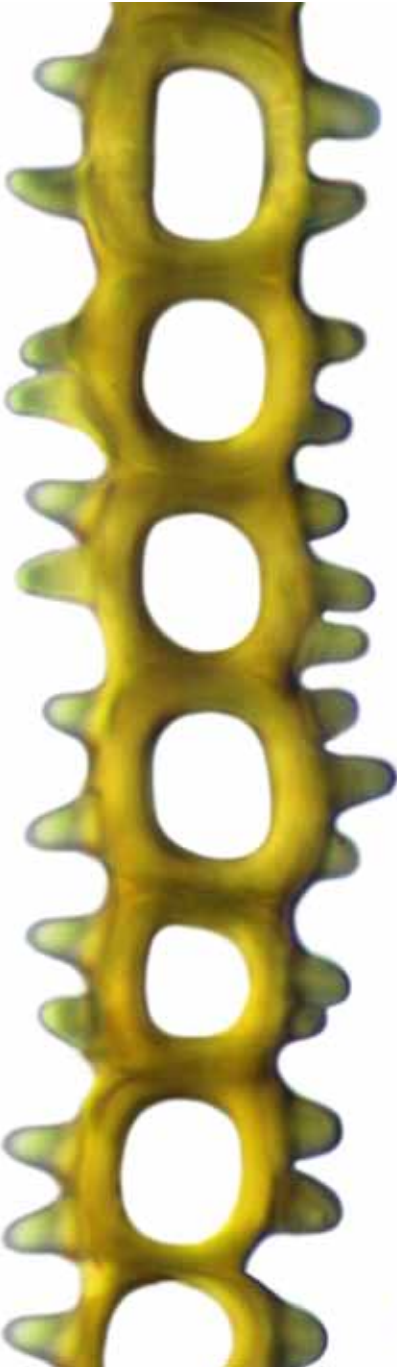
*Zygodon hookeri* papillose cells midleaf  
10  $\mu\text{m}$

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*Zygodon hookeri* leaf cross-section  
10  $\mu\text{m}$

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*Zygodon hookeri* leaf cross-sections

10  $\mu\text{m}$  (whole leaf),

10  $\mu\text{m}$  (detail)

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**Zygodon intermedius** Bruch & Schimp.

**form:** tufts or turves of erect, radiculose, branched stems, 5–25(–55) mm, the leaves yellowish green above, red-brown below, glossy when dry

**habitat:** bark or rock in moist to semi-arid sites, sea level to 1500 m

**leaf:** size: 0.6–1.8 × 0.2–0.3 mm

*shape:* lanceolate to linear-lanceolate

*tip:* acute, often ending with a single smooth cell

*base:* basal cells rectangular, smooth

*costa:* failing shortly below the apex

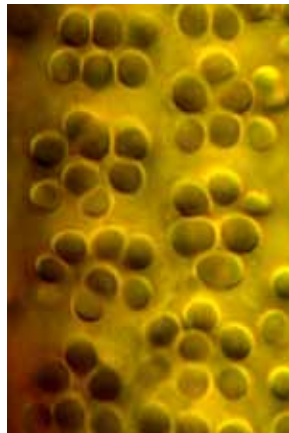
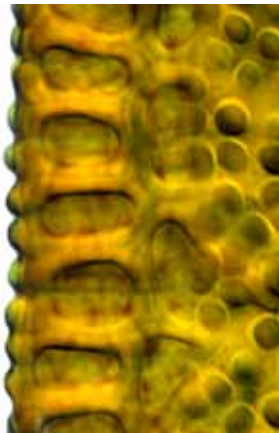
*border:* not differentiated

*margin:* minutely crenulate from papillae, rarely denticulate above, plane  
*cells:* 4–10(–15)  $\mu\text{m}$ ,  $\pm$  isodiametric, rounded, thick-walled, 4–8-papillose

**capsule:** 1.0–1.5 mm, cylindric to pyriform, 8-ribbed when dry, brown, exserted; seta 2.5–10 mm; calyptra smooth; peristome double, the exostome sometimes reduced or absent, the endostome segments 8, reduced and hyaline; spores 13–20  $\mu\text{m}$  in diam., papillose



fertile shoot (dry), capsule (dry), leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.1 mm, 0.1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



margin midleaf (detail), papillae midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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*Zygodon intermedius* capsule, calyptra, operculum, peristome, and spores  
0.5 mm

**Zygodon rufescens** (Hampe) Broth.

**form:** tufts of erect, sparsely branched stems, to 20 mm tall, red-radiculose  
**habitat:** bark of trees and shrubs in moist or humid sites

**leaf:** size: to 2 mm long

*shape:* lanceolate, shortly decurrent, crisped when dry, squarrose when moist

*tip:* acute

*base:* basal cells rectangular, hyaline, thin-walled, smooth

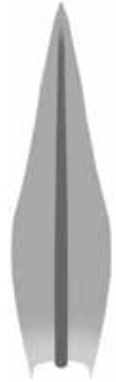
*costa:* failing below the apex, rough on the abaxial surface

*border:* not differentiated

*margin:* entire except for projecting papillae, plane

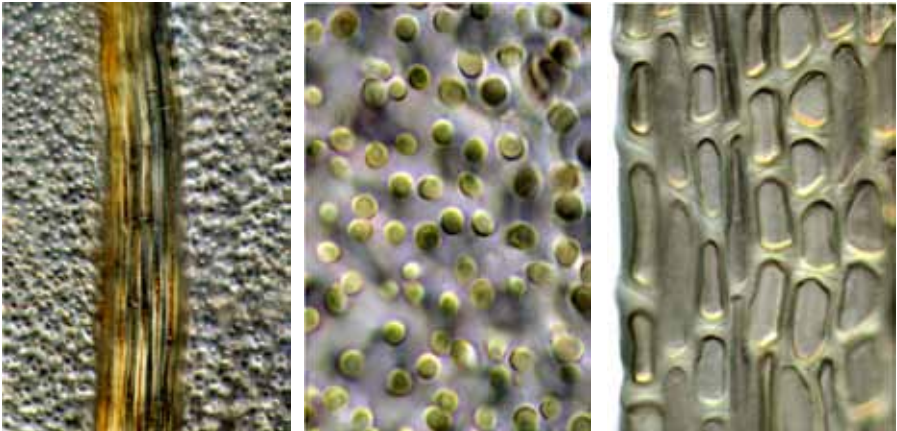
*cells:* 8–10  $\mu\text{m}$ ,  $\pm$  rounded-isodiametric, thick-walled, densely papillose

**capsule:** capsules unknown



vegetative shoot (dry), leaf outline, leaf apex (2), and leaf margin

1 mm, 0.5 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$



costa midleaf, lamina papillae, and margin just above basal angle

50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

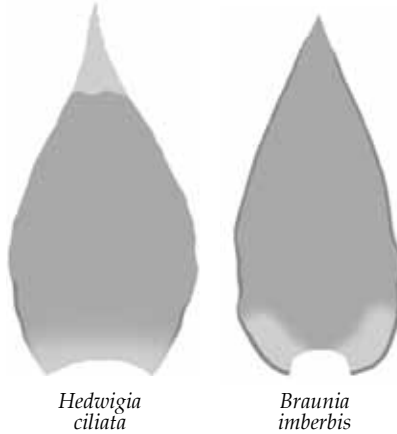
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*Zygodon rufescens* leaf outline and vegetative shoot (dry)  
0.1 mm, 1 mm

Key to the New Zealand species of the Hedwigiaceae (2)

- 1 Leaf tips abruptly white-tipped; midleaf margin plane..... ● **Hedwigia ciliata**  
 1: Leaf tips not white-tipped; midleaf margin reflexed..... ● **Braunia imberbis**





**Braunia imberbis** (Sm.) N.Dalton & D.G.Long

**form:** mats of creeping, irregularly branched, tapered stems, to 60 mm, the leaves pale green above, darker below, julaceous when dry

**habitat:** acidic dry rock at low to middle elevations, to 900 m

**leaf:** size: 1.3–2.0 × 0.6–0.8 mm

**shape:** ovate to oblong-ovate, concave, ± plicate

**tip:** acute to acuminate

**base:** cordate-auriculate; outer cells isodiametric in 12–15 rows, smooth

**costa:** none

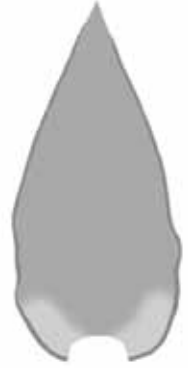
**border:** not differentiated

**margin:** entire, narrowly recurved throughout, ± decurrent

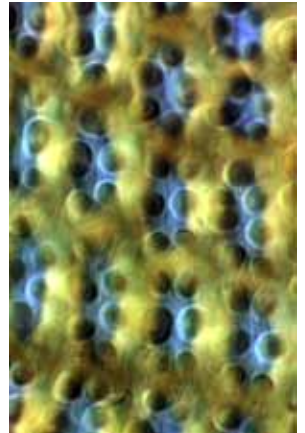
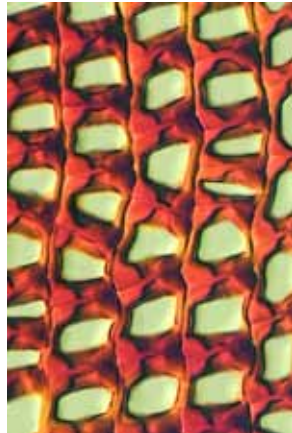
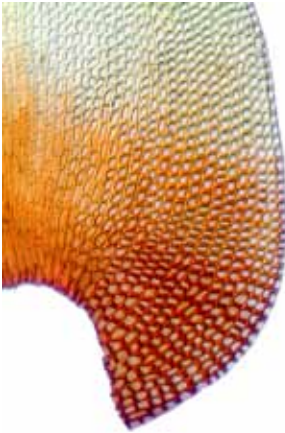
**cells:** 9–15 × 6 μm, subquadrate to oblong, incrassate, low-papillose

**capsule:** 1.5 × 1.0 mm, cylindric, deeply grooved when dry, immersed, gymnostomous; seta 0.5–1.0 mm; spores 27–33 μm in diam.

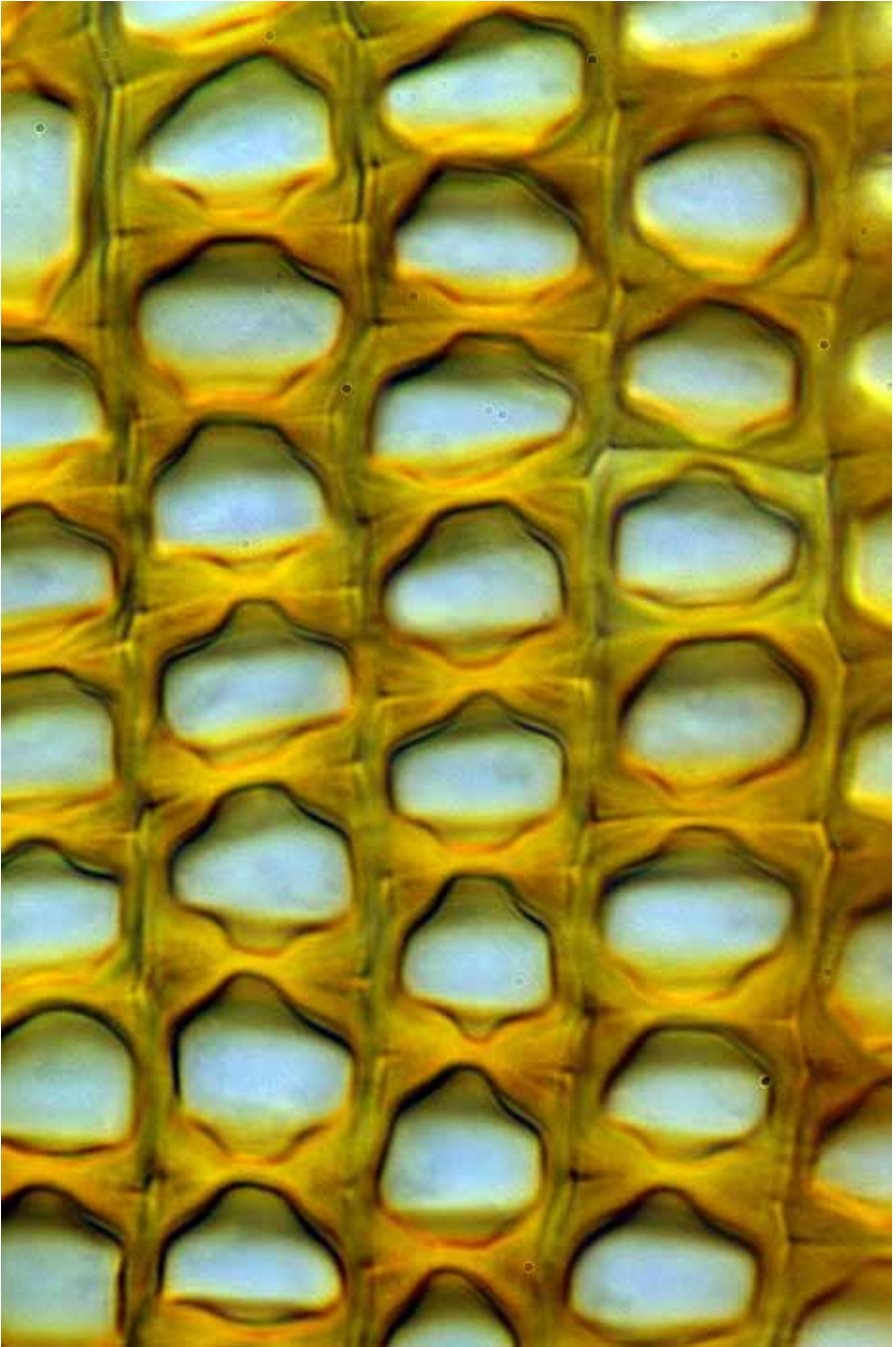
**note:** differs from *Hedwigia ciliata* in not having hyaline leaf tips and forked surface papillae



vegetative habit and shoot (dry), leaf outline, and leaf apex  
 1 mm, 1 mm, 0.5 mm, 10 μm



leaf basal angle, outer cells of leaf base, and leaf cell papillae  
 50 μm, 10 μm, 10 μm



*Braunia imberbis* cells of leaf basal angle  
10  $\mu\text{m}$

**Hedwigia ciliata** (Hedw.) P.Beauv.

**form:** loose mats of branched stems, to 50 mm, hoary, dull  
**habitat:** dryish rock or gravel, lowland to alpine, to 1200 m

**leaf:** size: 1.5–2.5 × 0.7–1.3 mm

**shape:** oblong-ovate to broadly ovate, weakly decurrent

**tip:** acute to acuminate, hyaline

**base:** alar cells quadrate to rectangular, 7–15 × 6–7 μm

**costa:** none

**border:** not differentiated

**margin:** entire to irregularly serrate toward the apex, mostly plane

**cells:** 10–15 × 6–7 μm, subquadrate to rhombic, walls thick and sinuose, pore toward base, surface papillae simple, stellate, or 1–2-forked

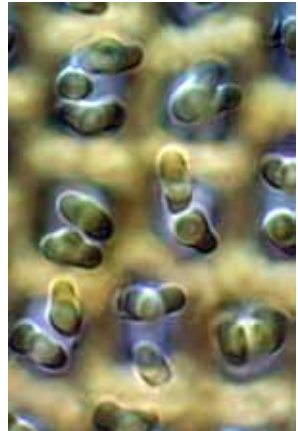
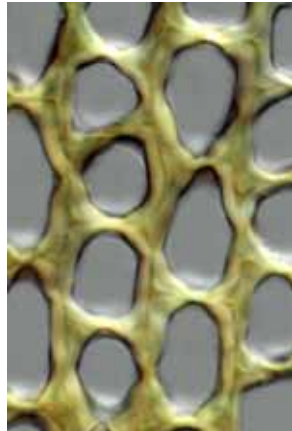
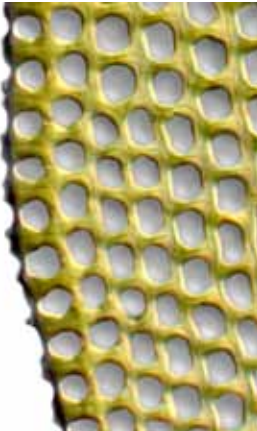
**capsule:** 1 × 0.8 mm, obovoid to subglobose, wide-mouthed, deeply immersed, glossy when dry; seta 0.4–1.5 mm; calyptre conic-mitrate, hairy; spores 20–30 μm long, reniform

**note:** its hyaline leaf tips readily distinguish it from *Braunia imberbis*



habit and vegetative shoot (dry), leaf outline, and hyaline leaf apex

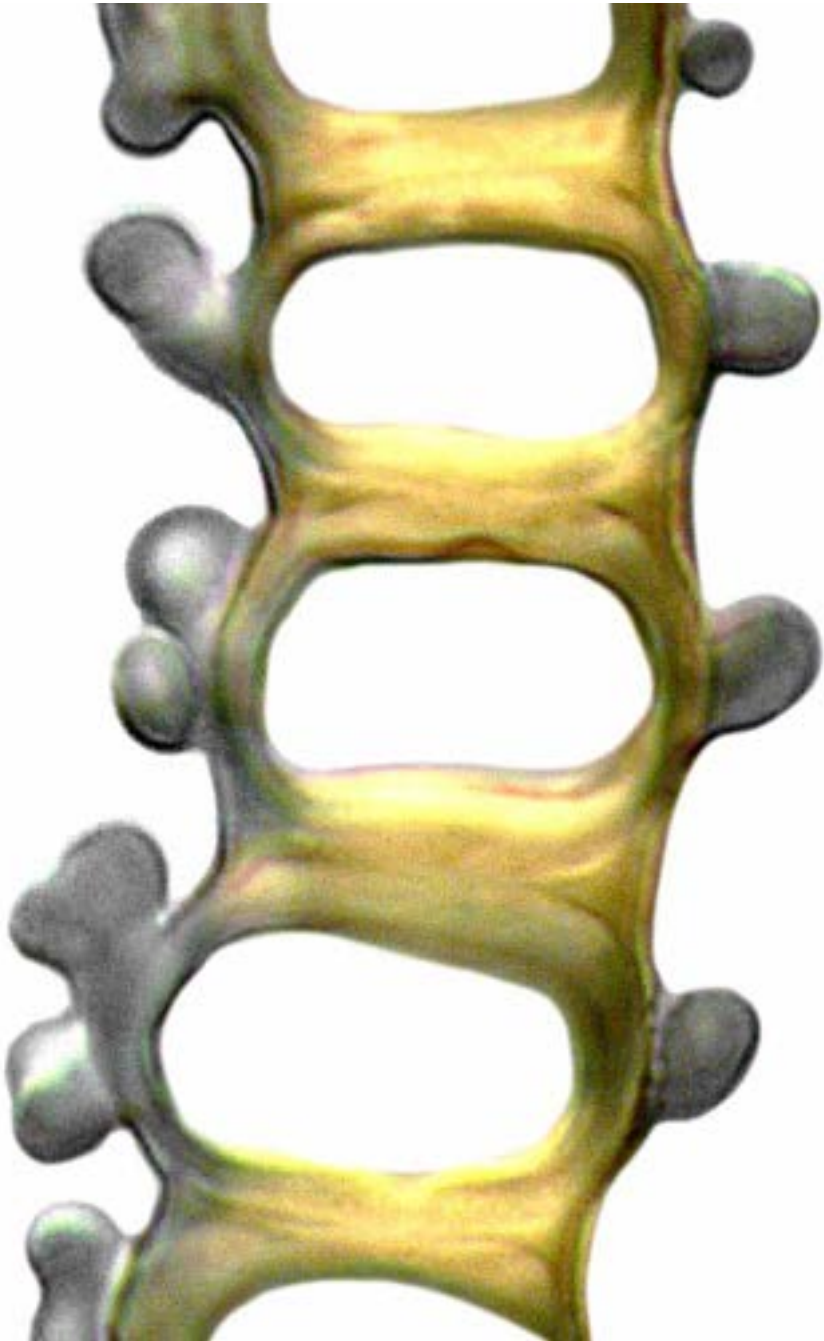
1 mm, 1 mm, 0.5 mm, 100 μm



margin midleaf, cells midleaf, and leaf cell forked papillae

10 μm, 10 μm, 10 μm

continued next page



*Hedwigia ciliata* midleaf cross-section showing forked and simple surface papillae  
5  $\mu$ m

**Rhacocarpus purpurascens** (Brid.) Paris**form:** matted, pinnately branched stems, 60–120 mm, yellowish**habitat:** damp or dripping acidic rock, often near water, to 1700 m**leaf:** *size:* branch leaves 1.5–2 × 0.4–0.5 mm; stem leaves larger*shape:* oblong-panduriform, concave, glossy when dry*tip:* acuminate, incurved toward the apex; hair-point long, red*base:* angle cells red, incrassate, subquadrate, in large auricles*costa:* none*border:* 3–4 rows of elongate cells, yellow*margin:* denticulate toward the apex, inrolled above*cells:* 30–42 × 7–9 μm, long-rhombic, thin-walled, opaque, rugulose  
surface ornamentation visible also in cross-section**capsule:** 2–2.5 mm, broadly cylindrical, erect, grooved when dry, wide-mouthed, exserted; seta 10–23 mm, flexuose, reddish; calyptra cucullate; operculum obliquely long-rostrate; peristome absent; stomata immersed; spores 20–28 μm in diam., papillose

shoots (dry) (3), leaf xs, fertile shoot and capsule (dry), calyptra, and leaf outline

■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 10 μm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 0.1 mm



margin at midleaf, margin cross-section, and leaf base cells

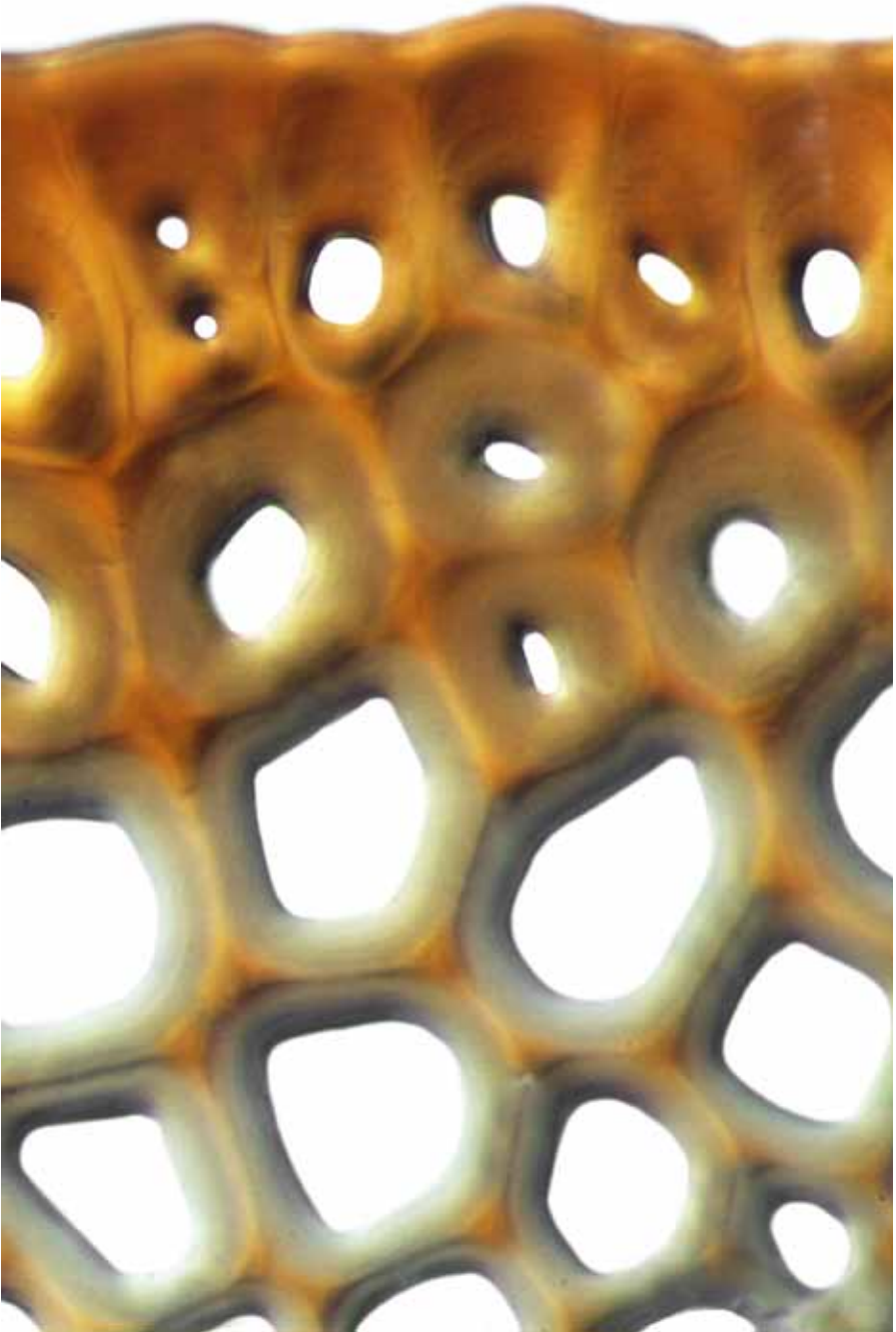
■ 10 μm, ■ 10 μm, ■ 10 μm

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*Rhacocarpus purpurascens* mature capsules  
1 mm

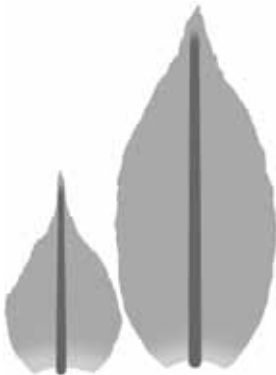
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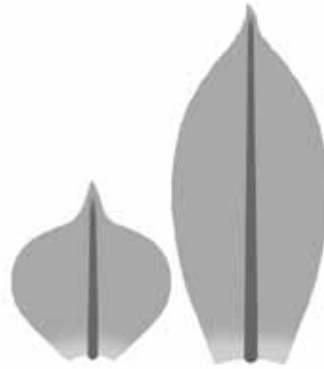
*Rhacocarpus purpurascens* stem cross-section  
10  $\mu\text{m}$

Key to the New Zealand species of *Calomnion* (2)

- 1 Leaf margin denticulate ..... ● *Calomnion brownseyi*  
 1: Leaf margin entire or minutely crenulate..... ● *Calomnion complanatum*

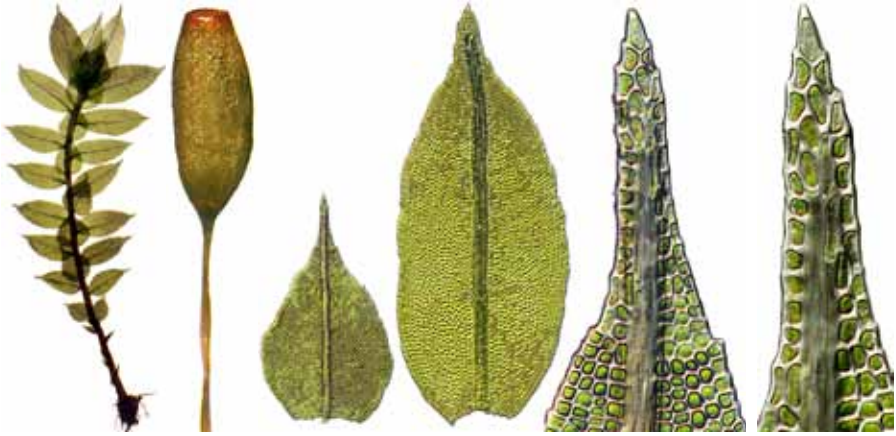
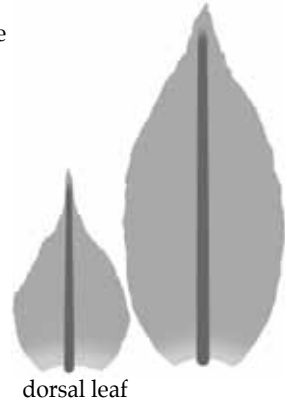


*Calomnion  
brownseyi*

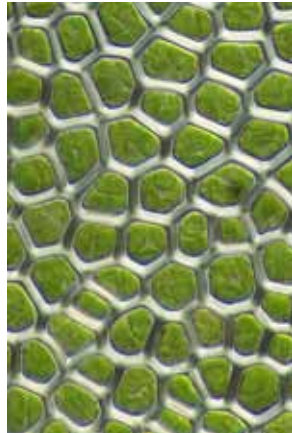
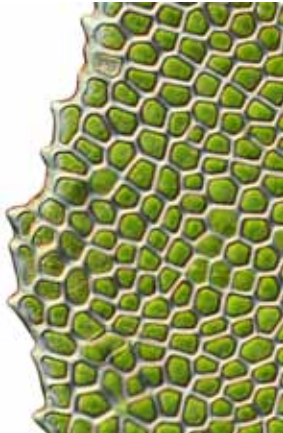


*Calomnion  
complanatum*



**Calomnion brownseyi** Vitt & H.A.Mill.**form:** patchy, erect, creeping stems, to 10 mm tall, complanate**habitat:** tree fern trunks or occasionally limestone**leaf:** *size:* lateral leaves 0.8–1.3 mm; dorsal leaves 0.4–0.7 mm*shape:* lateral leaves elliptic to oblanceolate, dorsal leaves broadly ovate to orbicular*tip:* lateral leaves acute, dorsal leaves acuminate*base:* not differentiated*costa:* percurrent or failing a few cells below the apex*border:* not differentiated*margin:* denticulate, plane*cells:* 7–10  $\mu\text{m}$ , rounded-hexagonal, firm-walled, smooth**capsule:** 1 mm, oblong-cylindric, erect, exserted, mouth reddish; seta 2–3 mm**note:** differs from *Calomnion complanatum* in having denticulate rather than entire or crenulate leaf margins

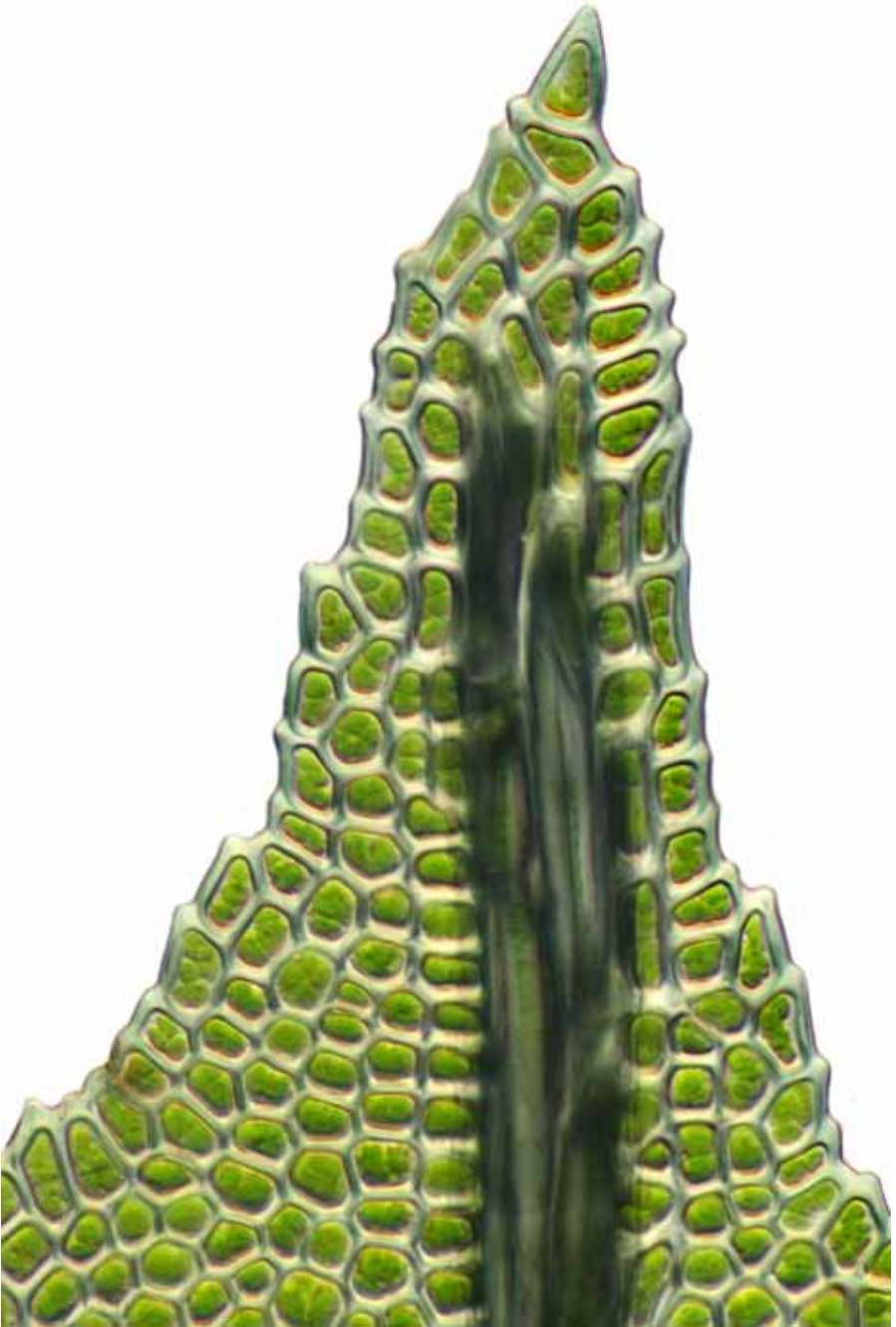
vegetative shoot, capsule, dorsal and lateral leaf outlines, and dorsal leaf apex (2)

 1 mm, 0.5 mm, 0.1 mm (2), 50  $\mu\text{m}$ , 50  $\mu\text{m}$ 


margin at midleaf, cells at midleaf, and costa at midleaf

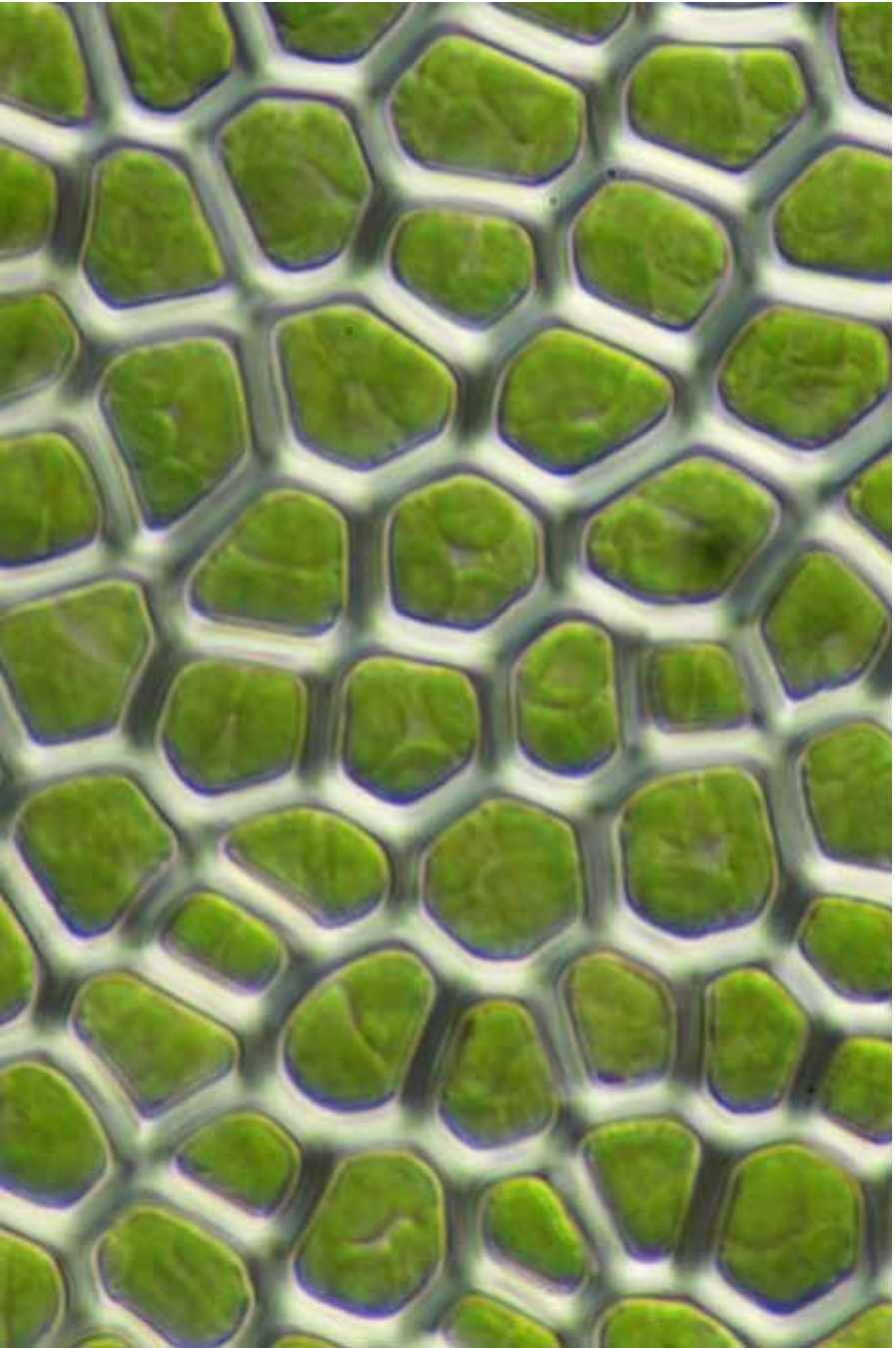
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 

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*Calomnion brownseyi* leaf apex  
10  $\mu\text{m}$

continued next page



*Calomnion brownseyi* leaf cells  
10  $\mu\text{m}$

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**Calomnion complanatum** (Hook.f. & Wilson) Lindb.

**form:** matted, unbranched, radiculose stems, to 12 mm tall, yellowish, glossy, arising from a persistent protonema

**habitat:** tree fern trunks in humid gullies

**leaf:** *size:* lateral leaves 0.7–1.1 mm; ventral leaves 0.4–0.7 mm

*shape:* lateral leaves oblong-lanceolate; ventral leaves suborbicular

*tip:* lateral leaves acute, mucronate, or acuminate; ventral leaves acute to acuminate

*base:* not differentiated

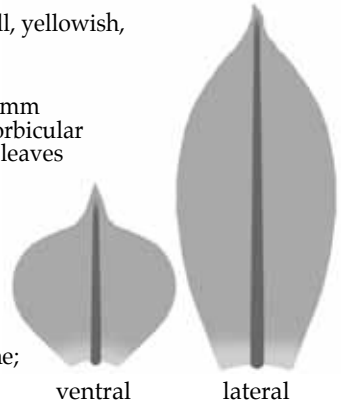
*costa:* failing in the apex to excurrent in the mucro

*border:* not differentiated

*margin:* entire or crenulate, plane

*cells:* 6–11  $\mu\text{m}$ ,  $\pm$  hexagonal, firm-walled, smooth

**capsule:** 1 mm, ovate-oblong, symmetrical, erect, mouth reddish; seta 2–6 mm, terminal, flexuose; peristome none; spores 14  $\mu\text{m}$  in diam., brown



ventral

lateral



vegetative shoots (3), capsule, and dorsal and lateral leaf outlines

■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 0.5 mm, ■ 0.1 mm (2)



lateral leaf apex, margin at midleaf, and costa at midleaf

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Cryptopodium bartramioides** (Hook.) Brid.

**form:** tufted, branched, ± dendroid, radiculose stems, 50–250 mm, orange- or brown-tinged, curved or flexuose, densely foliate

**habitat:** bark or rock, moist lowland forest, to 1230 m

**leaf:** size: 7–12 × 0.7–0.9 mm

**shape:** narrowly subulate from a lanceolate base, carinate, ± falcate

**tip:** subulate

**base:** basal cells rectangular; alar cells little differentiated

**costa:** percurrent to excurrent, doubly toothed on abaxial surface

**border:** not differentiated

**margin:** bistratose, spinose-serrulate above with double teeth, ± reflexed below

**cells:** 10–15 μm, irregularly rounded, thick-walled, smooth

**capsule:** to 2 mm, oblong-oval, short-necked, erect, immersed, reddish brown, smooth; seta 2–3 mm, often aggregated in 2–3; annulus broad, revoluble; operculum low-conic; peristome double; exostome teeth lanceolate, ± yellow; endostome with cilia; spores 12–15 μm in diam.



fertile shoots (moist), vegetative shoots (dry) (2), mature capsules (2), and leaf outline  
 5 mm, 5 mm, 5 mm, 0.5 mm (2), 1 mm



margin at midleaf (2), and basal leaf cells  
 10 μm, 10 μm, 10 μm



*Cryptopodium bartramioides* leaf cross-sections showing margin and costa  
10  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)

**Goniobryum subbasilare** (Hook.) Lindb.

**form:** tufted or matted, glossy, ± unbranched, radiculose stems, 10–45 mm tall  
**habitat:** soil, bark, rotting logs, or tree fern trunks, montane forest, to 1100 m

**leaf:** size: 2–3.5 × 0.5–0.7 mm

**shape:** oblong or linear-lanceolate, twisted when dry

**tip:** acute

**base:** weakly decurrent; basal cells little differentiated

**costa:** narrow, failing below the apex

**border:** faint, 1–2 rows of linear cells

**margin:** singly or doubly toothed in the upper half of the leaf, plane

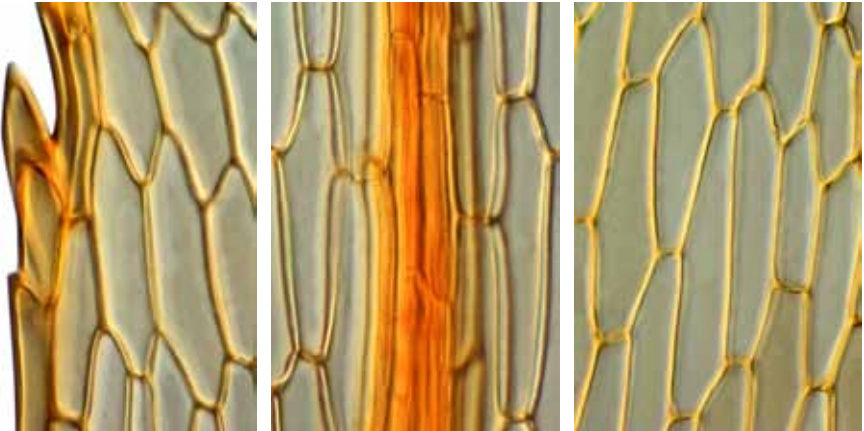
**cells:** 60–130 × 4–6 μm, hexagonal, thin-walled, smooth

**capsule:** 2.5–3.5 mm, oblong-cylindric, asymmetrical, horizontal, curved, pale brown, wide-mouthed when empty; seta 20–50 mm, lateral at base of stem, flexuose, orange; operculum conic; calyptra cucullate, to 3 mm; peristome double, exostome teeth papillose, unbordered; endostome segments not split, cilia 2–3, nodulose; spores 13–16 μm in diam.



fertile shoot and capsule (dry), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 10 μm



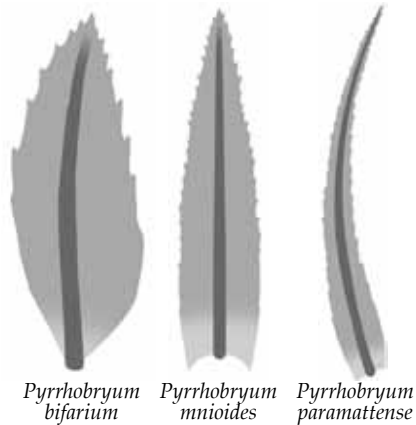
toothed margin at midleaf, costa at midleaf, and cells at midleaf

■ 10 μm, ■ 10 μm, ■ 10 μm

**Key\* to the New Zealand species and subspecies of *Pyrrhobryum* (3)**

- 1 Stems dendroid; branch leaves 2-ranked..... ● ***Pyrrhobryum bifarium***  
 1: Stems never dendroid; branch leaves not 2-ranked..... 2
- 2(1:) Leaves strongly curled and twisted when dry; leaf size not varying much along the stem; stems tomentose on lower half to one-third.....  
 ..... ● ***Pyrrhobryum mnioides* subsp. *contortum***
- 2: Leaves merely curved when dry; leaf size varying markedly along the stem; stems tomentose at only the base ..... ● ***Pyrrhobryum paramattense***

\* based on Gilmore, SR (2006): Rhizogoniaceae. *Flora of Australia* 51, 359.





**Pyrrhobryum bifarium** (Hook.) Manuel

**form:** turves of dendroid, tomentose stems, 12–22 mm; leaves complanate,  
**habitat:** logs, humus, tree trunks, rock in damp montane forests, to 1100 m

**leaf:** *size:* stem 1.6–2.2 × 0.4–0.5 mm; branch 1.0–1.8 × 0.3–0.4 mm

*shape:* stem leaves ± lanceolate; branch leaves ovate-lanceolate

*tip:* stem leaves acuminate; branch leaves acute

*base:* stem leaves long-decurrent

*costa:* stem leaves: excurrent in the acumen; branch leaves: failing, toothed

*border:* narrow

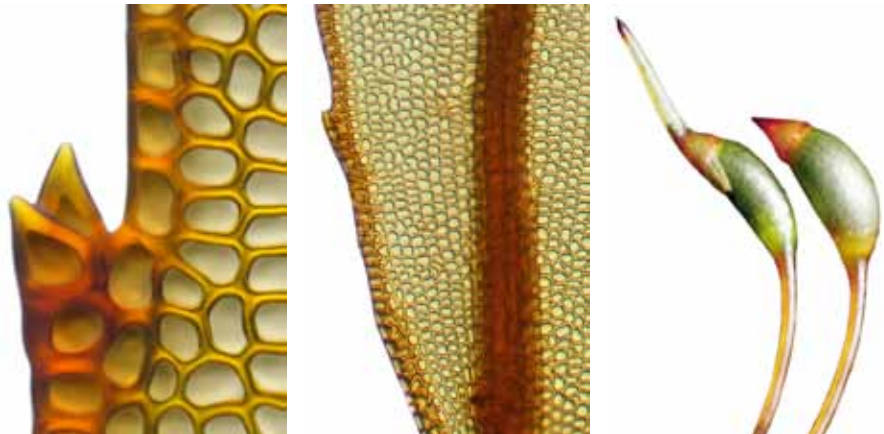
*margin:* thickened and doubly toothed, plane above, recurved below

*cells:* 10–15 μm, isodiametric, firm-walled, smooth

**capsule:** 1.5–1.8 mm, ovoid, asymmetric, curved, horizontal, mouth reddish; seta 14–35 mm, flexuose, reddish; operculum conic; calyptra cucullate, smooth; peristome double, exostome orange, cross-striolate below, papillose above; endostome basal membrane half the segment height; segments not split; cilia 2, nodulose; spores 15 μm in diam.



fertile shoot, branch apex, branch leaf outline, and leaf apex  
 ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 50 μm



paired marginal teeth, leaf basal angle, and capsules and calyptra  
 ■ 10 μm, ■ 50 μm, ■ 1 mm

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*Pyrrhobryum bifarium* vegetative habit  
1 mm

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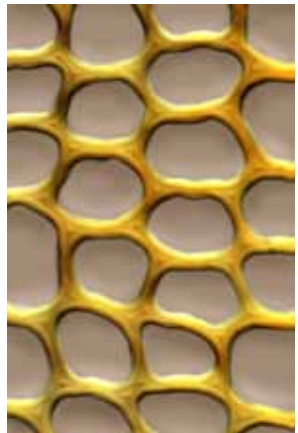
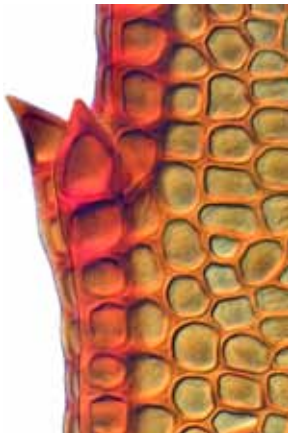
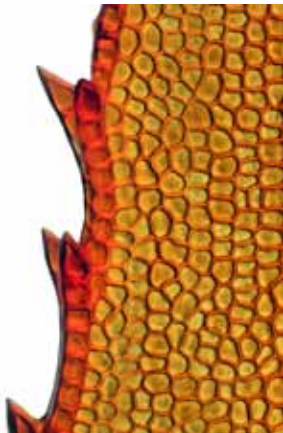


*Pyrrhobryum bifarium* shoot  
1 mm

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***Pyrrhobryum mnioides* subsp. *contortum*** (Hook.f. & Wilson) Fife**form:** turves of flexuose, radiculose,  $\pm$  unbranched stems, 30–70 mm**habitat:** soil, rarely bark, damp forest from sea level to high montane, to 1340 m**leaf:** *size:* 3–5  $\times$  0.8–1.2 mm*shape:* lanceolate, concave, contorted when dry*tip:* acute*base:* weakly auriculate and decurrent; alar cells not differentiated*costa:* failing just below the apex, toothed on the back*border:* thickened, pigmented*margin:* doubly toothed, plane*cells:* 8–13  $\mu\text{m}$ ,  $\pm$  subquadrate, firm-walled, smooth**capsule:** 2.0–2.5 mm, ovoid, horizontal, asymmetrical,  $\pm$  curved, brown, mouth reddish; seta 30–50 mm, lateral, flexuose, red,  $\pm$  multiple; calyptra cucullate, smooth; operculum obliquely conic-rostrate; peristome double, exostome teeth lanceolate, hyaline-margined, papillose, endostome processes split, cilia 2–4, nodulose; spores 18–21  $\mu\text{m}$  in diam.

fertile and vegetative shoots (3), young and mature capsules, and leaf outline and apex  
 5 mm, 1 mm, 1 mm, 0.5 mm, 1 mm, 0.5 mm, 50  $\mu\text{m}$

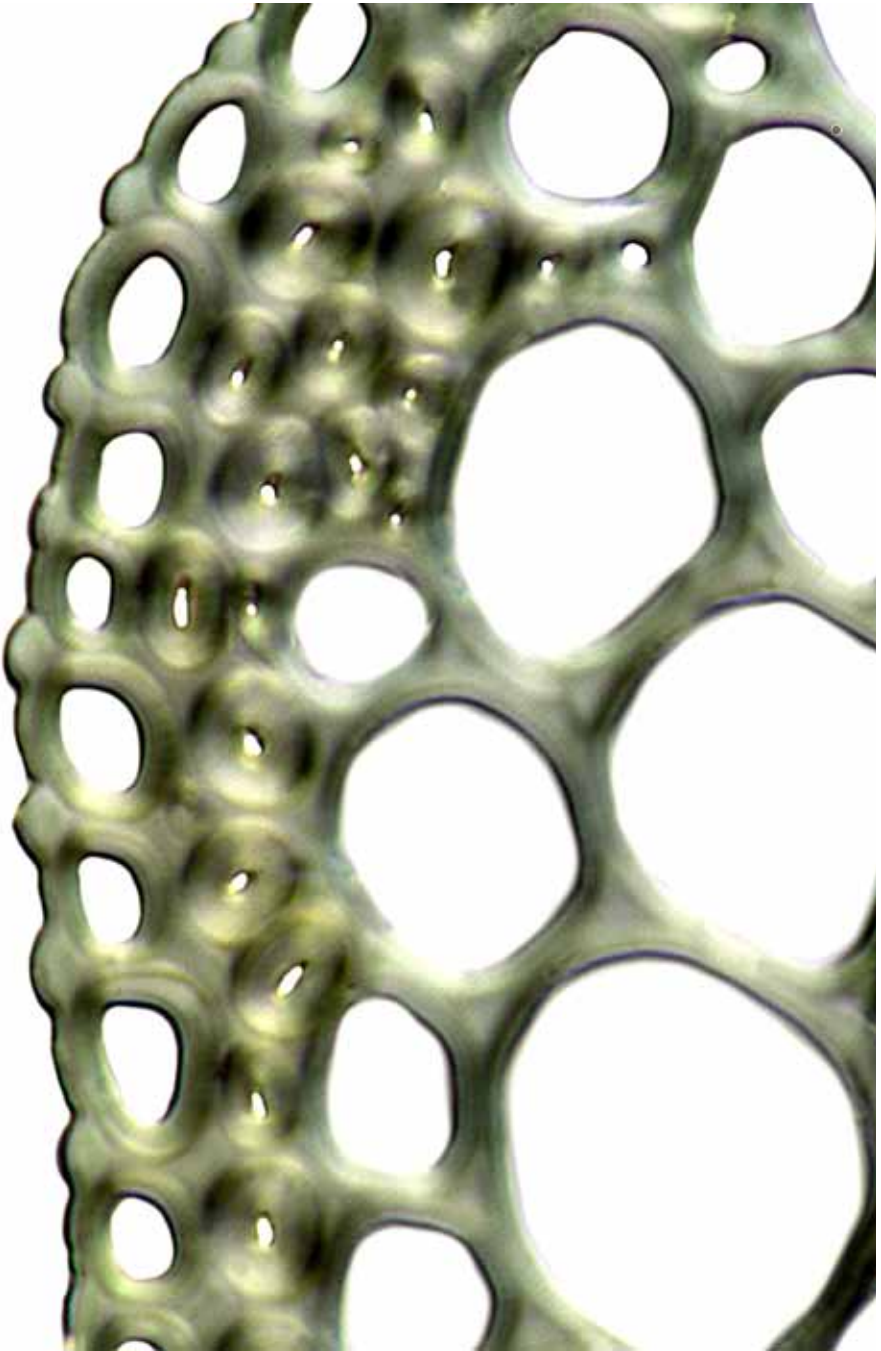


doubly toothed margin (2), and cells at midleaf  
 50  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$



*Pyrrhobryum mnioides* subsp. *contortum* mature capsule  
1 mm

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*Pyrrhobryum mnioides* subsp. *contortum* stem cross-section (portion)  
10  $\mu$ m

continued next page



*Pyrrhobryum mnioides* subsp. *contortum* leaf cross-section showing bistratose margin  
10  $\mu$ m (left), 10  $\mu$ m (right)

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**Pyrrhobryum paramattense** (Müll.Hal.) Manuel

**form:** tufts of unbranched, ± comose, basally radiculose stems, to 50 mm, the leaves pale to dark olive-green

**habitat:** moist soil, rotting wood, or occasionally rock, damp forests, to 500 m

**leaf:** size: 4.5–6.0 × 0.3 mm

**shape:** linear-lanceolate, ± falcate

**tip:** acuminate

**base:** not decurrent; alar cells not differentiated

**costa:** excurrent, doubly toothed on the back above

**border:** 2–4-stratose, pigmented

**margin:** doubly toothed, plane

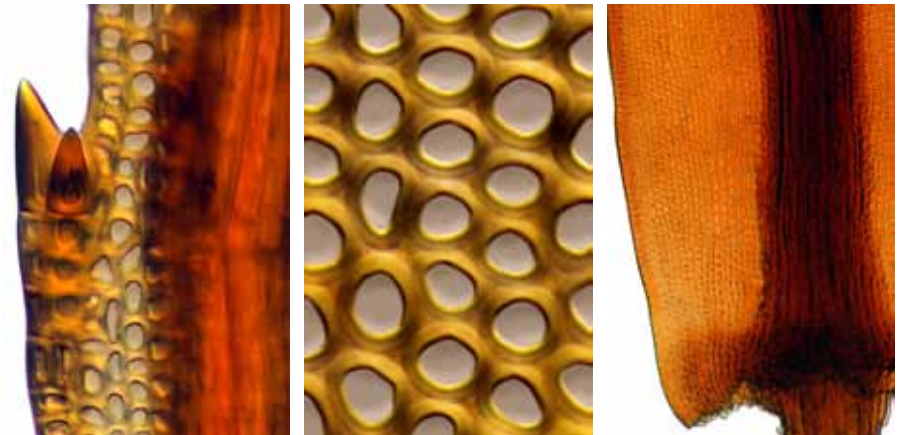
**cells:** 6–15 μm, ± isodiametric, firm-walled, smooth

**capsule:** 2.3–2.6 mm, elongate to cylindric, asymmetric, inclined, dark red; seta to 42 mm, erect to curved, from near stem base; operculum obliquely conic-rostrate; calyptra cucullate, smooth; peristome double, exostome teeth lanceolate, endostome cilia 3, papillose; spores 15–18 μm in diam.



fertile shoot (dry) (2), leaf outline, leaf apex, leaf subapex, and upper margin

5 mm, 1 mm, 0.5 mm, 50 μm, 50 μm, 50 μm



doubly toothed margin, cells at midleaf, and leaf basal angle

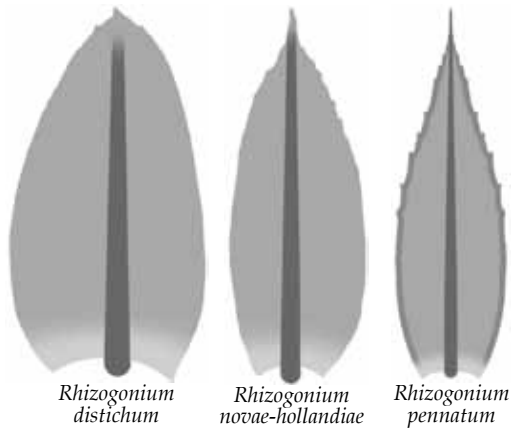
50 μm, 10 μm, 100 μm

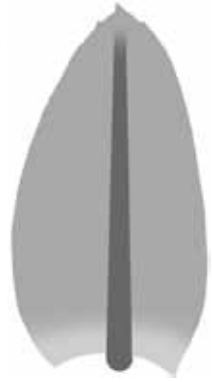


**Key\* to the New Zealand species of *Rhizogonium* (3)**

- 1 Leaves bordered by elongate cells ..... ● ***Rhizogonium pennatum***  
 1: Leaves not bordered by elongate cells ..... 2
- 2(1:) Costa failing below the apex; leaf apex coarsely toothed; leaves wider than 0.6 mm  
 ..... ● ***Rhizogonium distichum***  
 2: Costa excurrent; leaf apex not coarsely toothed; leaves narrower than 0.6 mm .....  
 ..... ● ***Rhizogonium novae-hollandiae***

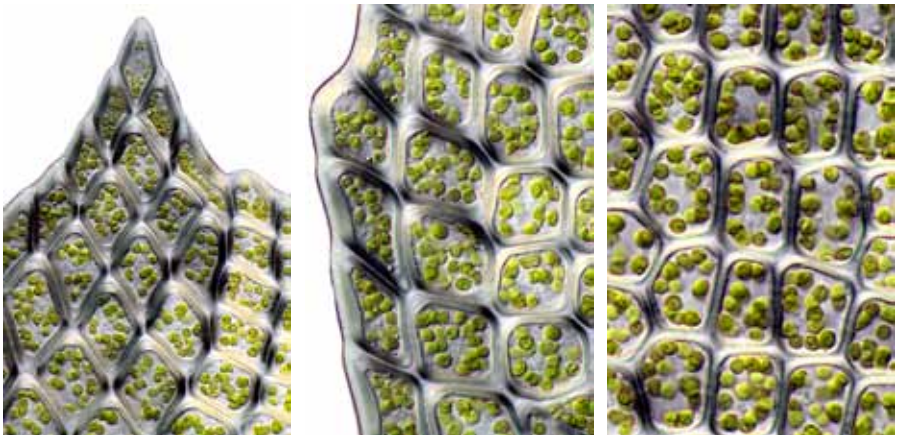
\* based on Gilmore, SR (2006): Rhizogoniaceae. *Flora of Australia* 51, 364.



**Rhizogonium distichum** (Sw.) Brid.**form:** turves of simple, tomentose stems, 10–25 mm, distichous**habitat:** rotting logs, soil, or tree fern trunks, damp forest, to 1200 m**leaf:** size: 1.5–2.2 × 0.9–1.2 mm**shape:** oblong to ovate-oblong, distichous, ± asymmetric at base**tip:** obtuse to subacute, apiculate, ending with a single large cell**base:** undifferentiated, weakly decurrent**costa:** stout, failing below the apex**border:** not differentiated**margin:** entire below, coarsely serrate toward the apex, plane**cells:** 12–20 μm, rounded-hexagonal, incrassate, smooth**capsule:** 2 mm, oblong to cylindric, inclined to pendent, red-mouthed; seta 20–35 mm; calyptra cucullate; operculum short-rostrate; peristome double; cilia 2–3; spores 15–19 μm in diam.**note:** differs from other *Rhizogonium* species in having a costa that fails below the apex, and an apical tooth ending with a large cell

habit, shoot (moist), capsule with calyptra, peristome, and leaf outline

1 mm, 1 mm, 1 mm, 0.1 mm, 0.1 mm



leaf apex, margin at midleaf, and cells at midleaf

10 μm, 10 μm, 10 μm

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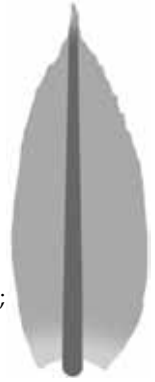
*Rhizogonium distichum* habit  
1 mm

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*Rhizogonium distichum* leaf margin cross-section  
10  $\mu$ m

continued next page

**Rhizogonium novaehollandiae** (Brid.) Brid.**form:** curves of simple, tomentose stems, 8–15 mm, distichous**habitat:** tree fern trunks, tree bases, exposed roots, logs, or soil, to 1200 m**leaf:** size: 1.0–1.6 × 0.3–0.4 mm**shape:** ovate to oblong-ovate, slightly asymmetric at base**tip:** acute**base:** not decurrent; basal cells subquadrate**costa:** excurrent in a stout arista**border:** 2–3 rows of slightly narrower cells**margin:** irregularly serrate above, the teeth unicellular, plane**cells:** 10–14 μm, hexagonal, firm-walled, smooth or striolate**capsule:** 1.5–2.5 mm, cylindric, neck tapered, inclined to cernuous, mouth red-rimmed; seta 10–20 mm; calyptra cucullate; operculum short-rostrate; peristome double, exostome teeth 16, endostome processes cracked; spores 15–18 μm in diam., brown**note:** differs from *Rhizogonium distichum* in having an excurrent costa

vegetative habit and shoot, leaf outline, mature capsule, and leaf apex



leaf insertions, margin at upper leaf, and cells at midleaf

continued next page

**Rhizogonium pennatum** Hook.f. & Wilson

**form:** curves of simple, radiculose, erect, complanate stems, 15–35 mm, the leaves distichous, pale yellow-green, glossy

**habitat:** soil, bark, tree ferns, or rotting wood, in damp forest, to 960 m

**leaf:** size: 1.5–2.5 × 0.3–0.5 mm

*shape:* ovate-lanceolate, little altered when dry

*tip:* ± toothed arista

*base:* not decurrent; alar cells not differentiated

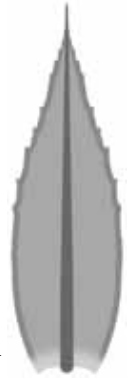
*costa:* excurrent in a stout toothed arista

*border:* 3–5 rows of thick-walled, bistratose cells

*margin:* entire below, distantly toothed above, ± incurved below

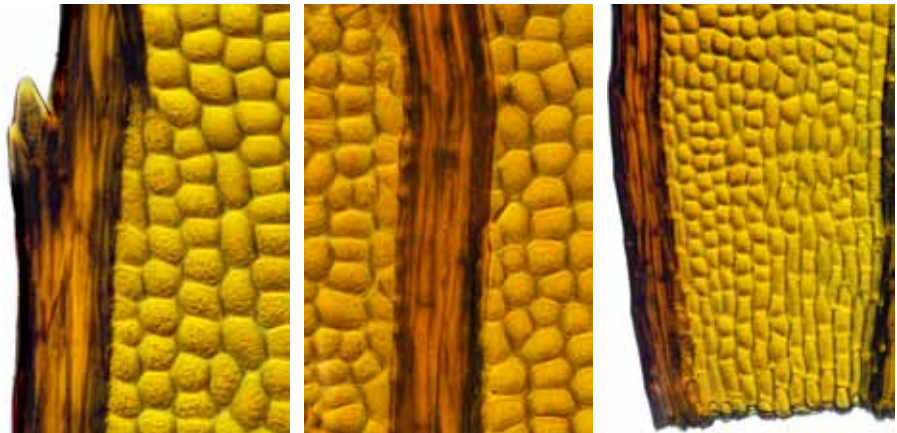
*cells:* 12–15 μm, isodiametric to hexagonal, firm-walled, smooth

**capsule:** to 2 mm, ± oblong, suberect to horizontal, exserted, brown, with red mouth; seta to 25 mm, basal, red, twisted when dry; operculum beak half the length of the capsule, curved; peristome double, the 16 outer teeth distally hyaline, papillose



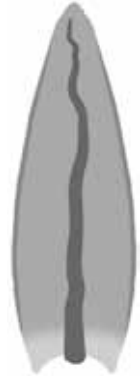
vegetative shoot (dry), capsule (dry), leaf outline, apex (2), and subapex

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 50 μm, ■ 50 μm, ■ 50 μm



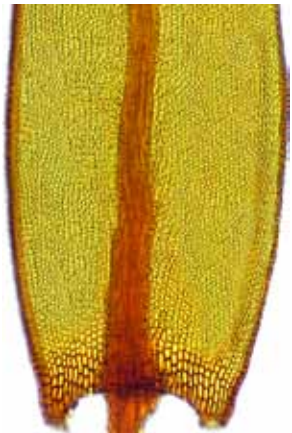
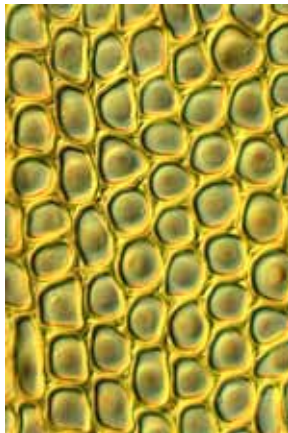
margin at midleaf, costa at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

**Aulacomnium palustre** (Hedw.) Schwägr.**form:** dense tuves of ± branched, tomentose stems, 40–150 mm, yellow**habitat:** soil and rotting wood in grassy subalpine swamps, tarns, to 1800 m**leaf:** *size:* 1.8–4 × 0.6–0.9 mm*shape:* oblong-lanceolate to ovate-lanceolate*tip:* acute, acuminate, or obtuse*base:* alar cells not differentiated; basal cells thick-walled, inflated, coloured*costa:* stout, sinuose above, failing below the apex, two stereid bands in xs*border:* not differentiated*margin:* entire to ± serrulate above, recurved in the basal three-quarters*cells:* 11–15 μm, ± rounded, incrassate, collenchymatous, unipapillose**capsule:** not known in New Zealand; 2.5–4 mm, oblong to cylindric, slightly curved, sulcate when dry; seta 25–45 mm; peristome bryoid**notes:** multicellular gemmae 0.1–0.2 mm long produced on leafless terminal pseudopodia (the gemmae soon falling, dispersed by birds or livestock); dwarf plants often seen in plant nurseries, perhaps introduced in peat.

vegetative shoots (dry) (2), leaf outline, and leaf apex

1 mm, 1 mm, 0.5 mm, 10 μm



revolute margin in lower leaf, unipapillose cells at midleaf, and leaf base

10 μm, 10 μm, 100 μm

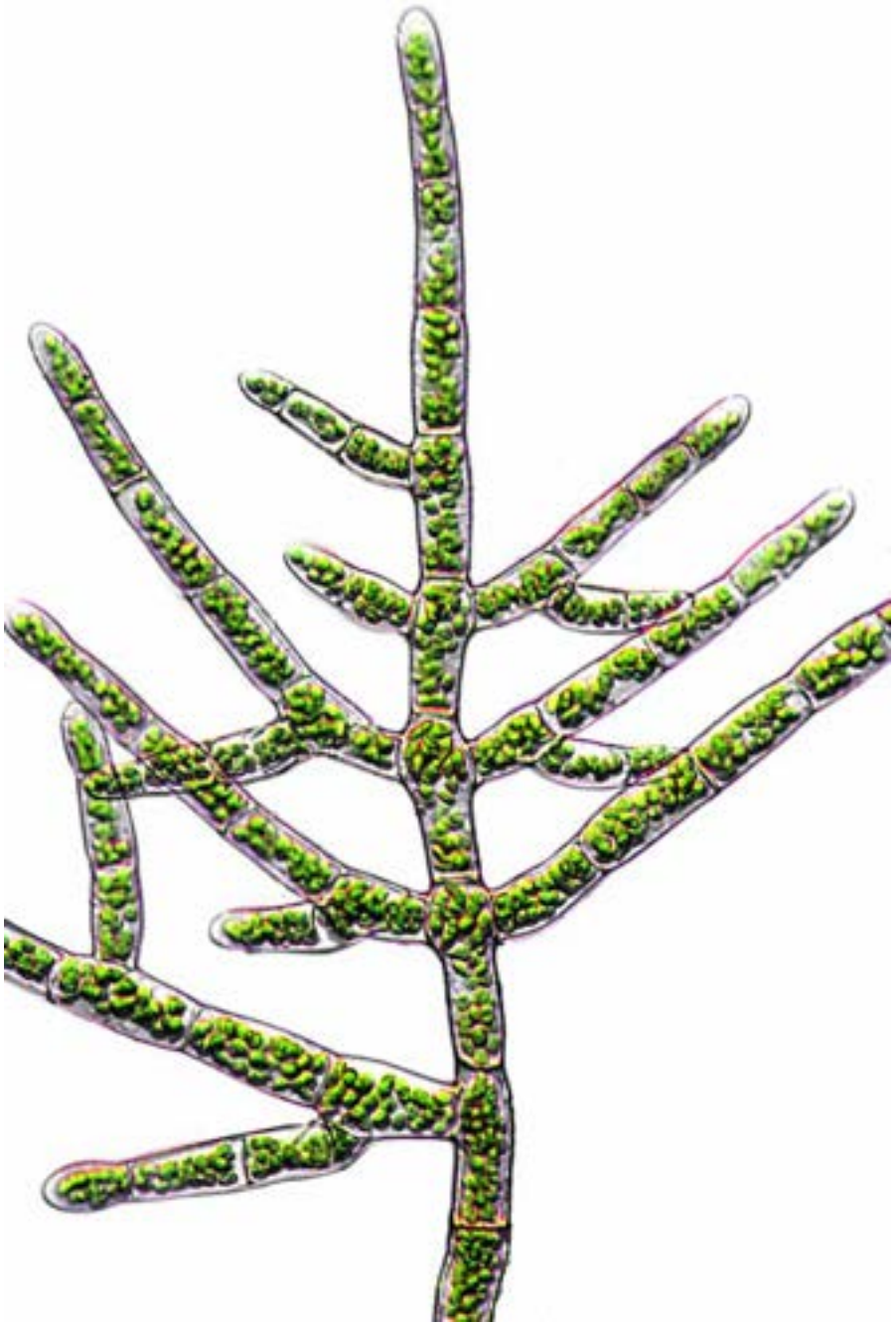
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*Aulacomnium palustre* young shoot with gemmae, and single gemma  
1 mm, 10  $\mu$ m

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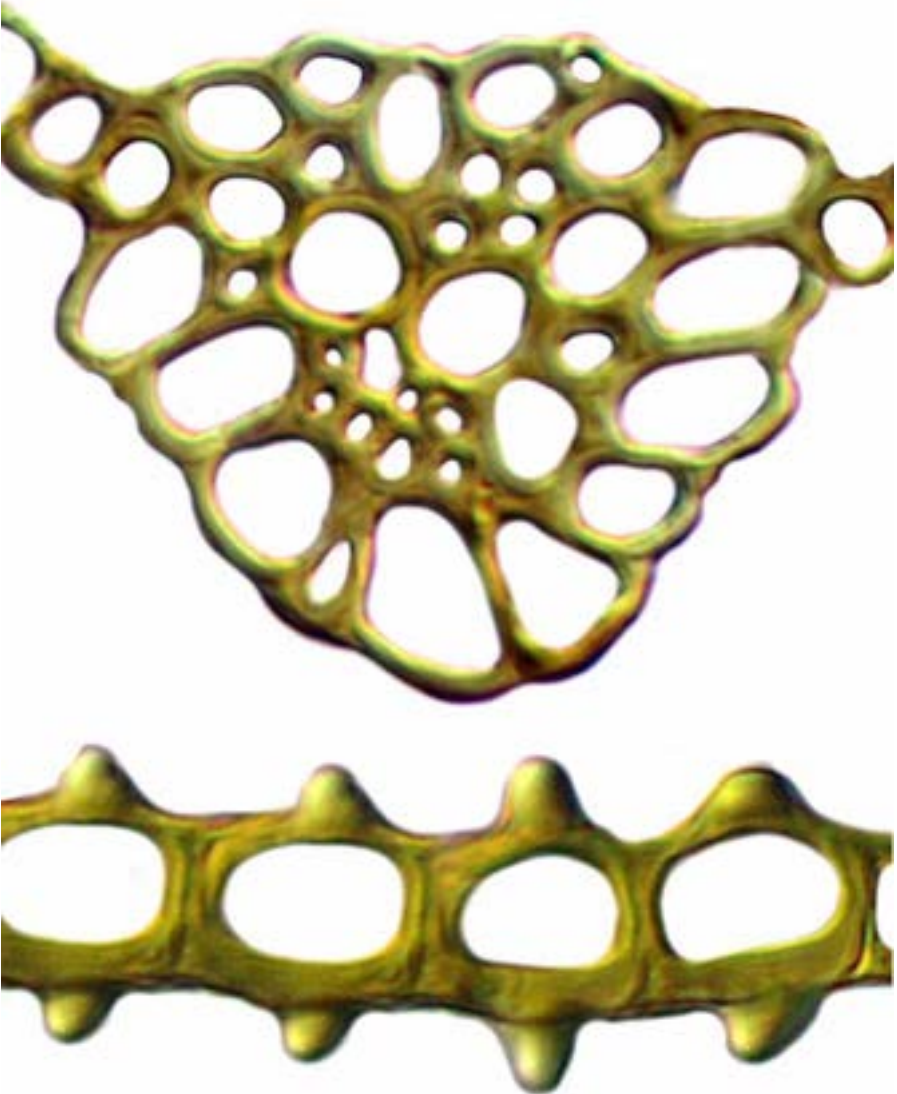
*Aulacomnium palustre* protonema  
10  $\mu\text{m}$

continued next page



*Aulacomnium palustre* leaf cross-section  
50  $\mu\text{m}$

continued next page



*Aulacomnium palustre* costa and leaf cross-sections  
10  $\mu\text{m}$ , 10  $\mu\text{m}$

**Hymenodon pilifer** Hook.f. & Wilson

**form:** tufted, erect, filiform, branched, tomentose stems, to 10 mm tall, the leaves appearing to be two-ranked

**habitat:** bark or rock in damp forest

**leaf:** size: 1.0–1.3 × 0.4–0.6 mm

*shape:* elliptic-oblong, little altered when dry, hydrophobic when fresh

*tip:* obtuse, with a long, thin, smooth hair-point

*base:* not differentiated

*costa:* appearing to be interrupted just below the apex

*border:* not differentiated

*margin:* entire below, crenulate above, plane

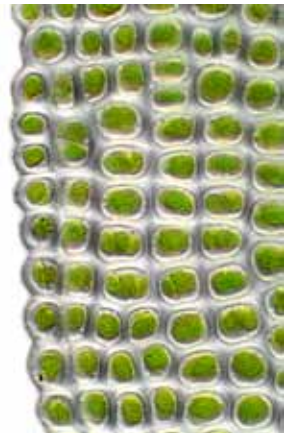
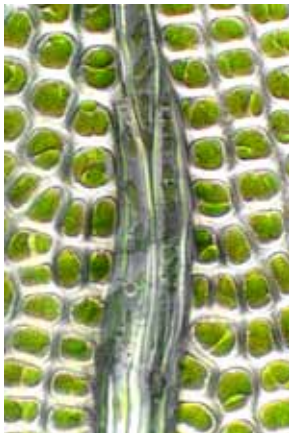
*cells:* 10–12  $\mu\text{m}$ , rounded, incrassate, strongly mammillose

**capsule:** 1–2 mm, ovoid to oblong, erect to inclined, short-necked, stomatose below; seta 10–15 mm, slender, lateral from base of stem; operculum conic, umbonate, calyptra cucullate; exostome absent, endostome of 16 tapering processes, to 300  $\mu\text{m}$ ; spores 12–16  $\mu\text{m}$  in diam.



vegetative habit, vegetative shoot, leaf outline, capsule, and leaf apex

1 mm, 1 mm, 0.1 mm, 1 mm, 0.1 mm



leaf subapex, costa near leaf base, and margin at midleaf

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Hymenodon pilifer* vegetative shoot  
1 mm

**Leptotheca gaudichaudii** Schwägr.

**form:** densely tufted, slender, erect stems, to 30 mm tall, pale, yellowish  
**habitat:** soil, tree roots, logs, or rock, forests and scrubland

**leaf:** size: 1.5–4 × 0.6–1.6 mm

*shape:* oblong-lanceolate

*tip:* acuminate to acute

*base:* not differentiated

*costa:* excurrent in a stout point

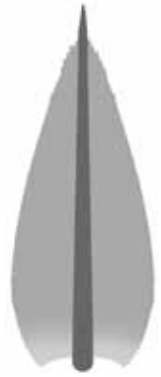
*border:* not differentiated

*margin:* toothed at the apex, ± reflexed above

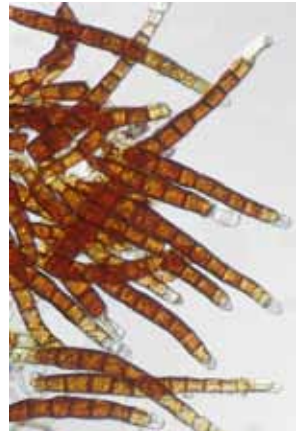
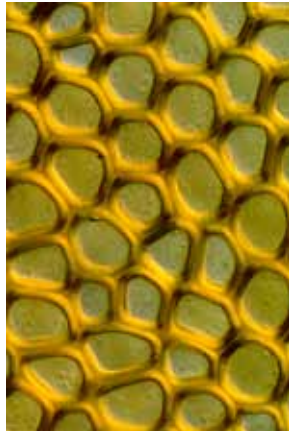
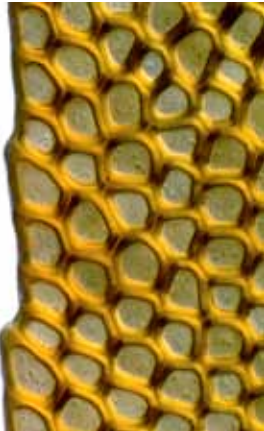
*cells:* 10–14 μm, ± isodiametric, rounded, incrassate, smooth

**capsule:** 3–4 mm, narrowly cylindric, neck tapered, ± erect, 8-ribbed  
 when dry; seta 20–30 mm, slender; operculum bluntly conic; calyptra  
 cucullate, smooth, naked; peristome double, exostome teeth lanceolate,  
 endostome cilia 2; spores 10–15 μm in diam.

**notes:** brood bodies filamentous, multicellular, axillary, reddish brown



shoot with propagules (moist) (2), capsules (young, mature), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm (2), ■ 0.5 mm, ■ 50 μm



margin at midleaf, cells at midleaf, and propagules  
 ■ 10 μm, ■ 10 μm, ■ 100 μm

**Orthodontium lineare** Schwägr.

**form:** tufted, delicate, silky, radiculose stems, to 5 mm tall, the leaves yellowish

**habitat:** soil, rotting or burnt wood, and rock, moist montane forest

**leaf:** size: 3.5–5 × 0.4–0.7 mm

**shape:** linear-subulate

**tip:** acute

**base:** basal cells broader and shorter than the blade cells

**costa:** failing below the apex

**border:** not differentiated

**margin:** entire, plane

**cells:** 80–190 × 7–15 μm, linear-rhombic, firm-walled, smooth

**capsule:** 1.5–2.5 mm, cylindric, with a tapering neck, erect, ± sulcate when dry; seta 20–35 mm; operculum obliquely short-beaked; peristome double, exostome teeth 16, pale or hyaline, endostome processes 16, filiform; spores 16–20 μm in diam., brown, finely papillose

**notes:** highly variable; introduced into Europe in the early 1900s



fertile shoot (2), young capsules (2), mature capsule, leaf outline, and leaf apex  
 ■ 1 mm, ■ 0.5 mm, ■ 0.5 mm (2), ■ 0.5 mm, ■ 0.5 mm, ■ 10 μm



margin at midleaf, costa at midleaf, and cells in lower leaf  
 ■ 10 μm, ■ 10 μm, ■ 10 μm

**Braithwaitea sulcata** (Hook.) A.Jaeger

**form:** primary stems naked, scattered, secondary stems bipinnately branched, 50–120 mm long, green or yellow-green, metallic lustre

**habitat:** tree trunks in moist forest

**leaf:** *size:* stem leaves 3–5 mm, branch leaves 2–3 mm

*shape:* stem leaves ovate-lanceolate, branch leaves ovate-oblong

*tip:* obtuse with a short acumen

*base:* angle cells small and quadrate

*costa:* shortly excurrent, toothed at the back above

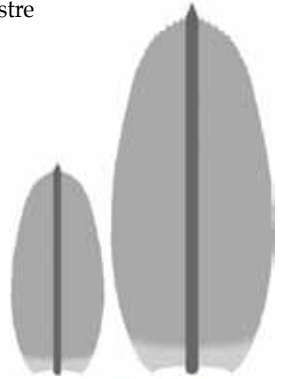
*border:* not differentiated

*margin:* finely denticulate toward the apex, plane

*cells:* 40–60 × 5 μm, linear, firm-walled, prorulose at distal end

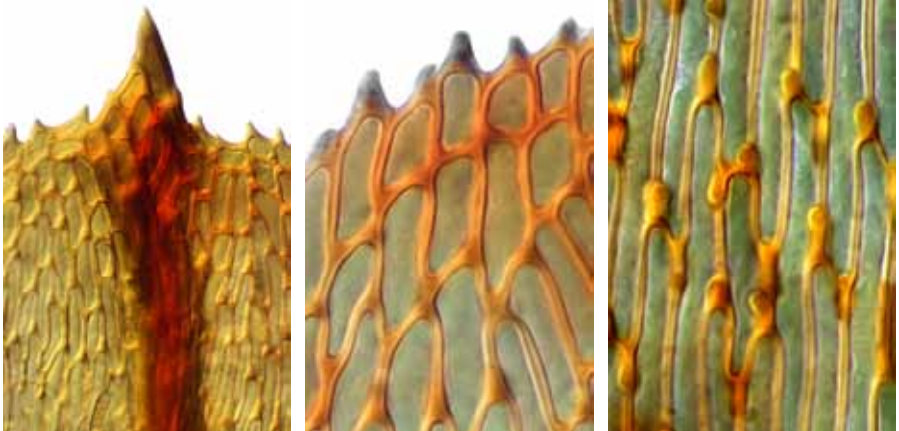
**capsule:** 3–5 mm, light brown, ± cylindrical, symmetrical, horizontal; seta 6–15 mm, lateral, reddish, curved; peristome teeth filiform, papillose, up to 1 mm long

**note:** papillose brood-bodies on stem among the upper leaves



fertile habit, branch and stem leaf outlines, and brood body (portion)

10 mm, 5 mm, 1 mm (2), 10 μm



apiculate leaf apex, upper leaf margin, and prorulose midleaf cells

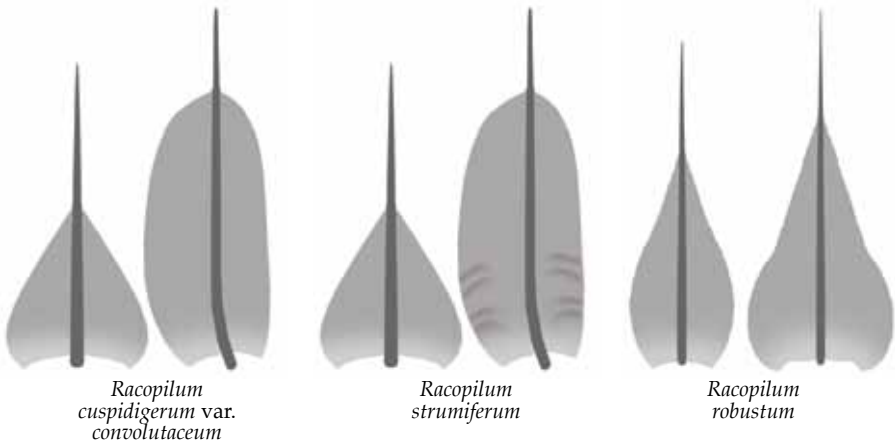
10 μm, 10 μm, 10 μm



**Key\* to the New Zealand species of *Racopilum* (3)**

- 1 Stem and branch leaves  $\pm$  similar; leaf cells smooth..... ● ***Racopilum robustum***  
 1: Stem and branch leaves different; leaf cells strongly mammillose.....2
- 2(1:) Leaves weakly bordered with 2–3 rows of slightly elongate cells; calyptra mitrate;  
 capsule strumose..... ● ***Racopilum strumiferum***  
 2: Leaves not bordered; calyptra cucullate; capsule not strumose.....  
 ..... ● ***Racopilum cuspidigerum* var. *convolutaceum***

\* based partly on van Zanten, BO (2006): *Racopilaceae. Flora of Australia* 51, 374.



**Racopilum cuspidigerum** var. **convolutaceum** (Müll.Hal.) Zanten & Dijkstra

**form:** matted, pinnately branched, tomentose stems, 10–100 mm tall, lateral leaves 4-ranked, distichous, dorsal leaves 2-ranked

**habitat:** soil, rock, or bark in damp shaded forest

**leaf:** *size:* lateral leaves 1–2 × 0.5–1.0 mm (excluding arista); dorsal leaves smaller

*shape:* lateral leaves oblong; dorsal leaves triangular

*tip:* lateral leaves obtuse; dorsal leaves acute

*base:* not differentiated

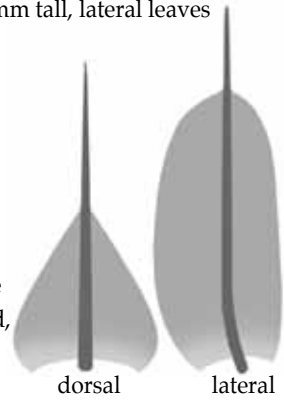
*costa:* variably excurrent in a hyaline arista

*border:* not differentiated

*margin:* serrulate below, serrate above, plane

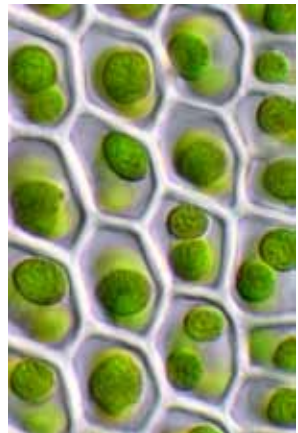
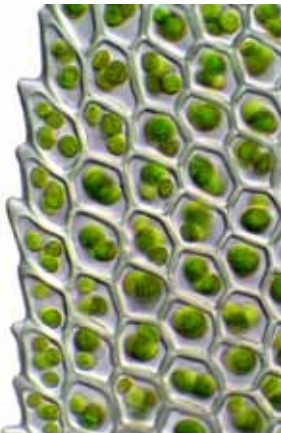
*cells:* 8–16  $\mu\text{m}$ ,  $\pm$  hexagonal, firm-walled, strongly mammillose

**capsule:** 2.5–3.5 mm, cylindric, short-necked, curved, inclined, not strumose, brown; seta 10–25 mm, smooth, orange; operculum rostrate; calyptra cucullate, hairy



vegetative shoot, leaf outlines (dorsal leaf on left), lateral leaf apex, and capsule

1 mm, 0.5 mm (2), 100  $\mu\text{m}$ , 1 mm



costa at midleaf, serrulate margin at midleaf, and leaf cells

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Racopilum cuspidigerum* var. *convolutaceum* immature capsules with calyptrae

1 mm

continued next page



*Racopilum cuspidigerum* var. *convolutaceum* vegetative shoot showing dorsal leaves

1 mm

continued next page



*Racopilum cuspidigerum* var. *convolutaceum* leaf cross-section (strongly mammillose)  
10  $\mu$ m

continued next page

**Racopilum robustum** Hook.f. & Wilson

**form:** matted, creeping,  $\pm$  unbranched, radiculose stems, 20–70 mm long, the leaves yellow-green

**habitat:** rock, soil, rarely bark, moist forest, sea level to 1000 m

**leaf:** size: 2–3 mm

*shape:* ovate-cordate, concave,  $\pm$  distichous

*tip:* acuminate

*base:* basal cells shorter than the other blade cells

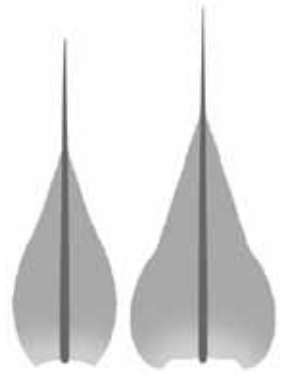
*costa:* excurrent in a long piliform arista

*border:* 1–2 rows of elongate cells

*margin:* entire to  $\pm$  serrulate, plane

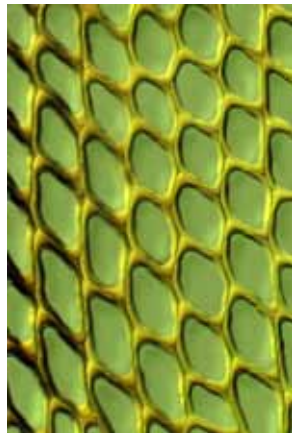
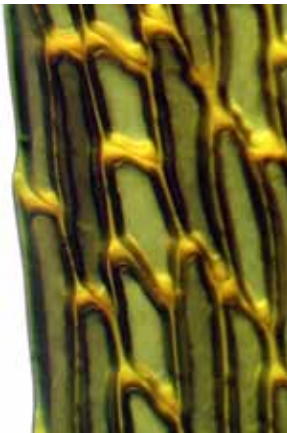
*cells:* 12–15  $\times$  10  $\mu\text{m}$ , short-oval, firm-walled, smooth

**capsule:** 4–5 mm, strumose,  $\pm$  cylindric, curved, suberect, stomatose, deeply grooved; seta 13–20 mm, reddish, twisted; calyptra mitrate, hairy; operculum erect-rostrate; peristome double; spores 12–16  $\mu\text{m}$  in diam., smooth



vegetative shoots (dry) (3), leaf outlines (2), and leaf subapex

5 mm, 1 mm, 0.5 mm (2), 0.5 mm, 10  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

**Racopilum strumiferum** (Müll.Hal.) Mitt.

**form:** matted, pinnate, tomentose stems, 20–70 mm long, lateral leaves 4-ranked, distichous, dorsal leaves 2-ranked

**habitat:** soil, rock, bark, or rotting wood, damp forest to 1000 m

**leaf:** size: lateral leaves 1–2 × 0.5–1.0 mm (excluding arista); dorsal leaves smaller

**shape:** lateral leaves obovate; dorsal leaves triangular

**tip:** lateral leaves obtuse; dorsal leaves acute

**base:** not differentiated

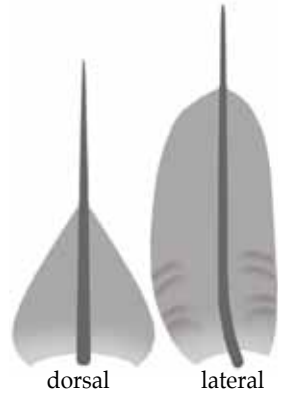
**costa:** variably excurrent in a hyaline arista

**border:** weak, 2–3 rows of slightly elongate cells

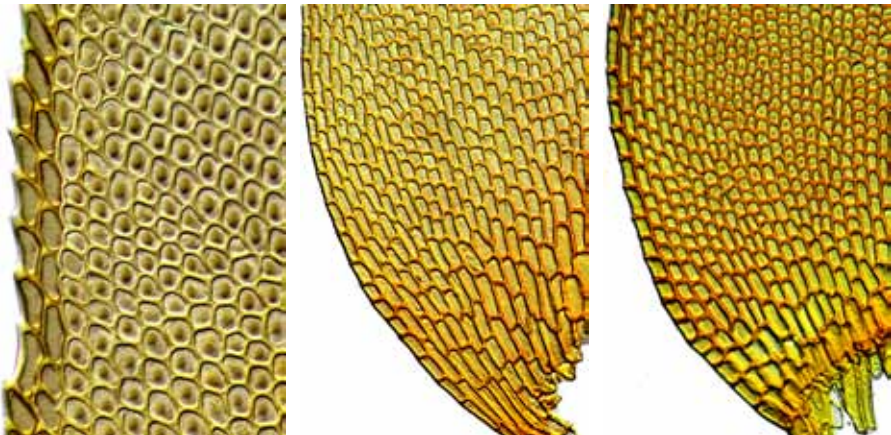
**margin:** entire to serrulate, plane above, often undulate below

**cells:** 9–15  $\mu\text{m}$ ,  $\pm$  hexagonal, firm-walled, strongly mammillose

**capsule:** 2.5–3.0 mm, cylindric, curved, inclined, exserted, strumose, brown; seta 8–20 mm, smooth; operculum erect-beaked; calyptra mitrate,  $\pm$  hairy; peristome double, exostome teeth cross-striolate, endostome cilia 2–4



vegetative shoot (moist), capsule base, leaf outlines (2), and dorsal leaf apex and margin  
 1 mm, 1 mm, 0.5 mm (2), 10  $\mu\text{m}$ , 10  $\mu\text{m}$



lateral leaf margin, lateral leaf basal angle, and dorsal leaf basal angle  
 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$



(left and middle) *Racopilum strumiferum* capsule, operculum, and mitrate calyptra  
 (bottom right) *Racopilum cuspidigerum* var. *convolutaceum* cucullate calyptra  
 1 mm

continued next page





*Racopilum strumiferum* vegetative shoot showing dorsal leaves  
1 mm

**Cyrtopus setosus** (Brid.) Hook.f.

**form:** robust plants, the primary stems loosely tufted, radiculose, secondary stems branched, to 120 mm long, in  $\pm$  pendent mats, often golden

**habitat:** on smooth bark of forest trees, less commonly on vertical rock

**leaf:** size: 5–7  $\times$  0.9–1.3 mm

**shape:** subulate from an oblong base, plane, bistratose patches above

**tip:** gradually subulate

**base:** outer cells isodiametric in up to 15 rows; inner cells linear, thick-walled

**costa:** variably excurrent in an abaxially toothed subula; biconvex in xs

**border:** not differentiated

**margin:** entire below, laxly toothed in the subula, plane

**cells:** 15–25  $\mu$ m, isodiametric, thick-walled, smooth; inner base cells porose

**capsule:** 2–3 mm, oblong to cylindrical, straight, erect, exserted; seta 3–4 mm; operculum conic-rostrate; calyptra cucullate; peristome double, exostome red, papillose; endostome processes equalling the teeth in length, subulate; spores 8–10  $\mu$ m in diam., smooth



fertile shoot, capsule, leaf outline, apex, subapex, and margin in lower leaf  
 ■ 1 mm, ■ 0.5 mm, ■ 1 mm, ■ 50  $\mu$ m, ■ 50  $\mu$ m, ■ 20  $\mu$ m

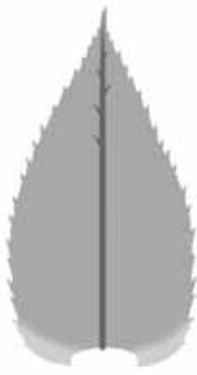


outer isodiametric and inner rectangular cells in lower leaf, and costa and lamina xs  
 ■ 20  $\mu$ m, ■ 20  $\mu$ m, ■ 10  $\mu$ m, ■ 10  $\mu$ m

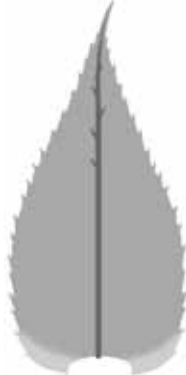
**Key\* to the New Zealand species of Hypnodendron (3) and Mniodendron (4)**

- 1 Square crystals in cells near base of branch leaf costa..... ● **Mniodendron colensoi**  
 1: No square crystals in cells near base of branch leaf costa.....2
- 2(1:) Stipe naked or tomentose at only the base .....3  
 2: Stipe tomentose ± throughout .....5
- 3(2) Stipe naked; stem leaf insertion straight and horizontal .....4  
 3: Stipe tomentose at only the base; stem leaf insertion U- or V-shaped .....  
 ..... ● **Hypnodendron spininervium** subsp. **spininervium**
- 4(3) Branched above into a pinnate complanate frond, glossy and green when dry; stem  
 leaves spreading wet or dry ..... ● **Hypnodendron arcuatum**  
 4: Branched above into a terminal whorl; not glossy and green when dry; stem leaves  
 appressed wet or dry..... ● **Hypnodendron marginatum**
- 5(2:) Leaf border thickened; costa wide; branches straight, not tapering .....6  
 5: Leaf border unistratose; costa narrow; branches curved, tapering .....  
 ..... ● **Mniodendron comatum**
- 6(5) Branch leaves coarsely serrate in the upper third; costa and apex wide .....  
 ..... ● **Mniodendron comosum** var. **sieberi**  
 6: Branch leaves only weakly serrate; costa and apex narrow .....  
 ..... ● **Mniodendron comosum** var. **comosum**

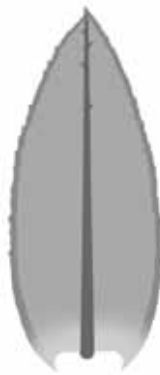
\* based on Beaver, J; Allison, KW; Child, J (1992): *The Mosses of New Zealand*. University of Otago Press, Dunedin, 110, plus Scott, GAM; Stone, IG; Rosser, C (1976): *The Mosses of Southern Australia*. Academic Press, London, 341, and Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 314.



*Hypnodendron  
spininervium* subsp.  
*spininervium*



*Hypnodendron  
arcuatum*



*Hypnodendron  
marginatum*



*Mniodendron  
comatum*



*Mniodendron  
comosum* var.  
*comosum*



*Mniodendron  
comosum* var.  
*sieberi*



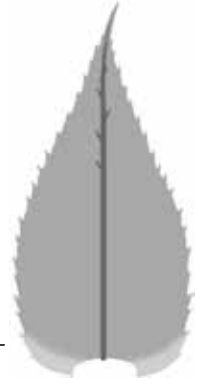
*Mniodendron  
colensoi*

**Hypnodendron arcuatum** (Hedw.) Mitt.

**form:** primary stem creeping; secondary stems dendroid, to 80 mm  
**habitat:** wet soil or rock near deeply shaded forest streams

**leaf:** *size:* stem leaves: 1.5–2.5 mm; branch leaves: 1.5–2 mm  
*shape:* stem: ovate-lanceolate; branch: ovate; KOH reaction deep red  
*tip:* stem: subulate; branch: ovate  
*base:* basal cells shorter and wider than the other lamina cells  
*costa:* stem: excurrent, serrate on the back above; branch: percurrent  
*border:* not differentiated  
*margin:* spinulose-serrate, plane  
*cells:* 30–50 × 5–8 μm, rhombic to linear, firm-walled, distally prorose on abaxial surface

**capsule:** 3–4 mm, oblong-cylindric, ± cernuous, ± curved, exserted, red-brown; setae 1–8 per stem, 15–30 mm, reddish; operculum long-rostrate; peristome double, exostome teeth hyaline-margined, basal membrane half the height of the teeth; cilia 2–4



vegetative shoot (dry), stem and branch leaf outlines, apex, and margin midleaf  
 ■ 5 mm, ■ 0.1 mm (2), ■ 10 μm, ■ 10 μm



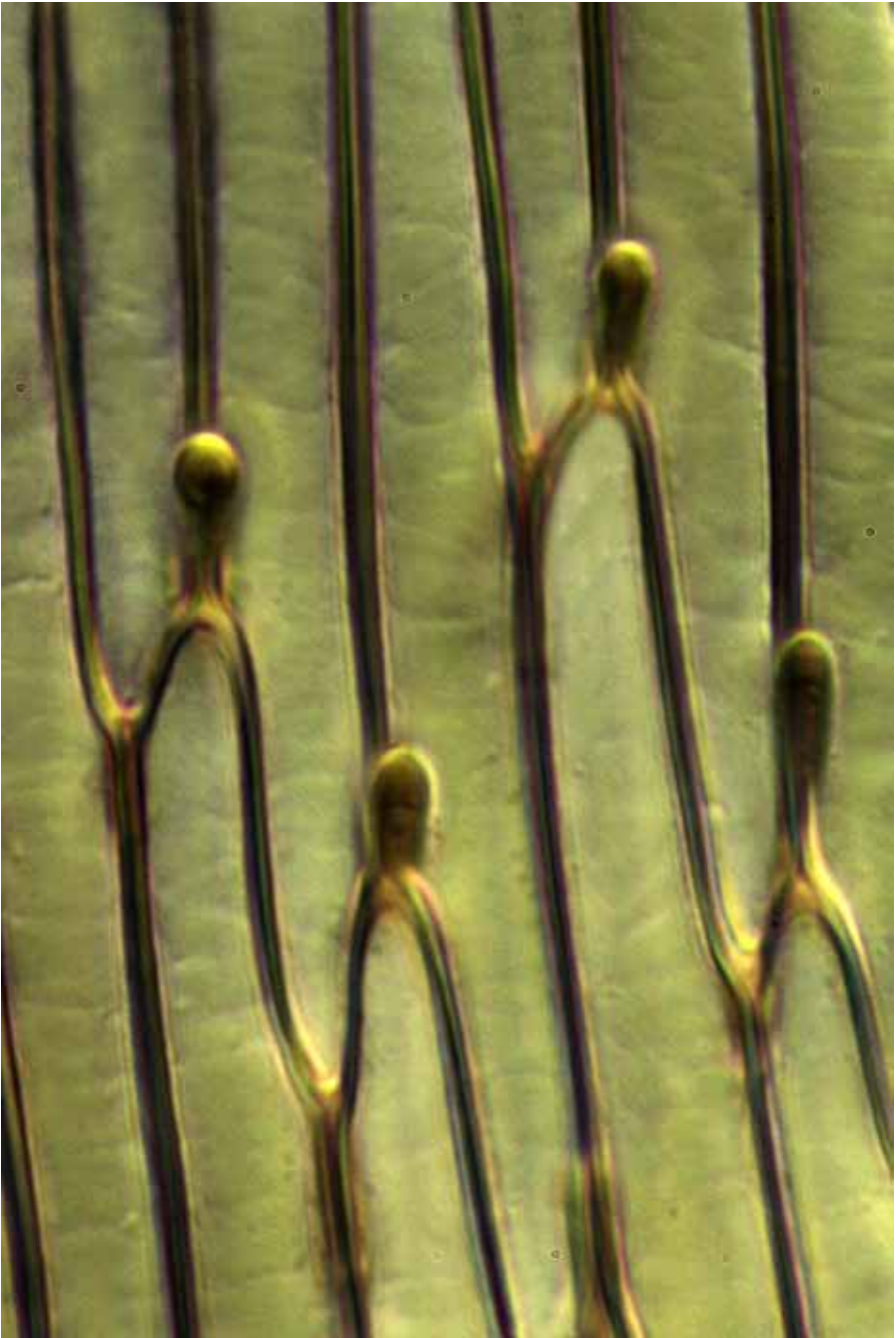
costa at midleaf, branch leaf prorose cells, and branch leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 100 μm

continued next page



*Hypnodendron arcuatum* margin midleaf  
10  $\mu\text{m}$

continued next page



*Hypnodendron arcuatum* prorse leaf cells midleaf  
10  $\mu$ m

continued next page

**Hypnodendron marginatum** (Hook.f. & Wilson) A.Jaeger

**form:** primary stems creeping, secondary stems to 40 mm tall, brittle, black or dark red, branches in a terminal whorl

**habitat:** damp soil in forest

**leaf:** size: stem leaves 3 mm; branch leaves 2–3 mm

**shape:** stem leaves widely triangular-lanceolate; branch leaves oblong-lanceolate to narrowly ovate, ± concave

**tip:** stem leaves finely tapered; branch leaves acute

**base:** alar cells little differentiated

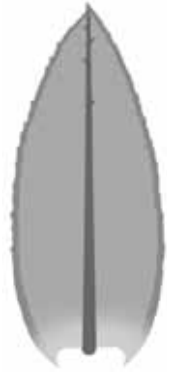
**costa:** stem leaves excurrent in a rigid point; branch leaves percurrent

**border:** 4–5 rows of linear, thick-walled cells

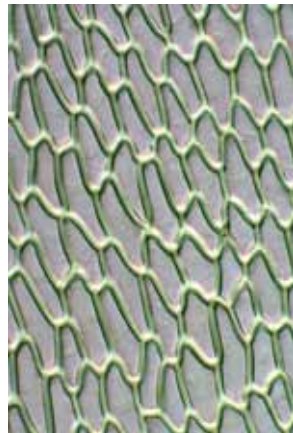
**margin:** stem leaves entire, plane; branch leaves dentate above, plane

**cells:** branch leaves  $25\text{--}38 \times 5\text{--}9 \mu\text{m}$ , ± rhombic, firm-walled, smooth

**capsule:** 3–4 mm, oblong-cylindric, grooved, horizontal or cernuous; seta 25–30 mm, numerous (to 25), red, flexuose; operculum long-rostrate; peristome double, endostome cilia 2–4; spores  $12 \mu\text{m}$  in diam.



vegetative habit, capsule apex, with calyptra, branch leaf outline, and branch leaf apex  
 ■ 5 mm, ■ 0.5 mm, ■ 0.5 mm, ■ 10  $\mu\text{m}$



branch leaf margin at midleaf, midleaf branch cells, and stipe leaves  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 1 mm





*Hypnodendron marginatum* leaf border cross-section  
10  $\mu\text{m}$

continued next page

**Hypnodendron spininervium** (Hook.) A. Jaeger subsp. **spininervium**

**form:** primary stems creeping, secondary stems to 40 mm tall,  
branched above in a whorl, 3-ranked, with the upper leaves small

**habitat:** wet soil and rotting logs in forest

**leaf:** size: stipe leaves 1–2 × 0.7 mm; branch leaves 1.5–3.0 × 1.0 mm

**shape:** stem leaves acuminate from a triangular base; branch leaves  
ovate-lanceolate

**tip:** acute

**base:** angle cells subquadrate, pigmented

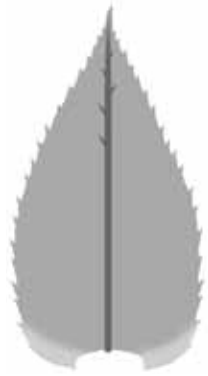
**costa:** percurrent or slightly excurrent, toothed on the back

**border:** not differentiated

**margin:** strongly toothed (sometimes paired), reflexed below

**cells:** 40–60 × 7 μm, rectangular, thin-walled, prorate-papillose

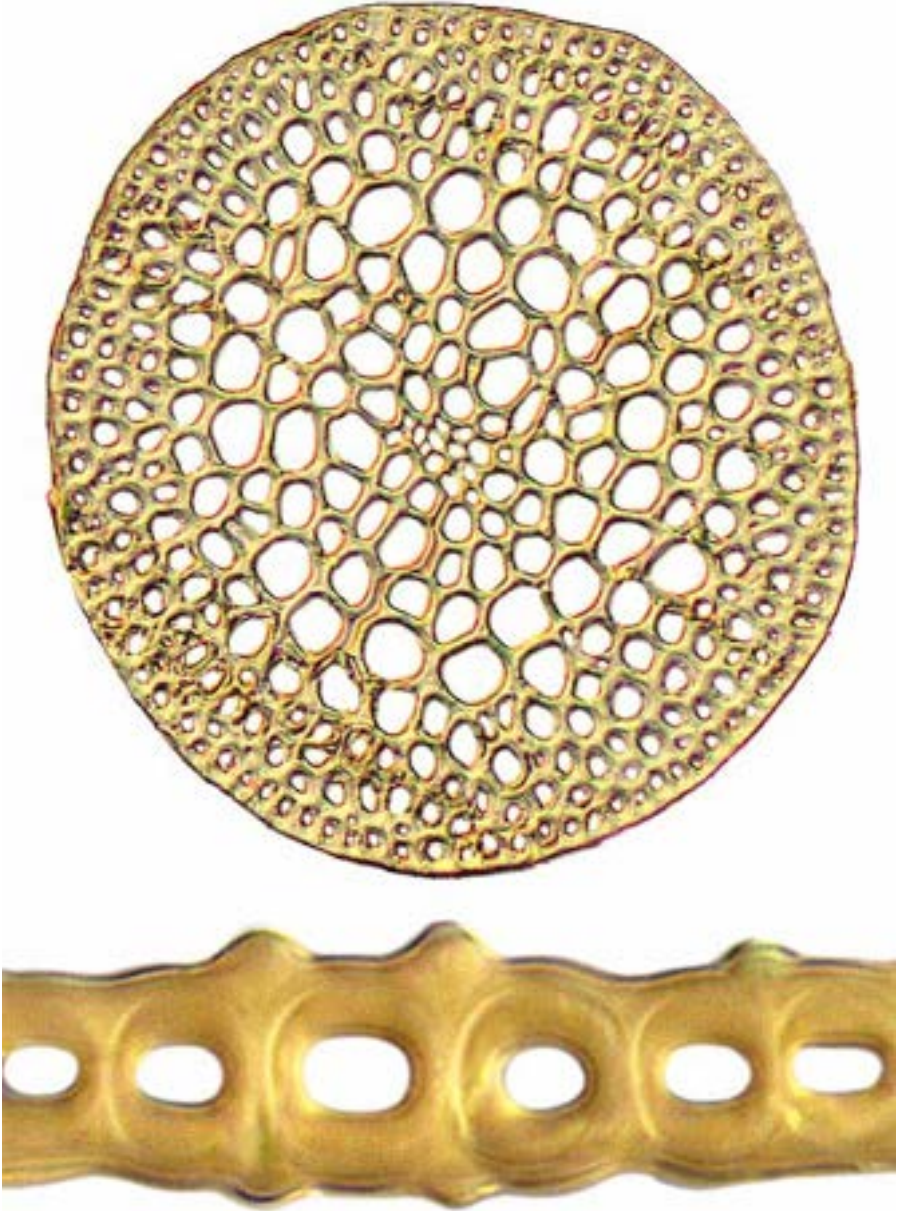
**capsule:** 3.5 mm, cylindric, ± curved, horizontal, deeply grooved;  
seta 20–30 mm, red, up to 8 per frond; peristome double, well-  
developed, the endostome ciliate



fertile plant, stipe leaves, single branch (dry), branch leaf outline, branch leaf apex  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm



branch leaf margin at midleaf, toothed costa, and prorate leaf cells  
 ■ 10 μm, ■ 10 μm, ■ 10 μm



*Hypnodendron spininervium* subsp. *spininervium* seta and leaf cross-sections  
50  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)

continued next page



*Hypnodendron spininervium* subsp. *spininervium* costa cross-section  
10  $\mu$ m

continued next page

**Mniodendron colensoi** (Hook.f. & Wilson) Besch.

**form:** primary stems creeping; secondary stems to 40 mm tall, tip branches whorled; stipes with dense red-brown tomentum; leaves green to golden

**habitat:** soil or rotting logs in shaded forest

**leaf:** size: 2.5–3.0 mm

*shape:* narrowly subulate from a triangular or cordate base

*tip:* subulate with widely spaced sharp teeth

*base:* basal angle cells wider and shorter than other lamina cells

*costa:* excurrent; densely covered with square crystals toward the base

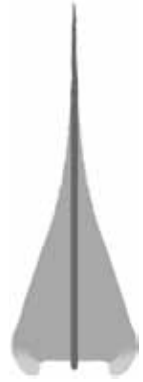
*border:* not differentiated

*margin:* ± entire below, sharply lax-dentate above, plane

*cells:* 50–90 × 10 μm, linear, firm-walled, smooth

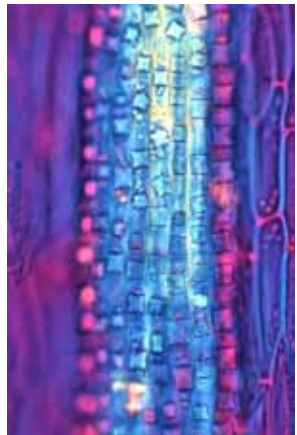
**capsule:** 3–5.5 mm, cylindric, horizontal to cernuous, grooved, exerted, brown; seta 20–60 mm, single; operulum long-rostrate; peristome double, well-developed, ciliate

**note:** recognized by the square birefringent crystals at the base of the costa



vegetative habit (moist), leaf outline, leaf apex (2), and margin upper leaf

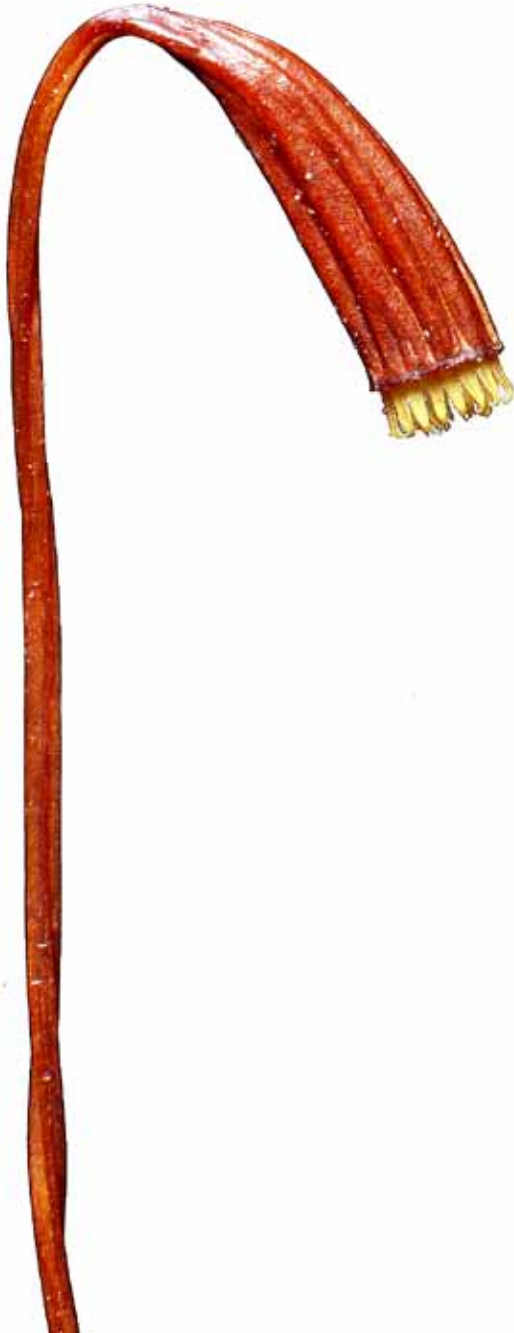
■ 5 mm, ■ 1 mm, ■ 50 μm, ■ 10 μm, ■ 10 μm



cells at midleaf, leaf basal angle, and square crystals at base of costa

■ 10 μm, ■ 50 μm, ■ 10 μm

continued next page

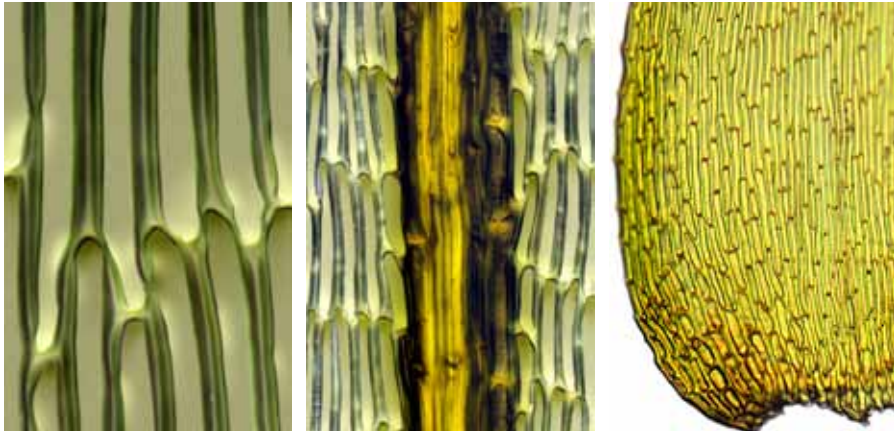


*Mniodendron colensoi* mature capsule  
1 mm

continued next page

**Mniodendron comatum** (Müll.Hal.) Lindb.**form:** slender stems, to 80 mm tall, the branches curved and tapering**habitat:** soil, rotting logs, and rock in damp to wet forest and rainforest**leaf:** *size:* stem leaves  $3 \times 1.0$  mm; branch leaves smaller*shape:* narrowly triangular*tip:* gradually acuminate, ending in a denticulate arista*base:* cells at the basal angles widened in several rows*costa:* narrow, excurrent*border:* unistratose throughout*margin:* variably and distantly toothed, plane*cells:*  $50\text{--}100 \times 3\text{--}7$   $\mu\text{m}$ , narrowly linear, firm-walled, smooth**capsule:** 3.5–5.0 mm, cylindric, horizontal to cernuous, deeply grooved  
when mature, reddish; seta 30–60 mm, red, single to multiple; peristome  
hypnoid, well-developed, ciliate**note:** differs from *M. comosum* in being less robust, having a unistratose  
margin, a narrower costa, and curved and tapering branches

fertile shoot (dry), branch (dry), capsule, leaf outline, leaf apex, and margin midleaf  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 50  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



cells at midleaf, costa at midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

**Mniodendron comosum** (Labill.) Mitt. var. **comosum**

**form:** primary stems creeping, secondary stems 40–80 mm tall, umbrella-shaped, heavily tomentose below, the branches straight, not tapering

**habitat:** soil, rotting logs, and rock in damp to wet forest and rainforest

**leaf:** *size:* stem leaves  $3 \times 1.0$  mm; branch leaves  $2.2\text{--}2.5 \times 0.7\text{--}0.8$  mm

*shape:* narrowly subulate from a triangular or cordate base,  $\pm$  plicate

*tip:* a smooth to denticulate subula or arista

*base:* cells at the basal angles widened in several rows

*costa:* stout, excurrent, sometimes toothed adaxially near the leaf apex

*border:* variably bistratose, the cells shorter and wider in 2–3 rows

*margin:* variably toothed, plane

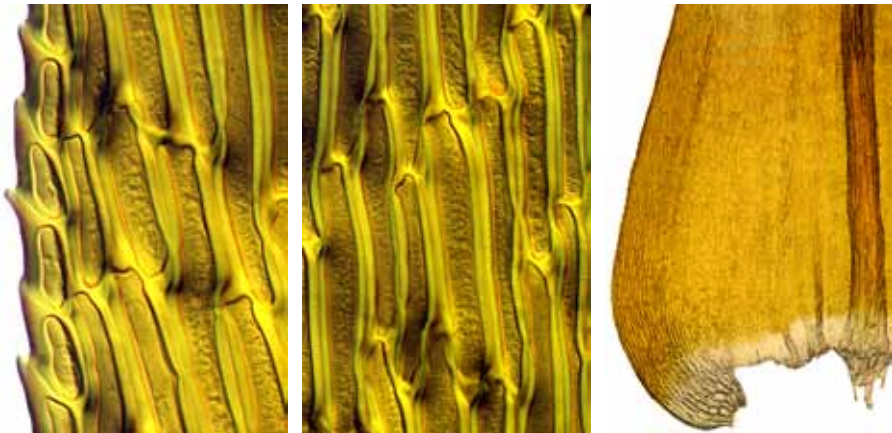
*cells:*  $50\text{--}100 \times 3\text{--}7$   $\mu\text{m}$ , narrowly linear, firm-walled, smooth

**capsule:** 3.5–5.0 mm, cylindric, horizontal to cernuous, deeply grooved, reddish; seta 30–60 mm, red, single to multiple

**note:** var. *sieberi* differs in being larger and having a wider costa and more strongly toothed leaves



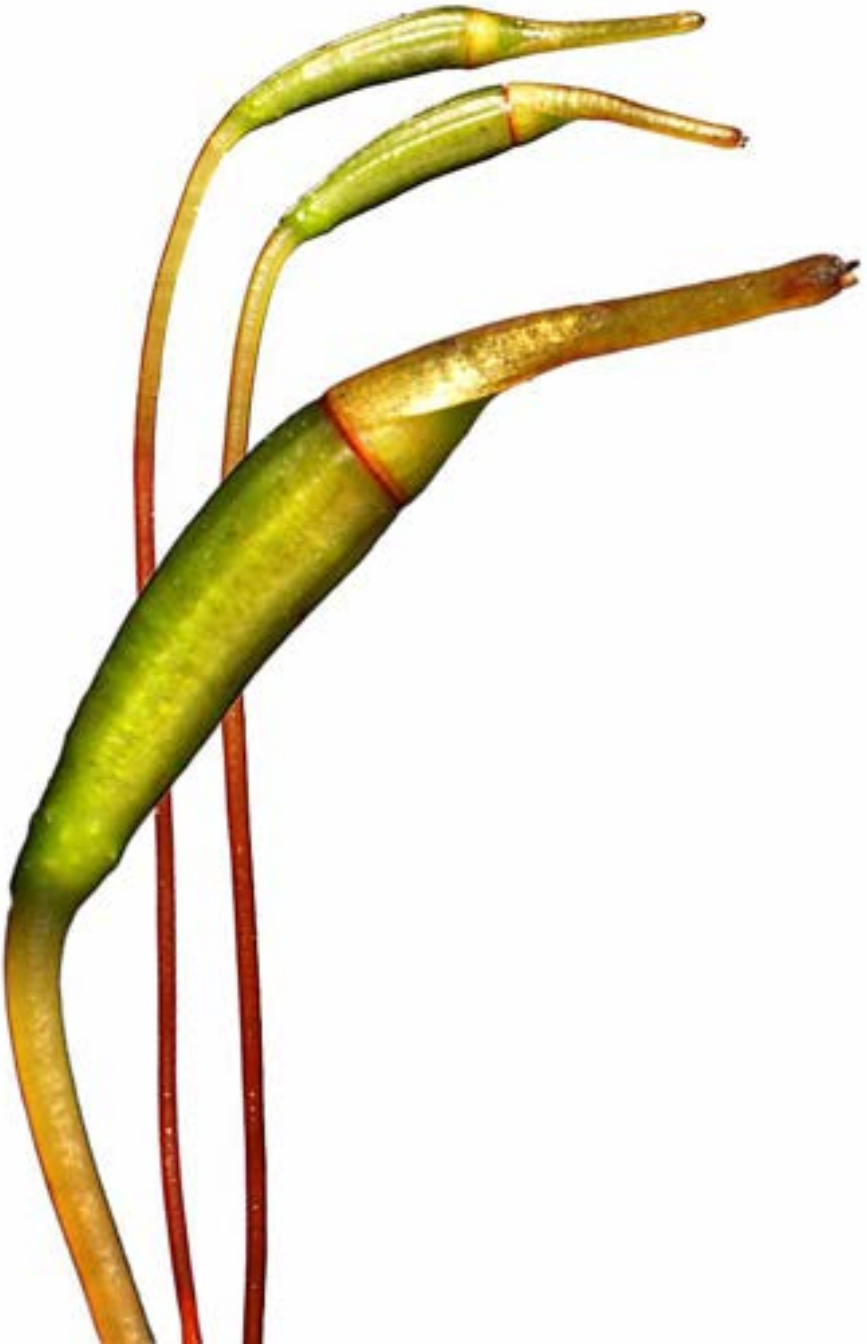
fertile shoot, stipe, mature capsule, leaf outline, leaf apex, and margin midleaf  
 ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 5  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle  
 ■ 5  $\mu\text{m}$ , ■ 5  $\mu\text{m}$ , ■ 0.1 mm

continued next page





*Mniodendron comosum* var. *comosum* capsules and calyptrae  
■ 1 mm (above), ■ 1 mm (below)

continued next page



*Mniodendron comosum* var. *comosum* margin midleaf  
10  $\mu$ m

continued next page

**Mniodendron comosum** var. **sieberi** (Müll.Hal.) Touw

**form:** primary stem creeping, secondary branches 30–60 mm tall, dendroid  
**habitat:** constantly moist soil and rock in forest

**leaf:** *size:* stipe: 3 mm; branch: 2.2–2.5 mm; KOH reaction red

*shape:* stipe: lanceolate; branch: triangular-lanceolate

*tip:* stipe: denticulate arista; branch: laxly denticulate subula

*base:* basal cells shorter and wider than the other lamina cells

*costa:* excurrent in the arista

*border:* not differentiated

*margin:* entire below, coarsely serrate in the upper third, plane

*cells:* 50–100 × 3–7 μm, linear, firm-walled, prorse at the distal end

**capsule:** 3.5–5.0 mm, cylindric, horizontal to cernuous, long-exserted, brown; operculum long-rostrate; seta 30–60 mm, red; peristome double, exostome teeth hyaline-margined, striolate, lamellate; basal membrane half the height of the teeth, cilia 2–4

**note:** the var. *comosum* leaf is smaller, narrow-costate, and weakly toothed

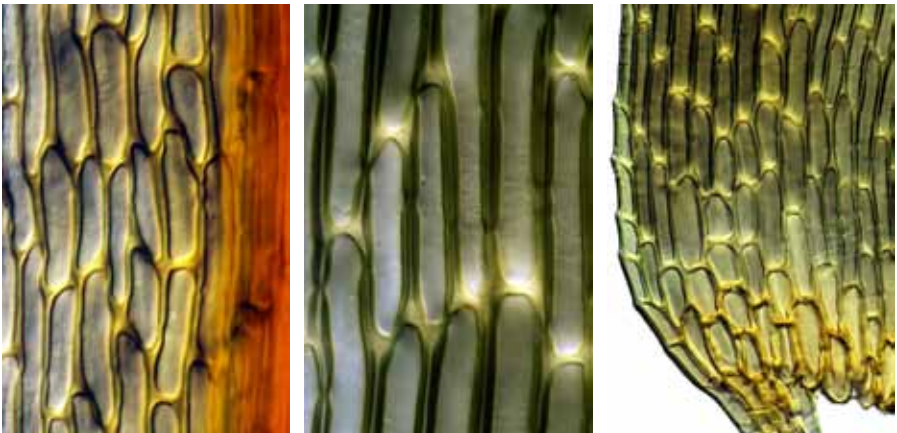


branch leaf



vegetative shoot (dry), branch leaf outline, apex (2), and margin midleaf

10 mm, 0.5 mm, 100 μm, 50 μm, 10 μm



costa at midleaf, cells of lower branch leaf, and branch leaf basal angle

10 μm, 10 μm, 10 μm

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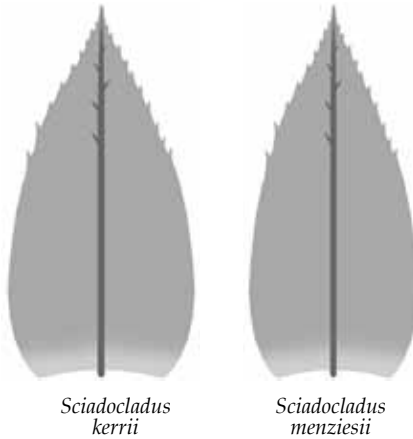


*Mniodendron comosum* var. *sieberi* branch leaf margin  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Sciadocladus* (2)**

- 1 Setae numerous per stem; capsule 2.0–2.5 mm long, asymmetrical..... ● ***Sciadocladus kerrii***  
 .....  
 1: Setae 1–few per stem; capsule 2.5–3.0 mm long, symmetrical..... ● ***Sciadocladus menziesii***  
 .....

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 342.

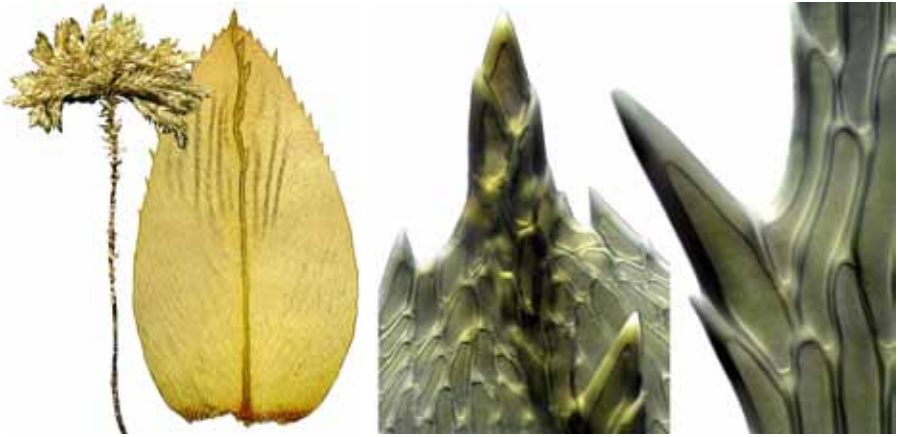
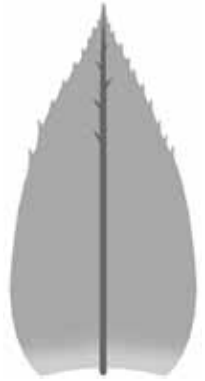


**Sciadocladus kerrii** (Mitt.) Broth.

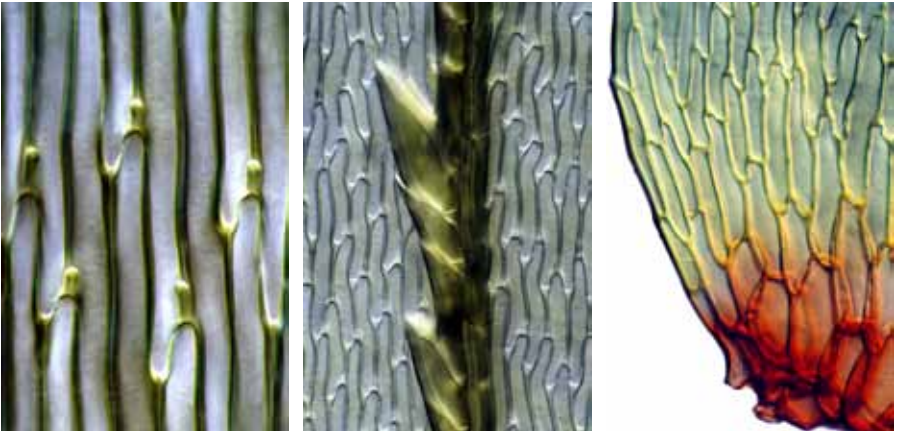
**form:** primary stems creeping, secondary stems 60–120 mm tall, erect, black, sparingly squarrose-foliate; frond branches in 1(–3) whorls  
**habitat:** soil, damp rotting logs, or rock

**leaf:** *size:* stem leaves: 2.5–3 mm; branch leaves: 2–2.3 mm  
*shape:* stem leaves: ovate-cordate; branch leaves: ovate, concave  
*tip:* stem leaves: long-acuminate to piliferous; branch leaves: acute  
*base:* basal cells little differentiated  
*costa:* stem and branch leaves: failing below the acumen or percurrent  
*border:* not differentiated  
*margin:* finely denticulate above, ± entire below, plane  
*cells:* 60–100 × 5–8 μm, narrowly linear, firm-walled, prorose

**capsule:** 2–2.5 mm, ovoid to oblong, horizontal to cernuous, exserted, brown; seta 15–35 mm, multiple (to 18), red, flexuose; teeth of the exostome yellow, joined at their bases; operculum conic and short-rostrate; peristome double, well-developed, endostome cilia 3–4

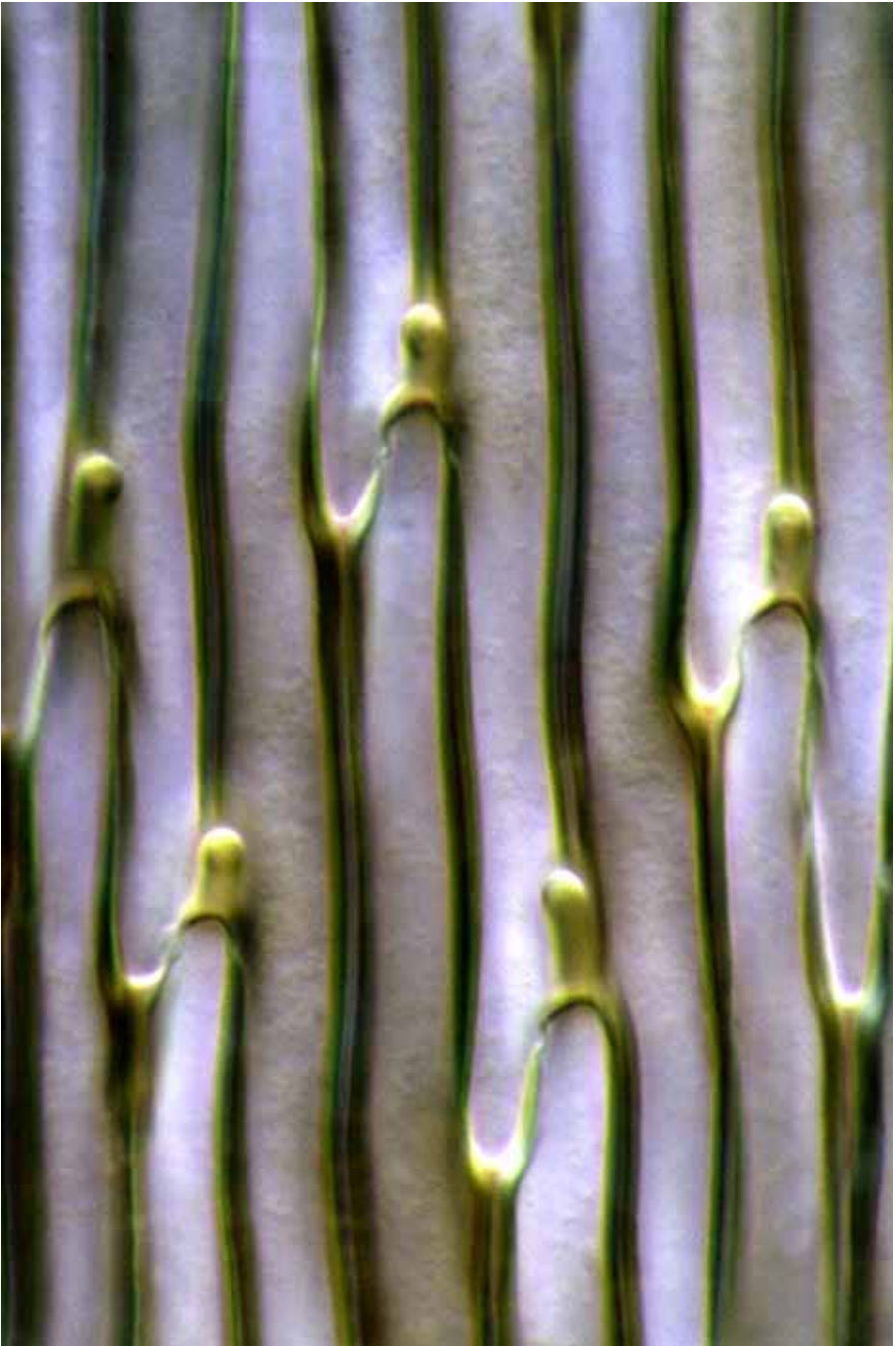


vegetative frond (dry), leaf outline, leaf apex, and spinose margin upper leaf  
 5 mm, 1 mm, 10 μm, 10 μm



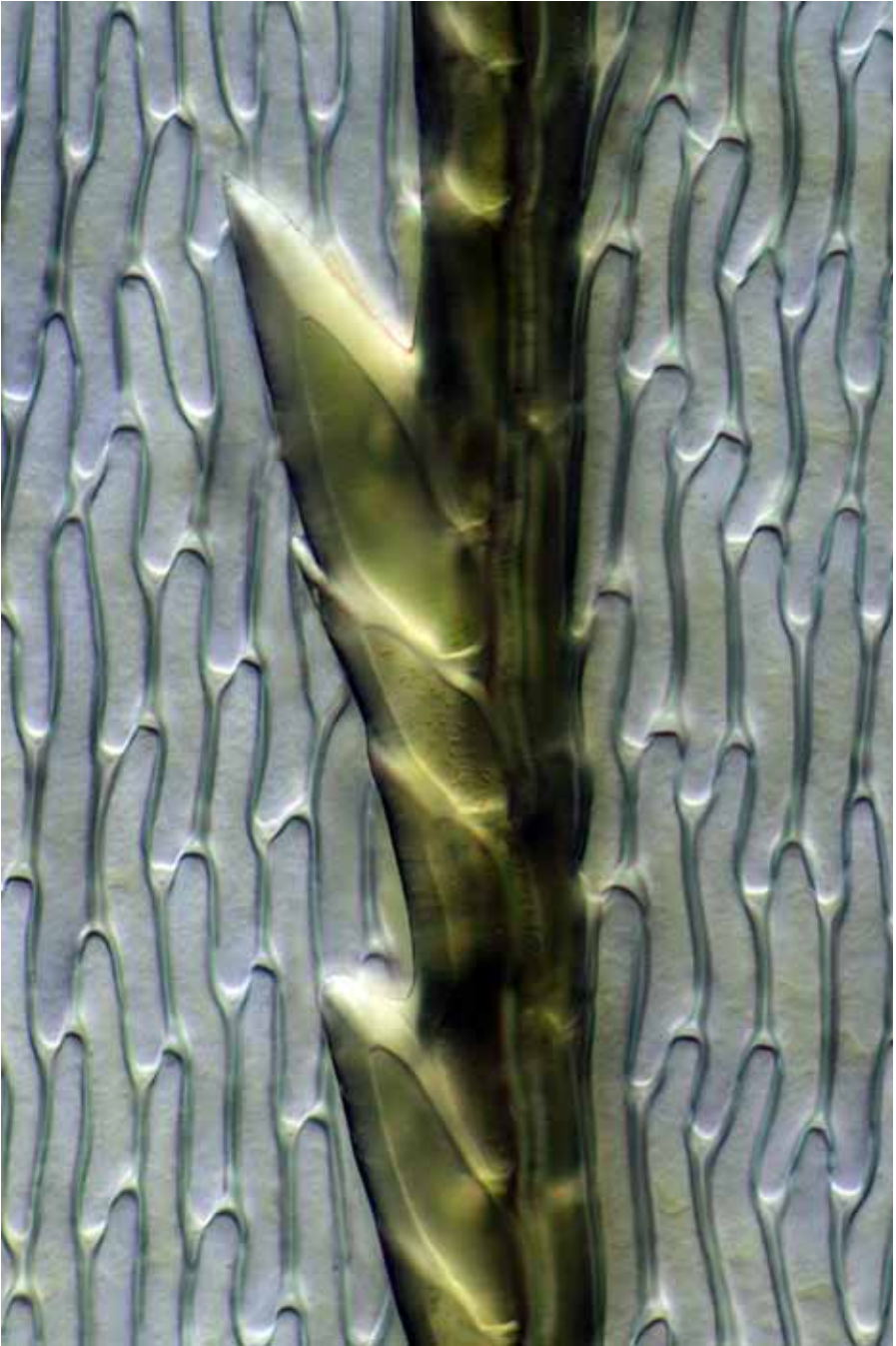
prorose cells at midleaf, spinose upper costa, and leaf basal angle  
 10 μm, 10 μm, 10 μm

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*Sciadocladus kerrii* strongly prorse cells midleaf  
10  $\mu\text{m}$

continued next page



*Sciaocladus kerrii* spinose upper costa  
10  $\mu$ m

continued next page



**Sciadocladus menziesii** (Hook.) Broth.

**form:** primary stems creeping, secondary stems 60–120 mm tall, with 1–2 terminal whorls; stipes black, not tomentose; leaves green to golden

**habitat:** damp rock, soil, or rotting logs in shaded forest

**leaf:** size: 2.5–3.0 mm

*shape:* narrowly ovate

*tip:* acute, ending in a sharp excurrent costa

*base:* basal angle cells wider and shorter than other lamina cells

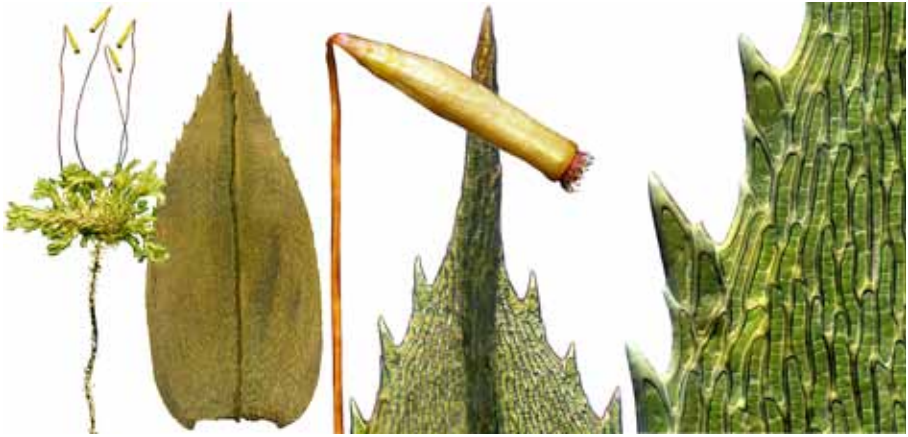
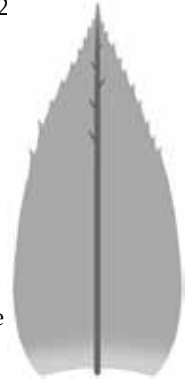
*costa:* excurrent

*border:* not differentiated

*margin:* ± entire below, sharply dentate above, plane

*cells:* 50–90 × 5–10 μm, linear, firm-walled, ± prorate

**capsule:** 4–7 mm, cylindrical, horizontal to cernuous, exserted, brown, smooth; seta 60–70 mm, up to 5; operculum curved-rostrate; peristome yellow, endostome cilia 3–4, nodulose; spores 16–18 μm in diam.



fertile shoot (dry), leaf outline, mature capsule, leaf apex, and margin midleaf

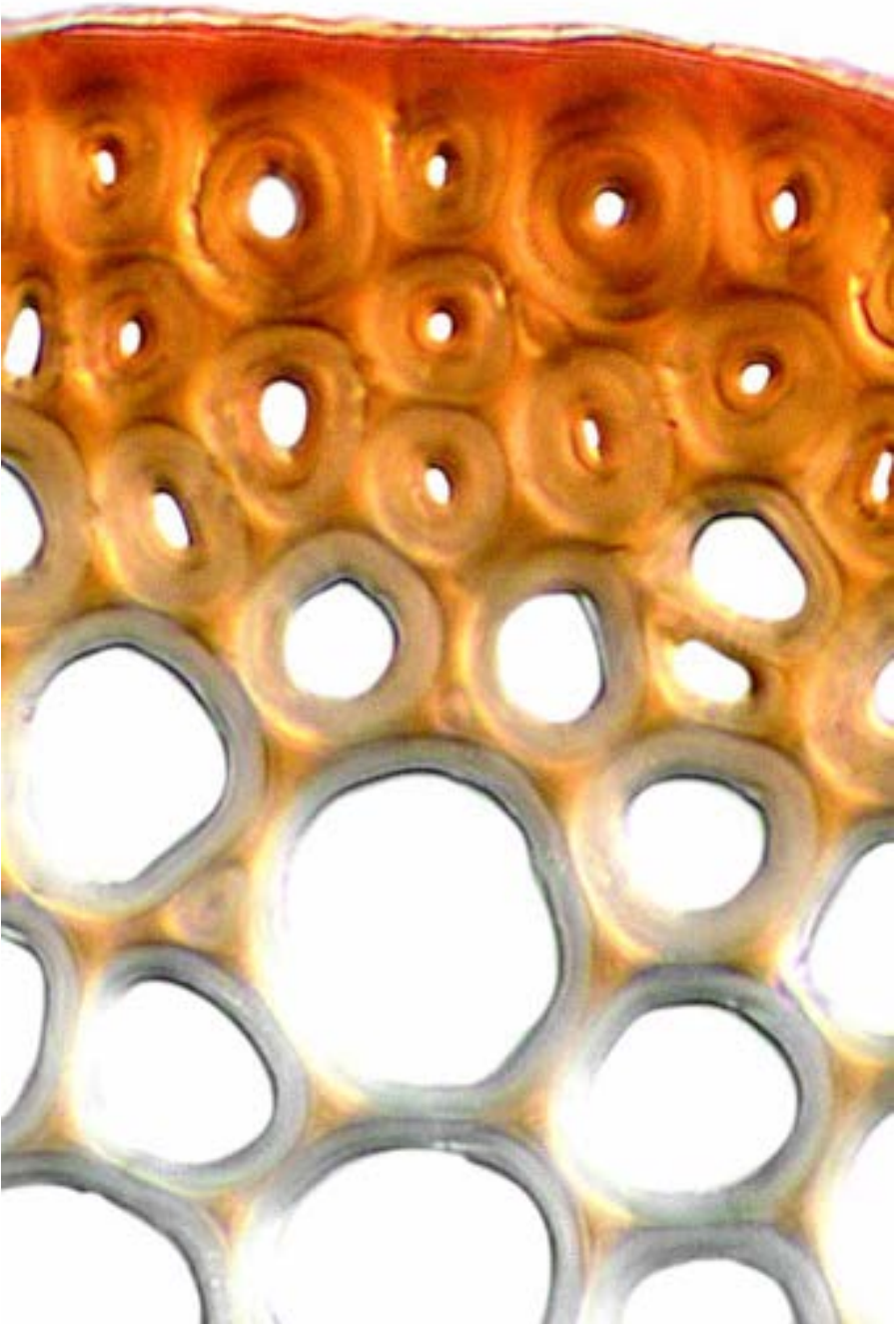
10 mm, 0.5 mm, 0.5 mm, 50 μm, 50 μm



marginal tooth, cells at midleaf, and leaf basal angle

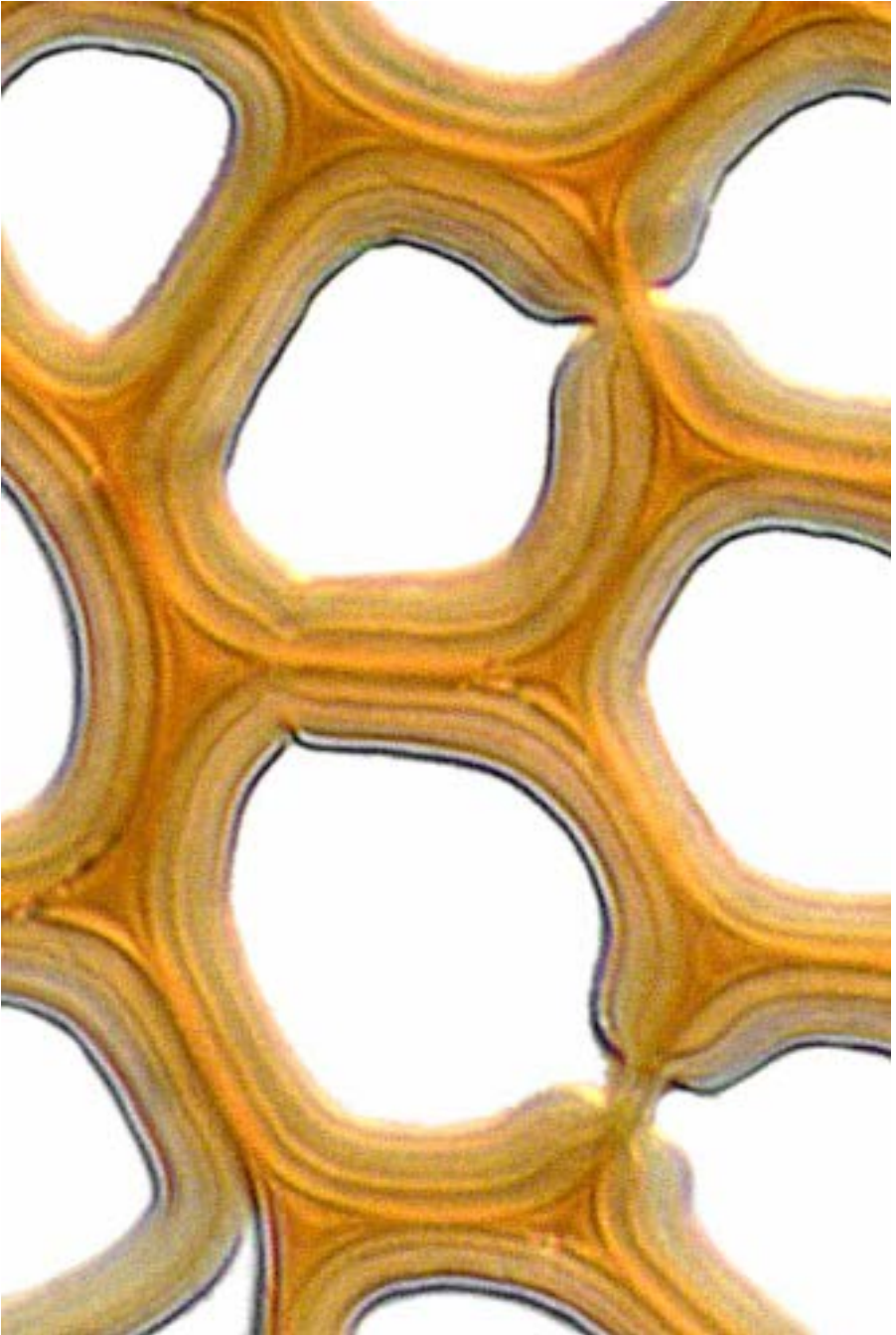
10 μm, 10 μm, 10 μm

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*Sciadocladus menziesii* stem cross-section  
10  $\mu$ m

continued next page



*Sciadocladus menziesii* porose cells in stem cross-section  
10  $\mu\text{m}$

continued next page



*Sciadocladus menziesii* leaf cross-sections  
10  $\mu\text{m}$

**Cladomnion ericoides** (Hook.) Hook.f. & Wilson

**form:** primary stems creeping, radiculose, secondary stems  $\pm$  pendent, flexuose, irregularly branched, with few paraphyllia, 40–120 mm, golden, glossy  
**habitat:** bark in canopy of wet forests, to 1200 m

**leaf:** size: 3–3.2  $\times$  1.5–1.7 mm

**shape:** secondary leaves ovate or elliptic, plicate

**tip:** bluntly acuminate, the apex strongly reflexed

**base:** clasping, small auricles of red, quadrate cells

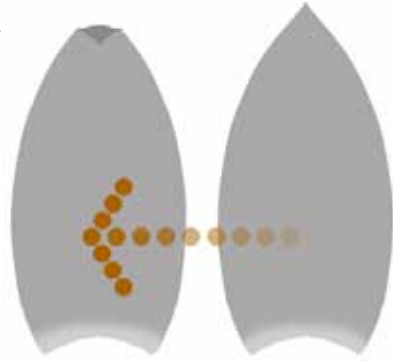
**costa:** none or short and double

**border:** not differentiated

**margin:** toothed below, crenulate above, plane

**cells:** 30–45  $\times$  5–6  $\mu$ m, linear, incrassate, porose

**capsule:** 2.5–3 mm, elliptic, ribbed, not necked; seta 5–13 mm; calyptra covering capsule; peristome double; spores multicellular, green, 80–150  $\mu$ m

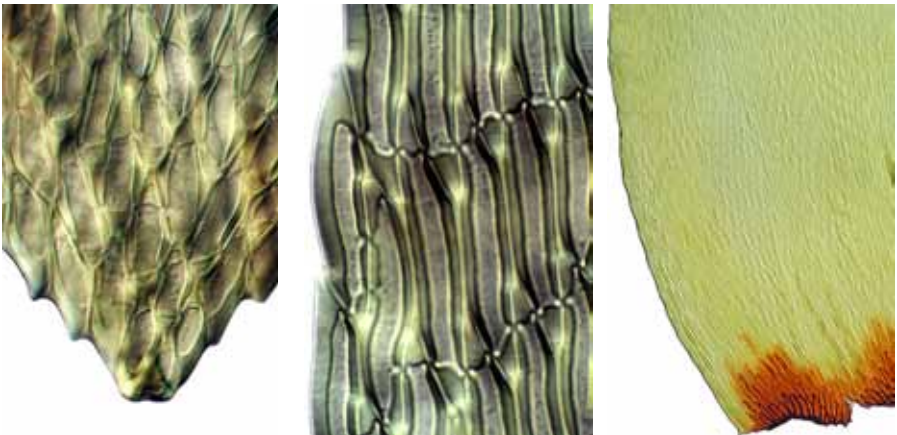


coverslipped



fertile shoot, capsule, reflexed leaf tips (dry) (2), and leaf outline

5 mm, 1 mm, 1 mm, 1 mm, 1 mm



leaf tip (reflexed), margin at midleaf, and leaf basal angle

10  $\mu$ m, 10  $\mu$ m, 100  $\mu$ m

continued next page



*Cladomnion ericoides* immature capsules, calyptra, exostome tooth, mature capsule  
 1 mm (2), 50  $\mu$ m, 1 mm

continued next page



*Cladomnion ericoides* leaf cross-section

50  $\mu\text{m}$  (background),

10  $\mu\text{m}$  (foreground)

**Dichelodontium nitidum** (Hook.f. & Wilson) Broth.

**form:** mats of pinnately branched stems, to 40 mm, the leaves imbricate, glossy, pale yellow-green

**habitat:** smooth bark in damp forest, to 900 m

**leaf:** size: 0.9–1.2 × 0.3–0.4 mm

**shape:** elliptic, cochleariform, stem and branch similar

**tip:** rounded, retuse; apical cells markedly shorter

**base:** alar cells 6–8, irregular, pigmented

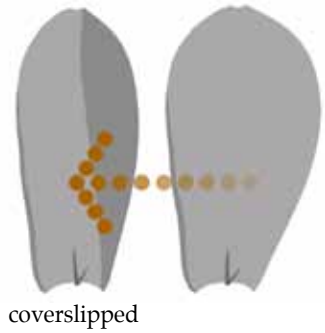
**costa:** absent or short and double

**border:** not differentiated

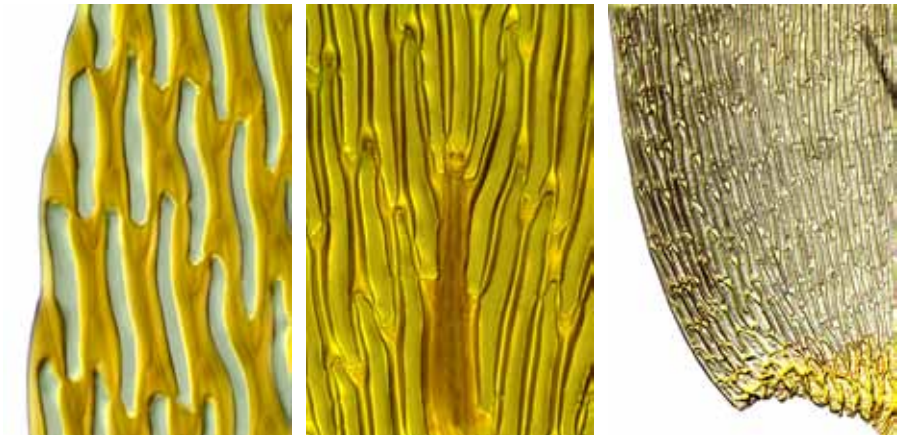
**margin:** entire, plane or slightly reflexed at the base

**cells:** 40–50 × 3–4 μm, linear, incrassate, smooth

**capsule:** 1.3–2 mm, oval-oblong or cylindric, symmetric, erect, 8-ribbed, dark reddish brown; seta 4–6 mm; stomata superficial; peristome endostome only; spores 18–33 μm long, oval, papillose



vegetative shoot (moist) (2), capsule, leaf outline (coverslipped), and retuse apex  
 1 mm, 1 mm, 0.5 mm, 0.5 mm, 10 μm



margin at midleaf, costa terminus near leaf base, and leaf basal angle  
 10 μm, 10 μm, 50 μm



**Glyplothecium sciuroides** (Hook.) Hampe

**form:** wefts of pendent, radiculose, branched stems with upturned tips, 20–40(–80) mm, the leaves glossy, yellow;

**habitat:** bark or rarely rock in damp forest, to 1100 m

**leaf:** size: 2–3 × 0.8–1.2 mm

*shape:* ovate-lanceolate, slightly concave

*tip:* gradually acuminate, usually twisted (torquate)

*base:* dark and well-defined alar region

*costa:* faint, short and double

*border:* not differentiated

*margin:* denticulate above, widely reflexed at the base

*cells:* 30–40 × 10 μm, mostly rhombic, incrossate, porose, smooth

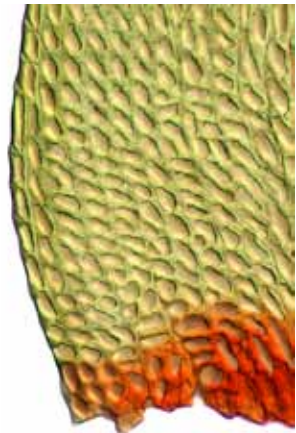
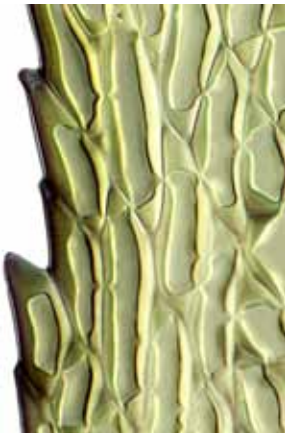
**capsule:** 1.5–2 mm, ellipsoid, short-necked, erect, exserted, ribbed when dry; seta 5 mm, reddish; operculum beaked; calyptra cucullate; peristome double, endostome rudimentary; spores 15–30 μm in diam.

**note:** vegetative reproduction by axillary brood bodies



shoots (3), mature capsule, leaf outline, leaf apex, and propagule

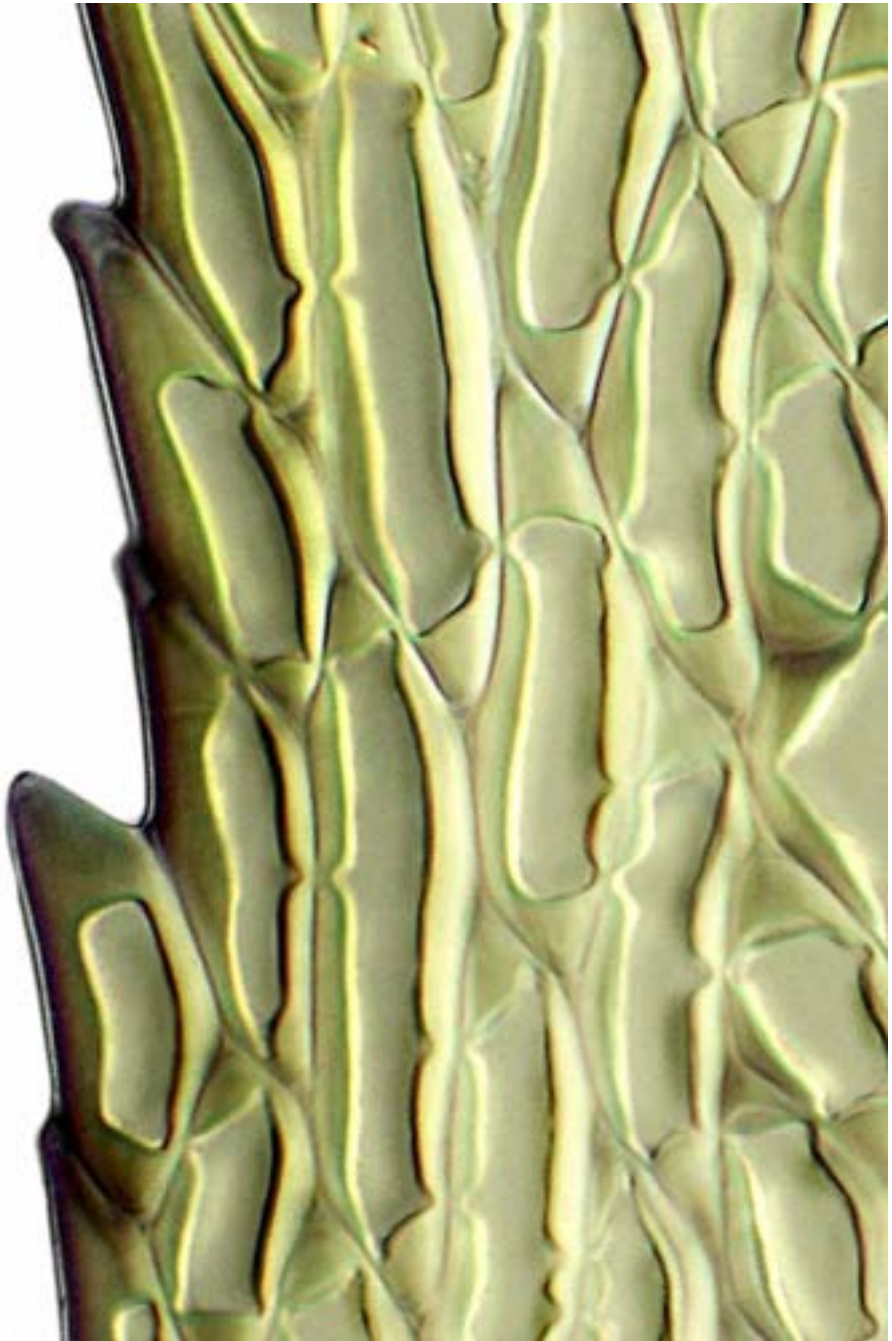
■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 0.2 mm, ■ 0.5 mm, ■ 10 μm, ■ 10 μm



denticulate margin at midleaf, cells at midleaf, and leaf basal angle

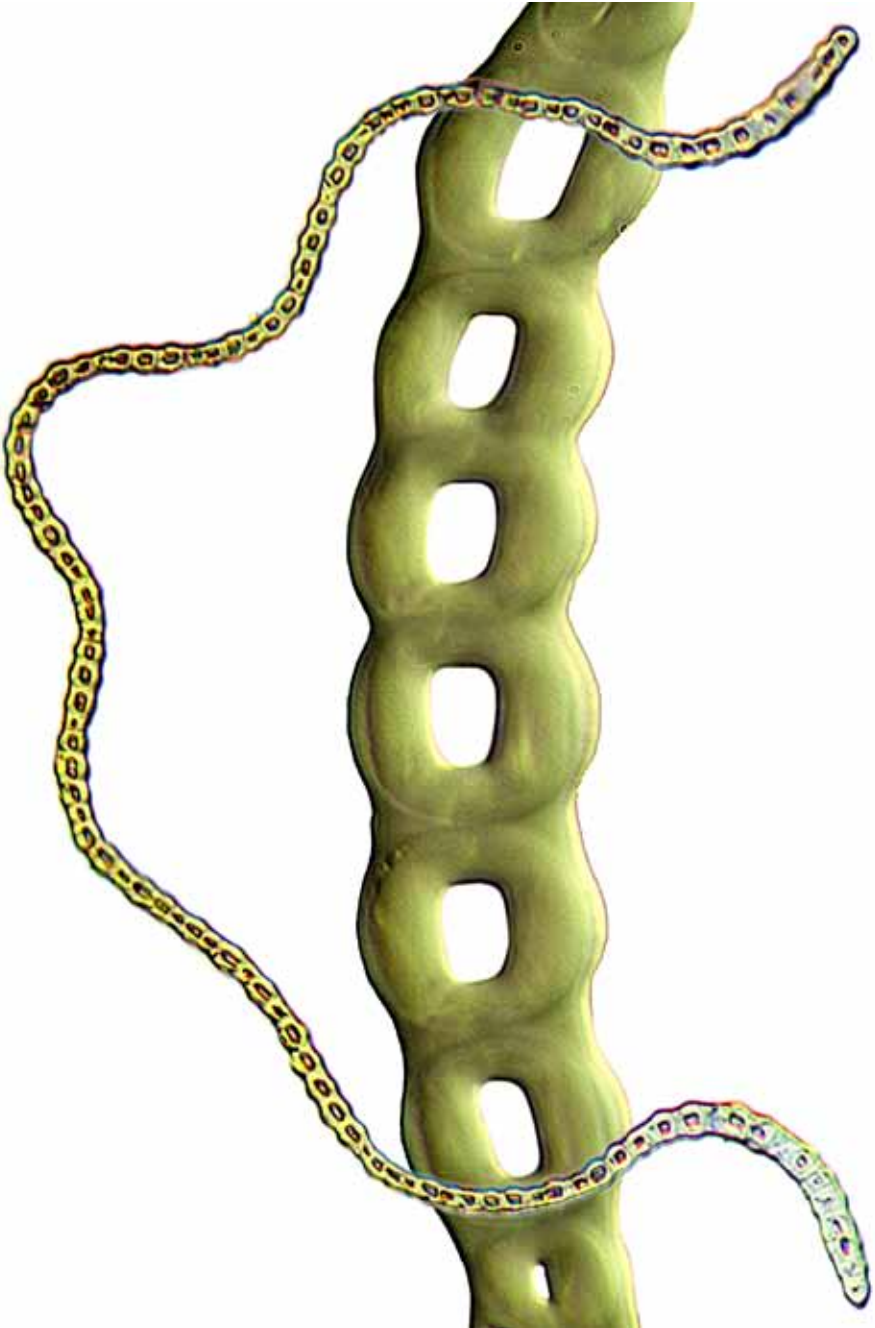
■ 10 μm, ■ 10 μm, ■ 50 μm

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*Glyphothecium sciuroides* denticulate midleaf margin  
10  $\mu$ m

continued next page



*Glyphthecium sciuiroides* leaf cross-sections

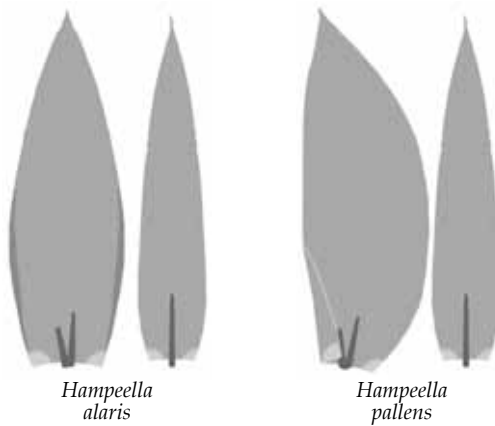
10  $\mu\text{m}$  (background),

50  $\mu\text{m}$  (foreground)

**Key\* to the New Zealand species of *Hampeella* (2)**

- 1 Lower leaves symmetric ..... ● ***Hampeella alaris***  
 1: Lower leaves asymmetric ..... ● ***Hampeella pallens***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 342.



***Hampeella alaris*** (Dixon & Sainsbury) Sainsbury

**form:** tufts of creeping, radiculose stems; secondary stems irregularly branched, 20–30 mm, the leaves yellowish

**habitat:** bark in damp forest

**leaf:** size: 1.5–2.2 × 0.4–0.7 mm

**shape:** lower leaves oblong-oval, concave; upper leaves narrower

**tip:** lower leaves cuspidate; upper leaves acuminate

**base:** basal cells subquadrate, incrassate, pigmented, in auricles

**costa:** none or short and double

**border:** not differentiated

**margin:** entire to sharply denticulate, plane or recurved below

**cells:** 60–80 × 5–8 μm, linear-rhombic, firm-walled, smooth, orange at the insertion

**capsule:** 2 mm, oblong, necked, erect, strongly 8-ribbed, brown; seta 4–5 mm, ± flexuose

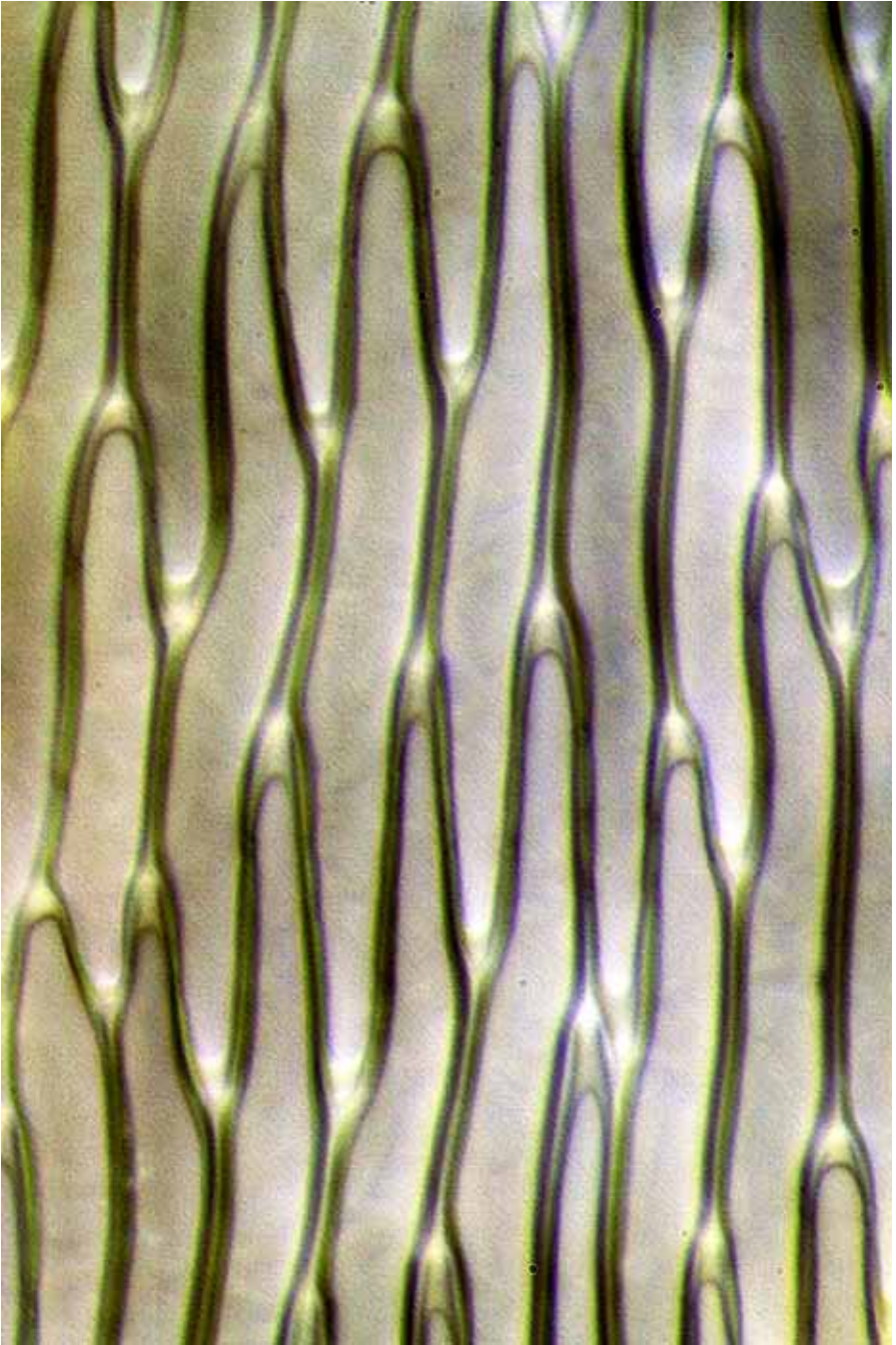
**note:** *Hampeella pallens* differs in having asymmetric lower leaves



fertile shoot, mature capsule, vegetative shoots, lower and upper leaf outlines, leaf apex  
 ■ 1 mm, ■ 0.5 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm (2), ■ 100 μm



leaf apex, margin at midleaf, and costa at midleaf  
 ■ 10 μm, ■ 10 μm, ■ 10 μm



*Hampeella alaris* midleaf cells  
10  $\mu$ m

continued next page

**Hampeella pallens** (Dixon & Sainsbury) Sainsbury

**form:** mats of creeping, radiculose stems; secondary stems to 20 mm  
**habitat:** bark in damp forest

**leaf:** size: to 2 mm

**shape:** lower leaves ovate-lanceolate, strongly asymmetric; upper leaves narrowly lanceolate, symmetric,  $\pm$  decurrent, rugose

**tip:** acute

**base:** angle cells sometimes coloured and thick-walled

**costa:** faint, short, single or double

**border:** not differentiated

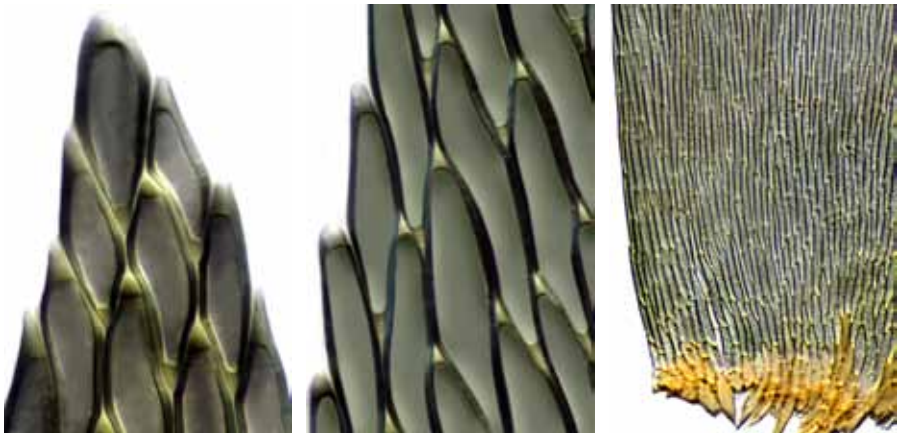
**margin:** serrulate, plane

**cells:** 70–100  $\times$  10–14  $\mu\text{m}$ , linear-rhombic, firm-walled, smooth

**capsule:** 2–2.5 mm, oblong to cylindric, suberect, sharply 8-ribbed when dry, exserted; operculum obliquely long-rostrate; annulus none; seta 6–9 mm, lateral, curved, reddish or yellow; exostome teeth hyaline-margined, endostome ecliate; spores 14–32  $\mu\text{m}$  in diam., irregular

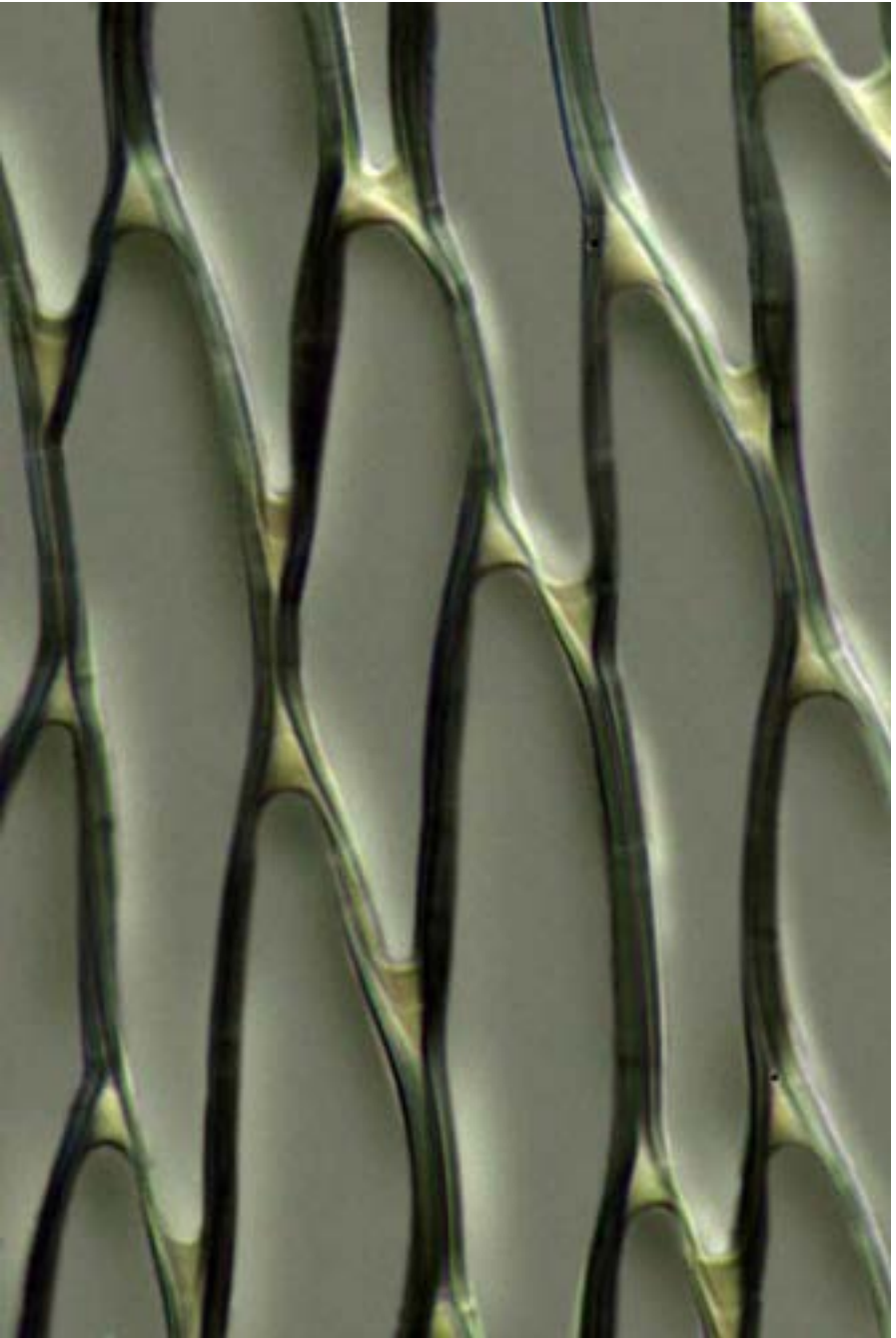


vegetative shoot (2) (dry), capsule (dry), lower leaf outline, and lower leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50  $\mu\text{m}$



apex of lower leaf, margin of upper leaf, and lower leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

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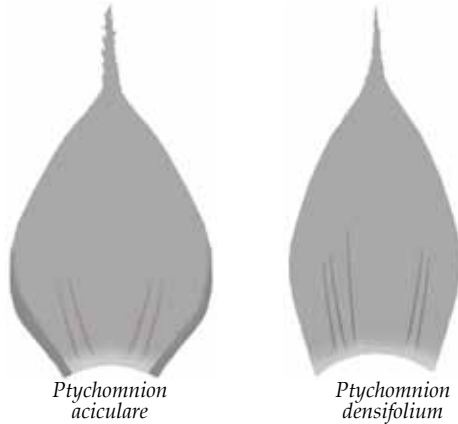
*Hampeella pallens* cells of upper lateral leaf  
10  $\mu\text{m}$



**Key\* to the New Zealand species of Ptychomnion (2)**

- 1 Cell walls narrower than the lumen; leaf apex abruptly elongate with few to many large sharp teeth; sheathing leaf bases rarely overlapping .. ● **Ptychomnion aciculare**  
 1: Cell walls wider than the lumen; leaf apex short-acute or -acuminate with marginal serrations; sheathing leaf bases often overlapping ..... ● **Ptychomnion densifolium**

\* based on Seppelt, RD (1994): *The Moss Flora of Macquarie Island*. Australian Antarctic Division, Kingston, 238.



**Ptychomnion aciculare** (Brid.) Mitt.

**form:** mats of creeping, branched stems, to 100 mm, the leaves golden, papery, translucent, glossy

**habitat:** soil, bark, and rock in damp beech forest, to 1100 m

**leaf:** size: 3–5 × 1.2–2.0 mm

**shape:** ovate from a narrow plicate base, papery, rugose when dry

**tip:** abruptly long-acuminate, the acumen tooth twisted (torquate)

**base:** several marginal rows with short, coloured cells

**costa:** none or faint and double

**border:** weak, 3–4 rows of enlarged cells

**margin:** denticulate above, coarsely serrate in the acumen, plane

**cells:** 30–50 × 7–10 μm, linear, incrassate, porose, smooth

**capsule:** 3–4 mm, cylindric, deeply grooved when dry, horizontal to cernuous; seta 25–40 mm, slender, flexuose, brown; peristome double, exostome teeth cross-striolate below, papillose above; endostome cilia 2–3; spores 8–12 μm in diam., pale, smooth



habit, vegetative shoot (fully hydrated on right) (2), leaf outline, and leaf acumen  
 10 mm, 5 mm (2), 1 mm, 50 μm



margin at midleaf, cells at midleaf, and double peristome  
 50 μm, 50 μm, 0.5 mm

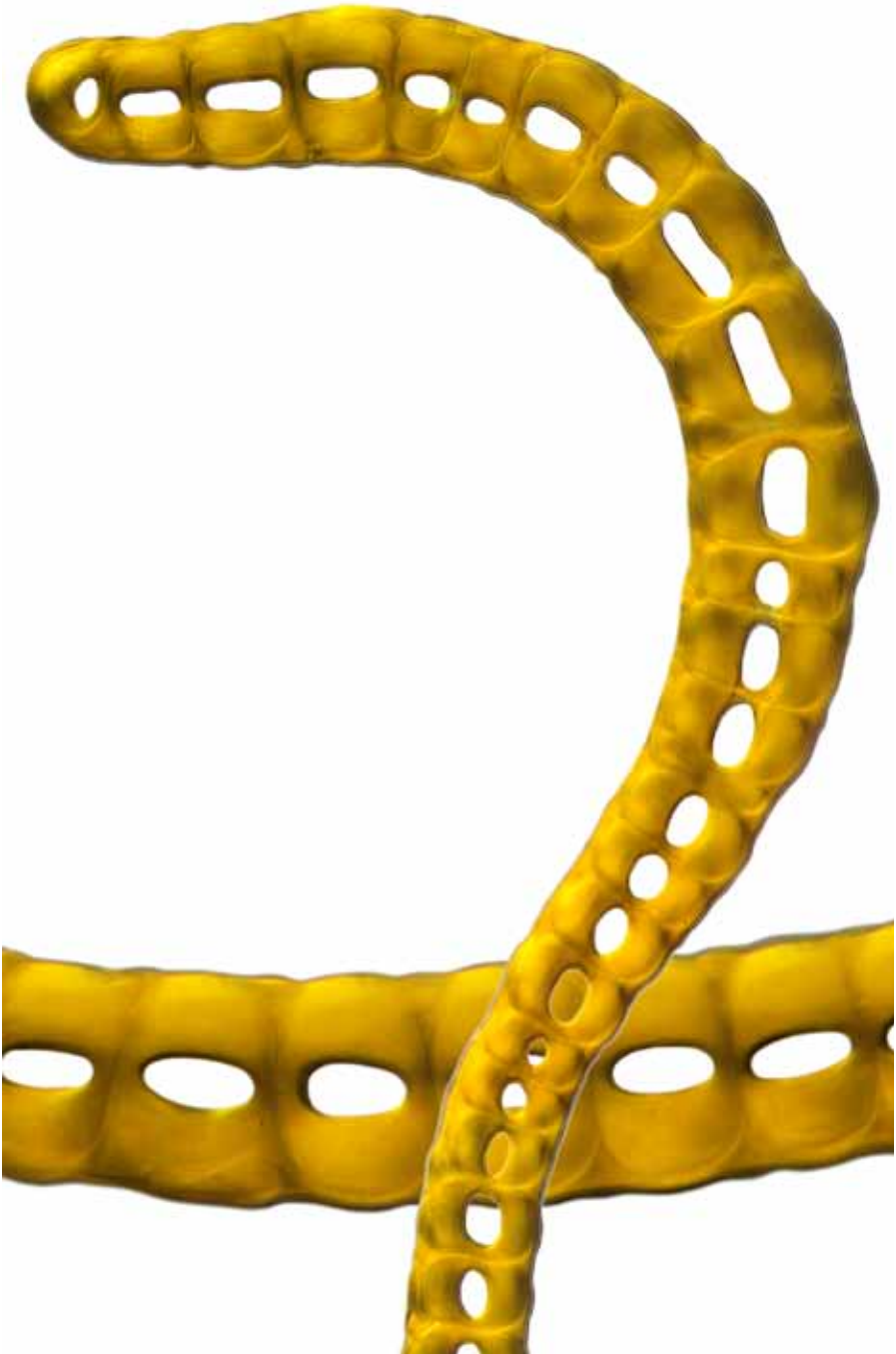
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*Ptychomnion aciculare* vegetative shoots (dry on left, fully hydrated on right)

1 mm

continued next page



*Ptychomnion aciculare* cross-section of leaf margin (above) and lamina midleaf (below)  
10  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)

continued next page

**Ptychomnion densifolium** (Brid.) A.Jaeger

**form:** mats of procumbent, creeping, branched stems, 40–100 mm,  
leaves papery, translucent, glossy, crumpled, little changed when dry  
**habitat:** soil or rotting logs in grassland or scrub, to 1400 m

**leaf:** size: 3.5–4.2 × 1.6–2.0 mm

*shape:* ovate from a plicate, sheathing base

*tip:* abruptly acuminate, the tip toothed and twisted (torquate)

*base:* not differentiated; insertion area ± pigmented

*costa:* none or faint and double

*border:* not differentiated

*margin:* denticulate above, ± serrate in the acumen, plane

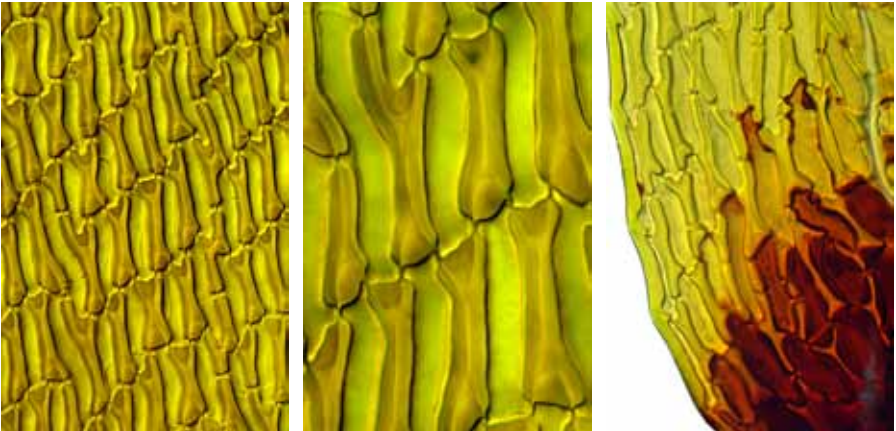
*cells:* 45–60 × 8–12 μm, rectangular to linear, porose, incassate, smooth

**capsule:** 3.5 mm, oblong-cylindric, gibbous, exserted, ± horizontal,  
brown, deeply grooved when dry; hypophysis strumose; seta to 25  
mm; operculum long-rostrate; peristome double, exostome teeth red,  
endostome hyaline



vegetative shoot (dry), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm, ■ 10 μm



cells at midleaf (2), and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

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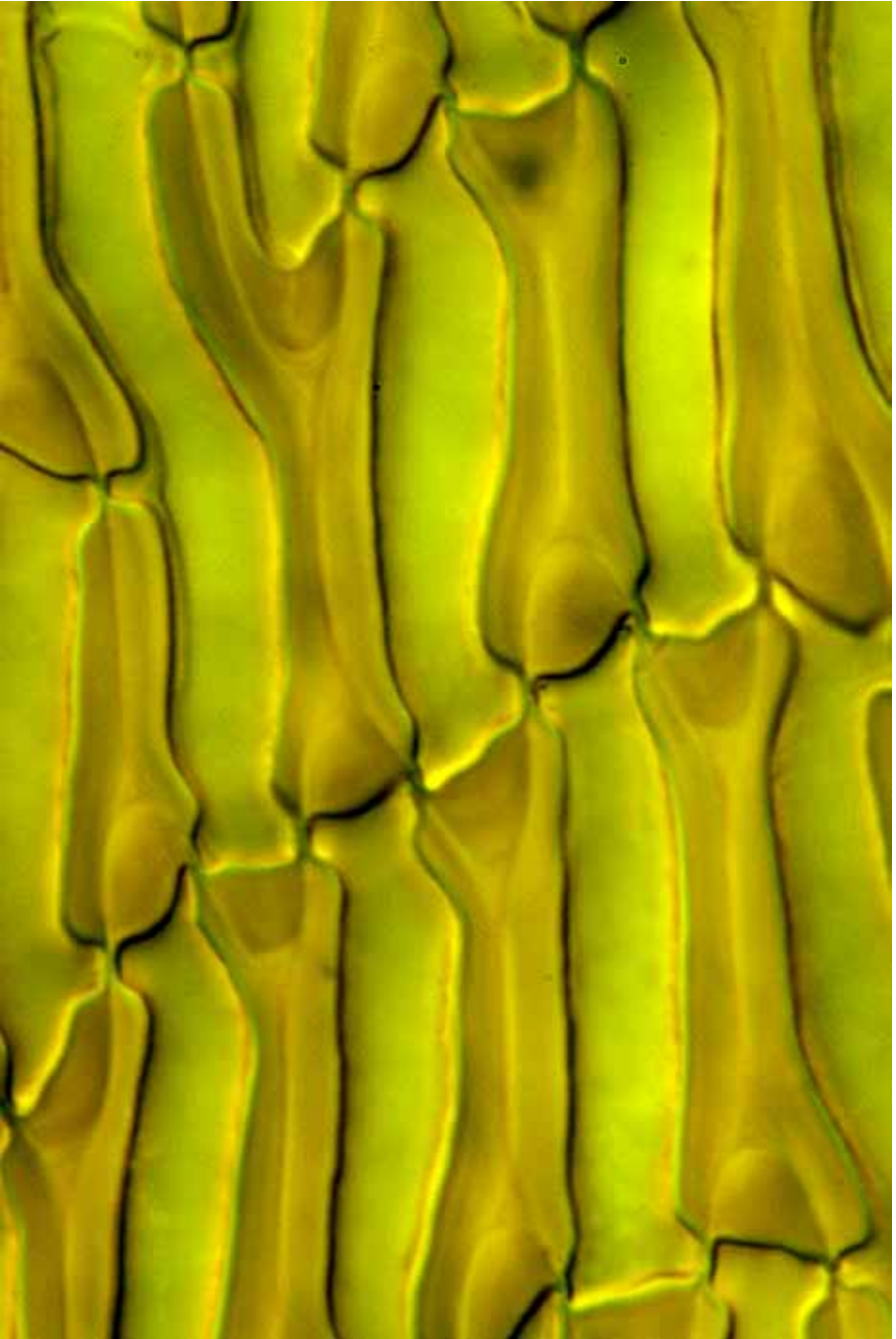
*Ptychomnion densifolium* vegetative shoot (dry)  
1 mm

continued next page



*Ptychomnion densifolium* margin midleaf  
10  $\mu$ m

continued next page



*Ptychomnion densifolium* cells midleaf  
10  $\mu\text{m}$



**Tetraphidopsis pusilla** (Hook.f. & Wilson) Dixon

**form:** tufts of erect, unbranched, radiculose stems, 5–40 mm, the leaves glossy, yellowish, 5-ranked; gemmae often clustered on tips of shoots

**habitat:** bark of twigs or vines, near streams in damp forest, to 760 m

**leaf:** size: 0.8–1.5 × 0.3–0.4 mm

*shape:* lanceolate

*tip:* acute

*base:* alar cells ± quadrate, pigmented

*costa:* short, obscure

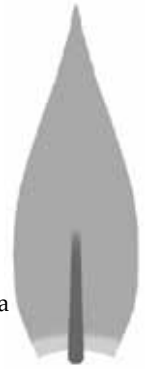
*border:* not differentiated

*margin:* entire below, crenulate above, plane or narrowly reflexed

*cells:* 25–40 × 7–9 μm, rhombic-hexagonal, firm-walled, smooth

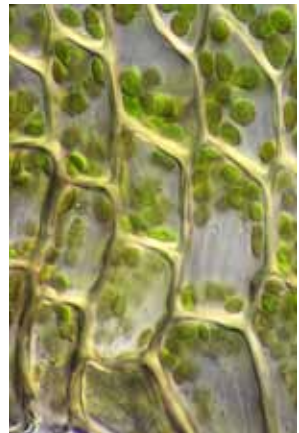
**capsule:** 1 mm, narrowly elliptic, erect, symmetrical, strongly 8-ribbed; seta 3 mm, reddish; peristome double; spores dimorphic, 30–45 μm in diam.

**note:** some stems gemmiferous, with a terminal globose cluster of 5-celled filamentous brood bodies



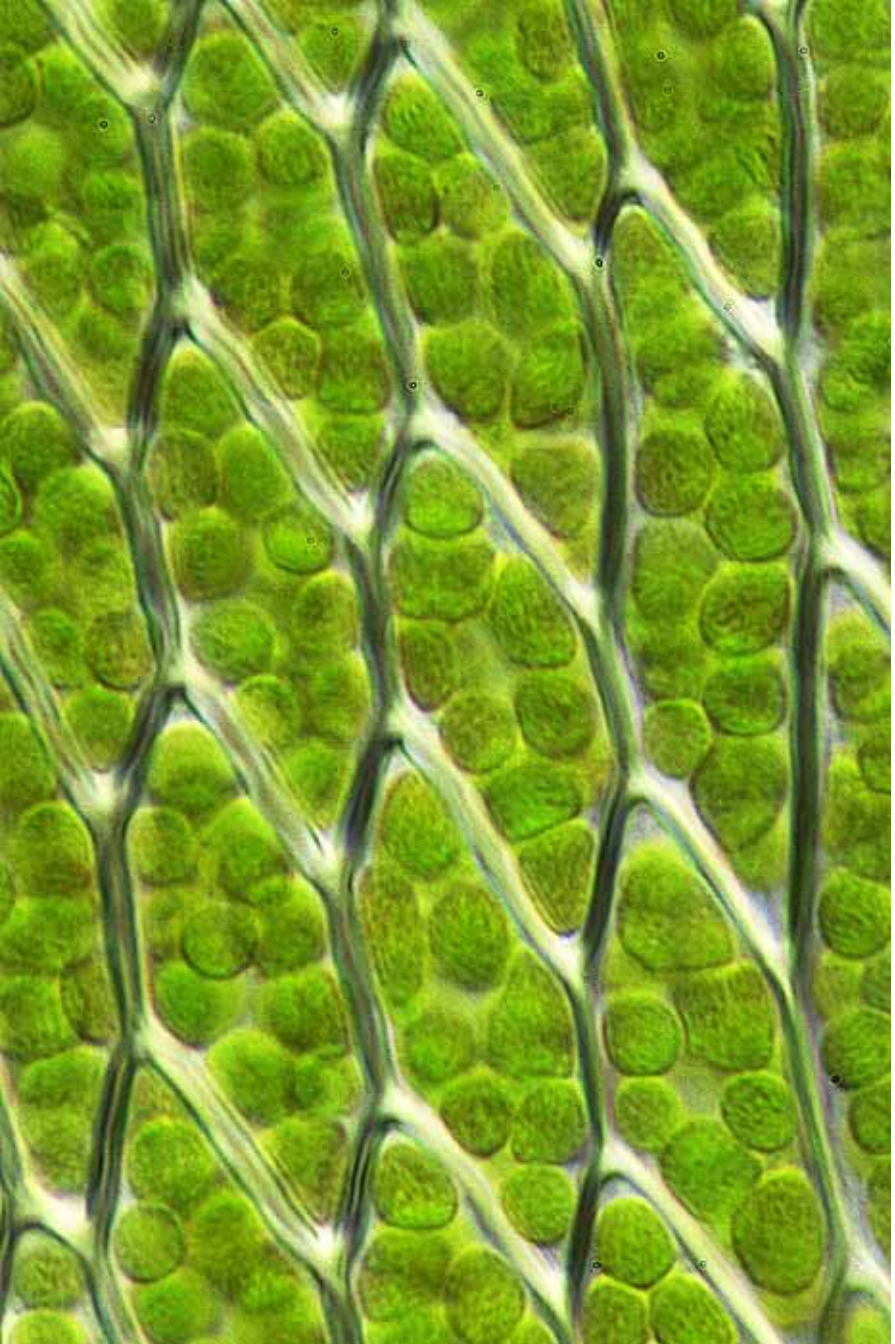
vegetative shoot, terminal brood bodies, leaf outlines (2), and leaf apex

1 mm, 10 μm, 0.1 mm, 10 μm



margin at midleaf, costa at midleaf, and cells near leaf base

10 μm, 10 μm, 10 μm



*Tetrarhizidium pusilla* cells midleaf  
10  $\mu\text{m}$

**Canalhypopterygium tamariscinum** (Hedw.) Kruijer

**form:** primary stems creeping, secondary stems 30–60 mm tall, erect, blackish, naked, glossy, frondose, the leaves whitish green

**habitat:** moist soil or rock in damp forest

**leaf:** size: 1–1.5 mm

**shape:** lateral leaves ovate to triangular-ovate, distichous, asymmetric; amphigastria smaller, dimorphic (either bristle-like or ovate-lanceolate)

**tip:** bluntly acuminate

**base:** basal cells larger and laxer than other blade cells

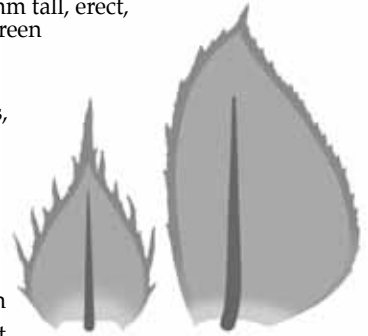
**costa:** reaching well up the blade

**border:** 2–3 rows of elongate cells

**margin:** denticulate to spinulose-ciliate, plane

**cells:** 14–20 × 6–12 μm, ± hexagonal, firm-walled, smooth

**capsule:** 2 mm, seta 6–9 mm, stout, red; oblong, pendent, fleshy, pale brown with a darker mouth; peristome double; spores 10–12 μm in diam.



vegetative shoot, amphigastria and rudimentary leaves, and rudimentary leaf  
 ■ 5 mm, ■ 1 mm, ■ 10 μm



leaf outlines (2), margin at midleaf, and cells at midleaf  
 ■ 0.1 mm (2), ■ 10 μm, ■ 10 μm



*Canalohipopterygium tamariscinum* vegetative shoot  
5 mm

continued next page



*Canaloptygium tamariscinum* capsules  
1 mm

**Catharomnion ciliatum** (Hedw.) Hook.f. & Wilson

**form:** primary stems creeping, tomentose, secondary stems 5–25 mm tall, frondose, bristly, pinnately branched, the leaves soft, yellow-green

**habitat:** bark

**leaf:** size: 0.6–1 mm

*shape:* ovate-orbicular

*tip:* acuminate, piliferous

*base:* basal cells laxer than the other blade cells

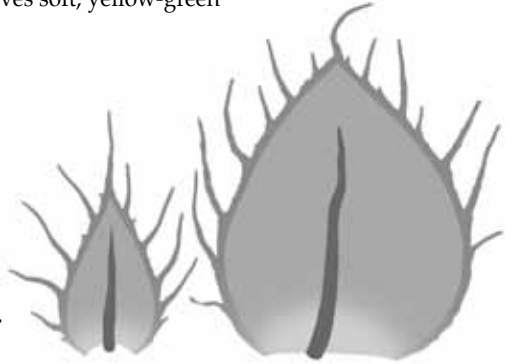
*costa:* vanishing above midleaf

*border:* 1–2 rows of narrow, elongate cells

*margin:* strongly ciliate, plane

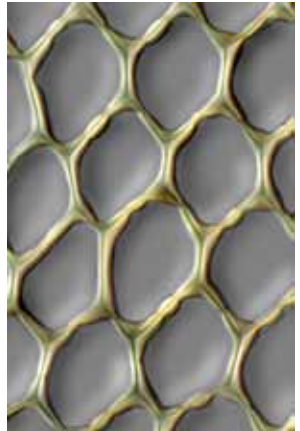
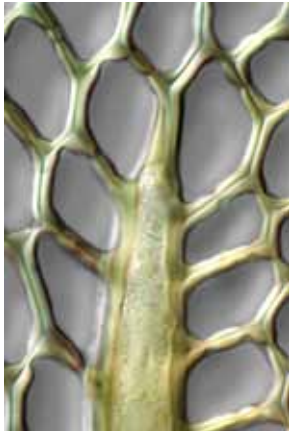
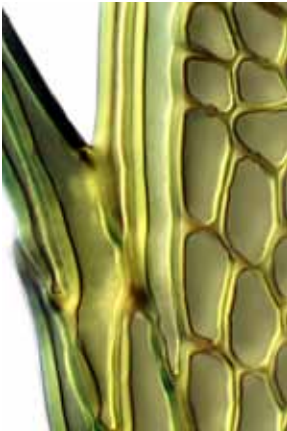
*cells:* 15–20 × 12 μm, rhombic to hexagonal, firm-walled, smooth

**capsule:** 1.5–2 mm, oblong-cylindric, erect to inclined, red-brown, exannulate, short-necked; seta 4–6 mm, smooth, red, curved or straight



vegetative habit, leaf outlines (2), and margin midleaf

■ 1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, costa terminus, and cells at midleaf

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Catharomnion ciliatum* vegetative habit (moist)

1 mm

continued next page



*Catharomnion ciliatum* rain-wet (hydrophobic) vegetative frond  
1 mm

continued next page





*Catharomnion ciliatum* capsule, calyptra, and peristome  
1 mm

**Cyathophorum bulbosum** (Hedw.) C.M.

**form:** primary stems creeping, tomentose, secondary stems 40–100(–200) mm long, distichous

**habitat:** damp humus, logs, or rock in shaded forest

**leaf:** size: 3–12 × 2.5–7.2 mm; underleaves smaller

*shape:* obliquely ovate, concave; underleaves orbicular

*tip:* acuminate; underleaves apiculate

*base:* not differentiated

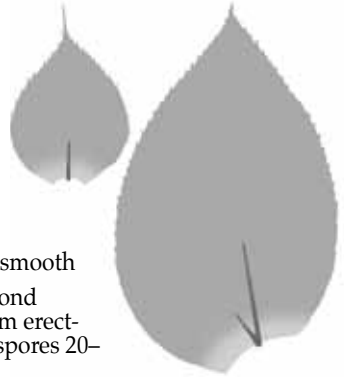
*costa:* short, single or bifid

*border:* absent or faint toward the base

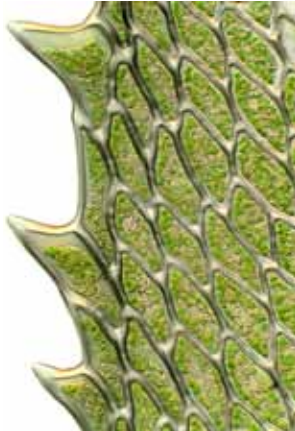
*margin:* sharply dentate above, plane

*cells:* 80–100 × 25–35 μm, oblong-hexagonal, firm-walled, smooth

**capsule:** 1.5 mm, oval, globose, straight, pendent, on frond underside; seta 1 mm; calyptra conic, beaked; operculum erect-rostrate; exostome cross-striolate, endostome cilia 1–3; spores 20–24 μm in diam., smooth



vegetative habit, shoot underside, and leaf and underleaf outlines  
 ■ 10 mm, ■ 1 mm, ■ 1 mm (2)

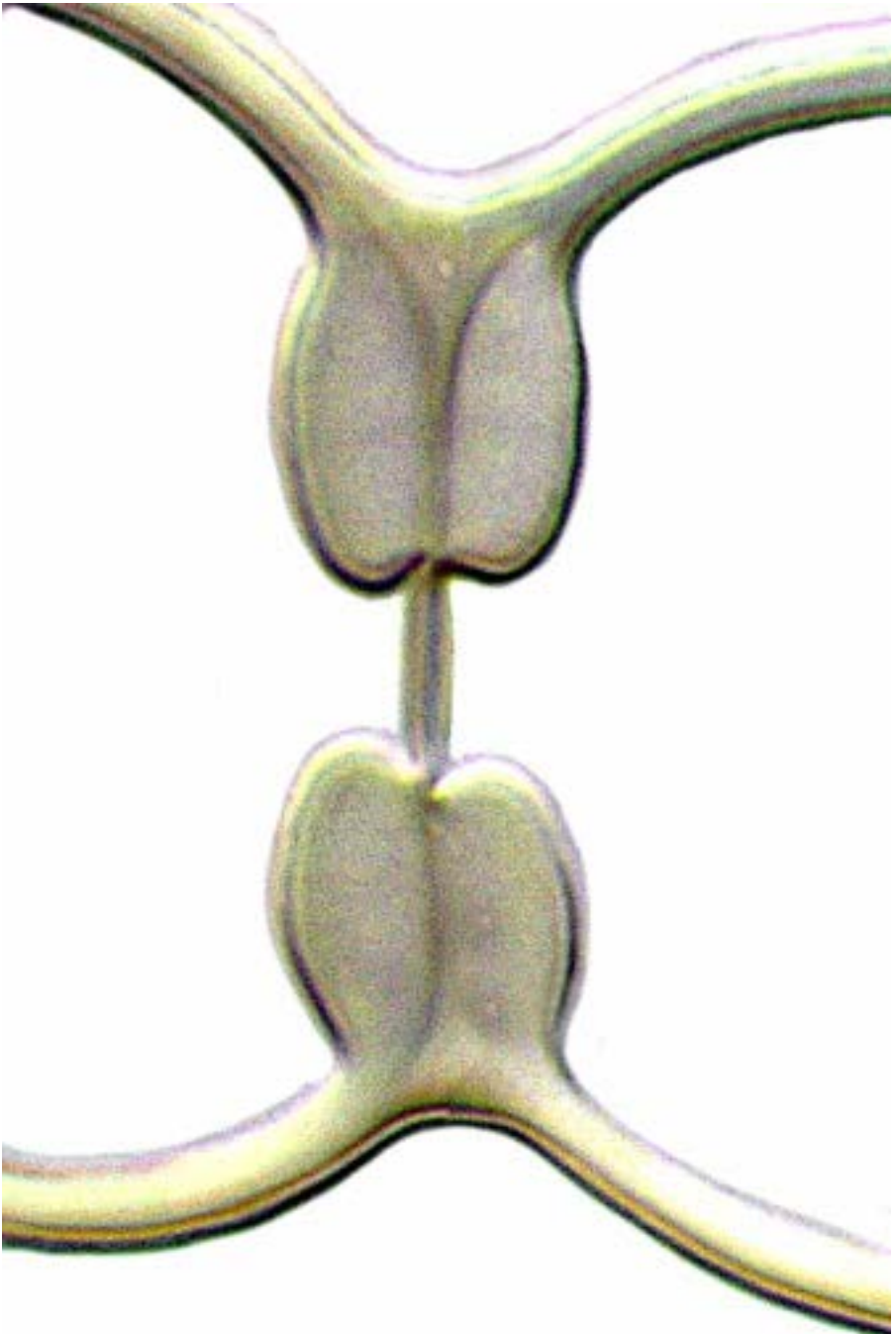


leaf apex, margin at midleaf, and capsules (underside of stem)  
 ■ 50 μm, ■ 50 μm, ■ 1 mm



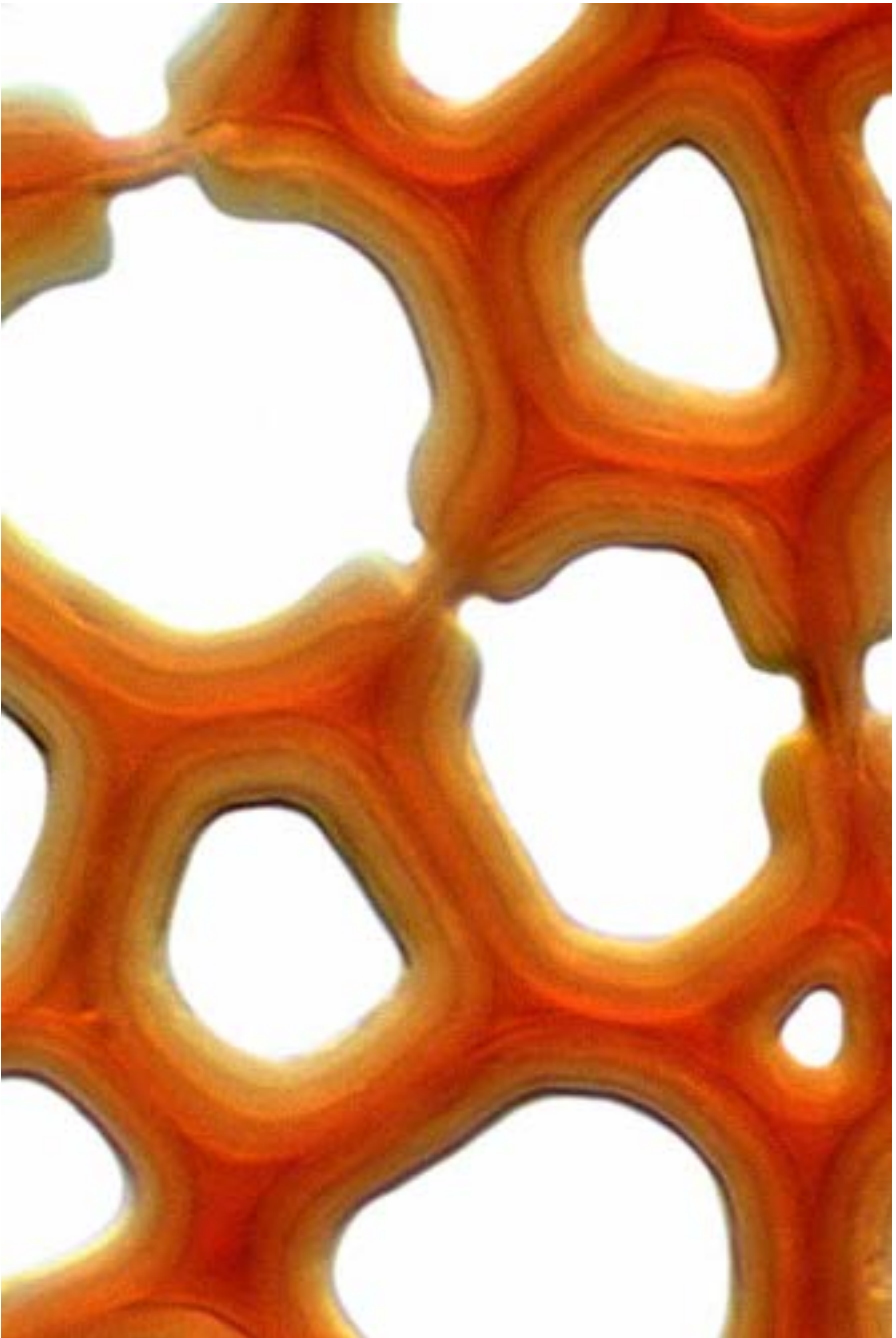
*Cyathophorum bulbosum* leaf margin cross-section  
10  $\mu$ m

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*Cyathophorum bulbosum* leaf cross-section showing porose cell walls  
10  $\mu\text{m}$

continued next page



*Cyathophorum bulbosum* stem cross-section showing porose cell walls  
10  $\mu\text{m}$

**Dendrohypopterygium filiculiforme** (Hedw.) Kruijer

**form:** primary stem creeping, secondary stems 100–130 mm tall, erect, frondose, tomentose, glabrous when old

**habitat:** moist shaded soil, rotting logs, and rock in forest

**leaf:** size: 1–1.5 mm

*shape:* lateral leaves triangular-ovate; underleaves ovate-lanceolate

*tip:* stem leaves bluntly acuminate, underleaves sharply acuminate

*base:* some leaves with basal bristly rhizoids

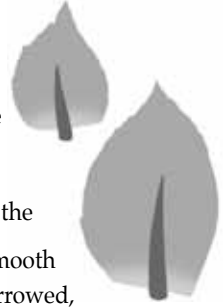
*costa:* ending well below the leaf apex

*border:* not differentiated

*margin:* lateral leaves spinulose-serrate on one side, denticulate on the other, slightly decurved; underleaves spinulose-ciliate, plane

*cells:* 10–40 × 5–20 μm, hexagonal or wide-rhombic, firm-walled, smooth

**capsule:** 2 mm, ellipsoid, pendent, the base tubercled, abruptly narrowed, brown; seta 6–9 mm; operculum rostrate; exostome yellow, cilia 1(–3); spores 10–16 μm



vegetative "umbrella" habit, vegetative frond (portion), and leaf outlines (2)

50 mm, 5 mm, 1 mm (2)



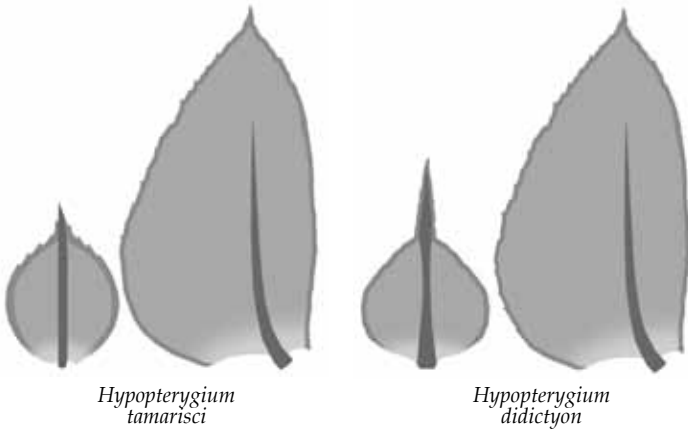
leaf apex (2), and costa terminus

50 μm, 10 μm, 10 μm

**Key\* to the New Zealand species of Hypopterygium (2)**

- 1 Branch leaves in five rows (four flattened lateral rows plus one dorsal row) ..... ● **Hypopterygium didictyon**  
 1: Branch leaves in only three rows (two lateral rows plus one dorsal row)..... ● **Hypopterygium tamarisci**

\* based on Meagher, D; Fuhrer, B (2003): *A Field Guide to the Mosses and Allied Plants of Southern Australia*. Flora of Australia Supplementary Series Number 20, 158.



**Hypopterygium didictyon** Müll.Hal.

**form:** palmate or umbellate fronds atop erect stipes, up to 30 mm, tomentose but glabrous when young, arising from a creeping rhizoid; stipe leaves in 8 ranks, frond leaves dimorphic, in 3 or 8 ranks; to 1660 m elev.

**habitat:** soil, rock, rotting logs, or tree trunks in humid woodland and scrub

**leaf:** amphigastria  $0.2\text{--}1.5 \times 1.0\text{--}1.5$  mm; lateral leaves  $0.5\text{--}3.0 \times 0.2\text{--}1.0$  mm

*shape:* amphigastria  $\pm$  circular; lateral leaves asymmetric, ovate-oblong

*tip:* amphigastria stoutly cuspidate; lateral leaf  $\pm$  apiculate

*base:* alar cells rectangular, longer than the other lamina cells

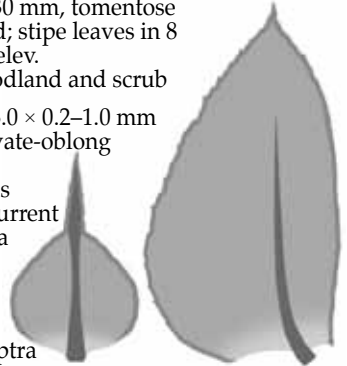
*costa:* percurrent to excurrent in amphigastria; none to percurrent in lateral leaves, usually reaching about  $2/3$  up the lamina

*border:* 2–4 rows of linear, thick-walled cells in most leaves

*margin:* entire to coarsely serrate or dentate, plane

*cells:*  $20\text{--}95 \times 5\text{--}30$   $\mu\text{m}$ , hexagonal, firm-walled, smooth

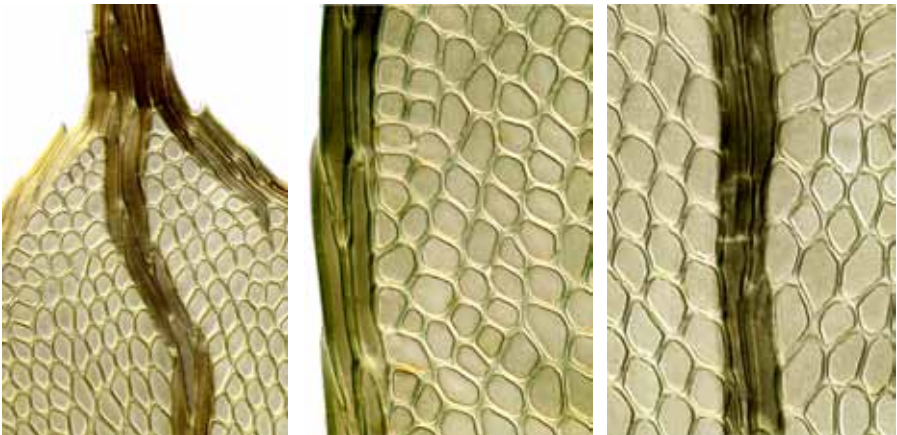
**capsule:**  $1\text{--}2 \times 0.7\text{--}1.5$  mm, ellipsoidal; seta 12–18 mm; calyptra 3–4 mm



dimorphic frond leaves



vegetative frond (portion, dry) (2), frond leaf outlines (2), and amphigastria apex  
 1 mm, 1 mm, 1 mm (2), 50  $\mu\text{m}$



amphigastria subapex, lateral frond leaf margin midleaf and costa midleaf  
 50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

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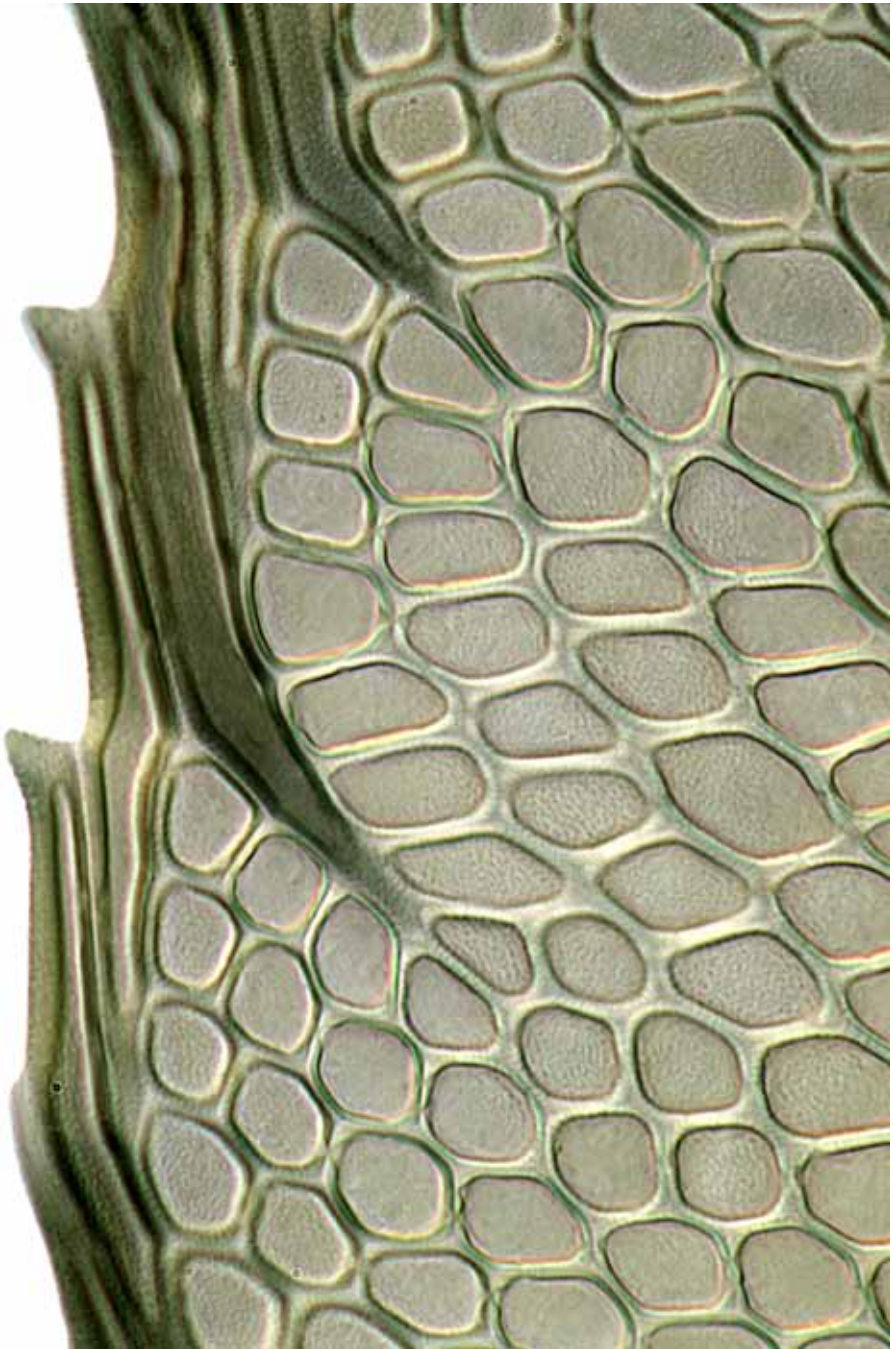




*Hypopterygium didictyon* vegetative shoot (cleared)

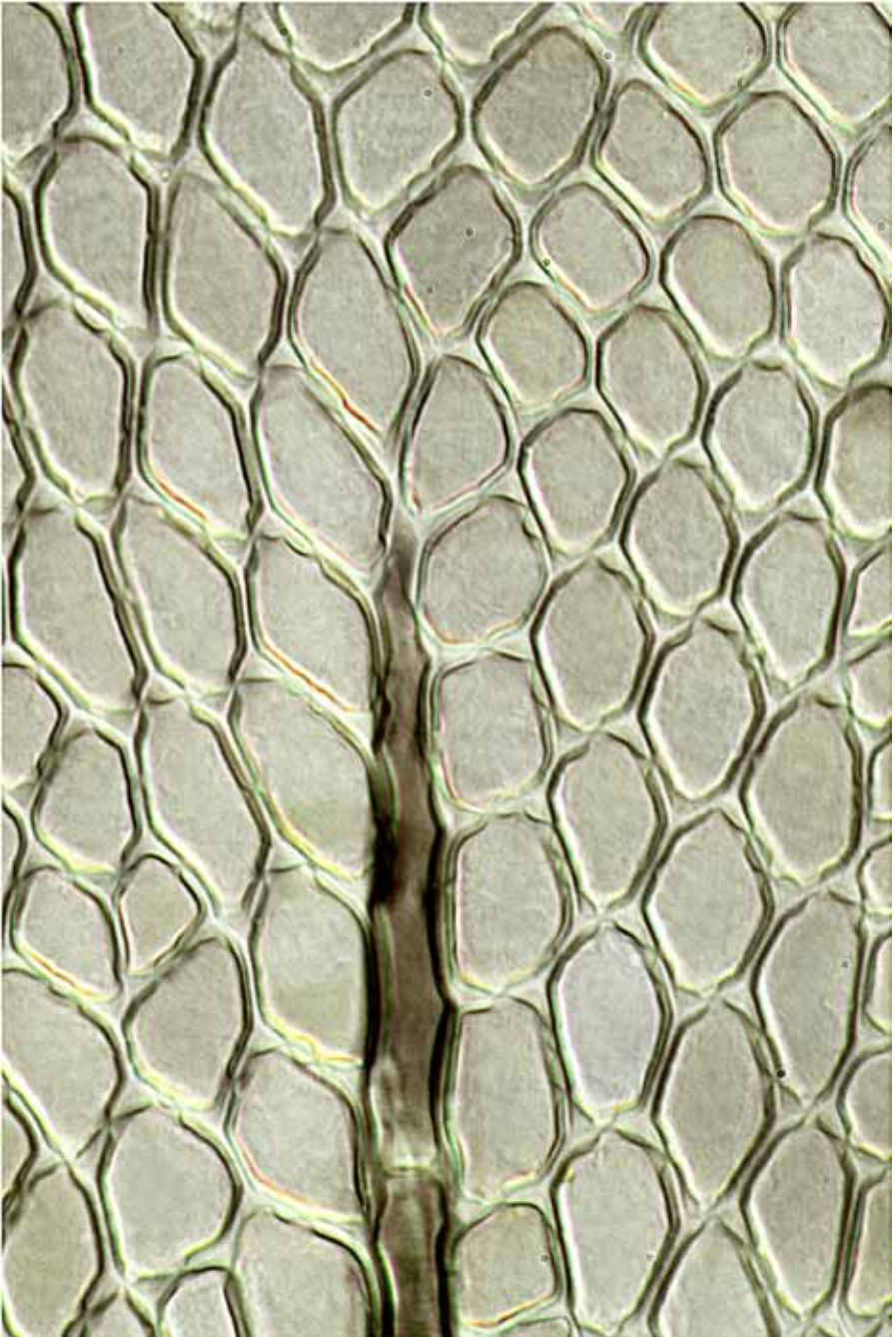
1 mm

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*Hypopterygium didictyon* bordered amphigastria leaf  
10  $\mu\text{m}$

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*Hypopterygium didictyon* lateral frond leaf showing lamina cells and costa terminus  
10  $\mu\text{m}$

**Hypopterygium tamarisci** (Sw.) Müll.Hal.

**form:** primary stem creeping, stipes tomentose, to 15 mm tall  
**habitat:** rock, bark, and tree ferns, or rotting logs and soil in shaded forests, often near streams, up to 480 m elevation

**leaf:** size: branch leaves 1.1–1.3 × 0.5–0.7 mm; underleaves 0.6–0.9 × 0.3–0.5 mm; stipe leaves in 3 or 11 ranks; frond leaves in 3 ranks

**shape:** branch leaves asymmetric; underleaves suborbicular

**tip:** branch leaves apiculate; underleaves acuminate

**base:** not differentiated

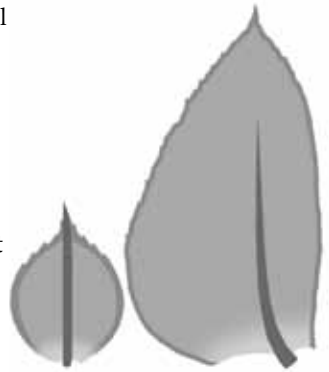
**costa:** branch leaves 2/3 up leaf blade; underleaves excurrent

**border:** 1–3 rows of elongate-linear cells 100–130 × 6 μm

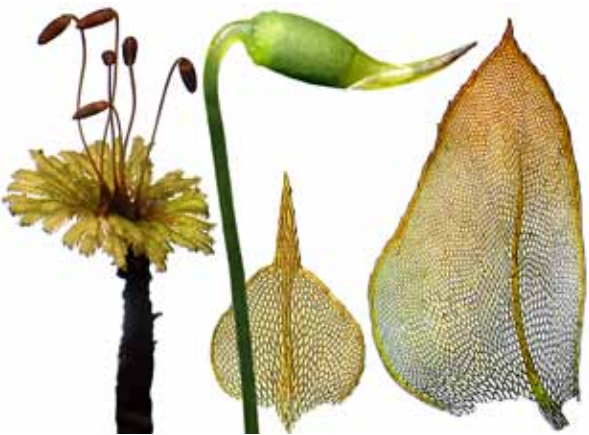
**margin:** entire to serrate-dentate above, plane

**cells:** 20–60 × 10–25 μm, ± hexagonal, firm-walled, smooth

**capsule:** 1–2 mm, ovoid, horizontal to pendent, pale brown; seta 10 mm



branch leaf



vegetative habit, fertile shoot with mature capsules, young capsule, and leaf outlines (2)  
 1 mm, 5 mm, 1 mm, 0.5 mm (2)



lateral leaf apex, lateral leaf margin, and lateral leaf basal angle  
 50 μm, 10 μm, 50 μm

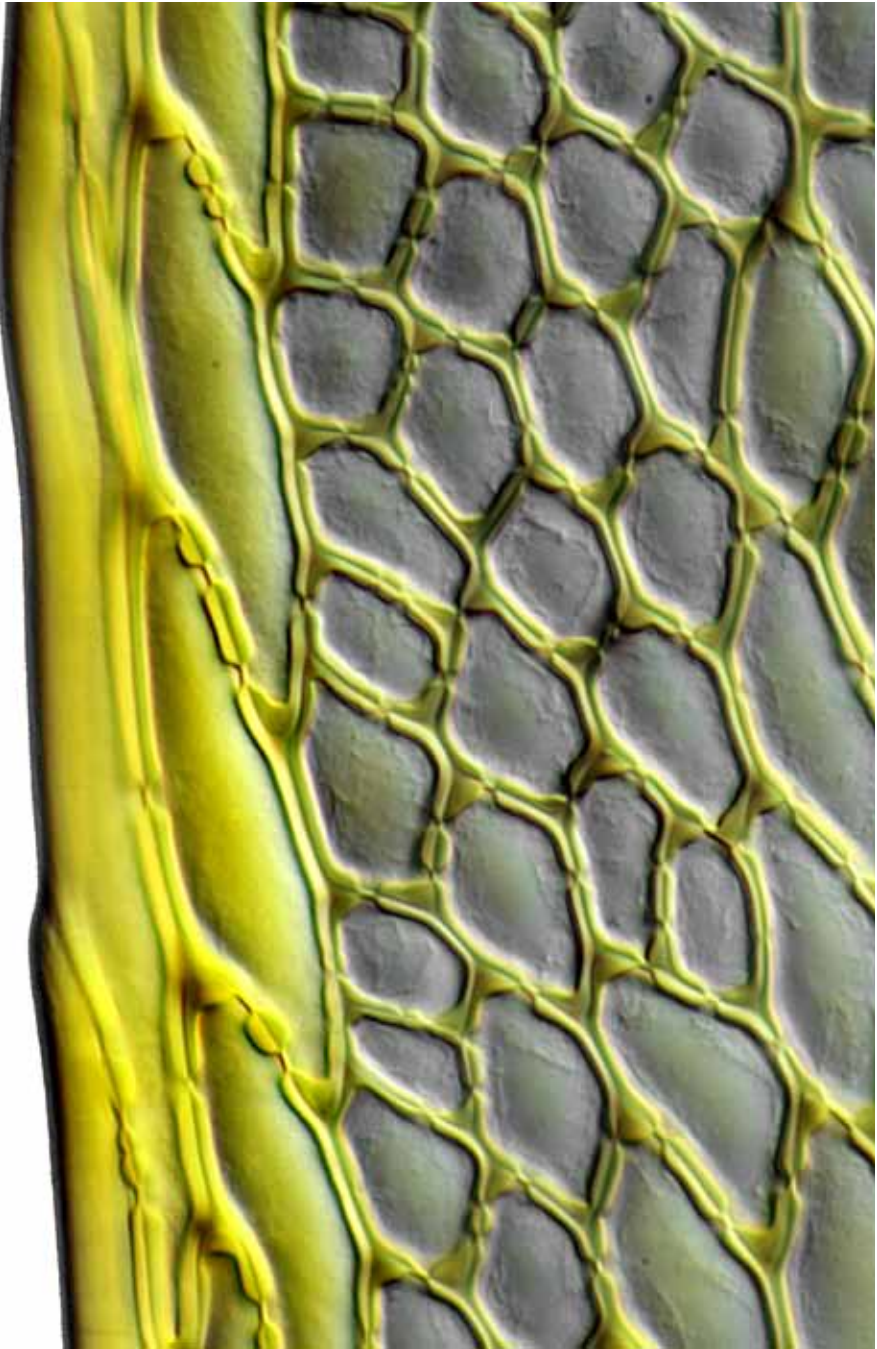
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*Hypopterygium tamarisci* vegetative habit

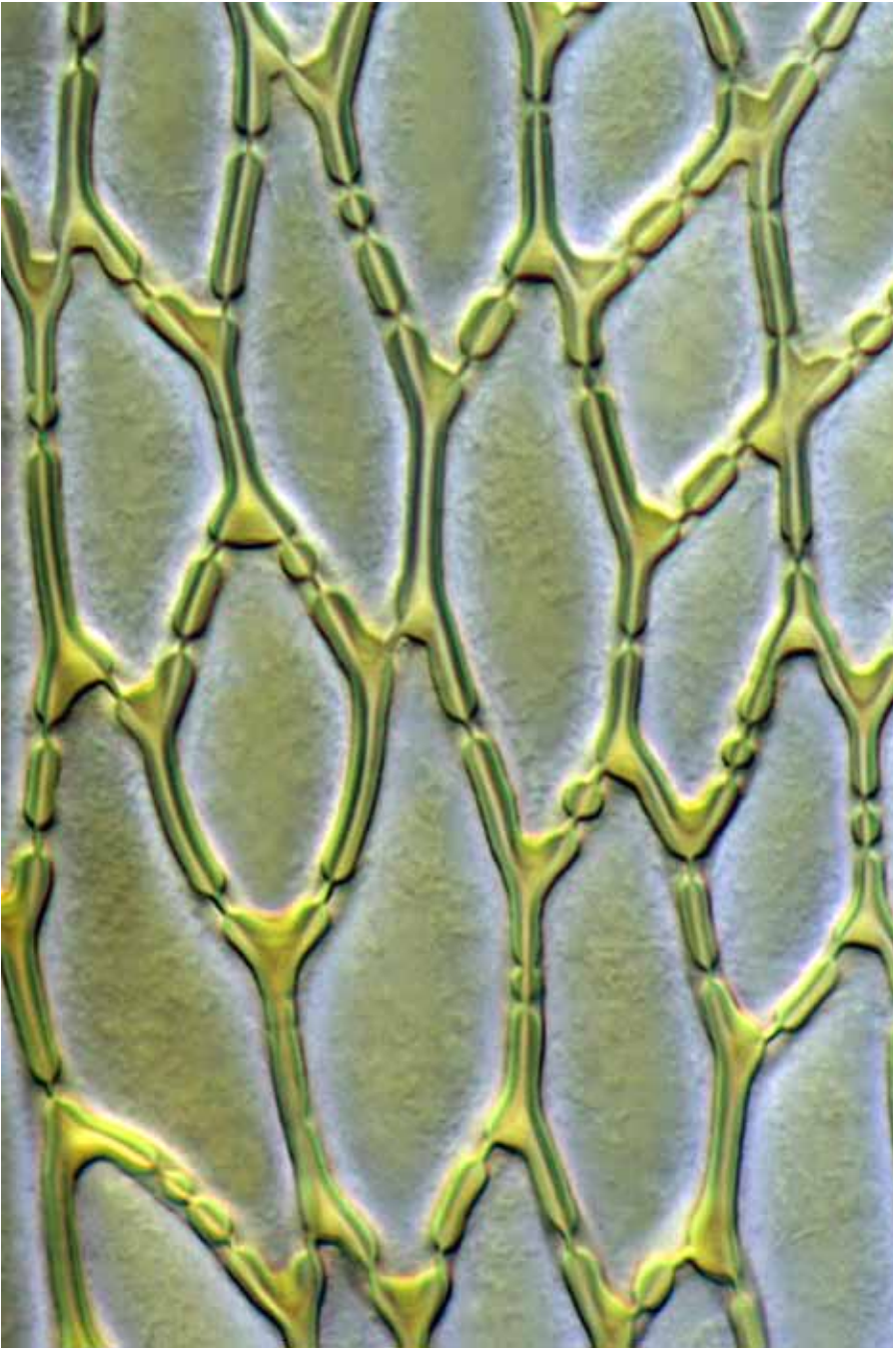
1 mm

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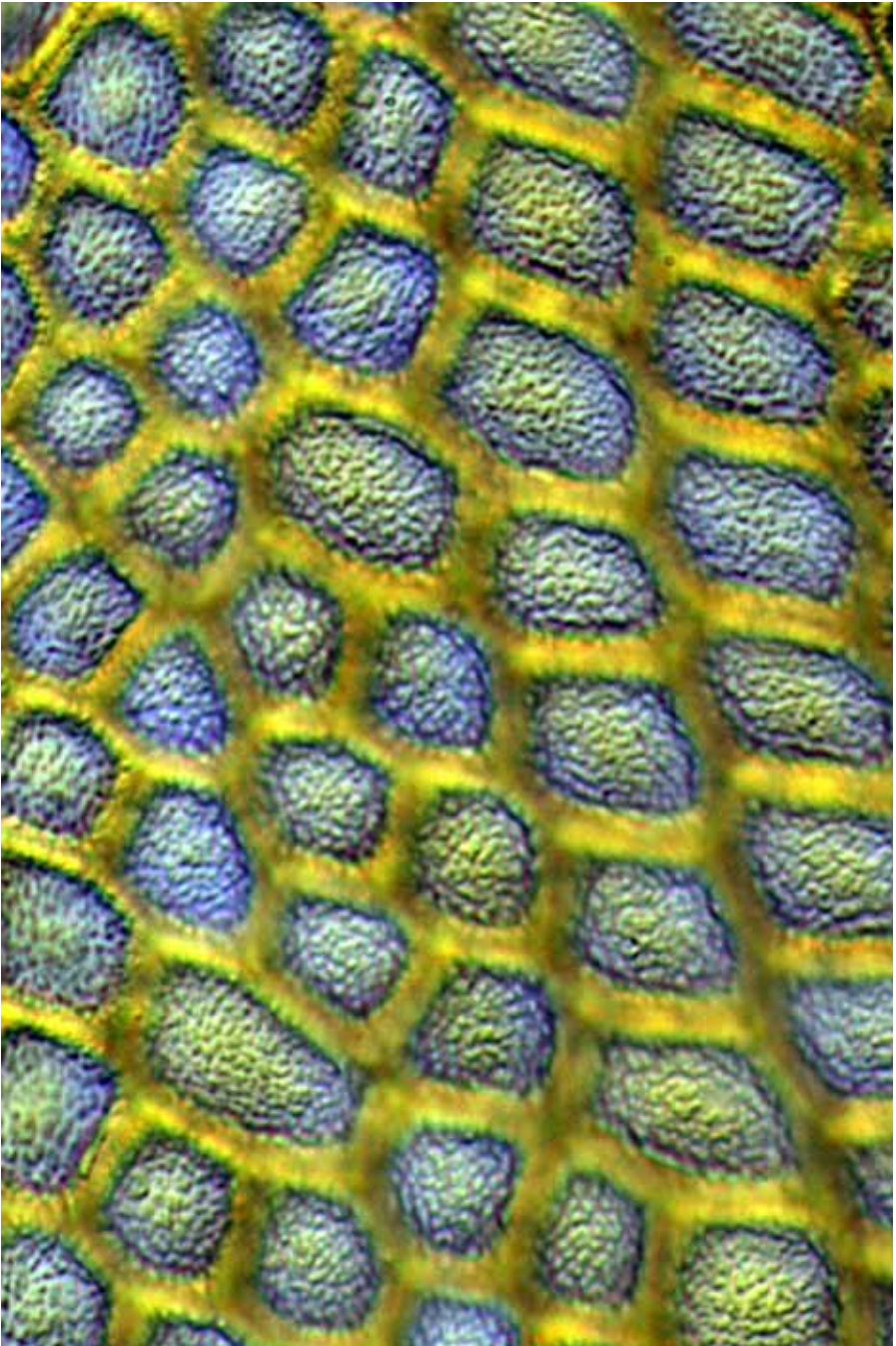
*Hypopterygium tamarisci* lateral leaf margin  
10  $\mu$ m

continued next page



*Hypopterygium tamarisci* underleaf cells  
10  $\mu\text{m}$

continued next page



*Hypopterygium tamarisci* underleaf cells, minutely scabrid surface  
10  $\mu\text{m}$

continued next page





*Hypopterygium tamarisci* mature capsule and double peristome  
0.5 mm

continued next page



*Hypopterygium tamarisci* leaf margin cross-section  
10  $\mu\text{m}$

continued next page



*Hypopterygium tamarisci* leaf cross-section  
10  $\mu\text{m}$

**Lopidium concinnum** (Hook.) Hook.f. & Wilson

**form:** primary stems creeping, radiculose, secondary stipe 30–100 mm tall, blackish, frondose, pinnately branched, distichous

**habitat:** soil, damp bark, litter, humus, or rock

**leaf:** size: branch leaves  $1.5\text{--}2 \times 0.5\text{--}0.7$ ; underleaves  $0.8\text{--}1.0 \times 0.5$  mm

**shape:** branch leaves oblong-lingulate; underleaves ovate-lanceolate

**tip:** branch leaves short-acuminate; underleaves long-acuminate

**base:** not differentiated

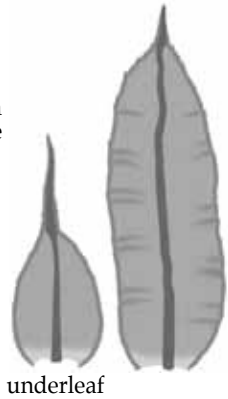
**costa:** stout, flexuose above, long-excurrent in the acumen

**border:** 2–3 rows of linear cells

**margin:** denticulate above, plane to  $\pm$  undulate

**cells:** 10–12  $\mu\text{m}$ , isodiametric, incrassate,  $\pm$  mammillose

**capsule:** 1.5–2 mm, oblong-cylindric, erect, light brown; seta 4–8 mm, flexuose or cygneous, reddish; calyptra cucullate, dark above; operculum erect long-rostrate; exostome teeth striolate, endostome cilia absent; spores 12–14  $\mu\text{m}$  in diam., smooth



underleaf



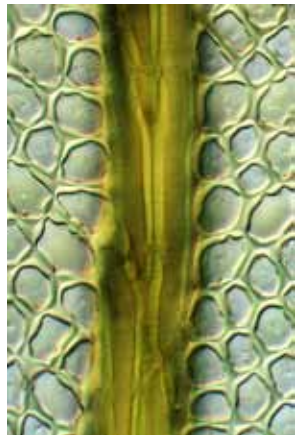
fertile habit, underleaves, immature capsule with calyptra, and leaf outlines (2)

5 mm,

1 mm,

1 mm,

0.5 mm (2)



leaf apex, margin at midleaf, and costa at midleaf

50  $\mu\text{m}$ ,10  $\mu\text{m}$ ,10  $\mu\text{m}$



*Lopidium concinnum* leaf apex  
10  $\mu\text{m}$

**Sauloma tenella** (Hook.f. & Wilson) Mitt.

**form:** matted branched stems, 20–60  $\mu\text{m}$  tall, leaves pale green, glossy  
**habitat:** bark, rotting wood, soil, or rarely rock in damp sites

**leaf:** size: 2–3.5  $\times$  0.5–0.8 mm

*shape:* oblong,  $\pm$  triangular, or ovate-lanceolate, 1-plicate in midleaf

*tip:* obtuse or rounded to acuminate or acute, strongly reflexed or not

*base:* alar cells few; basal cells to 180  $\times$  20  $\mu\text{m}$ ; cells near margin shorter

*costa:* absent, faint, or short and double

*border:* not differentiated

*margin:* entire,  $\pm$  recurved above

*cells:* median cells 80–140  $\times$  10–15  $\mu\text{m}$ , linear-rhombic, thin-walled,

porose; lower cells larger; fusiform gemmae in axils, to 120  $\mu\text{m}$

**capsule:** 0.5–1.8 mm, oblong-oval, horizontal to nearly erect, brown;

seta 8 mm, reflexed just below the capsule; calyptra mitrate;

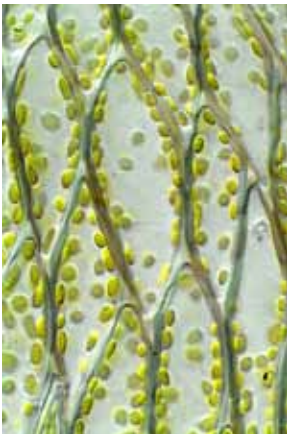
operculum erect conic-rostrate; exostome teeth joined below, cross-

striate, filiform above, endostome as tall; spores 12–14  $\mu\text{m}$ , green



habit, vegetative shoot (moist), leaf outline, and leaf apex

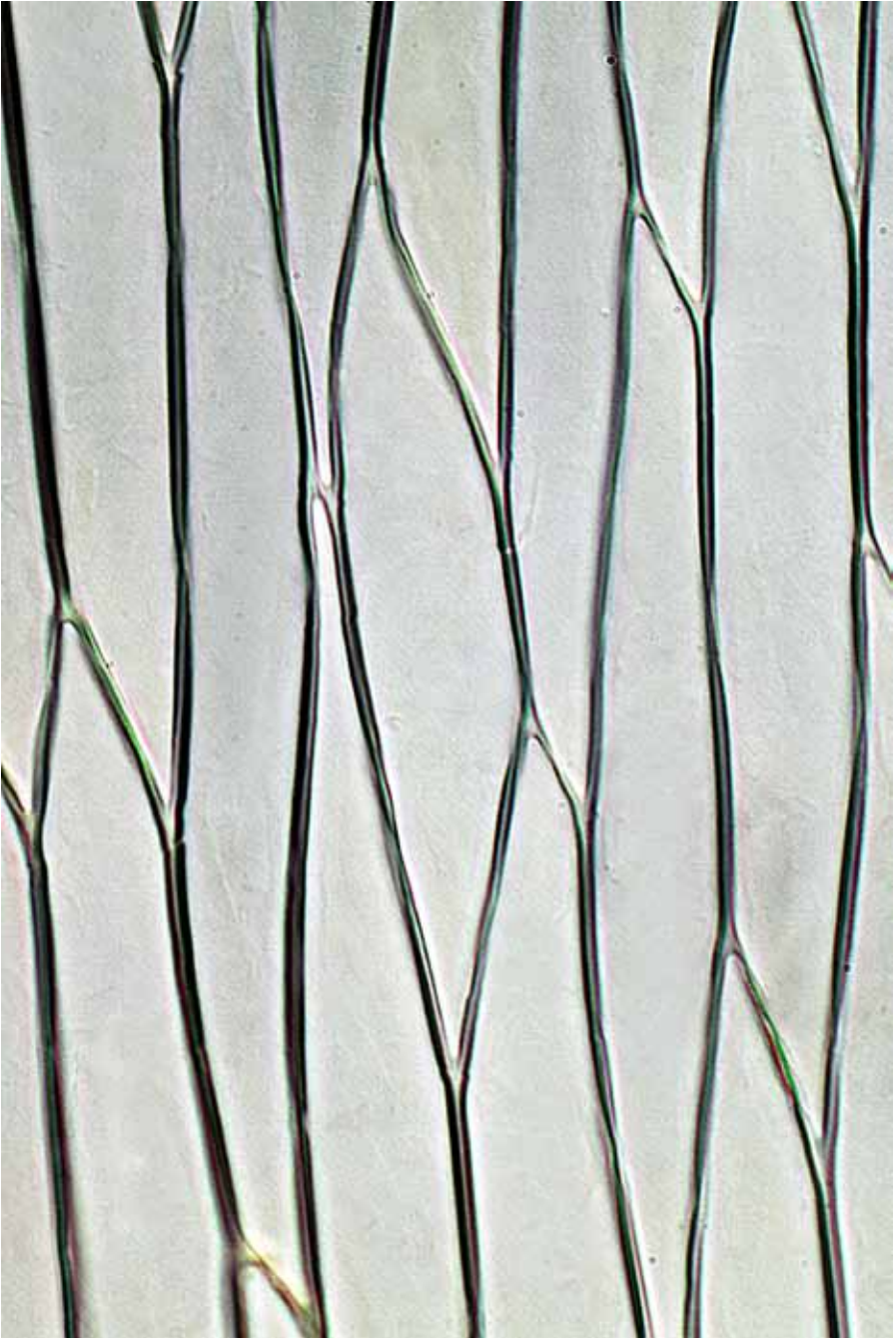
■ 1 mm, ■ 1 mm, ■ 0.25 mm, ■ 10  $\mu\text{m}$



cells at midleaf, leaf basal angle, and capsule with peristome

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 1 mm

continued next page



*Sauloma tenella* thin-walled, linear-rhombic cells midleaf  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Achrophyllum* (2)**

- 1 Midleaf cells 40–60  $\mu\text{m}$  in diam.; marginal teeth 2–4-celled ..... ● ***Achrophyllum dentatum***  
 1: Midleaf cells 80–100  $\mu\text{m}$  in diam.; marginal teeth 1-celled ..... ● ***Achrophyllum quadrifarium***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 159.



*Achrophyllum  
dentatum*



*Achrophyllum  
quadrifarium*



**Achrophyllum dentatum** (Hook.f. & Wilson) Vitt & Crosby

**form:** loosely tufted, fleshy, flattened, ascending stems, 5–50 mm long, unbranched, the leaves in 6–8 rows

**habitat:** damp logs, humus, or damp or wet rock

**leaf:** size: 2–4 mm in diam.

*shape:* ovate to nearly circular

*tip:* rounded

*base:* ± asymmetric, but otherwise not differentiated

*costa:* unevenly forked, ending about midleaf

*border:* not differentiated

*margin:* laxly toothed (teeth 2–4-celled), plane

*cells:* 40–60 μm, hexagonal, collenchymatous, smooth

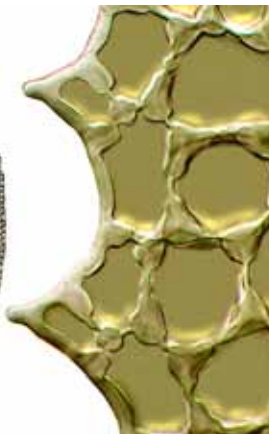
**capsule:** 1–2 mm, oblong to ovoid, cernuous to pendent, dark brown to nearly black, ± tuberculose at the base, seta 12–20 mm, arcuate above

**note:** the L-shaped propagules are distinctive



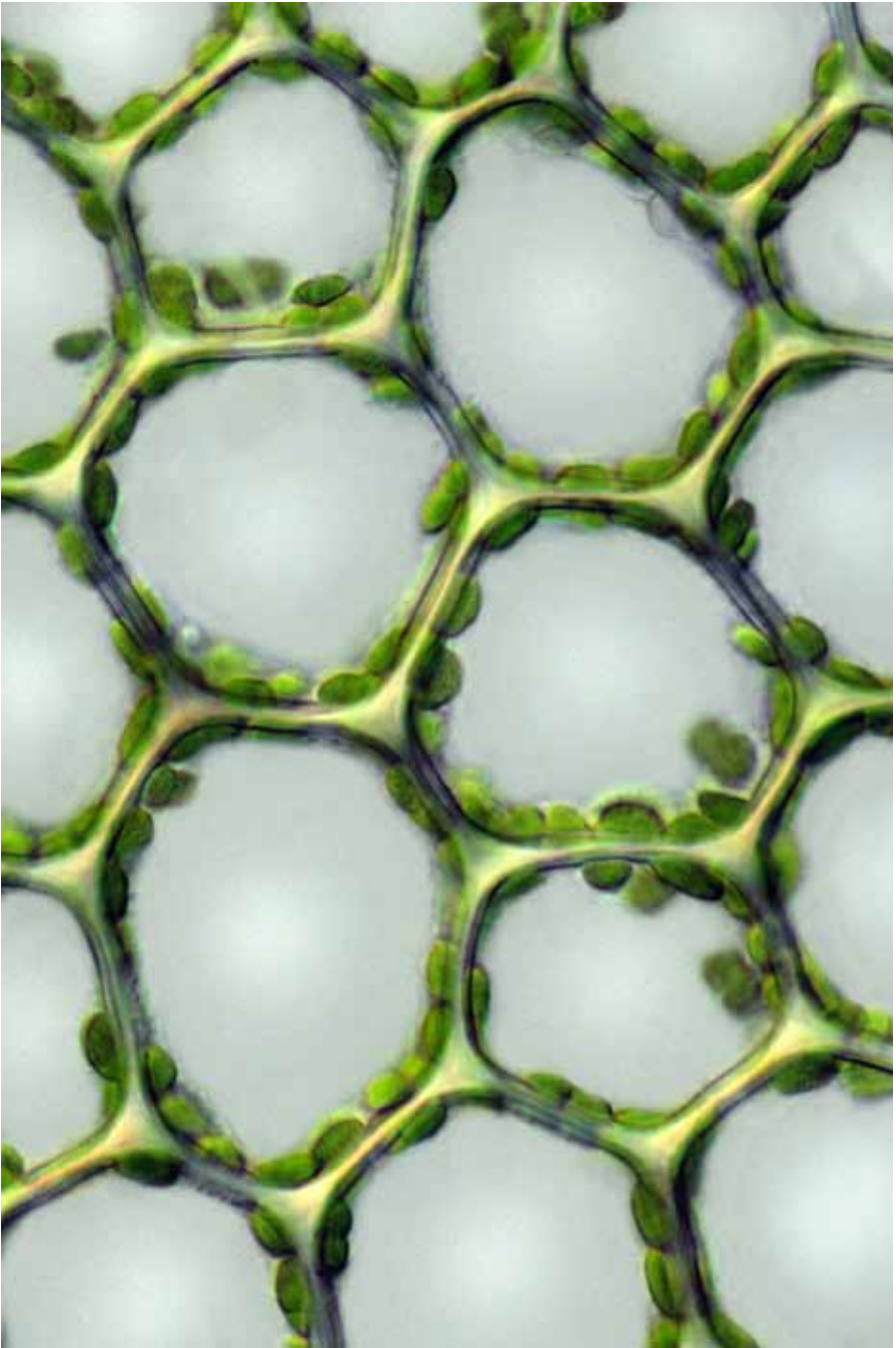
vegetative habit, fully hydrated shoot, and leaf margin brood bodies (2)

5 mm, 5 mm, 50 μm (2)



leaf outline, toothed leaf margin, and capsule

1 mm, 50 μm, 1 mm



*Achrophyllum dentatum* leaf cells  
50  $\mu\text{m}$

continued next page

**Achrophyllum quadrifarium** (Sm.) Vitt & Crosby

**form:** loosely tufted, unbranched, basally radiculose stems, 20–120 mm tall, complanate

**habitat:** humus or rotting logs or rock in damp forest

**leaf:** size: 3–7 mm, densely imbricate

*shape:* ± orbicular; lateral leaves asymmetric near base

*tip:* rounded

*base:* not differentiated

*costa:* strong, unevenly forked, ending about midleaf

*border:* not differentiated

*margin:* laxly toothed (teeth mostly 1-celled), plane

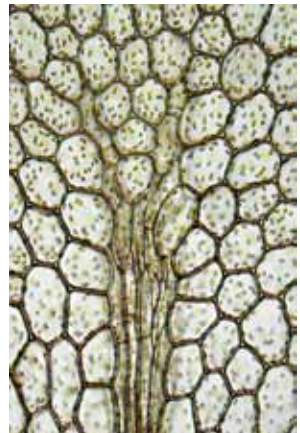
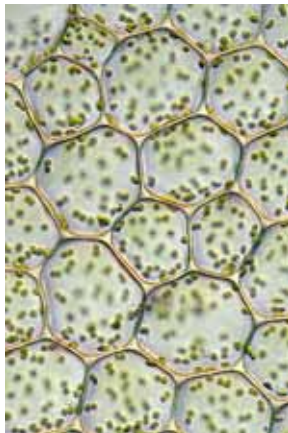
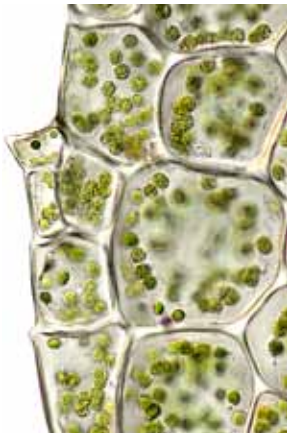
*cells:* 80–100 μm in diam., hexagonal, thin-walled, smooth

**capsule:** 1.5–3 mm, oblong or ovoid, cernuous or pendent, dark brown to black; seta 15–35 mm; peristome double; spores 12–18 μm in diam.



vegetative habit (2), and leaf outline (portion)

5 mm, 5 mm, 0.5 mm



margin at midleaf, cells at midleaf, and costa at midleaf

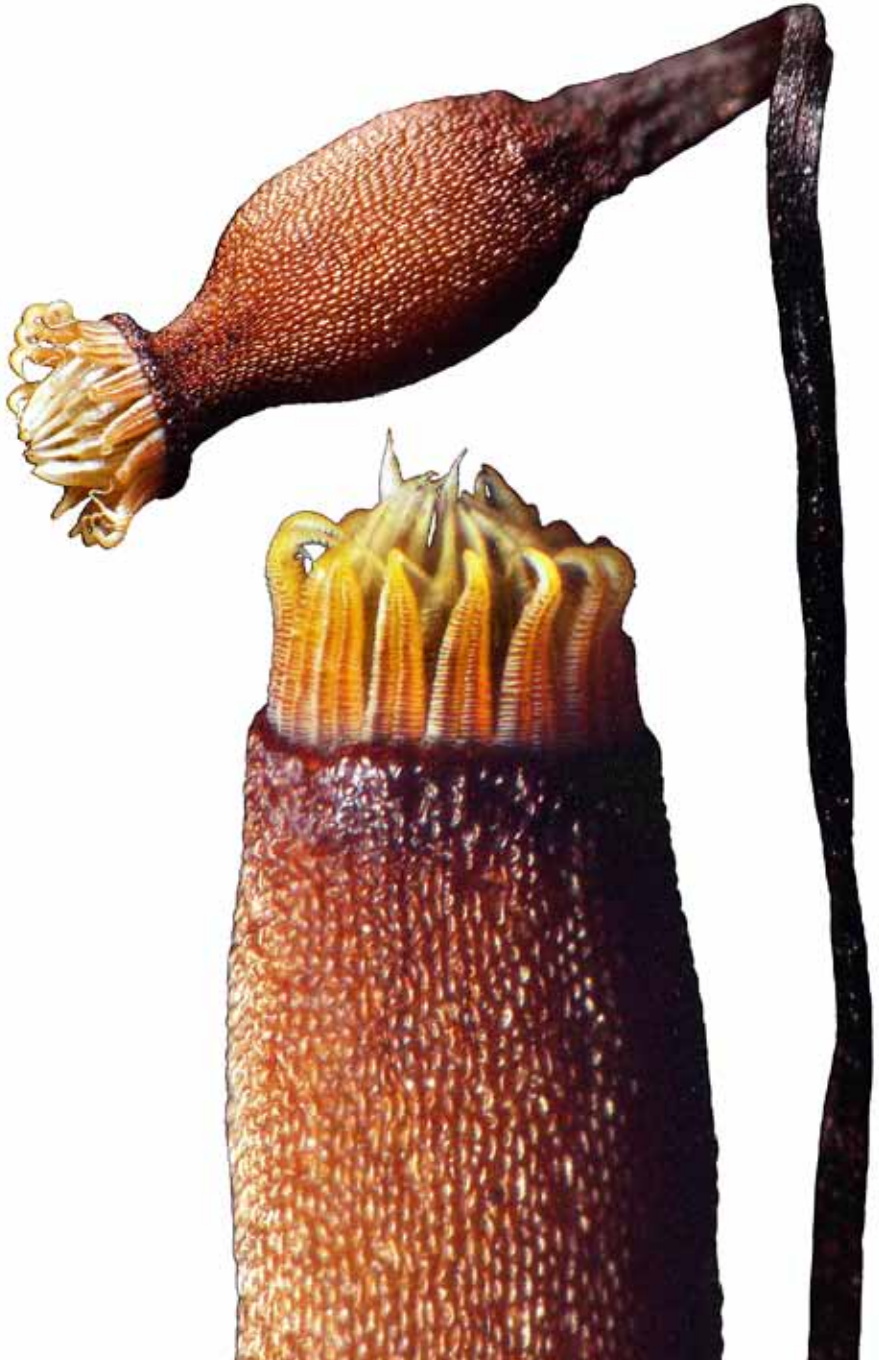
100 μm, 100 μm, 100 μm

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*Achrophyllum quadrifarium* habit  
1 mm

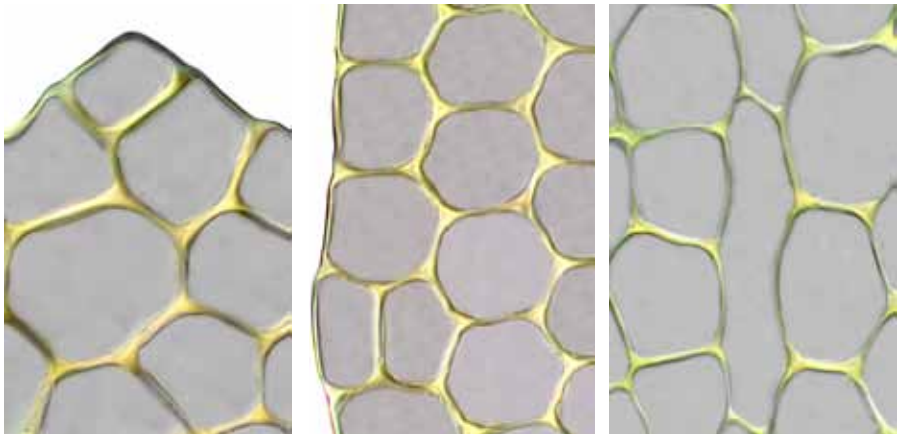
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*Achrophyllum quadrifarium* mature capsule

0.5 mm (above),

0.5 mm (below)

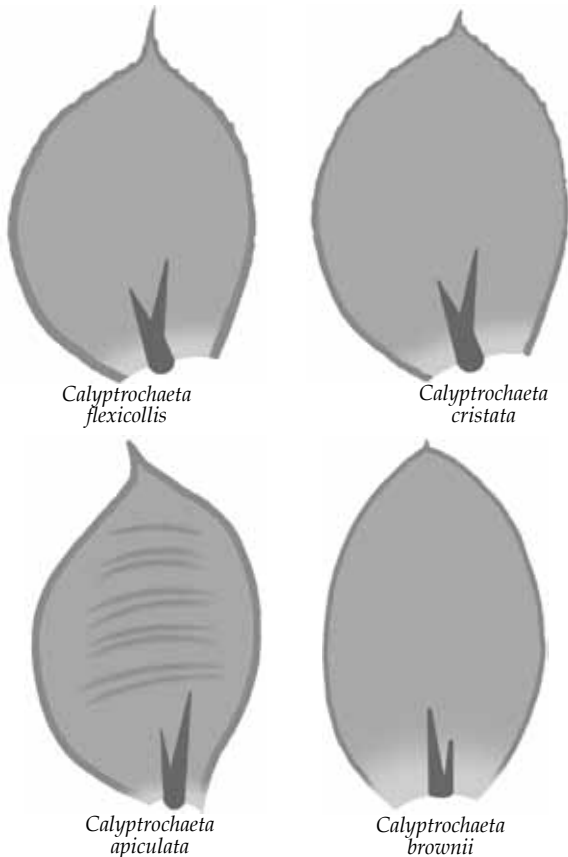
**Beeveria distichophylloides** (Broth. & Dixon) Fife**form:** prostrate, unbranched stems to 45 mm tall, leaves yellowish**habitat:** moist shaded limestone or clayey soil in damp forest**leaf:** size: 1.3–2.5 mm*shape:* elliptic*tip:* acute or weakly cuspidate*base:* basal cells oblong; alar cells not differentiated*costa:* ill-defined, ending half to three-quarters up the leaf blade*border:* not differentiated*margin:* entire, plane*cells:* 24–42  $\mu\text{m}$ , isodiametric or nearly so, thin-walled, smooth**capsule:** 1–1.5 mm, ovoid, erect, short-necked, reddish; seta 7–11 mm, smooth, red; calyptra mitrate, lobed; operculum erect long-rostrate; peristome double; spores 12  $\mu\text{m}$ **note:** stems often end in leafless pseudopodia 2–3 mm long and tipped with a cluster of narrowly fusiform, 5–9-septate gemmaeshoot and propagules, propagule cluster, propagule wm (apex only), and leaf outline  


leaf apex, margin at midleaf, and costa at midleaf

**Key\* to the New Zealand species of *Calyptrochaeta* (4)**

- 1 Leaf border 1–2 cells wide; apiculus 30–50  $\mu\text{m}$  long..... ● ***Calyptrochaeta brownii***  
 1: Leaf border 3–7 cells wide; apiculus 35–300  $\mu\text{m}$  long..... 2
- 2(1:) Leaf border 5–7 cells wide; apiculus 240–300  $\mu\text{m}$  long; leaves yellowish, crisped or curled when dry..... ● ***Calyptrochaeta apiculata***  
 2: Leaf border 3–4(–5) cells wide; apiculus 100–200  $\mu\text{m}$  long; leaves green, nearly straight when dry ..... 3
- 3(2:) Upper cells 18–40  $\mu\text{m}$  wide ..... ● ***Calyptrochaeta flexicollis***  
 3: Upper cells 50–60  $\mu\text{m}$  wide..... ● ***Calyptrochaeta cristata***

\* based partly on Streimann, H (2000): Taxonomic studies on Australian Hookeriaceae (Musci) 3: The genera *Calyptrochaeta*, *Daltonia*, *Hookeriopsis*, and *Sauloma*. *Journal of the Hattori Botanical Laboratory* 88, 103, plus Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 103.



***Calypstrochaeta apiculata*** (Hook.f. & Wilson) Vitt

**form:** tufted, branched, tomentose stems, 15–30 mm tall, complanate, two lateral leaf rows, plus two rows each of dorsal and ventral

**habitat:** shaded, damp soil, humus, or rock in damp forest

**leaf:** size: lateral 2.0–2.7 mm long; dorsal and ventral smaller

*shape:* ovate to orbicular, asymmetric, crisped when dry

*tip:* abruptly acuminate

*base:* narrow; basal cells rectangular, thin-walled

*costa:* absent or short and double and faint

*border:* 5–7 rows of porose, linear cells

*margin:* entire, plane

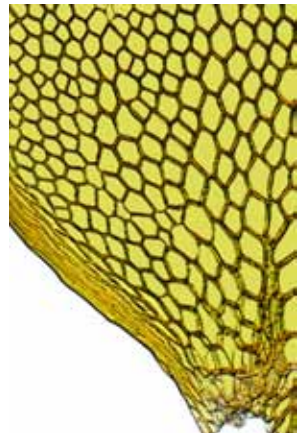
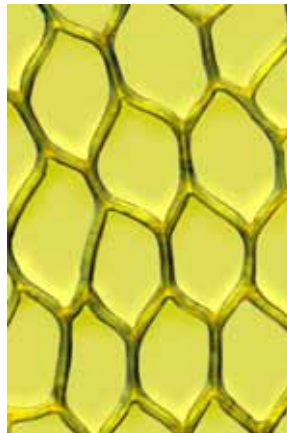
*cells:* 20–50  $\mu\text{m}$ , hexagonal to isodiametric, firm-walled, smooth

**capsule:** 1–1.5 mm, ovoid, lateral, erect to inclined, exserted, brown; seta 5–8 mm; calyptra long-fringed; operculum rostrate; exostome teeth cross-striolate, fused at base, endostome reduced; spores 16–24  $\mu\text{m}$  in diam.



vegetative shoot (dry), lateral leaf outline and leaf apex

1 mm, 0.1 mm, 10  $\mu\text{m}$

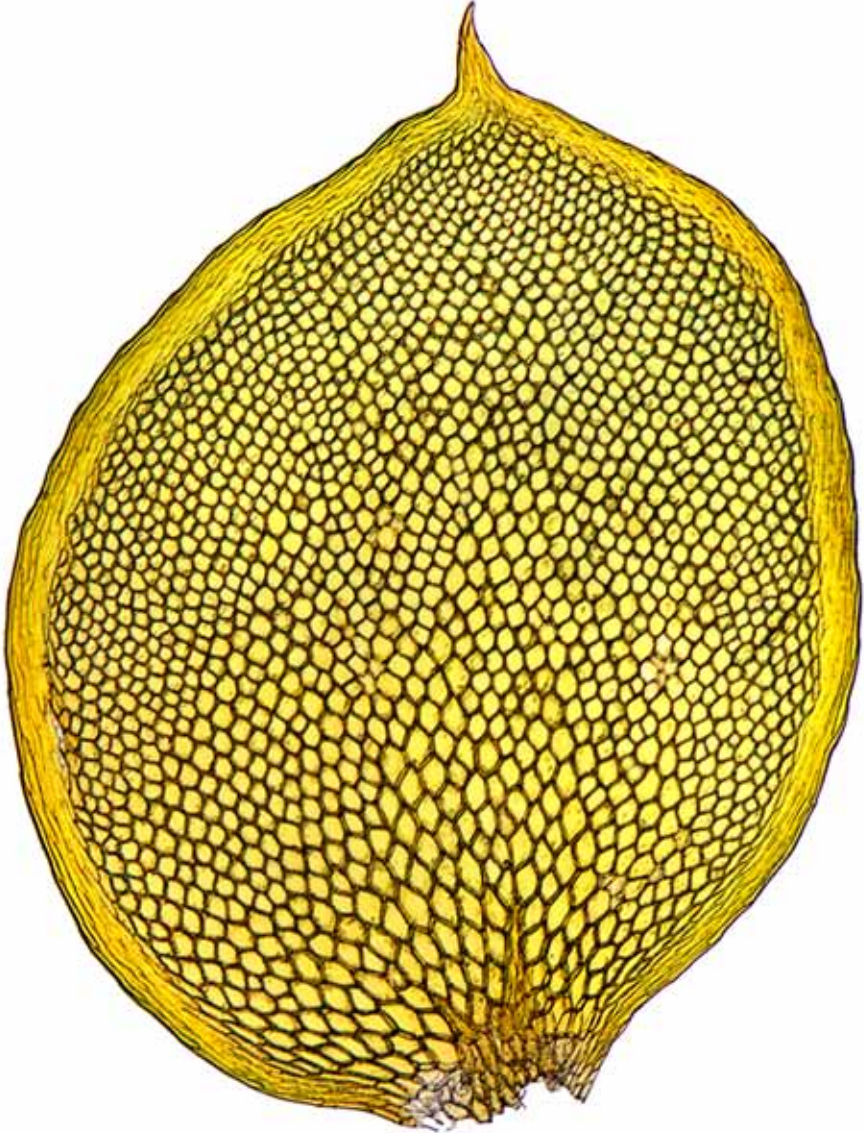


margin at midleaf, cells at midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page





*Calyptra chaeta apiculata* lateral leaf outline  
0.1 mm

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***Calypstrochaeta brownii*** (Dixon) J.K.Bartlett

**form:** tufted, prostrate, branched stems, 8–15 mm tall; complanate, leaves dull dark green

**habitat:** damp shaded rock or rotting wood in moist forest

**leaf:** size: 2.0–2.7 mm long; dorsal and ventral leaves smaller

**shape:** lateral elliptic to obovate, asymmetric

**tip:** short-apiculate

**base:** narrow, basal cells elongate, thin-walled

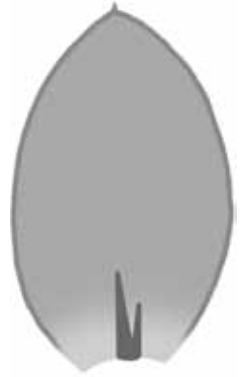
**costa:** absent or short and double, faint

**border:** 1–2 rows of firm-walled linear cells

**margin:** entire, plane

**cells:** 25–45 × 20–30 μm, rhombic-hexagonal, thin-walled, smooth

**capsule:** 0.6–1.0 mm, widely oval, lateral, horizontal or pendent, exserted, brown; seta 2–5 mm; operculum erect-rostrate; calyptra campanulate, densely fringed; peristome double, cilia absent; spores 10–16 μm in diam., smooth



vegetative shoot (dry) (2), lateral leaf outline, and lateral leaf apex

1 mm, 1 mm, 0.5 mm, 10 μm



lateral leaf margin, lateral leaf cells, and lateral leaf basal angle

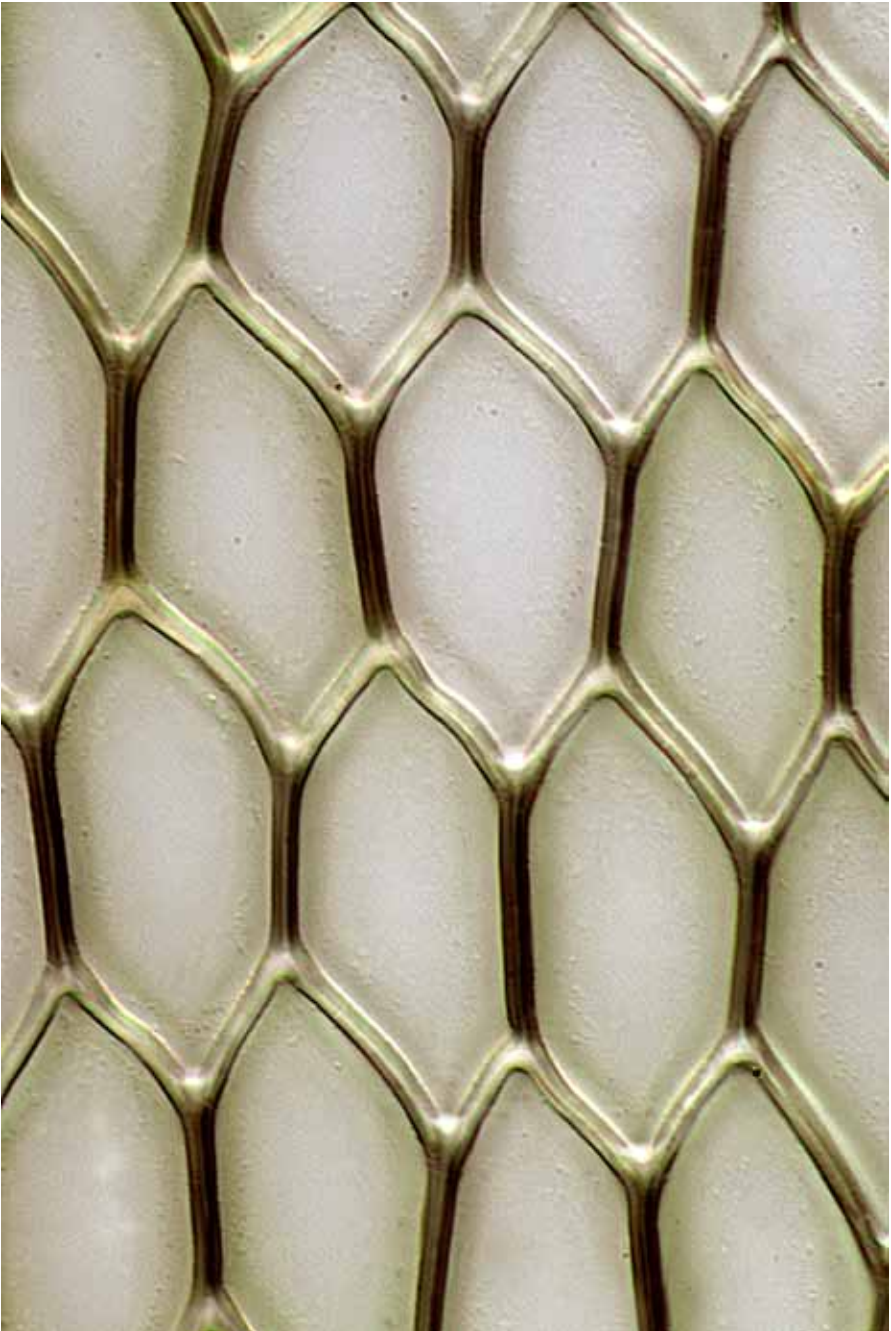
50 μm, 50 μm, 50 μm

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*Calypstrochaeta brownii* margin midleaf  
10  $\mu\text{m}$

continued next page



*Calyptraocheta brownii* lateral leaf cells  
10  $\mu\text{m}$

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***Calypstrochaeta cristata*** (Hedw.) Desv.

**form:** matted, radiculose, erect stems, 20–120 mm tall, leaves glossy  
**habitat:** soil, damp logs, or rock in shaded forest

**leaf:** size: 2.0–4.5 mm

*shape:* dorsal and ventral leaves ± orbicular; lateral leaves obovate

*tip:* dorsal and ventral ± obtuse, ± apiculate; lateral subacute

*base:* basal cells rectangular, thin-walled

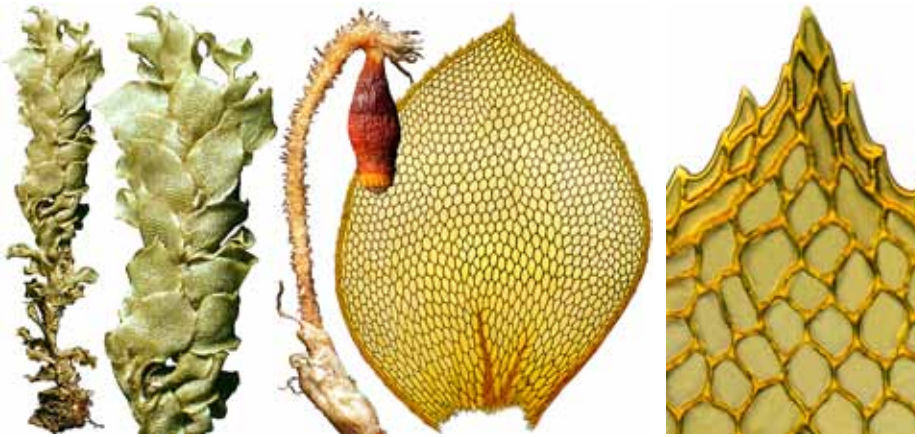
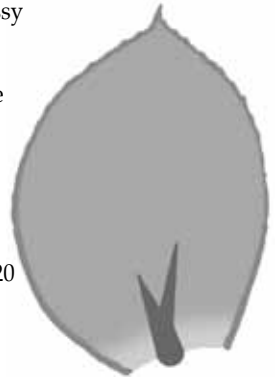
*costa:* double, one branch reaching about one-third up the leaf

*border:* 2–4 rows of narrow, elongate, firm- to thick-walled cells

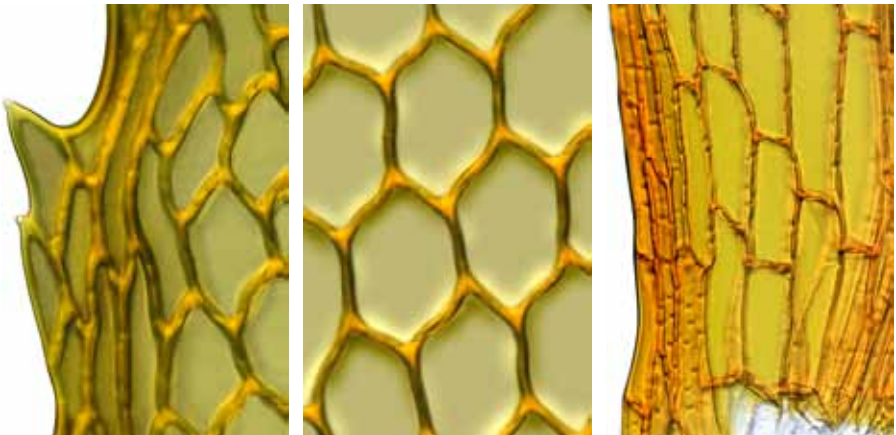
*margin:* irregularly dentate above, ± entire below, plane

*cells:* 70–100 × 50–60 μm, ± hexagonal, thin-walled, smooth

**capsule:** 1.3–2.0 mm, oval, exserted, pendent, red-brown; seta 5–20 mm, fleshy, yellowish, shaggy with hyaline, unicellular hairs; operculum rostrate; calyptra campanulate, shaggy, fringed; exostome teeth yellow, pale-margined, endostome cilia none; spores 12–16 μm in diam., smooth

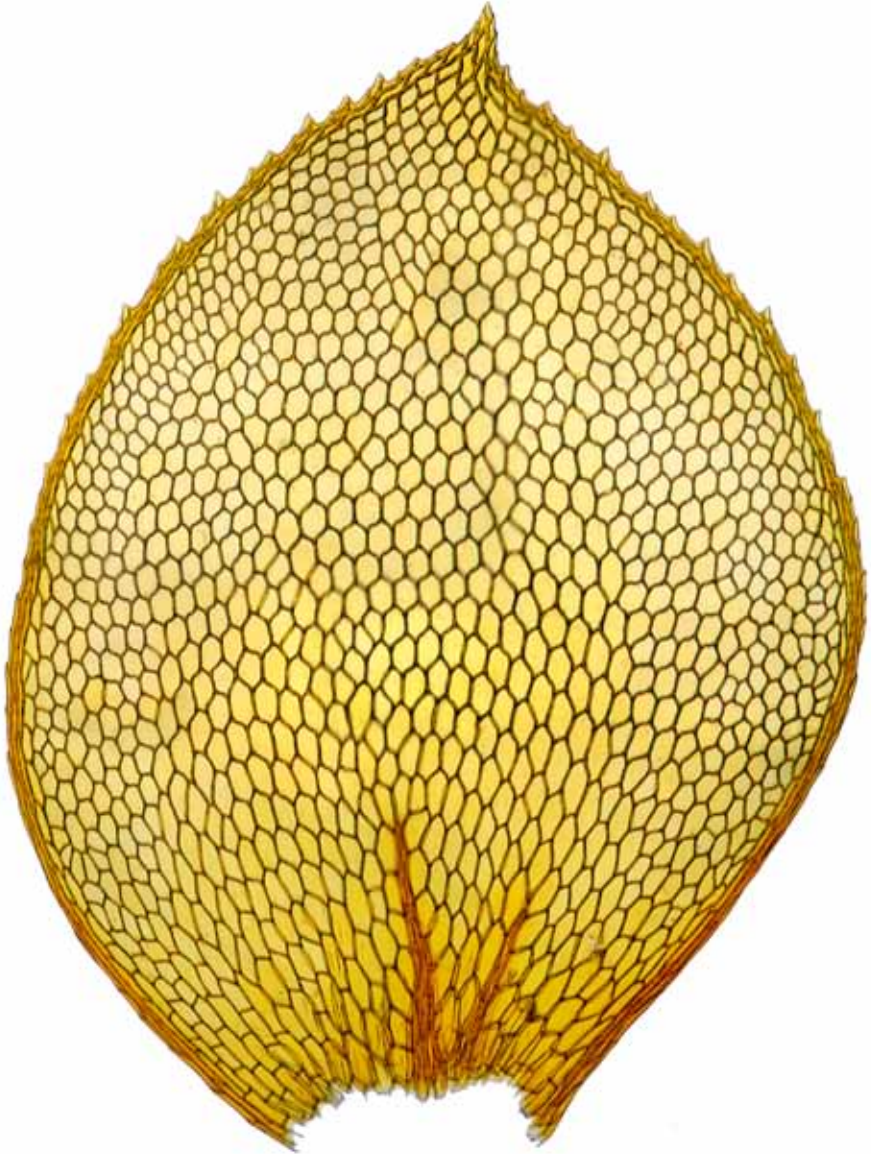


vegetative shoot (dry) (2), mature capsule with shaggy seta, and ventral leaf and apex  
 5 mm, 5 mm, 1 mm, 1 mm, 100 μm



margin at midleaf, cells at midleaf, and leaf basal angle  
 50 μm, 50 μm, 50 μm

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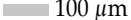
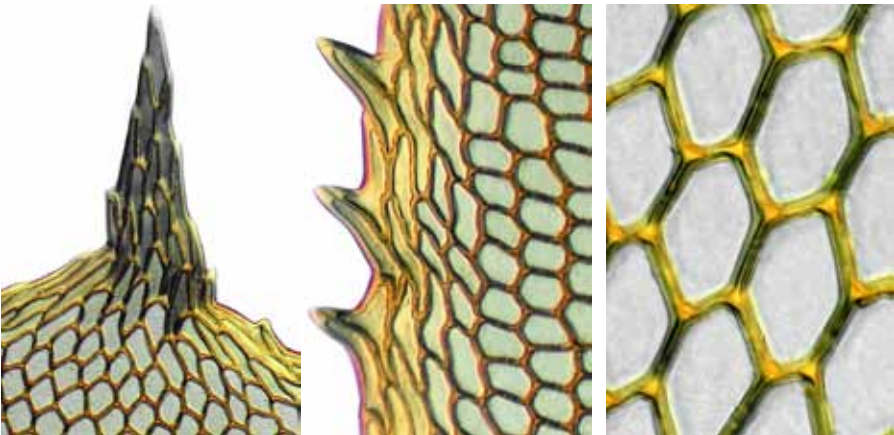
*Calypstrochaeta cristata* ventral leaf  
1 mm

continued next page



*Calyptraochaeta cristata* mature capsule with shaggy seta  
1 mm

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***Calypstrochaeta flexicollis* (Mitt.) Vitt****form:** tufted, unbranched stems, 12–30 mm tall, flattened**habitat:** moist soil, rotting wood, and rock, rarely tree trunks**leaf:** *size:* leaves in 6 rows, lateral leaves  $2.3\text{--}2.6 \times 1.0\text{--}1.5$  mm, spreading, dorsal and ventral leaves smaller, appressed*shape:* orbicular to orbicular-ovate, slightly asymmetrical*tip:* rounded to obtuse, acutely apiculate*base:* basal cells longer and wider than the blade cells*costa:* absent or weak, short, and forked*border:* 2–4 rows of narrow, elongate cells*margin:* entire, plane*cells:* 18–40  $\mu\text{m}$ ,  $\pm$  isodiametric, firm-walled, smooth**capsule:** 1 mm, ovoid, exserted, pendent, brown, narrowed at the mouth; seta 4–10 mm, shaggy, arcuate at the tipvegetative shoot (dry and moist), and lateral leaf outline and apex  
 1 mm,  1 mm,  100  $\mu\text{m}$ lateral leaf apiculus, toothed border at midleaf, and cells at midleaf  
 100  $\mu\text{m}$ ,  100  $\mu\text{m}$ ,  10  $\mu\text{m}$ 

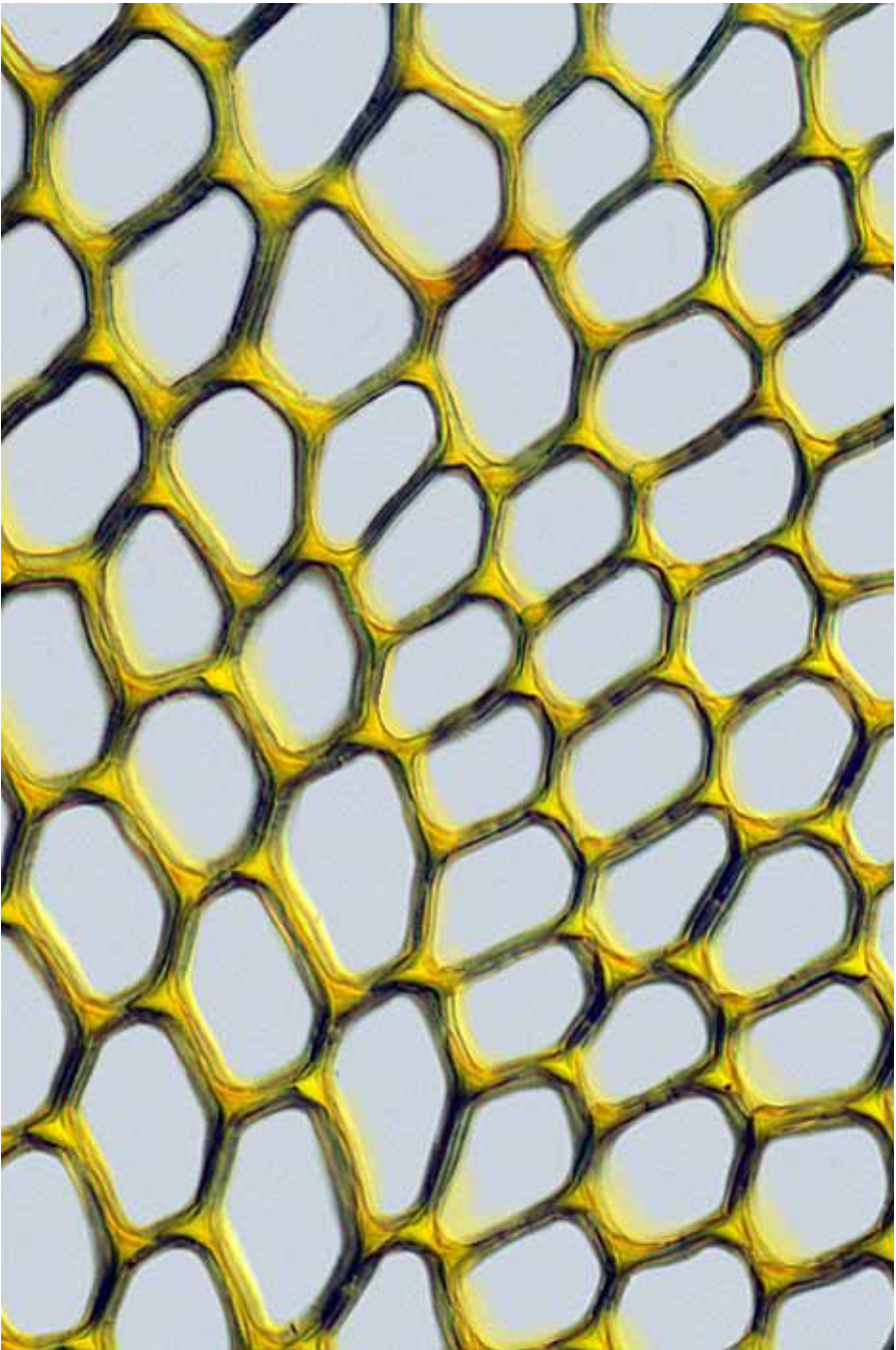
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*Calyptra chaeta flexicollis* leaf apex  
10  $\mu$ m

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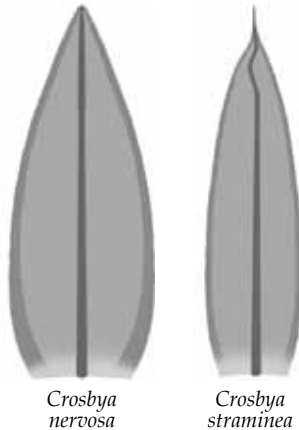


*Calyptra chaeta flexicollis* midleaf cells  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Crosbya* (2)**

- 1 Basal leaf cells hyaline, thin-walled, 1–2:1; border the same width throughout its length; apex cuspidate and asymmetric..... ● ***Crosbya nervosa***  
 1: Basal leaf cells not hyaline, thick-walled, 5–9:1; border much wider below than above; apex widely acuminate and symmetric..... ● ***Crosbya straminea***

\* based on Vitt, DH (1977): A taxonomic study of the genus *Crosbya* (= *Bellia*: Musci). *Canadian Journal of Botany* 55, 2081.



**Crosbya nervosa** (Hook.f. & Wilson) Vitt

**form:** matted, erect, branched stems, 15–25 mm tall; leaves golden, glossy  
**habitat:** bark of branches, trunks (rarely rock) in shady lowland forest

**leaf:** size: 1.5–2.5 mm

*shape:* ovate- to oblong-lanceolate

*tip:* acuminate, cuspidate, and asymmetric

*base:* basal cells  $27\text{--}50 \times 12\text{--}25 \mu\text{m}$

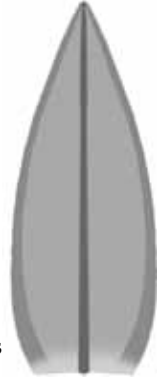
*costa:* excurrent into the apex, confluent with the border on both sides

*border:* 2–4 rows midleaf, of linear, thick-walled cells

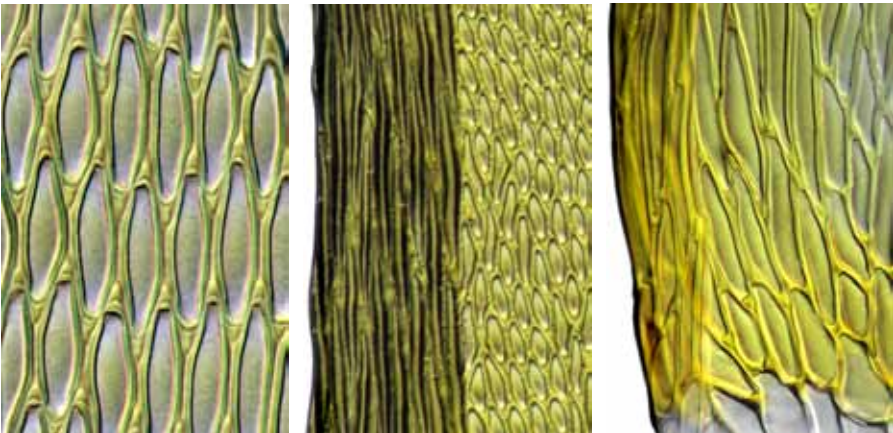
*margin:* entire, reflexed to recurved

*cells:*  $8\text{--}15 \times 7 \mu\text{m}$ , oval-rhombic, firm-walled, smooth

**capsule:** 0.5–1 mm, oblong-ovate, lateral, exserted, red-brown, erect;  
 seta 4–6 mm, red; operculum long-rostrate; calyptra mitriform, deeply  
 laciniate below; exostome teeth 16, cross-striolate, tips incurved,  
 endostome segments 16, keeled, perforate, papillose, cilia absent; spores  
 variable,  $15\text{--}38 \mu\text{m}$  in diam.

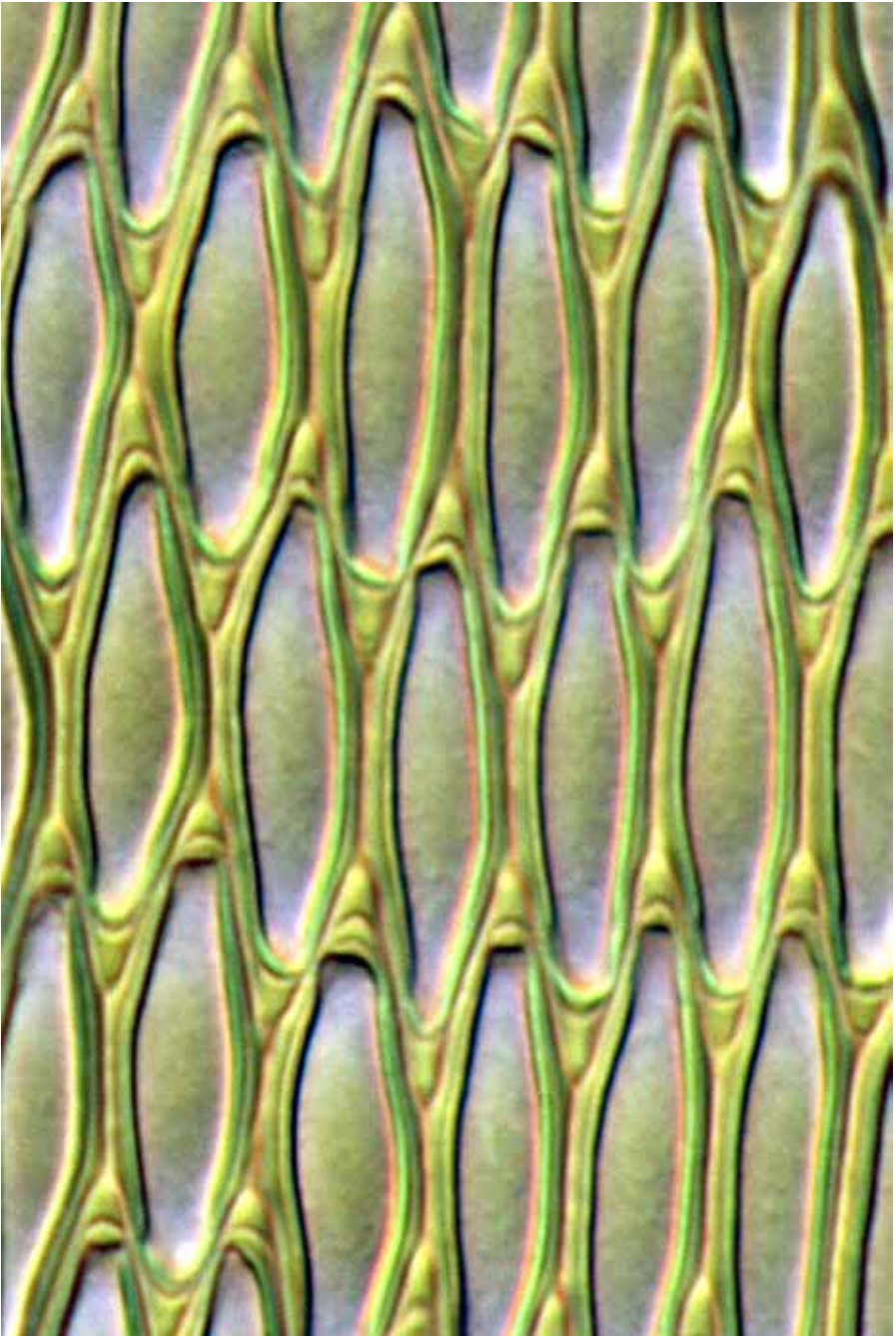


vegetative shoot (dry) (2), leaf outline, capsule (dry) (2), and leaf apex  
 1 mm, 1 mm, 0.1 mm, 0.1 mm, 0.1 mm, 10  $\mu\text{m}$



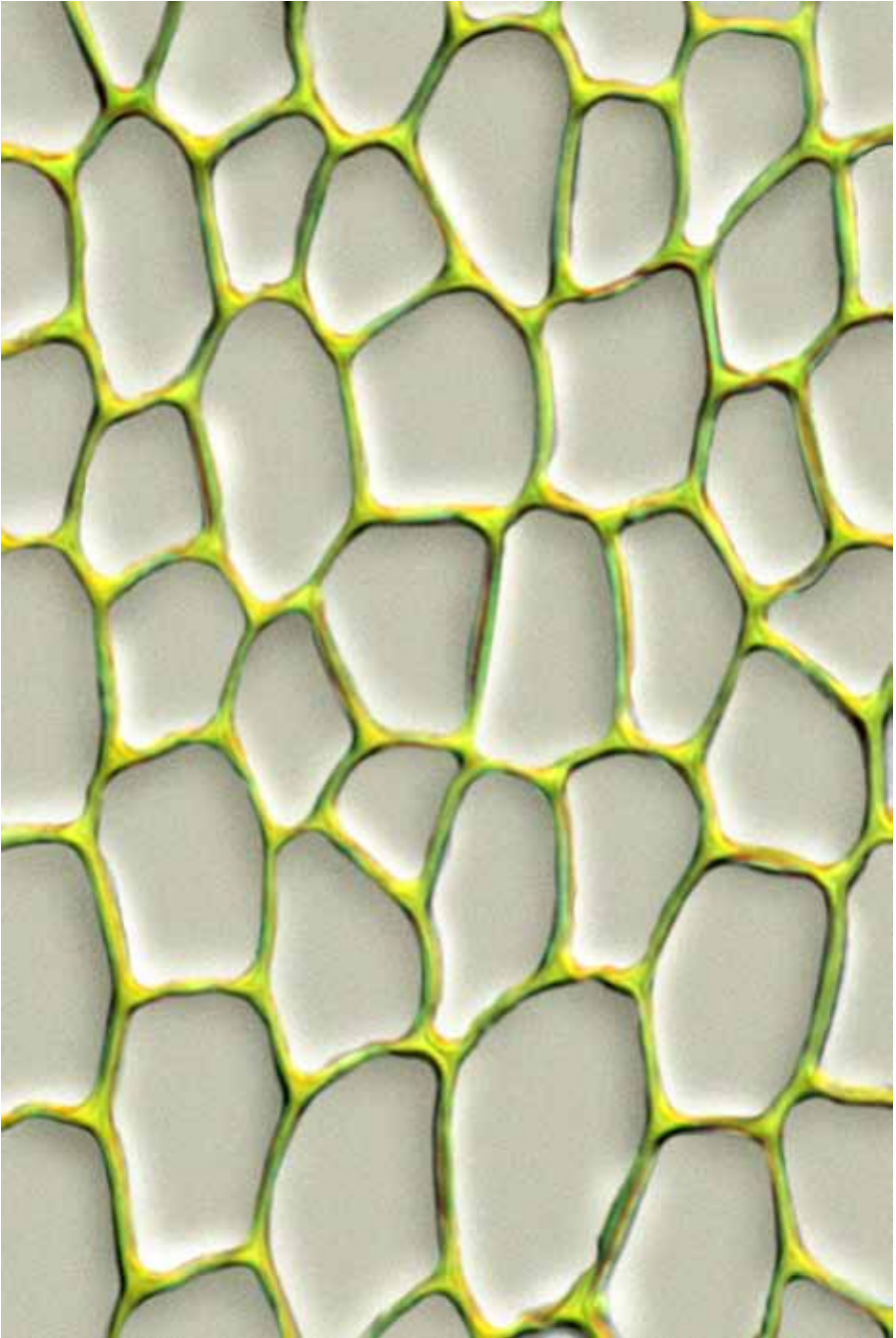
cells at midleaf, border of lower leaf, and leaf basal angle  
 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$

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*Crosbya nervosa* cells midleaf  
10  $\mu\text{m}$

continued next page



*Crosbya nervosa* cells near leaf base  
10  $\mu\text{m}$

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**Crosbya straminea** (Beckett) Vitt

**form:** matted, prostrate, irregularly branched stems, up to 35 mm tall, leaves yellow-green above, darker below, glossy

**habitat:** bark of tree trunks and branches in moist shaded lowland forest

**leaf:** size: 1.5–3 mm

**shape:** oblong-lanceolate, ± keeled, sometimes falcate-secund

**tip:** abruptly narrowed to an acumen

**base:** basal cells 30–70 × 4–10 μm

**costa:** percurrent, confluent with the border

**border:** at midleaf 8–10 rows of linear, thick-walled cells

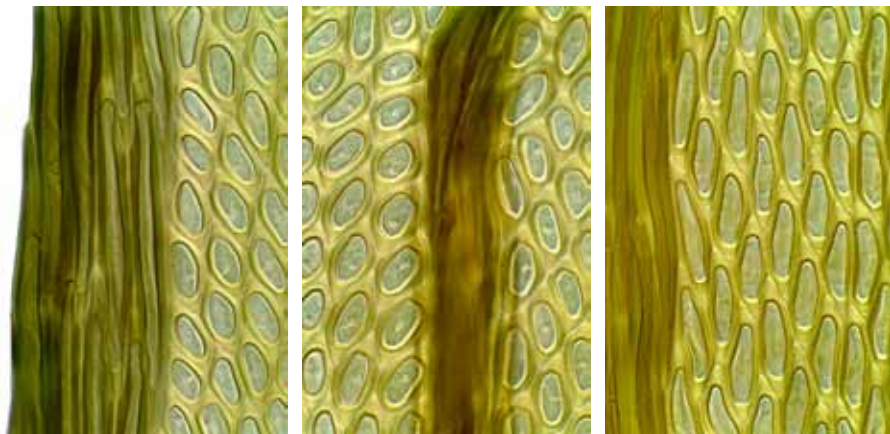
**margin:** entire to slightly toothed above, reflexed to recurved

**cells:** upper cells 15–30 × 7 μm, rhombic-hexagonal, thick-walled, smooth

**capsule:** 1–4 mm, ovate-cylindric, lateral, erect to inclined, smooth; seta 2–4.5 mm, curved or flexuose, red, rough above; calyptra mitriform, deeply laciniate; operculum conico-long-rostrate; exostome teeth 16, tips incurved, cross-striolate, endostome cilia absent; spores 30–50 μm in diam.



vegetative shoot, mature capsule, leaf outline, leaf apex, and leaf subapex  
 1 mm, 5 mm, 0.5 mm, 10 μm, 10 μm



margin of lower leaf, costa at midleaf, and costa in upper leaf  
 10 μm, 10 μm, 10 μm

**Daltonia splachnoides** (Sm.) Hook. & Taylor

**form:** densely tufted, radiculose stems, 5–15 mm tall, the leaves pale, glossy  
**habitat:** bark in damp forest

**leaf:** size: 1.5–3.5 × 0.4–0.5 mm

*shape:* linear-lanceolate to elliptic-lanceolate, keeled below

*tip:* variably acuminate

*base:* cells near the insertion isodiametric, inflated, and coloured

*costa:* thin, failing below the apex

*border:* 2–5 rows of linear cells, markedly wider toward the leaf base

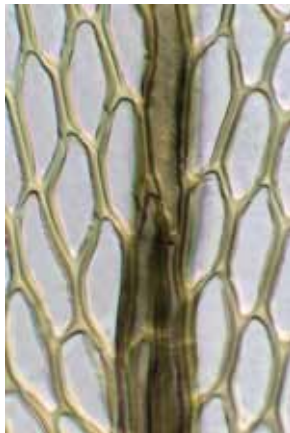
*margin:* entire, plane to variably recurved

*cells:* 24–32 × 8–9 μm, rhombic, firm-walled, smooth

**capsule:** 1.5–2 mm, widely oval, exserted, erect to inclined, neck short, tapered; seta 3–10 mm, lateral, rough; calyptra densely ciliate-fringed; operculum erect long-rostrate; exostome teeth long-subulate, coarsely papillose, endostome segments equalling the exostome teeth, filiform, papillose, cilia absent; spores variable, 10–22 μm in diam., anisoporous



habit, vegetative shoot (dry), capsules (2), leaf outline, and leaf apex  
 ■ 5 mm, ■ 1 mm, ■ 0.5 mm (2), ■ 0.1 mm, ■ 10 μm



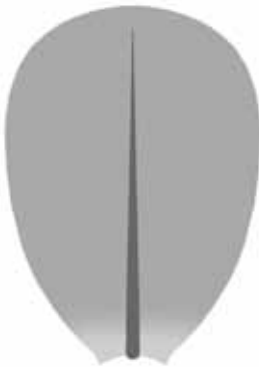
border at midleaf, costa at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 10 μm



Key\* to the New Zealand species and varieties of *Distichophyllum* (5)

- 1 Plants epiphyllous (on fern fronds) or corticolous..... ● *Distichophyllum crispulum* var. *adnatum*  
 1: Plants terrestrial or saxicolous ..... 2
- 2(1:) Leaves not bordered..... ● *Distichophyllum microcarpum*  
 2: Leaves bordered ..... 3
- 3(2:) Leaves obtuse or only weakly apiculate; perichaetial bracts obtuse ..... ● *Distichophyllum pulchellum*  
 3: Leaves long-acute or apiculate; perichaetial bracts acute ..... 4
- 4(3) Leaves 0.5–0.9 mm long, sharply denticulate above, stoutly apiculate..... ● *Distichophyllum rotundifolium*  
 4: Leaves to 2 mm long, weakly denticulate above, with a long acute point..... ● *Distichophyllum crispulum* var. *crispulum*

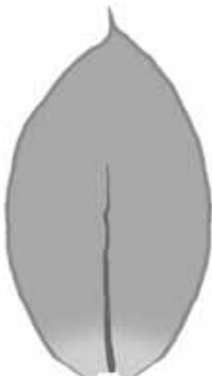
\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 397.



*Distichophyllum  
microcarpum*



*Distichophyllum  
pulchellum*



*Distichophyllum  
crispulum* var.  
*adnatum*



*Distichophyllum  
rotundifolium*



*Distichophyllum  
crispulum* var.  
*crispulum*

continued next page

***Distichophyllum crispulum* var. *adnatum*** (Hook.f. & Wilson) Dixon

**form:** tufted, prostrate, radiculose, unbranched stems, 5–13 mm tall  
**habitat:** bark or living fern fronds in damp forest

**leaf:** size: to 2 mm

*shape:* oval-oblong to obovate-oblong

*tip:* stoutly apiculate

*base:* strongly narrowed, alar region not differentiated

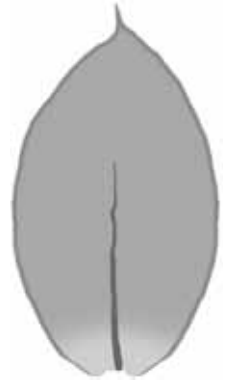
*costa:* failing above midleaf

*border:* 2–4 rows of elongate, firm-walled cells

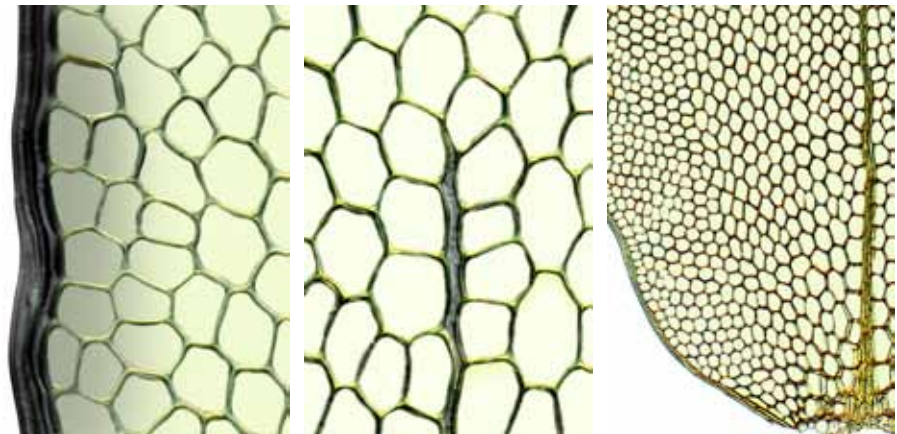
*margin:* entire, plane

*cells:* 20–24  $\mu\text{m}$ , isodiametric,  $\pm$  hexagonal, thin-walled, smooth

**capsule:** 1.5 mm, narrowly oblong, inclined to horizontal, exserted, pale brown; seta 5–10 mm, red, slender; calyptra mitriform, pilose above, fringed below; operculum conic-subulate; exostome teeth yellow, endostome segments equalling the exostome teeth; spores 9–12  $\mu\text{m}$  in diam., smooth



vegetative shoot (dry) (2), leaf outline, and leaf apex  
 1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$



margin at midleaf, costa terminus, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

**Distichophyllum crispulum** (Hook.f. & Wilson) Mitt. var. **crispulum**

**form:** ± unbranched, recumbent stems, to 100 mm long, in cushions,  
dark red below, complanate

**habitat:** soil of shaded vertical stream banks

**leaf:** size: 1.5–2.0 mm

*shape:* oval-oblong to oblanceolate

*tip:* abruptly acutely pointed

*base:* strongly narrowed, not differentiated; juxtacostal cells  $60 \times 30 \mu\text{m}$

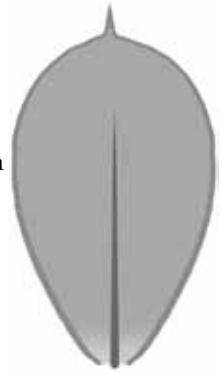
*costa:* failing about a third down from the apex

*border:* 2–3 rows of  $130 \times 4 \mu\text{m}$  cells, merging with apical apiculus

*margin:* entire to weakly denticulate, plane

*cells:* midleaf cells  $20 \times 14 \mu\text{m}$ , ± hexagonal, firm-walled, smooth

**capsule:** 1 mm, narrowly oblong, inclined, exserted, pale brown; seta  
5–10 mm, reddish, slender; calyptra mitrate, pilose, fringed;  
operculum erect conic-subulate; exostome teeth 16, yellow, cross-  
striolate; spores  $9\text{--}12 \mu\text{m}$  in diam., smooth



habit, vegetative shoot (dry), leaf outline, and leaf apex

1 mm, 1 mm, 0.1 mm, 50  $\mu\text{m}$



margin at midleaf, costa terminus, and leaf basal angle

50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Distichophyllum crispulum* var. *crispulum* leaf apex  
— 10  $\mu$ m

continued next page

***Distichophyllum microcarpum*** (Hedw.) Mitt.

**form:** patchy, creeping, radiculose stems, 20–100 mm tall, flattened, leaves in 6–8 rows

**habitat:** rotten logs, humus, or rock in damp forest

**leaf:** size: 2–4 × 1.5–1.0 mm

*shape:* obovate to elliptic-oblong from a narrow insertion

*tip:* obtuse to rounded

*base:* undifferentiated

*costa:* failing near the apex

*border:* not differentiated

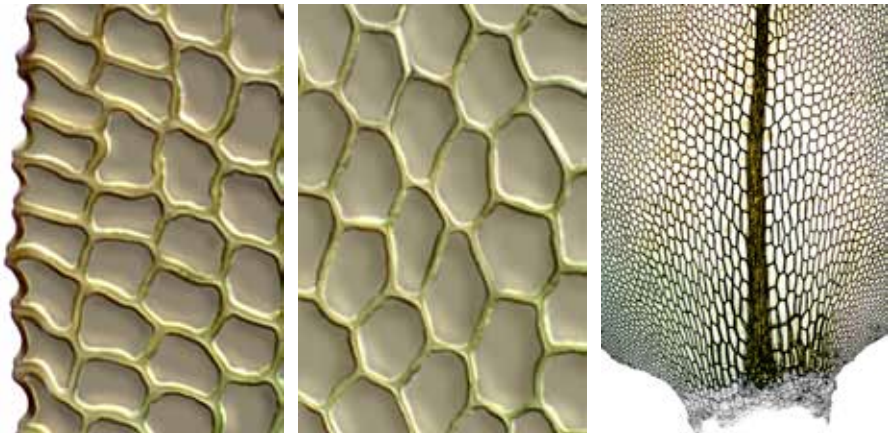
*margin:* entire, plane

*cells:* upper cells 10–18 μm, hexagonal, firm-walled, smooth; juxtacostal cells hyaline, larger and thinner-walled than the upper blade cells

**capsule:** 0.5–1.0 mm, ovoid, erect, dark purple-brown; seta 3–10 mm, purplish red; peristome double



vegetative shoot (dry on far left), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.25 mm



margin at midleaf, cells at midleaf, and enlarged juxtacostal cells in leaf base  
 ■ 10 μm, ■ 10 μm, ■ 100 μm

continued next page

***Distichophyllum pulchellum*** (Hampe) Mitt.

**form:** creeping, radiculose, ± unbranched stems, 10–50 mm tall  
**habitat:** moist, loamy soil, or decaying logs in damp forest

**leaf:** size: 1.3–1.8 × 0.6–0.8 mm

*shape:* obovate to spatulate, crowded, imbricate, distichous

*tip:* obtuse to rounded, mucronate to short-apiculate

*base:* alar cells little differentiated

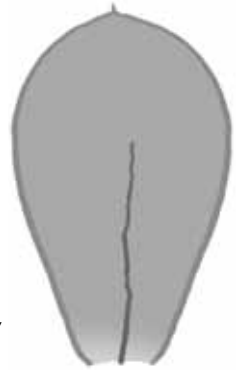
*costa:* failing about 2/3 up the blade

*border:* 2–3 rows of narrow elongate cells

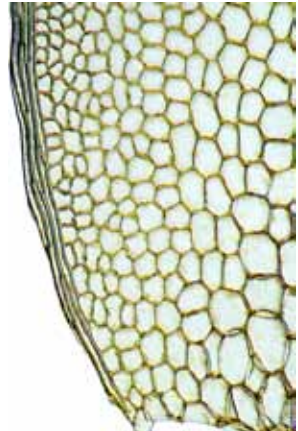
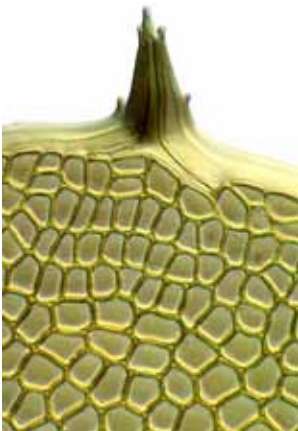
*margin:* entire, plane or reflexed toward the apex

*cells:* 10–20 μm, isodiametric, firm-walled, smooth

**capsule:** 1.5–2.0 mm, oblong, horizontal or cernuous, red-brown, lateral; seta 10–30 mm; calyptra mitriform, fringed; operculum erect, long-rostrate; exostome teeth yellow, striolate, joined basally, deeply furrowed, endostome segments equalling exostome teeth; spores 9–17 μm in diam., smooth



vegetative habit, shoots (moist) (2), capsule, and leaf outline  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm



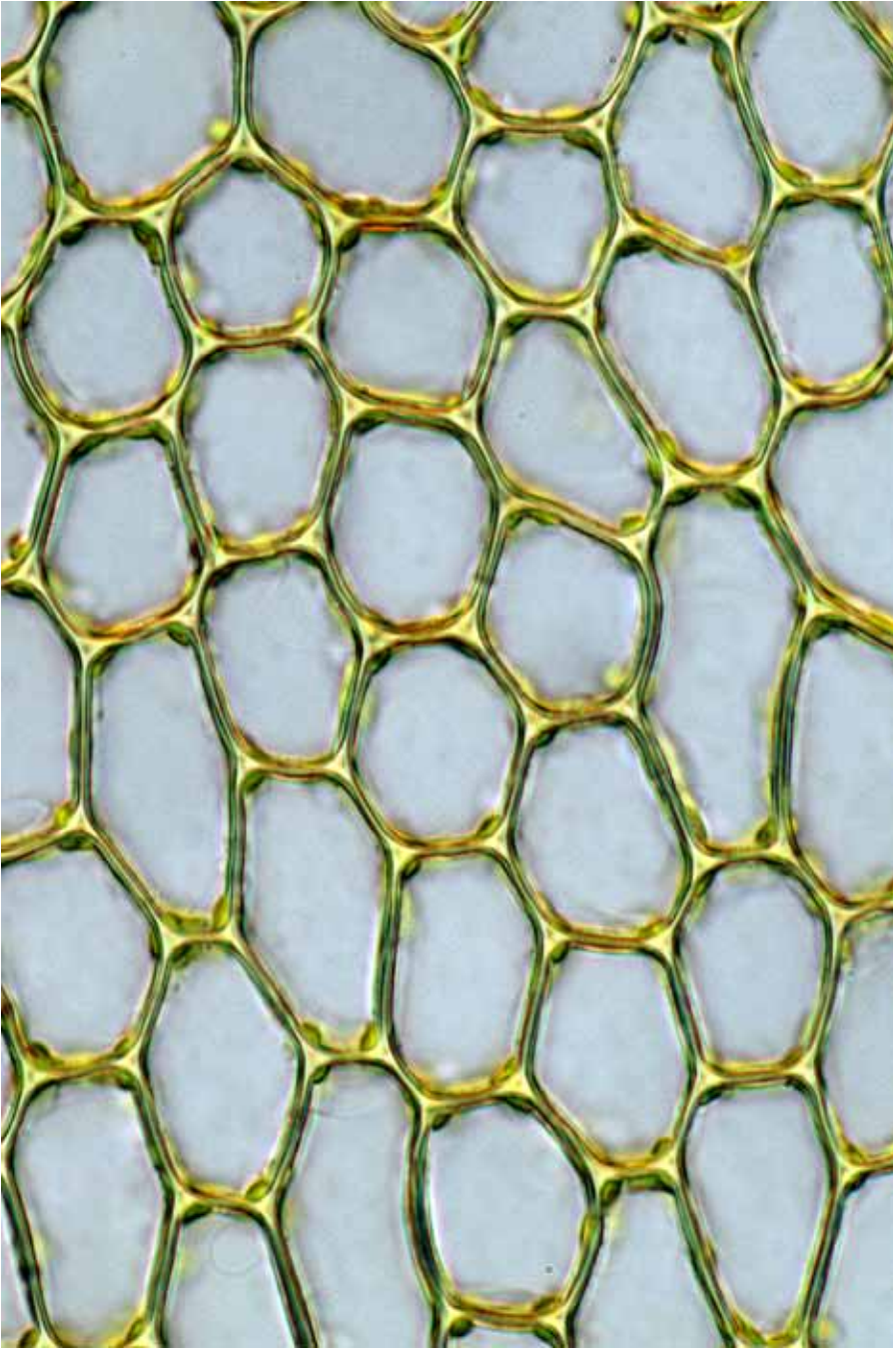
mucronate leaf apex, costa terminus, and leaf basal angle  
 ■ 10 μm, ■ 50 μm, ■ 50 μm

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*Distichophyllum pulchellum* habit (fully hydrated)  
1 mm

continued next page



*Distichophyllum pulchellum* midleaf cells  
10  $\mu\text{m}$

continued next page



***Distichophyllum rotundifolium*** (Hook.f. & Wilson) Müll.Hal. & Broth.

**form:** tufted, ± unbranched, radiculose stems, 5–13 mm tall, yellow-green

**habitat:** rotting logs and humus or rarely rock in damp forest

**leaf:** size: 0.5–0.9 mm

*shape:* ovate-orbicular, crisped when dry

*tip:* stoutly apiculate

*base:* basal cells longer and thinner-walled than other blade cells

*costa:* reaching halfway to two-thirds up the blade, ± flexuose

*border:* 2–4 rows of elongate, incrassate, hyaline cells

*margin:* entire below, denticulate above, plane

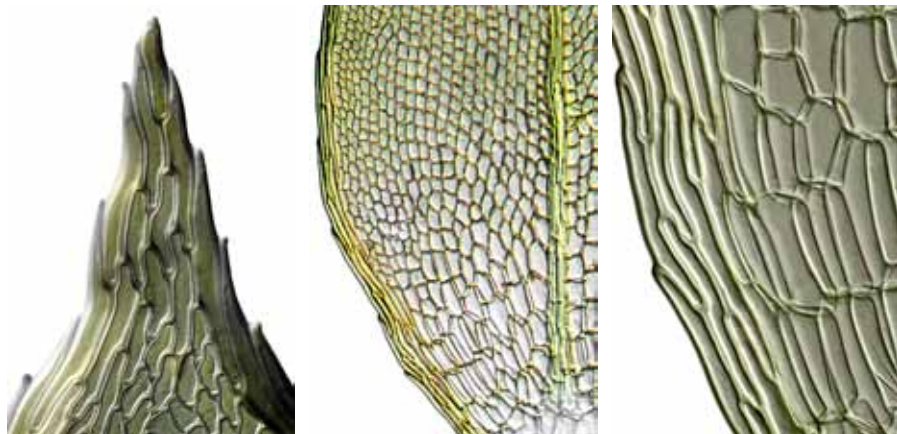
*cells:* 16–24  $\mu\text{m}$ , isodiametric, firm-walled, smooth

**capsule:** 1.5–2 mm, narrowly oblong, inclined to horizontal, exserted, pale brown; seta 5–10 mm, red, slender; calyptra mitriform, pilose above, fringed below; operculum conic-subulate; exostome teeth yellow, endostome segments equalling the exostome teeth in length; spores 9–12  $\mu\text{m}$  in diam., smooth



vegetative shoots (dry on left) (3), leaf outline and apex

1 mm, 1 mm, 1 mm, 0.1 mm, 100  $\mu\text{m}$



leaf apex, and leaf basal angle (2)

10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Distichophyllum rotundifolium* leaf apex detail  
10  $\mu\text{m}$

***Ephemeropsis trentepohlioides*** (Renner) Sainsbury

**form:** flat tufts of orange, persistent, interwoven protonemata that produce scattered capsules

**habitat:** bark and living leaves of shaded shrubs and vines

**leaf:** size: leaves none—persistent protonemata only

**capsule:** 0.4–0.9 mm, oblong-ovoid, erect, exserted, brown; seta 1–2 mm, rough; calyptra mitriform, ciliate at the base; operculum erect conico-rostrate; exostome teeth 100  $\mu$ m long, reflexed when dry, densely cross-striolate, endostome segments delicate, keeled, shorter than exostome teeth, cilia absent; spores fusiform, 3–5-celled, 100–200  $\mu$ m long

**note:** superficially resembles the green alga *Trentepohlia* in its colour and filamentous form



fertile habit, capsules, and multicellular spores

1 mm, 0.5 mm, 100  $\mu$ m



persistent protonema

100  $\mu$ m (left two), 50  $\mu$ m (right)

**Cyclodictyon blumeanum** (C.Müll.) C.Kuntze

**form:** pendent mats of branched, creeping stems, to 40 mm long, shoots complanate, leaves 6-ranked, light green and iridescent when young  
**habitat:** covering wet rocks or submerged in springs; Kermadecs only

**leaf:** size: 1.6–2 × 0.4–1 mm; pseudoparaphyllia lanceolate, to 400 μm  
*shape:* oblong-lanceolate to oblong-ovate or broadly ovate

*tip:* acute to ± cuspidate

*base:* cells ± rectangular, 60–100 × 15–30 μm; alar cells not differentiated

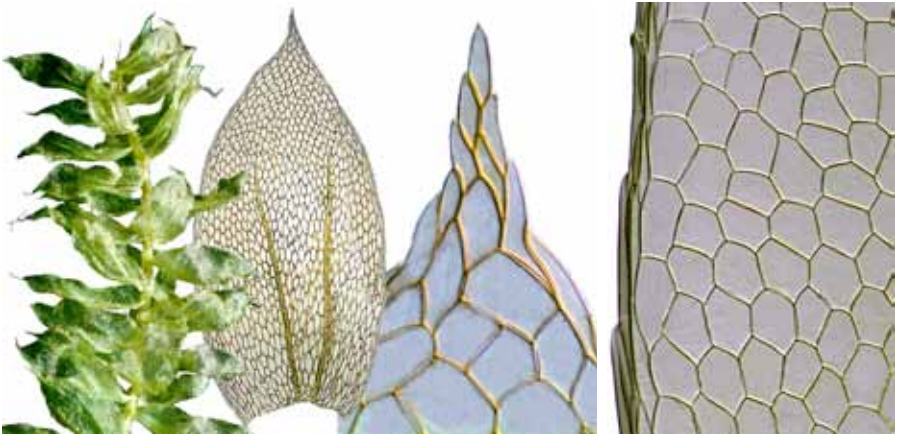
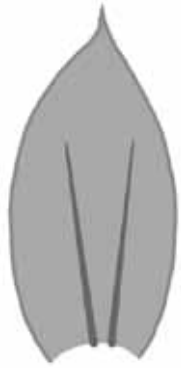
*costa:* two, narrow but strong, reaching about two-thirds up the blade

*border:* 2–3 rows of linear cells (125–150 μm long) from base to near apex

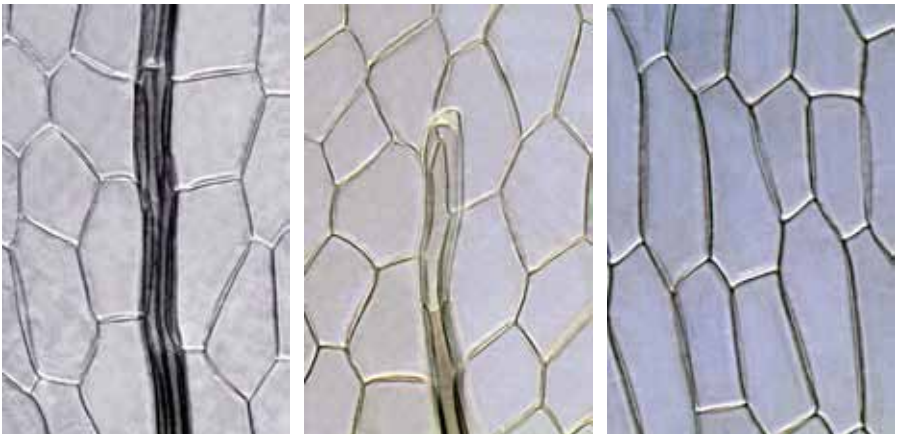
*margin:* weakly toothed above, plane or nearly so

*cells:* 30–60(–90) × 24–40 μm, oblong-hexagonal, thin-walled, smooth

**capsule:** not seen in New Zealand; 1.5–2 mm, ovoid to ovoid-cylindric, slightly curved, suberect to cernuous, dark brown; seta 12–20 mm, reddish; calyptra mitrate, covering the entire capsule; operculum long-rostrate; peristome double; spores 8–12 μm in diam., smooth



vegetative shoot (dry, crisped), bicostate leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 50 μm, 50 μm



costa midleaf (only one shown), spicule at a costa terminus, and cells near leaf base  
 50 μm, 50 μm, 50 μm

**Key\* to the New Zealand species of Trachyloma (2)**

- 1 Gemmiferous axes with large, usually fully developed leaves intermingled with gemmae; anticlinal walls of exothelial cells smooth to slightly undulate ..... ● **Trachyloma diversinerve**
- 1: Gemmiferous axes with highly reduced leaves that are most easily seen near the base of the axes after most of the gemmae have fallen off; anticlinal walls of exothelial cells nodulose ..... ● **Trachyloma planifolium**

\* based on Miller, NG; Manuel, MG (1982): *Trachyloma* (Bryophytina, Pterobryaceae): a taxonomic monograph. *Journal of the Hattori Botanical Laboratory* 51, 288, and Sainsbury, RGK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 154.



*Trachyloma  
diversinerve*



*Trachyloma  
planifolium*

**Trachyloma diversinerve** Hampe

**form:** patchy, erect, 1–2-pinnately branched, frondose stems, to 25 mm tall, leaves glossy, pseudoparaphyllia narrowly lanceolate

**habitat:** bark in damp forest

**leaf:** size: stem leaves 1.3–3.7 × 0.4–1.5 mm; branch leaves smaller

*shape:* stem and branch leaves ovate to ovate-lanceolate

*tip:* stem and branch leaves acute to obtuse

*base:* alar cells not differentiated

*costa:* none or short

*border:* not differentiated

*margin:* irregularly sharply serrulate above, ± entire below, plane

*cells:* 50–115 × 7–9 μm, linear, firm-walled, sinuose, porose, smooth

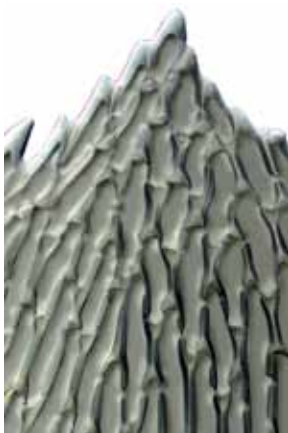
**capsule:** 3–6 mm, long-cylindric, exserted, erect, brown; seta 8–20 mm; calyptra smooth; operculum obliquely long-rostrate; peristome double; spores 12–16 μm, verrucose (coarsely warty)

**note:** filamentous multicellular gemmae 100–400 × 20 μm, 4–15-celled



vegetative frond (2), gemmiferous shoot (2), propagule, and leaf outline

10 mm, 10 mm, 1 mm, 0.5 mm, 10 μm, 0.5 mm



leaf apex, margin of upper leaf, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page



*Trachyloma diversinerve*  
vegetative frond  
5 mm

**Trachyloma planifolium** (Hedw.) Brid.

**form:** primary stems radiculose, creeping, leaves rudimentary, secondary stems dendroid, to 30 mm, 1–2-pinnately branched, complanate, leaves glossy, old leaves silvery

**habitat:** bark in damp forest

**leaf:** *size:* rachis leaves 2–3.5 × 1.2–1.9 mm; branch leaves smaller

*shape:* ovate to ovate-lanceolate, slightly asymmetric at the base

*tip:* obtuse to acuminate

*base:* basal cells porose and wider than the blade cells

*costa:* absent or weak and reaching about a quarter up the blade

*border:* not differentiated

*margin:* ± denticulate above, plane to incurved on one side

*cells:* 60–100 × 6–10 μm, linear-fusiform, firm-walled, smooth

**capsule:** 2–5 mm, narrowly cylindric, ± curved, suberect; seta 10–20 mm; peristome double, of distinctive white, hair-like teeth up to 1 mm long

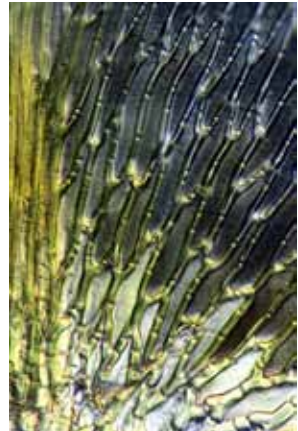
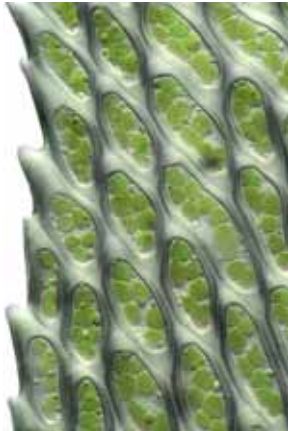
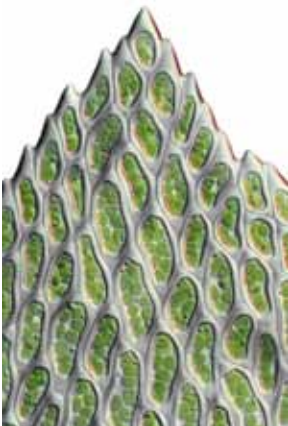


costa can be absent



shoots (2), capsule, peristome, single tooth, calyptra with operculum, and leaf outline

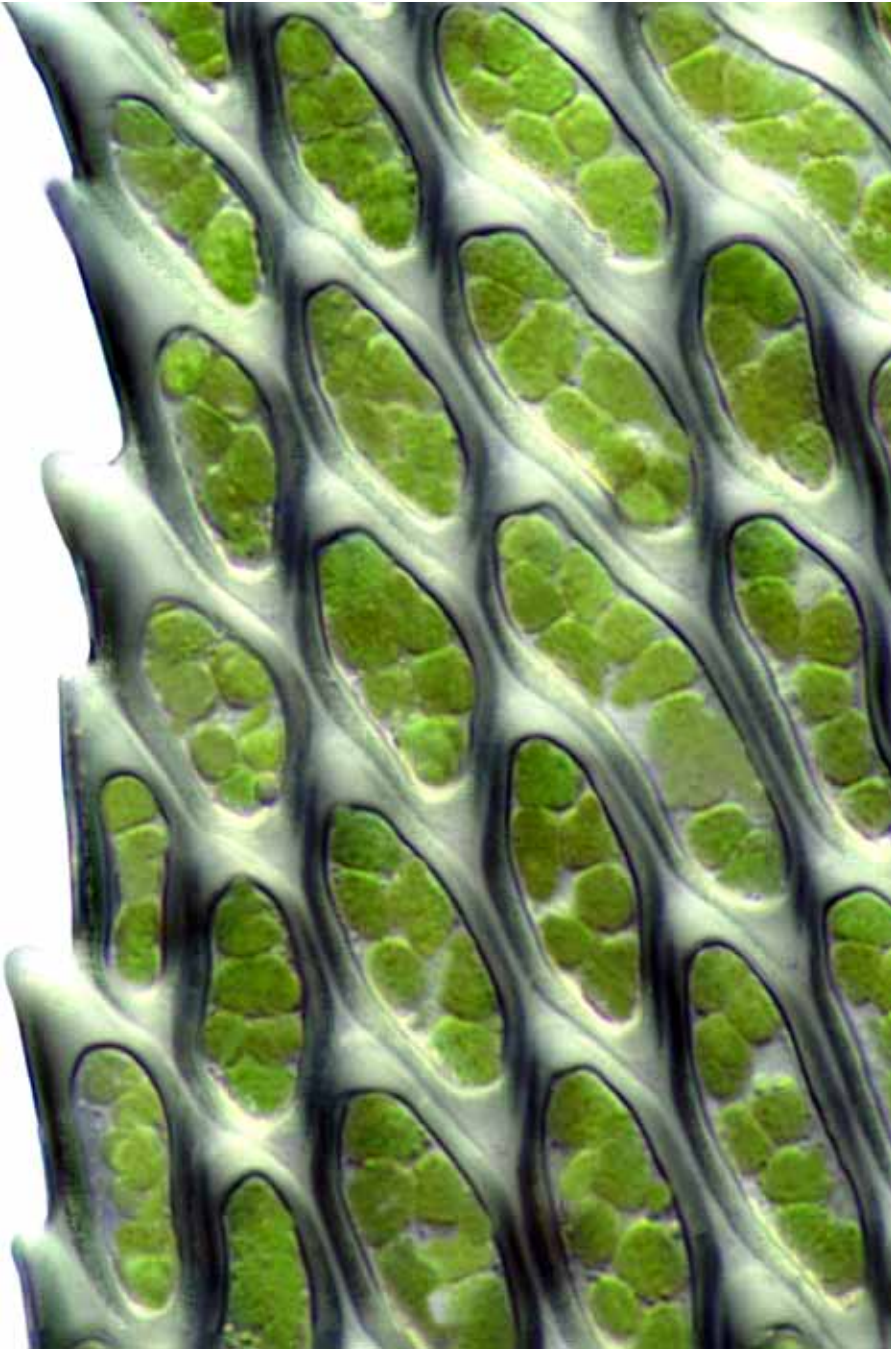
5 mm, 1 mm, 0.5 mm, 0.1 mm, 0.1 mm, 0.5 mm, 0.5 mm



leaf apex, margin of upper leaf, and basal juxtacostal cells

10 μm, 10 μm, 10 μm





*Trachyloma planifolium* margin upper leaf  
10  $\mu\text{m}$

**Climacium dendroides** (Hedw.) Weber & D.Mohr

**form:** primary stem creeping; secondary stem dendroid, radiculose, 30–40

mm, the leaves green or golden, glossy when dry; probably adventive

**habitat:** soil or humus, in swamps or cushion bogs or near streams or pools

**leaf:** size: stem leaves to  $2.3\text{--}2.8 \times 1.8$  mm; branch leaves  $2\text{--}3 \times 0.8\text{--}1.2$  mm

*shape:* ovate-lanceolate to oblong-lanceolate; branched paraphyllia common

*tip:* obtuse, dentate; stipe leaves mucronate and obscuring the stipe

*base:* auricles of pale, thin-walled,  $\pm$  inflated alar cells

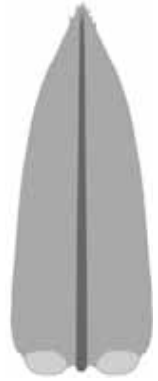
*costa:* strong, vanishing below the apex; often ending in an abaxial spicule

*border:* not differentiated

*margin:* entire below, the tip coarsely serrate to dentate, plane to incurved

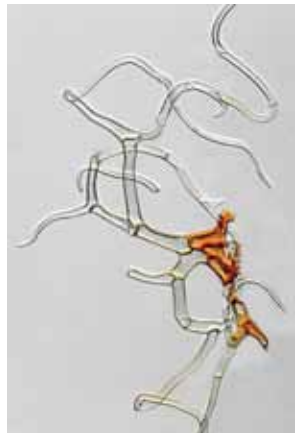
*cells:*  $30\text{--}50 \times 5\text{--}7$   $\mu\text{m}$ , narrowly rhombic, firm-walled, smooth,  $\pm$  porose

**capsule:** not seen in New Zealand; 3–5 mm, oblong-cylindric,  $\pm$  arcuate, exserted, erect to inclined; seta 18–45 mm; operculum rostrate; calyptra long,  $\pm$  twisted; peristome double; spores 13–22  $\mu\text{m}$  in diam., minutely papillose



vegetative shoots (3) (dry), leaf outline, and leaf apex

10 mm, 1 mm, 1 mm, 1 mm, 10  $\mu\text{m}$



margin at midleaf, costa at midleaf, and branched paraphyllia

10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$



*Climacium dendroides* vegetative shoots (dry)  
5 mm (left), 1 mm (right)

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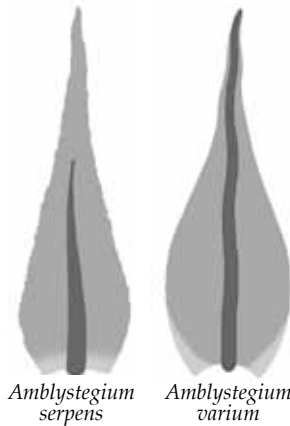


*Climacium dendroides* leaf cross-sections showing abaxially prominent costa  
10 µm (above), 50 µm (below)

**Key\* to the New Zealand species of *Amblystegium* (2)**

- 1 Costa reaching to only about midleaf; upper cells 3–5:1; paraphyllia absent..... ● ***Amblystegium serpens***  
 1: Costa reaching the acumen; upper cells 2–3:1; paraphyllia usually present, mostly uniseriate, up to 12 cells and 150  $\mu\text{m}$  long..... ● ***Amblystegium varium***

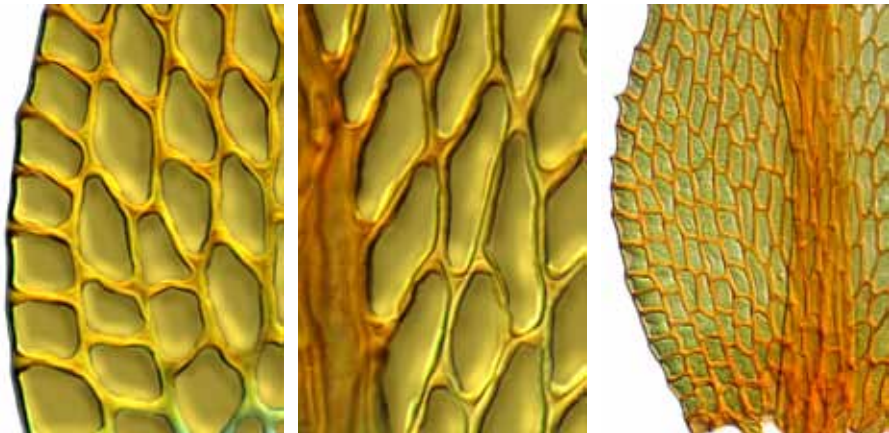
\* based on Sharp, AJ; Crum, HA; Eckel, P (1994): *The Moss Flora of Mexico*. New York Botanical Garden, Bronx, 892.



**Amblystegium serpens** (Hedwig) Bruch & W.P.Schimper**form:** matted, creeping, radiculose stems, to 30 mm long, branches filiform**habitat:** moist soil, fallen branches, logs, and rock in swamps or near lakes**leaf:** size: 0.5–0.8 × 0.2–0.3 mm (branch leaves slightly smaller and narrower)*shape:* lanceolate*tip:* tapering to a fine acumen*base:* narrowed; basal cells subquadrate, forming a weak alar group*costa:* failing above midleaf*border:* not differentiated*margin:* entire or weakly denticulate, plane*cells:* 20–30 × 7–9 μm, irregularly rhombic, firm-walled, smooth**capsule:** 1.8–2 mm, cylindrical, arcuate, exserted, inclined to horizontal, strangulate when dry; seta 10–25 mm, flexuose, red; calyptra cucullate, naked, smooth; operculum conic-apiculate; peristome double; spores 12–15 μm in diam., globose**note:** widely distributed in both hemispheres

vegetative shoot (dry), capsule (dry), leaf outline, leaf apex, and leaf subapex

1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



margin at midleaf, costa at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

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**Amblystegium varium** Hedw.

**form:** straggling, rigid, radiculose stems, 5–50 mm, leaves dull, yellowish

**habitat:** soil, humus, logs, bark, and rock in limey streams or marshes, to 800 m

**leaf:** *size:* stem leaves  $0.4\text{--}1.0 \times 0.2\text{--}0.3$  mm; branch leaves  $0.3\text{--}0.7 \times 0.2$  mm

*shape:* variable, mostly ovate-lanceolate,  $\pm$  decurrent

*tip:* tapered to an acumen

*base:* alar cells  $\pm$  quadrate, firm-walled, often yellowish

*costa:* flexuose above, disappearing below or in the acumen

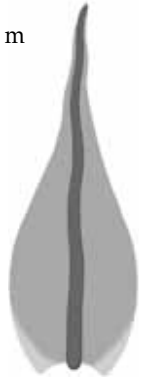
*border:* not differentiated

*margin:* entire or weakly serrulate, plane

*cells:*  $12\text{--}20 \times 6\text{--}7$   $\mu\text{m}$ , elongate-hexagonal, firm-walled, smooth, not porose

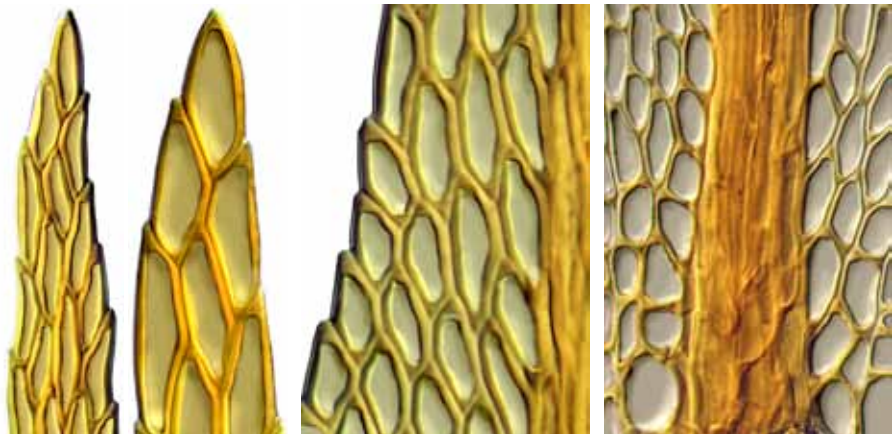
**capsule:** rare in New Zealand; 1.8 mm, cylindric, strongly curved, exserted, inclined to horizontal, brown; seta 20–32 mm, flexuose; operculum conic-apiculate; peristome double, cilia 1–3; spores 15–18  $\mu\text{m}$  in diam.

**note:** highly variable



vegetative shoots (3), and leaf outlines (2)

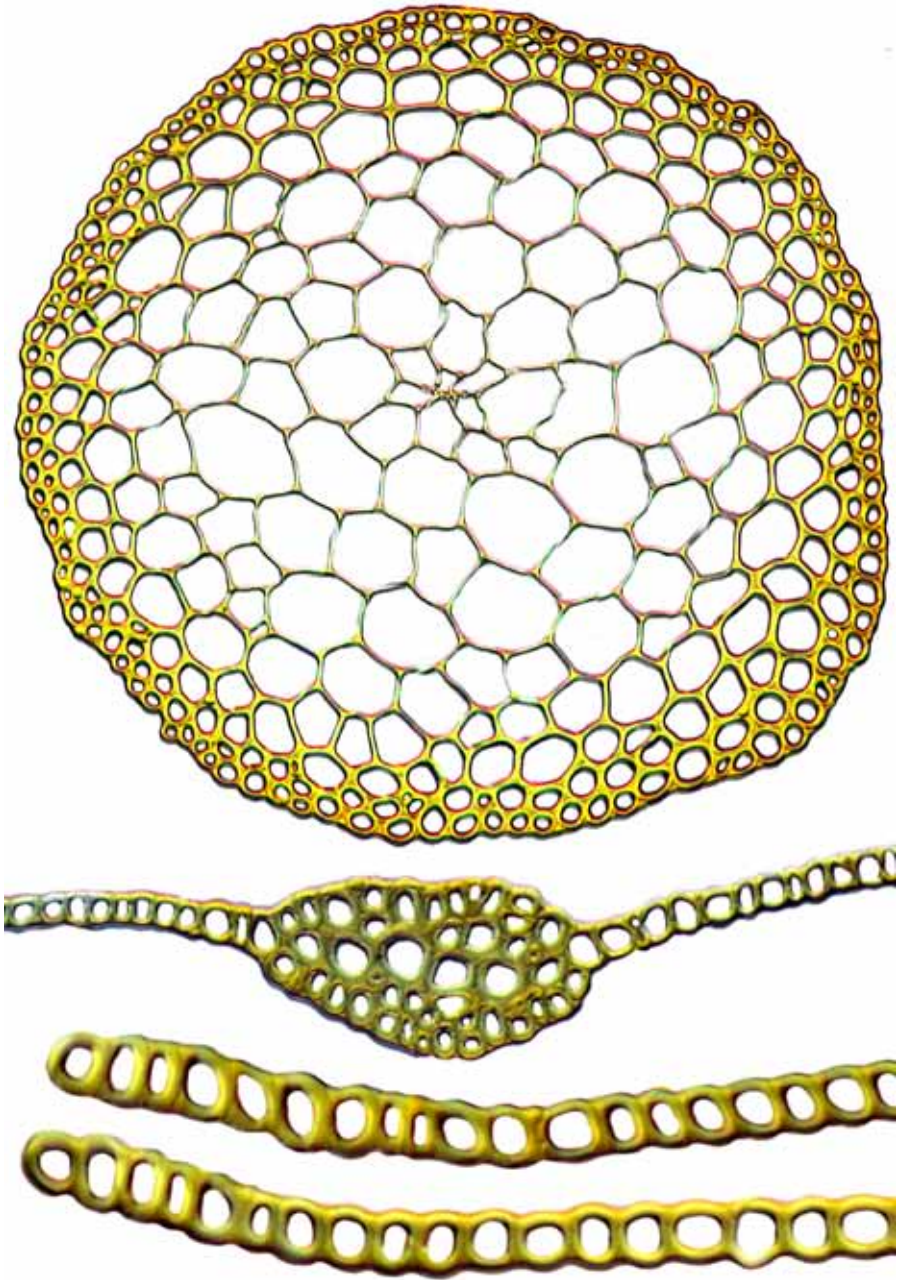
■ 2 mm (2), ■ 1 mm, ■ 0.5 mm (2)



leaf apices (2), leaf margin near apex, and costa at midleaf

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

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*Amblystegium varium* stem, costa, and leaf margin (2) cross-sections

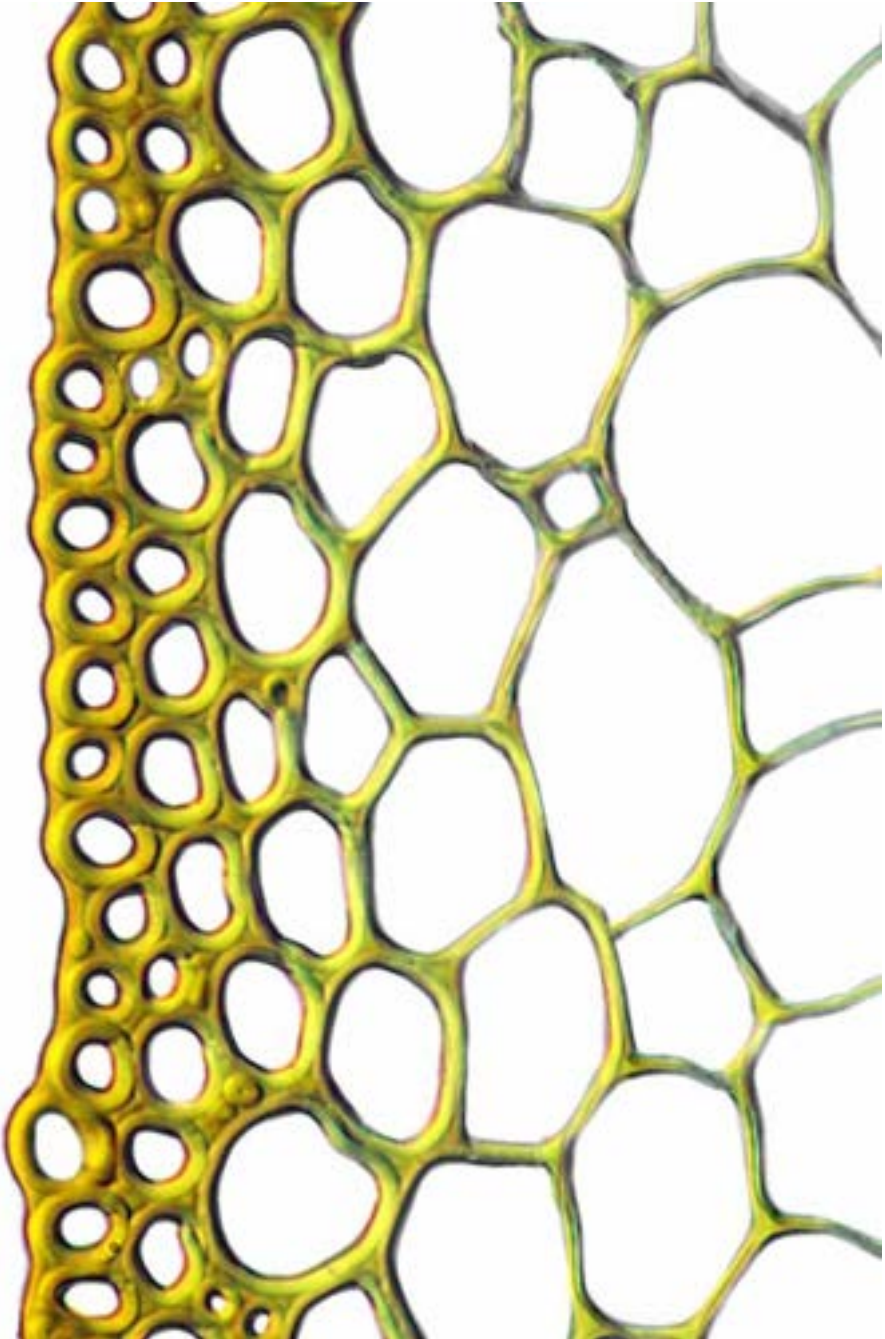
50  $\mu\text{m}$  (top),

50  $\mu\text{m}$  (middle),

10  $\mu\text{m}$  (bottom two)

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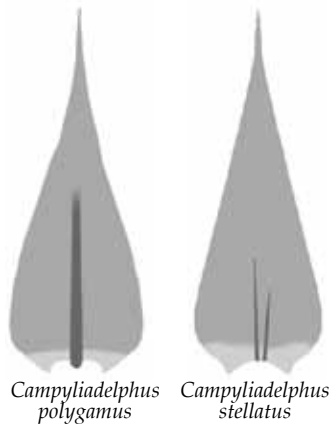


*Amblystegium varium* stem cross-section (detail)  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Campyliadelphus* (2)**

- 1 Costa single, ending about midleaf..... ● ***Campyliadelphus polygamus***  
 1: Costa none or short and double..... ● ***Campyliadelphus stellatus***

\* based on Crum, HA; Anderson, LE (1981): *Mosses of Eastern North America*. Columbia University Press, New York, 945.



**Campyliadelphus polygamus** (Bruch & Schimp.) Kanda

**form:** loosely tufted, irregularly branched, radiculose, procumbent stems,

15–45 mm tall, lacking paraphyllia, leaves glossy, golden

**habitat:** peat or soil in marshes and stream margins, ± aquatic, to 1600 m

**leaf:** size: 1.8–2.3 × 0.6–0.8 mm; branch leaves 1.2–1.4 × 0.3–0.4 mm

**shape:** stem leaves lanceolate, unistratose, little altered when dry

**tip:** tapered to a channelled, ± twisted acumen

**base:** cells enlarged at the angles and forming a distinct triangular group

**costa:** single, weak, reaching to about halfway up the lamina

**border:** not differentiated

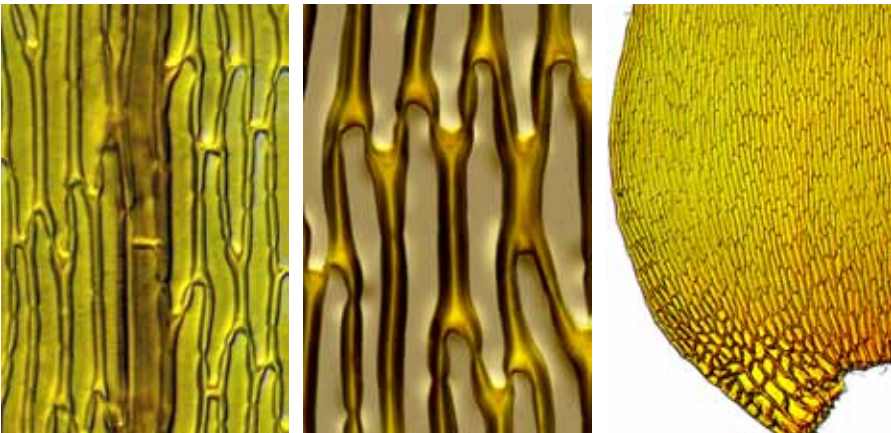
**margin:** entire to obscurely denticulate, plane

**cells:** 45–90 × 5–8 μm, narrowly linear, firm-walled, smooth, not porose

**capsule:** 2.5–3.0 mm, cylindrical, necked, curved, inclined to horizontal, exserted, brown, annulate; seta 20–30 mm, orange, flexuose; operculum conic; peristome hypnoid, endostome cilia 2, nodulose; spores 15–18 μm in diam., ± papillose

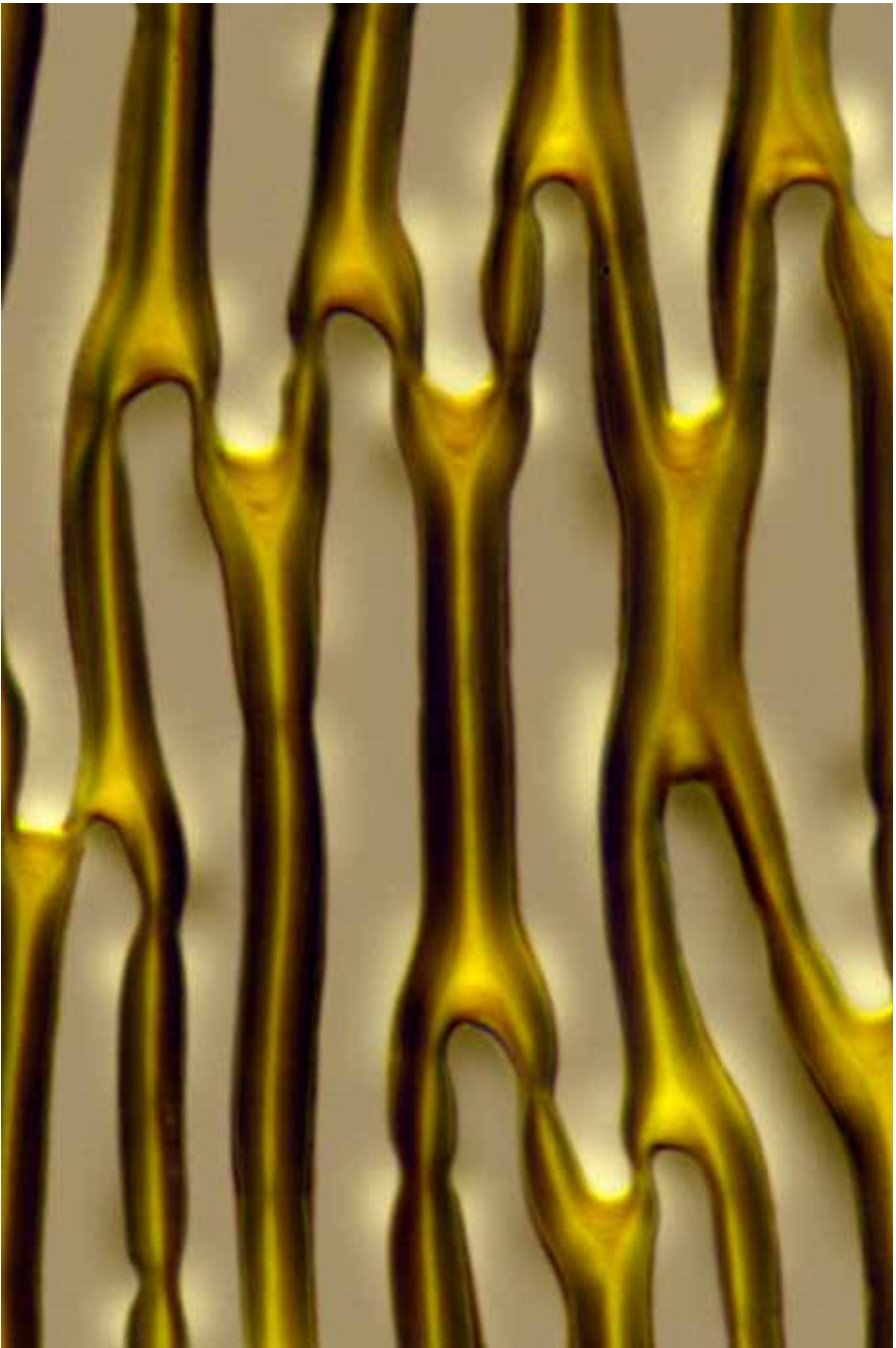


vegetative shoot (dry) (2), leaf outline, leaf apex, and margin midleaf  
 ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

continued next page



*Campyliadelphus polygamus* midleaf cells  
10  $\mu\text{m}$

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**Campyliadelphus stellatus** (Hedw.) Kanda

**form:** tufted or matted, ± erect, branched stems, 100 mm tall, leaves green or golden-brown, glossy

**habitat:** wet soil or humus in high-altitude limey fens or seeps, to 1600 m

**leaf:** *size:* stem leaves  $2.5\text{--}3.5 \times 0.8\text{--}1.0$  mm; branch leaves smaller

*shape:* lanceolate, tapering evenly to the apex, striolate when dry

*tip:* long, slender, channelled acumen, narrower in branch leaves

*base:* alar region ± auriculate, cells inflated, hyaline to pigmented

*costa:* absent, weak, or short and double

*border:* not differentiated

*margin:* entire above, serrulate below, plane

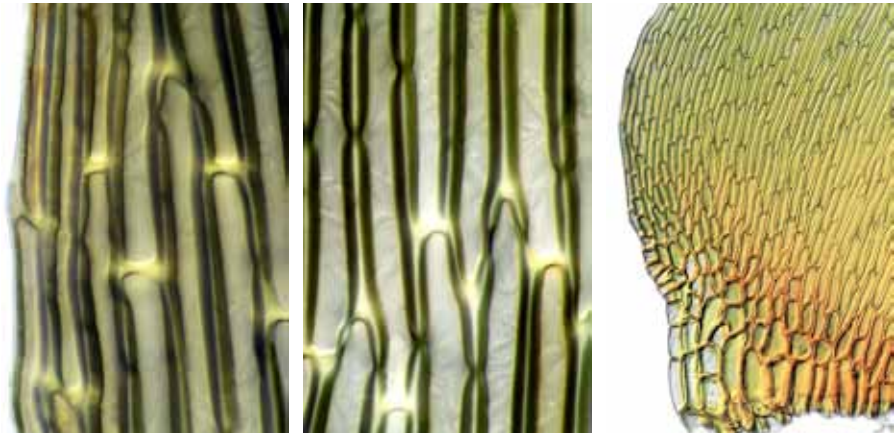
*cells:*  $40\text{--}90 \times 4\text{--}5$   $\mu\text{m}$ , vermicular, incrassate, porose, smooth

**capsule:** capsules not seen in New Zealand; 2–3 mm, cylindrical, curved, exserted, inclined to horizontal, strangulate when dry; seta 20–35 mm; operculum conic, apiculate; peristome double; spores 15–18  $\mu\text{m}$  in diam., finely papillose



vegetative shoot (dry) (2), branch leaf outline, and leaf apex (2)

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$



margin at midleaf, cells at midleaf, and branch leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

**Cratoneuron filicinum** (Hedw.) Spruce

**form:** interwoven mats of erect, pinnately branched (up to 45 mm), radiculose, and sparsely paraphylliate stems, 80(–120) mm tall, leaves green or golden

**habitat:** rock or soil in limey bogs, seepages, damp concrete, bricks, to 1500 m

**leaf:** size: stem leaves 1–1.2 × 0.6 mm; branch leaves 0.5–1.0 × 0.2 mm

**shape:** stem leaves wide-triangular, ± falcate-secund; branch leaves ovate-lanceolate

**tip:** gradually narrowed to a broad, plane subula

**base:** stem: auriculate, decurrent; branch: neither

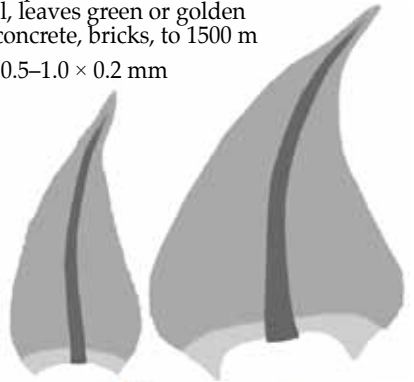
**costa:** percurrent or ending in the subula

**border:** not differentiated

**margin:** serrulate, plane to recurved at the base

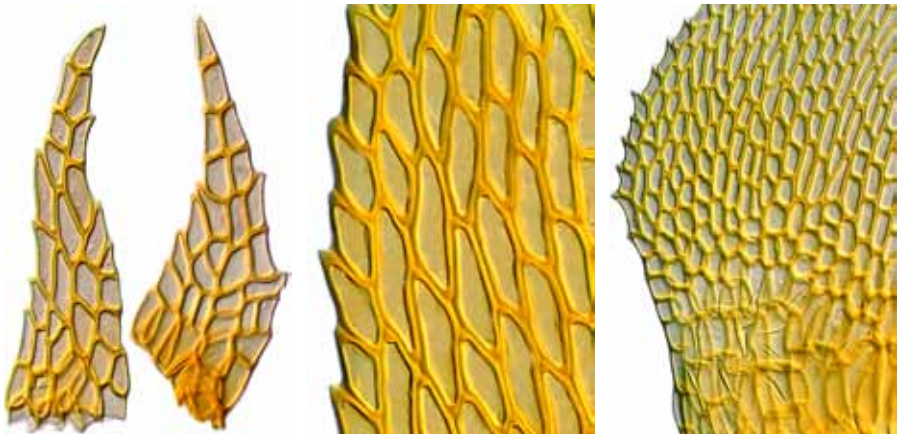
**cells:** 20–30 × 5–7 μm, oblong, firm-walled, smooth

**capsule:** no capsules in New Zealand; 2–2.5 mm, oblong to cylindric, strongly necked, inclined to horizontal, asymmetric, curved, strangulate when dry and empty; seta 25–35 mm



vegetative shoots (dry) (2), leaf outlines (2), and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 0.1 mm, ■ 10 μm



toothed paraphyllia, margin midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm, ■ 50 μm

**Cratoneuropsis relaxa** (Broth.) Fleisch.

**form:** (typical) dense and large mats of paraphylliate, irregularly branched stems, 100–250 mm long, the leaves yellowish, not glossy

**habitat:** shaded wet soil, rock, or logs, submerged or emergent, to 1600 m

**leaf:** *size:* stem leaves 1.2–1.8 × 0.6–0.9 mm; branch leaves same or smaller  
*shape:* cordate to lanceolate, ± constricted at midleaf, unchanged when dry

*tip:* acuminate, often oblique

*base:* basal cells shortly rectangular, not in distinct auricles or alar groups

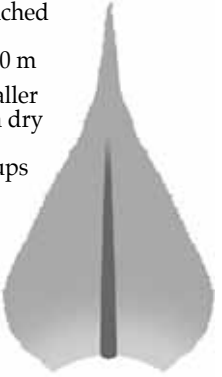
*costa:* evenly tapered, variably failing from midleaf to the acumen

*border:* weak or not differentiated

*margin:* entire to denticulate, plane to tubulose, recurved midleaf

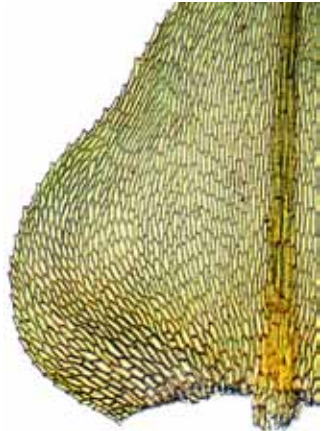
*cells:* 15–35 × 6–9 μm, linear-rhombic, firm-walled, smooth, not porose

**capsule:** 2–3 mm, cylindric-oblong, exserted, ± curved, horizontal, brown; seta 30–40 mm, red, flexuose; operculum conic, ± apiculate; exostome teeth yellow, fused at the base, endostome cilia 2–3; spores 12–16 μm in diam., smooth



vegetative shoots (dry) (2), leaf outline, and leaf apex (2)

5 mm, 1 mm, 0.5 mm, 50 μm, 50 μm



margin of upper leaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

continued next page



*Cratoneuropsis relaxa* vegetative shoots (moist)

1 mm, 1 mm

continued next page





*Cratoneuropsis relaxa* vegetative shoots (dry)

1 mm, 1 mm

**Key\* to the New Zealand species of *Drepanocladus* (2)**

- 1 Alar cells in inflated decurrent auricles; the costa of a leaf pulled off the stem takes with it some of the stem's cortex; costa reaching only halfway up the lamina ..... ● ***Drepanocladus aduncus***
- 1: Alar cells not in inflated decurrent auricles; the costa of a leaf pulled off the stem does not take with it any of the stem's cortex; costa reaching over two-thirds up the lamina..... ● ***Drepanocladus brachiatus***

\* based on Hedenäs, L (1998): An overview of the *Drepanocladus sendtneri* complex. *Journal of Bryology* **20**, 83–102.



**Drepanocladus aduncus** (Hedw.) Warnst.

**form:** matted or loose wefts of erect,  $\pm$  pinnately branched stems, to 50 mm tall, leaves golden yellow, not glossy

**habitat:** soil in meadows or floating in bogs or fens

**leaf:** size: stem leaves  $1.5\text{--}2.5 \times 0.5\text{--}0.8$  mm; branch leaves smaller

*shape:* ovate-lanceolate to oblong-lanceolate, usually falcate-secund

*tip:* short- to long-acuminate

*base:* narrowed to insertion, alar cells inflated, hyaline, in triangular auricles

*costa:* reaching about halfway up the lamina

*border:* not differentiated

*margin:* entire, plane to  $\pm$  inrolled

*cells:*  $30\text{--}60 \times 3\text{--}4$   $\mu\text{m}$ , vermicular, firm-walled, the ends rounded, not porose

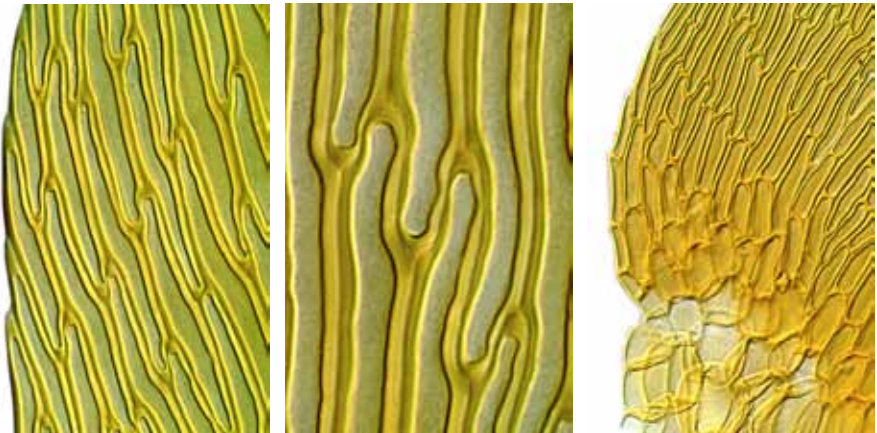
**capsule:** not seen in New Zealand; 2.5–3 mm, oblong, exserted, arcuate, horizontal, reddish brown; seta 30–80 mm, reddish; operculum conic, apiculate; peristome hypnoid; spores 16–20  $\mu\text{m}$  in diam.

**note:** cosmopolitan



fertile shoot (moist) (2), capsule, leaf outline, leaf apex, and leaf subapex

5 mm, 5 mm, 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

**Drepanocladus brachiatus** (Mitt.) Dixon

**form:** matted or loose wefts of erect, variously branched,  $\pm$  falcate-secund stems, 30–80 mm tall, leaves green, yellow-green, or golden

**habitat:** soil in limey, boggy sites, often submerged, to 1200 m

**leaf:** *size:* stem leaves  $2.0\text{--}5.0 \times 0.8\text{--}1.1$  mm; branch leaves smaller

*shape:* ovate-lanceolate, strongly concave,  $\pm$  falcate-secund

*tip:* tapered to an acumen

*base:* alar cells  $\pm$  inflated,  $\pm$  rectangular, pigmented, not decurrent

*costa:* single, ending about 70% up the blade

*border:* not differentiated

*margin:* entire below,  $\pm$  denticulate above, plane to reflexed below

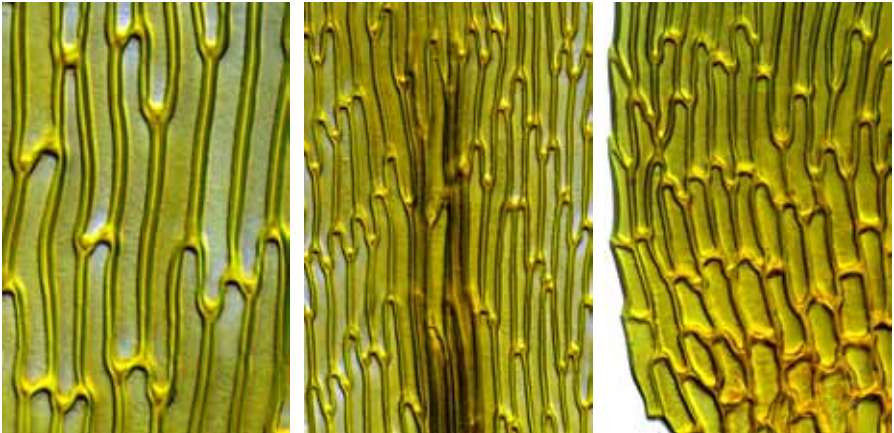
*cells:*  $60\text{--}120 \times 4\text{--}6$   $\mu\text{m}$ , linear, firm-walled, smooth

**capsule:** to 3.5 mm, cylindrical, curved throughout, inclined to horizontal, long-exserted, brown, not furrowed, constricted below the mouth when dry; seta 30–70 mm, red, smooth; operculum conic; peristome double, the exostome well-developed; spores 13–21  $\mu\text{m}$  in diam.



vegetative shoot (dry) (2), leaf outline, leaf apex, and margin lower leaf

1 mm, 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



cells at midleaf, costa terminus, and leaf basal angle

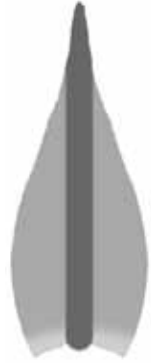
10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

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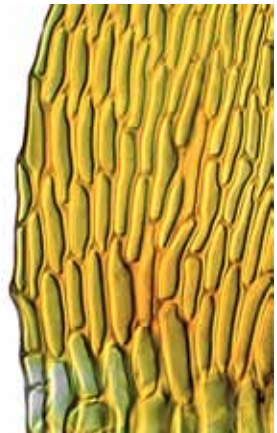


*Drepanocladus brachiatus* vegetative habit (dry)

■ 1 mm

**Hypnobartlettia fontana** Ochyra**form:** interwoven, wiry, branched, floating stems, to 60  $\mu\text{m}$  long**habitat:** fast-flowing calcareous springs**leaf:** size: 1.6–2.0  $\times$  0.6–0.9 mm**shape:** lanceolate to ovate-lanceolate, bistratose except near the base**tip:** acuminate**base:** alar cells little differentiated**costa:** excurrent into a stout cuspidate point**border:** not differentiated**margin:** distantly serrulate to entire, plane**cells:** 40–100  $\times$  8–10  $\mu\text{m}$ , linear-flexuose, thick-walled, prorulose**capsule:** capsules not known**note:** now thought to be an aquatic growth form of the highly variable *Cratoneuropsis relaxa*; restricted to Te Waikoropupū Springs near Nelson

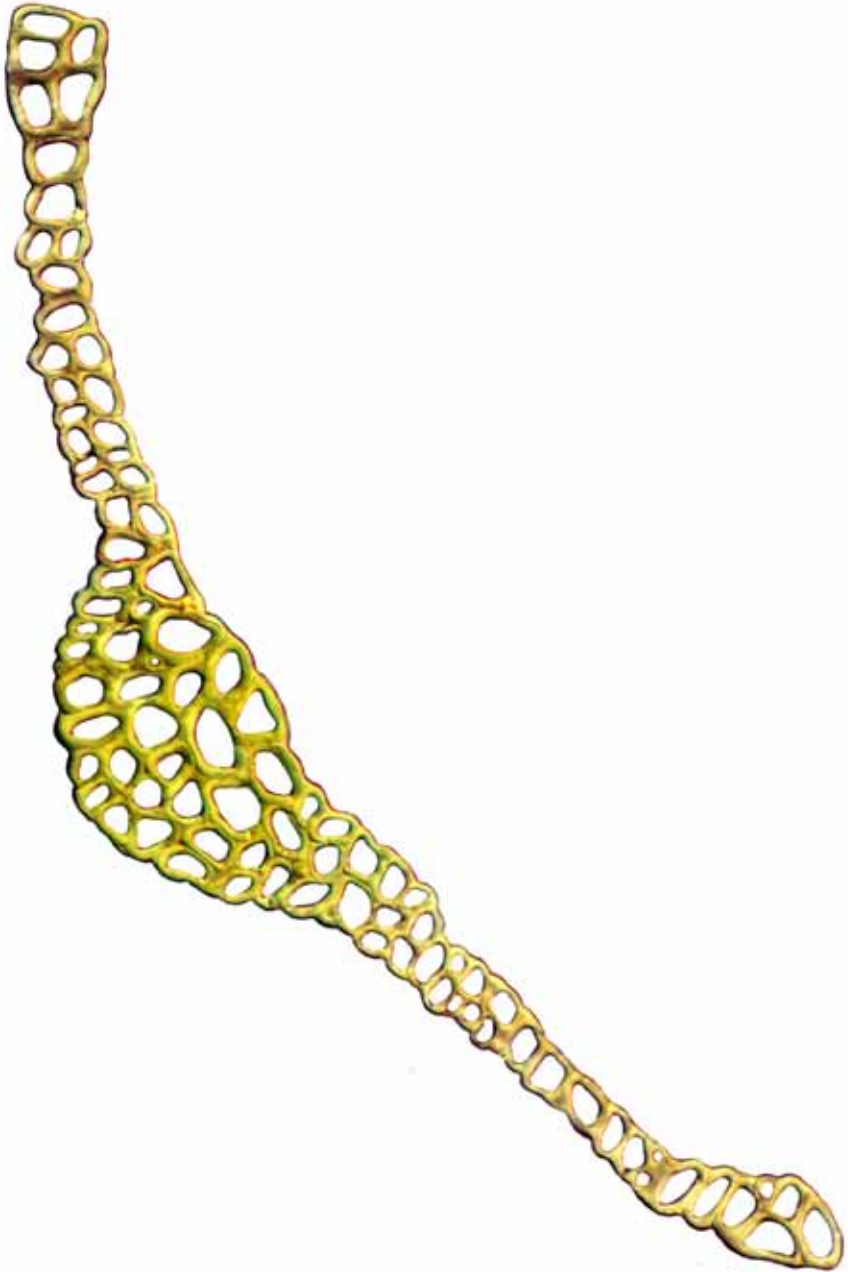
vegetative shoots (2), leaf outline, and leaf apex (2)

 1 mm, 1 mm, 0.5 mm, 100  $\mu\text{m}$ , 10  $\mu\text{m}$ 


margin at midleaf, cells at midleaf, and leaf basal angle

 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 

continued next page



*Hypnobartlettia fontana* leaf cross-section showing bistratose lamina  
10  $\mu\text{m}$

**Leptodictyum riparium** (Hedw.) Warnst.

**form:** creeping, subpinnately branched stems, to 100 mm long, ± flattened, lacking paraphyllia and rhizoids, leaves ± glossy, yellowish

**habitat:** wood, also on soil or rock in pools or swamps, to 600 m

**leaf:** size: stem and branch leaves similar, 2–4 × 0.8–1.6 mm

**shape:** ovate-lanceolate to oblong-lanceolate, highly variable, ± complanate

**tip:** acuminate

**base:** weakly decurrent, the basal cells rectangular, not arranged in auricles

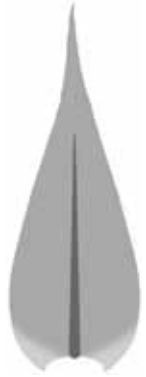
**costa:** narrow, reaching about 2/3 up the leaf blade

**border:** not differentiated

**margin:** entire, plane

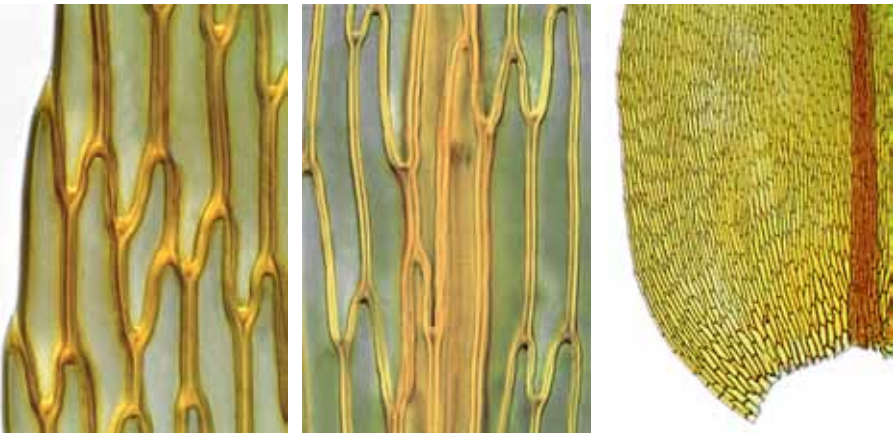
**cells:** 70–100 × 7–12 μm, linear-rhombic, firm-walled, smooth, not porose

**capsule:** to 2.5 mm, oblong-cylindric, mouth oblique when dry, strongly curved, inclined to horizontal, brown; seta 10–15 mm, red-orange; operculum low-conic, exostome teeth joined at base, hyaline-margined, striolate; endostome cilia 1–2; spores 10–18 μm in diam., green



vegetative shoots (moist and dry), leaf outline, leaf apex, and leaf subapex

■ 1 mm, ■ 1 mm, ■ 0.25 mm, ■ 10 μm, ■ 10 μm

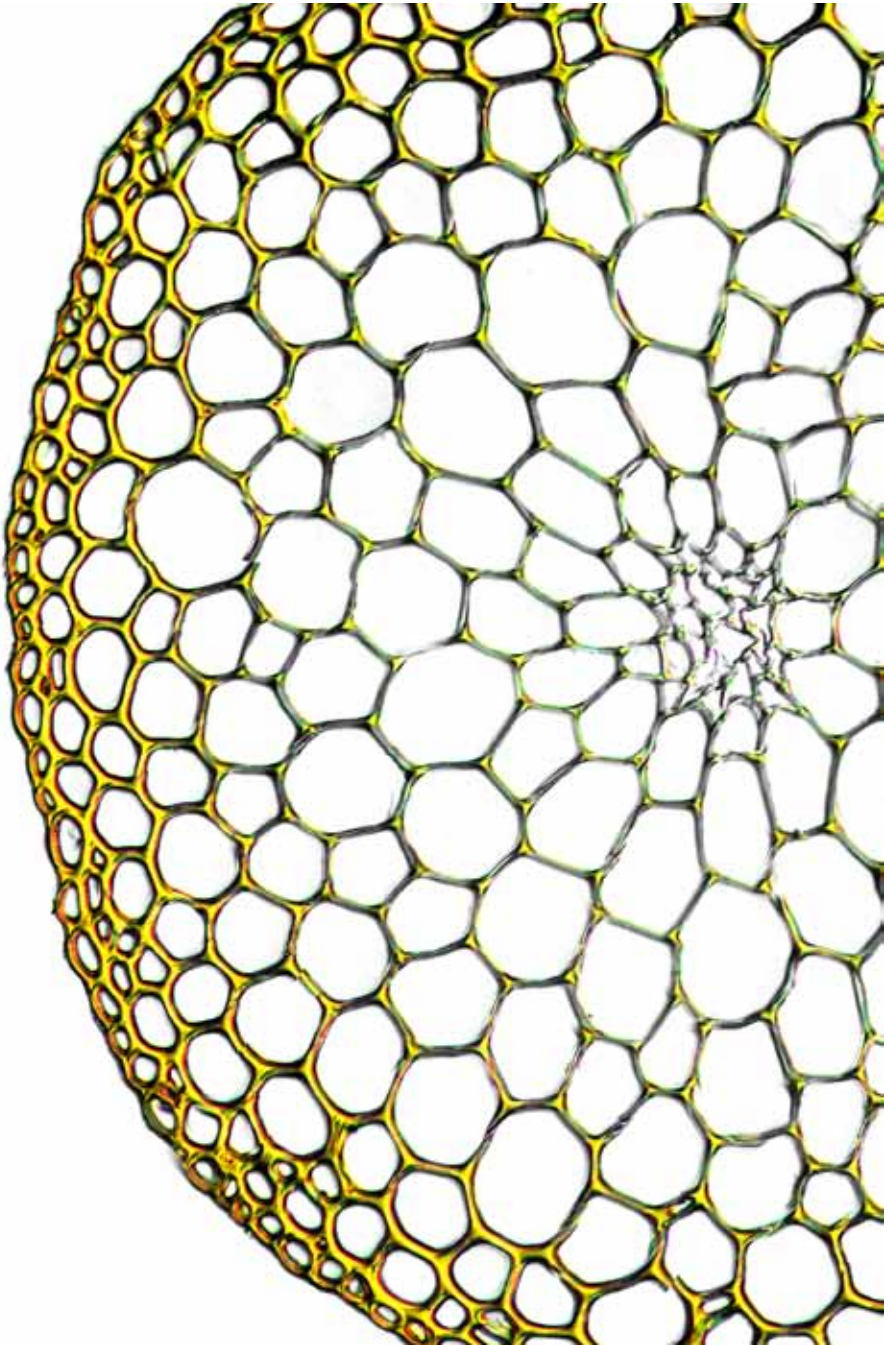


margin at midleaf, costa at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 100 μm

continued next page





*Leptodictyum riparium* stem cross-section  
10  $\mu$ m

**Sanionia uncinata** (Hedw.) Loeske

**form:** dense mats of creeping, variously branched stems, to 100 mm, the leaves falcate-secund, pale straw colour to golden, glossy

**habitat:** bark, rotting logs, or damp soil in bogs and swamps, to 1000 m

**leaf:** size: stem leaves  $2-4 \times 0.7-1.0$  mm; branch leaves smaller, less plicate

**shape:** ovate-lanceolate, falcate to circinate, plicate wet or dry,  $\pm$  decurrent

**tip:** narrowly acuminate

**base:** angle cells numerous, inflated, hyaline, porose, but not in auricles

**costa:** narrow, extending into the acumen,  $\pm$  obscured by plications

**border:** not differentiated

**margin:** entire to  $\pm$  serrulate above, plane

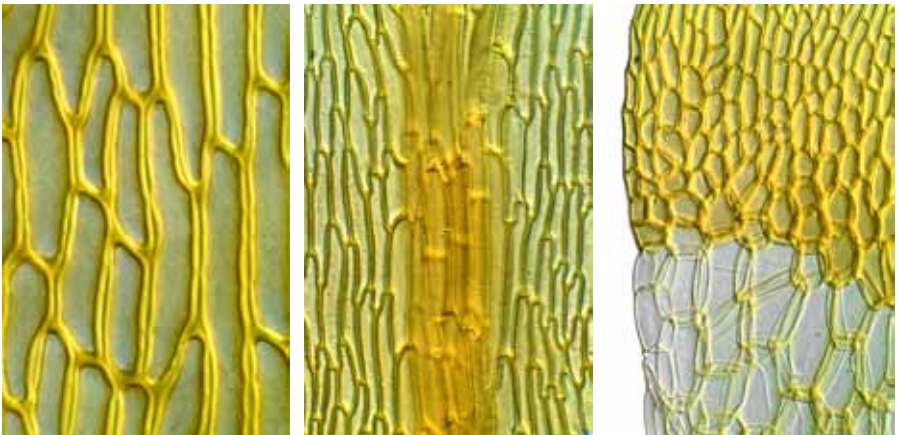
**cells:**  $35-75 \times 4$   $\mu\text{m}$ , linear, firm-walled, slightly sinuose, smooth

**capsule:** 1.5–2 mm, smooth, red, cylindrical,  $\pm$  arcuate, asymmetric, erect to cernuous; seta 20–35 mm, slender, flexuose; calyptra cucullate, smooth; operculum conic, apiculate; peristome double; exostome teeth cross-striolate below, papillose above; spores 14–20  $\mu\text{m}$  in diam.



vegetative shoot (dry) (2), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



cells at midleaf, costa at midleaf, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Scorpidium cossonii** (Schimp.) Hedenäs

**form:** interwoven mats of creeping, irregularly branched stems, 25–50 mm tall, leaves falcate-secund, golden, reddish or blackish

**habitat:** waterlogged soil or submerged, to 1600 m

**leaf:** size: 2–3 × 0.4 mm

*shape:* all leaves ovate to oblong-ovate, concave

*tip:* acute to obtuse, often minutely apiculate

*base:* a few outer angle cells inflated, hyaline, in weak auricles

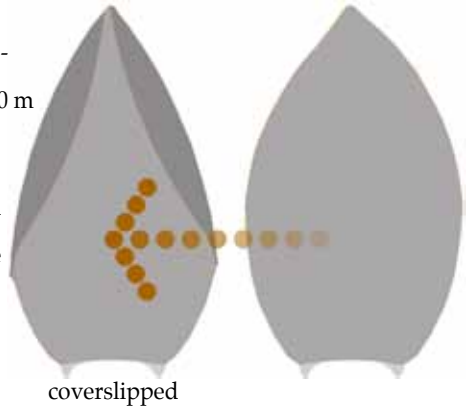
*costa:* absent, or to midleaf, or short and double

*border:* not differentiated

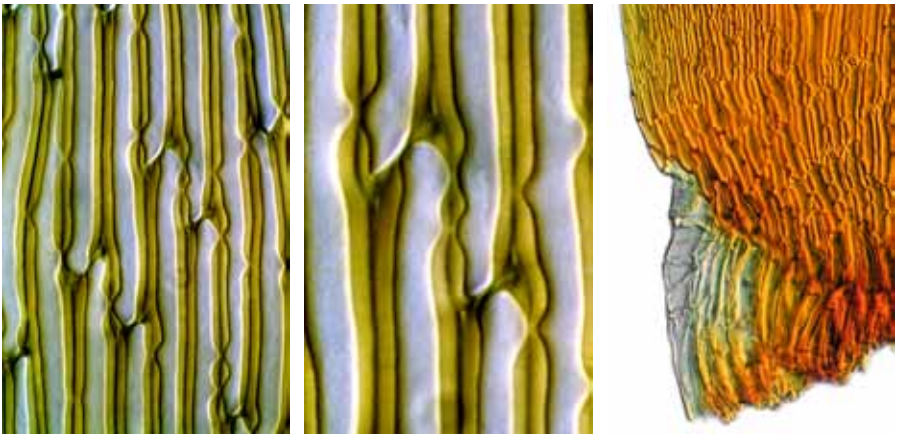
*margin:* entire, ± incurved above

*cells:* 50–90 × 3–4 μm, linear, incrassate, porose below, lumina rounded at the ends, smooth

**capsule:** not seen in NZ



vegetative shoots (dry) (2), shoot apex (moist), leaf outline, and leaf apex  
 5 mm, 1 mm, 1 mm, 0.5 mm, 50 μm



cells at midleaf (2), and leaf basal angle  
 10 μm, 10 μm, 50 μm

**Calliergon richardsonii** (Mitt.) Warnst.

**form:** large mats of ascending, branched stems, to 100 mm long, pseudoparaphyllia foliose, leaves yellowish, glossy  
**habitat:** boggy soil or humus, often submerged, to 1100 m

**leaf:** size: 2.5–3.5 × 1.4–1.9 mm; branch leaves narrower

*shape:* broadly ovate, deeply concave

*tip:* rounded-obtuse, ± cucullate

*base:* alar cells abruptly enlarged, inflated, hyaline, ± auriculate, and decurrent

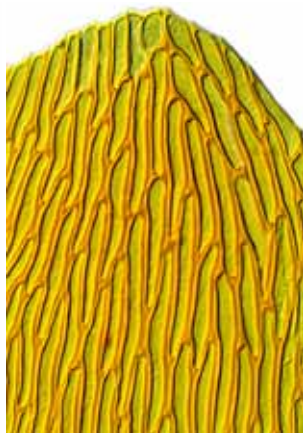
*costa:* reaching to three-quarters up the blade, forked or spurred

*border:* not differentiated

*margin:* entire, plane or incurved

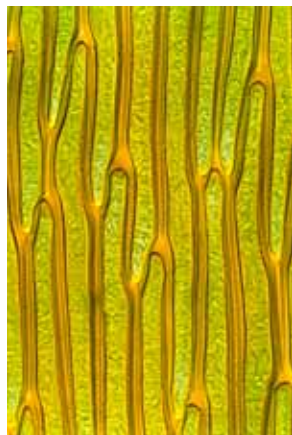
*cells:* 60–75 × 9 μm, linear-rhombic, firm-walled, smooth

**capsule:** not seen in New Zealand; 2.5–3 mm, oblong-cylindric, long-exserted, horizontal, curved, neck tapered; seta 45–60 mm; peristome hypnoid; spores 15–22 μm in diam., papillose



vegetative shoot (dry), leaf outline, and leaf apex

1 mm, 0.1 mm, 50 μm



margin of upper leaf, margin at midleaf, and cells at midleaf

10 μm, 10 μm, 10 μm

**Straminergon stramineum** (Brid.) Hedenäs

**form:** wefts or mats of  $\pm$  unbranched stems, 20–55 mm, leaves glossy

**habitat:** soil in wet meadows and boggy sites, to 1800 m

**leaf:** *size:* stem leaves  $0.8\text{--}1.8 \times 0.5$  mm; branch leaves similar

*shape:* stem leaves broadly ovate, concave, not plicate; stem leaves same

*tip:* obtuse to rounded, minutely apiculate

*base:*  $\pm$  decurrent; alar cells inflated, hyaline, thin-walled, in auricles

*costa:* weak, reaching  $2/3$  up the lamina

*border:* not differentiated

*margin:* entire, plane

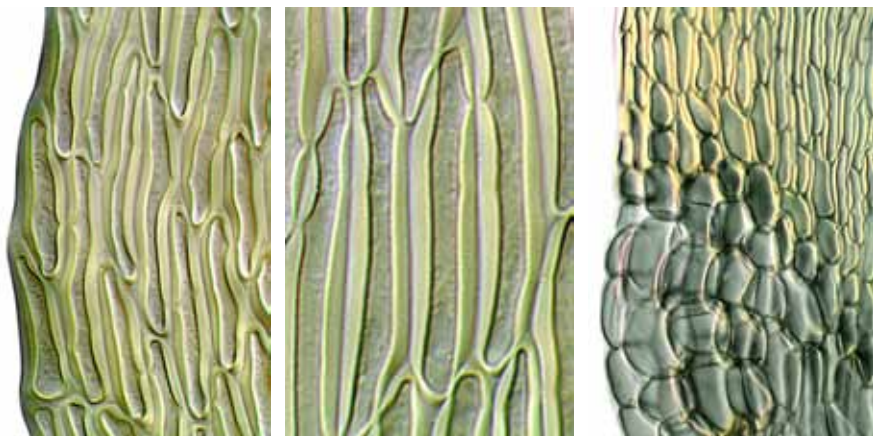
*cells:*  $20\text{--}50 \times 6\text{--}8$   $\mu\text{m}$ , oblong to linear, thick-walled, smooth

**capsule:** not seen in NZ; 2.5–3 mm; oblong-cylindric, long-exserted, curved, inclined to cernuous; exannulate; seta 30–60 mm; operculum conic, bluntly apiculate; calyptra cucullate, smooth, naked; exostome teeth yellowish, dentate, endostome cilia 2–3, nodose; spores  $13\text{--}23$   $\mu\text{m}$  in diam., finely papillose



vegetative shoots (dry) (3), leaf outline, and leaf apex

■ 1 mm (left two), ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$



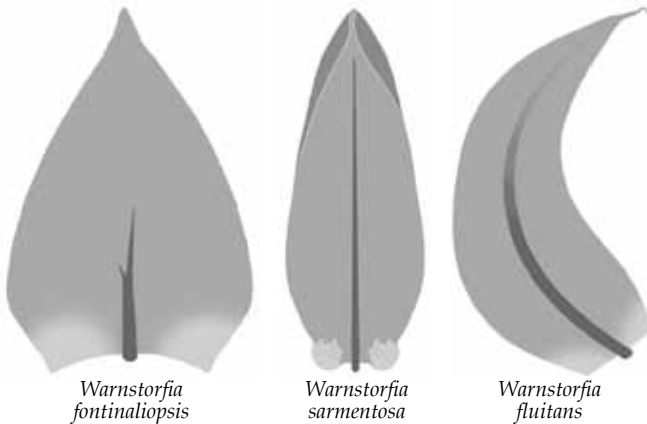
margin at midleaf, cells at midleaf, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Key\* to the New Zealand species of Warnstorfia (3)**

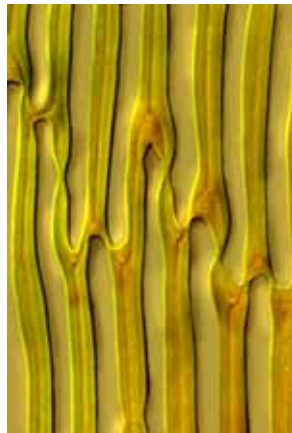
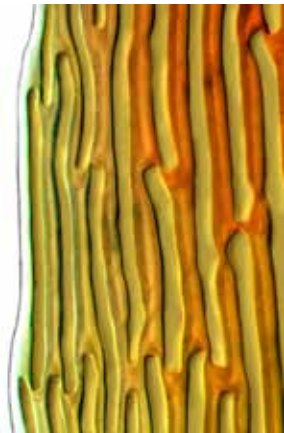
- 1 Leaves 0.9–1.2 mm, ovate to ovate-lanceolate ..... ● **Warnstorfia fontinaliopsis**  
 1: Leaves > 1.2 mm, lanceolate to narrowly lanceolate.....2
- 2(1:) Stem-tip leaves falcate-secund, tip gradually narrowed to a long, flexuose point;  
 stem leaves striolate when dry ..... ● **Warnstorfia fluitans**  
 2: Stem-tip leaves not falcate-secund, tip rounded and cucullate; stem leaves not striolate  
 when dry ..... ● **Warnstorfia sarmentosa**

\* based partly on Crum, HA; Anderson, LE (1981): *Mosses of Eastern North America*.  
 Columbia University Press, New York. 917.



**Warnstorfia fluitans** (Hedw.) Loeske**form:** matted, variously branched stems, 40–120 mm, leaves golden**habitat:** acidic meadows, bogs, tarns, ditches, ± submerged, to 1600 m**leaf:** *size:* 1.0–4.5 × 0.4–0.8 mm*shape:* narrowly lanceolate, concave, falcate-secund to ± circinate*tip:* gradually tapered to a long flexuose acumen*base:* basal cells inflated, hyaline, thin-walled, weakly auriculate*costa:* reaching to above midleaf*border:* not differentiated*margin:* denticulate or serrulate above, plane*cells:* 70–120 × 5–7 μm, linear-flexuose, firm-walled, prorate, smooth**capsule:** 2–3 mm, oblong, exserted, curved, inclined to horizontal; seta 40–70 mm; operculum short-conic; peristome hypnoid; spores 17–27 μm in diam.**note:** species of *Warnstorfia* have small clear cells (nematogons) near the leaf apex (one is arrowed in the acumen close-up below)

vegetative shoots (2), leaf outline, flexuose acumen with nematogon, and capsule  
 5 mm, 1 mm, 0.5 mm, 10 μm, 1 mm



margin at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page

**Warnstorfia fontinaliopsis** (Müll.Hal.) Ochyra

**form:** loosely matted, pinnately branched stems, 20–80 mm long  
**habitat:** soil or rarely rock, in boggy sites, sometimes submerged

**leaf:** size: 0.9–1.2 mm

*shape:* ovate to ovate-lanceolate

*tip:* acute to acuminate, blunt or rounded at the apex

*base:* cells of basal angle  $\pm$  inflated, sometimes in auricles

*costa:* single, often forked above, reaching to at least midleaf

*border:* not differentiated

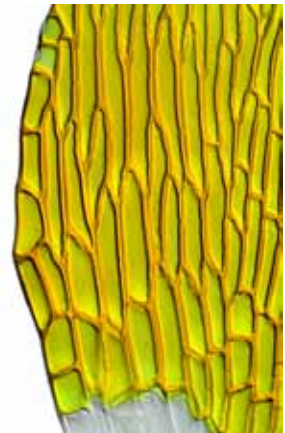
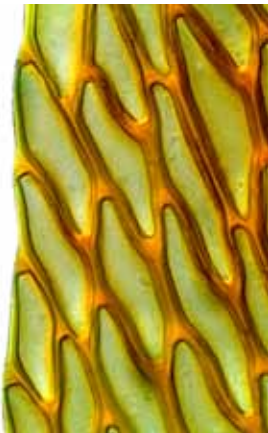
*margin:* entire, plane

*cells:* 30–60  $\times$  8–10  $\mu\text{m}$ , at the extreme apex 15–20  $\mu\text{m}$  and  $\pm$  quadrate, linear to fusiform below, firm-walled, smooth

**capsule:** 2–3 mm, oblong-cylindric, inclined to horizontal, curved, necked, asymmetric, brown, contracted below the mouth when dry; seta 45–60 mm, orange, flexuose, smooth; operculum bluntly conic; annulus none; calyptra cucullate



vegetative habit (dry), vegetative shoot (dry), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

continued next page



**Warnstorfia sarmentosa** (Wahlenb.) Hedenäs

**form:** matted, irregularly branched stems, 40–150 mm, often submerged;  
leaves purple-red to yellow-brown, glossy

**habitat:** rock or soil in rocky acidic or calcareous alpine seepages or tarns

**leaf:** size: 1.3–3.5 × 0.5–0.8 mm

*shape:* oblong-ovate, cucullate

*tip:* stem leaves rounded-obtuse, cucullate; branch leaves apiculate

*base:* alar cells in auricles, 20–40 × 16–20 μm, hyaline, inflated, decurrent

*costa:* single, reaching to nearly the tip of the lamina

*border:* not differentiated

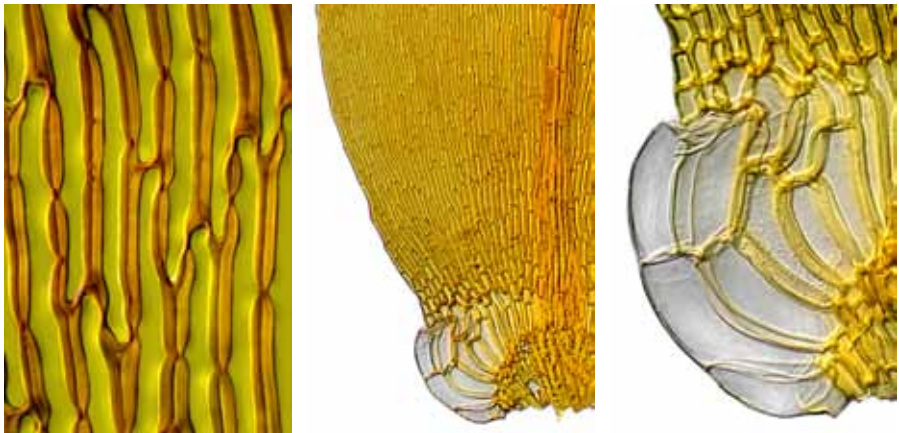
*margin:* entire, plane

*cells:* 40–75 × 3–6 μm, long-linear, flexuose, thick-walled, porose, smooth

**capsule:** not seen in NZ; 2.5 mm; oblong-cylindric, long-exserted,  
curved, inclined, stomatose in the neck, annulus none; seta 25–35 mm,  
red; operculum conic, apiculate; peristome hypnoid, endostome cilia  
1–3; spores 16–20 μm in diam., finely papillose



vegetative shoots (2), leaf outline, and margin midleaf  
 1 mm, 1 mm, 0.25 mm, 10 μm



cells at midleaf, leaf basal angle, and auricular alar cells  
 10 μm, 25 μm, 10 μm

continued next page



*Warnstorfia sarmentosa* vegetative habit (dry)  
1 mm

**Lindbergia maritima** Lewinsky

**form:** thinly matted, creeping, irregularly branched stems, 5–8 mm,  
leaves yellowish, clusters of brood branchlets in leaf axils

**habitat:** rock on the Waitakere Ranges coast

**leaf:** size: 0.4–0.6 × 0.2–0.3 mm

*shape:* broadly ovate

*tip:* acute to obtuse

*base:* base not decurrent; alar cells not differentiated

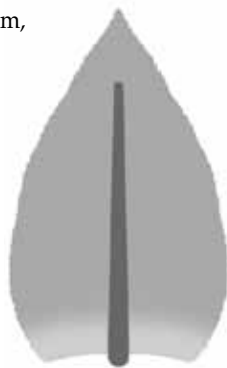
*costa:* strong, ending below the apex

*border:* not differentiated

*margin:* ± crenulate toward the apex, plane

*cells:* 7–12 μm, quadrate to hexagonal, firm-walled, mammillose

**capsule:** capsules not known



vegetative shoot (dry), leaf outline, and leaf apex

■ 0.1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, costa at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

**Pseudoleskea imbricata** (Hook.f. & Wilson) Broth.

**form:** primary stems matted, wiry, to 40 mm long, secondary stems curved, terete, julaceous, often parallel, simple or branched, not paraphylliate

**habitat:** wet limestone, in or near streams, lowland to montane

**leaf:** size: 0.5–0.8 × 0.3–0.4 mm

**shape:** broadly ovate, plicate

**tip:** acute to obtuse

**base:** weakly decurrent; basal margin cells subquadrate to oval

**costa:** failing below the apex

**border:** not differentiated

**margin:** ± crenulate toward the apex, plane to ± recurved below

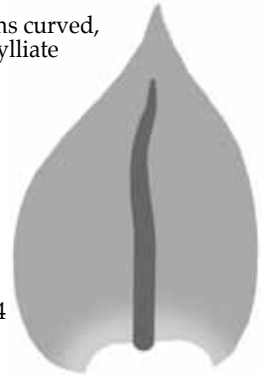
**cells:** 12–18 × 3–5 μm, oval to ± hexagonal, firm-walled, smooth

**capsule:** 2 mm, short-cylindric, exserted, erect, ± curved; seta 8–14

mm, flexuose, red; calyptra cucullate, naked; operculum conic;

exostome teeth hyaline-bordered, cross-striolate; endostome

equalling exostome teeth, cracked, cilia 1; spores 14–18 μm in diam.



vegetative habit (dry), leaf outline, and leaf apex

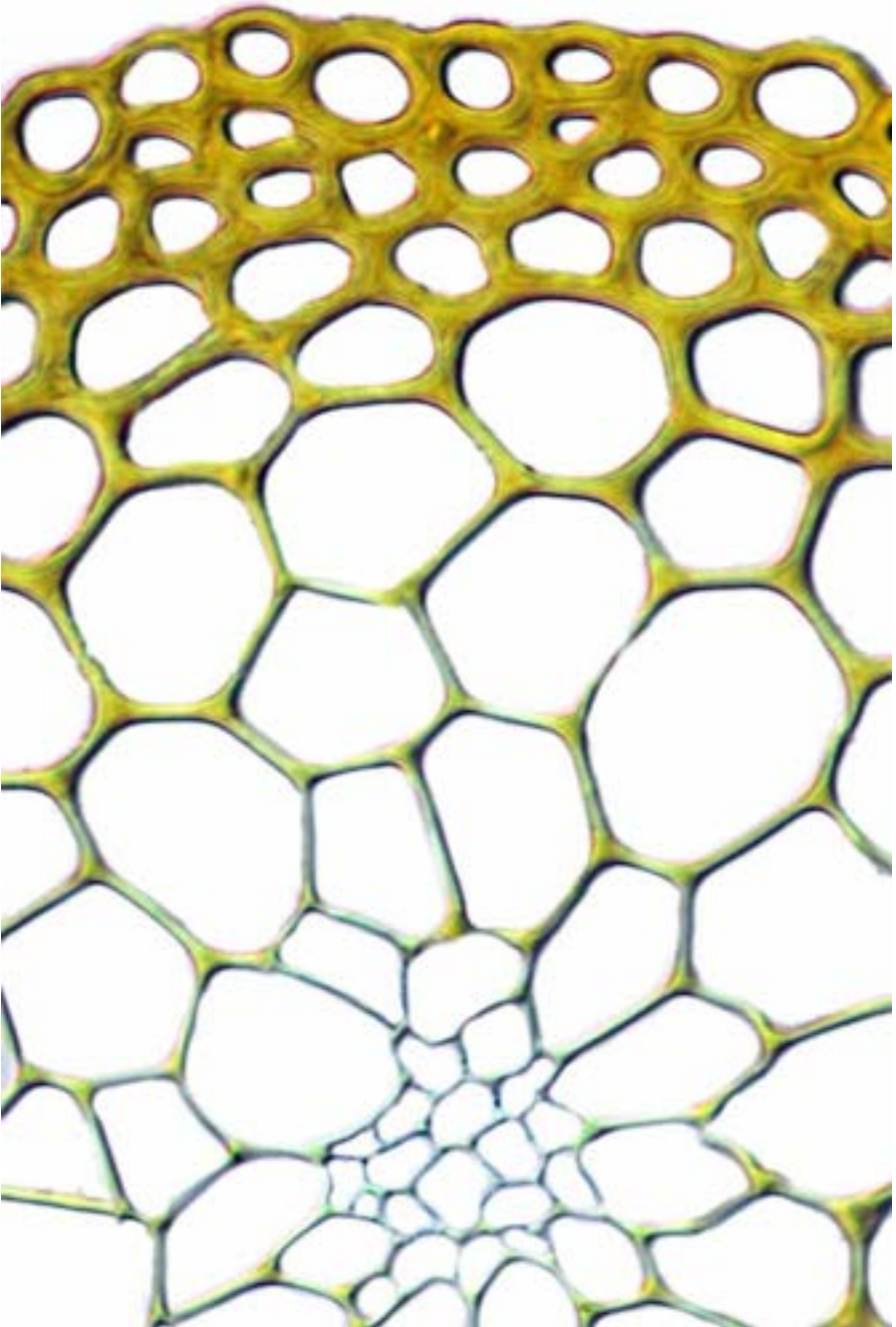
1 mm, 0.25 mm, 50 μm



margin at midleaf, costa at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

continued next page



*Pseudoleskea imbricata* seta cross-section  
10  $\mu\text{m}$

continued next page



*Pseudoleskea imbricata* leaf cross-section  
50  $\mu\text{m}$

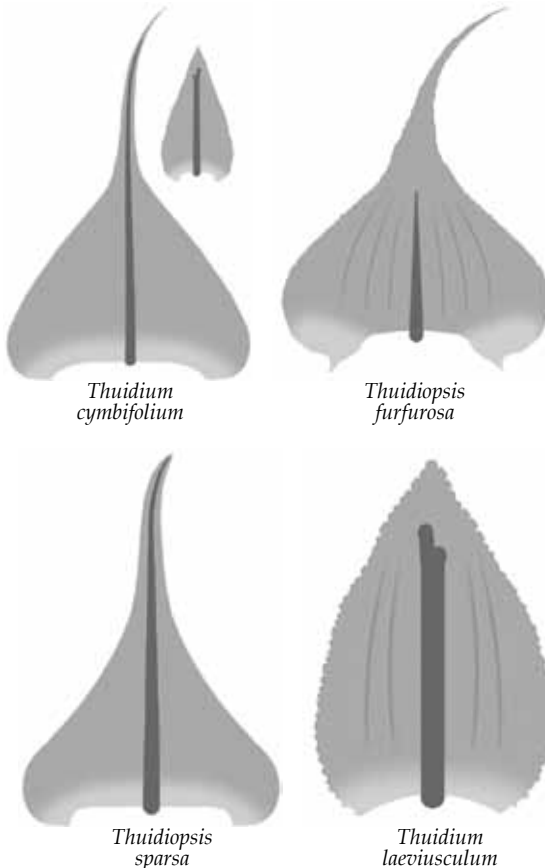


*Pseudoleskea imbricata* leaf margin cross-section  
10  $\mu\text{m}$

**Key\* to the New Zealand species of Thuidium and Thuidiopsis (4)**

- 1 Stem leaf apex a filiform acumen ending in a single row of cells..... ● **Thuidium cymbifolium**  
 ..... 2
- 1: Stem leaf apex not ending in a single row of cells ..... 2
- 2(1:) Stem leaf costa cristate on the back..... ● **Thuidium laeviusculum**  
 2: Stem leaf costa not cristate on the back ..... 3
- 3(2:) Leaf cells mostly 1–4-papillose..... ● **Thuidiopsis sparsa**  
 3: Leaf cells mostly 1-papillose..... ● **Thuidiopsis furfurosa**

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 415, plus Streimann, H (2002): *The Mosses of Norfolk Island. Flora of Australia Supplementary Series 14*, 158.



**Thuidiopsis furfurosa** (Hook.f. & Wilson) M.Fleisch.

**form:** matted, creeping, bipinnately branched, paraphylliate stems, to 100 mm long, leaves dull, yellowish

**habitat:** sunny to shady soil, bark, or rock, sea level to montane

**leaf:** size: stem leaves 1.5–2 mm; branch leaves 0.8–1 mm

**shape:** ovate-cordate to triangular-ovate, ± plicate, ± decurrent

**tip:** finely acuminate

**base:** decurrent; basal cells ± rectangular

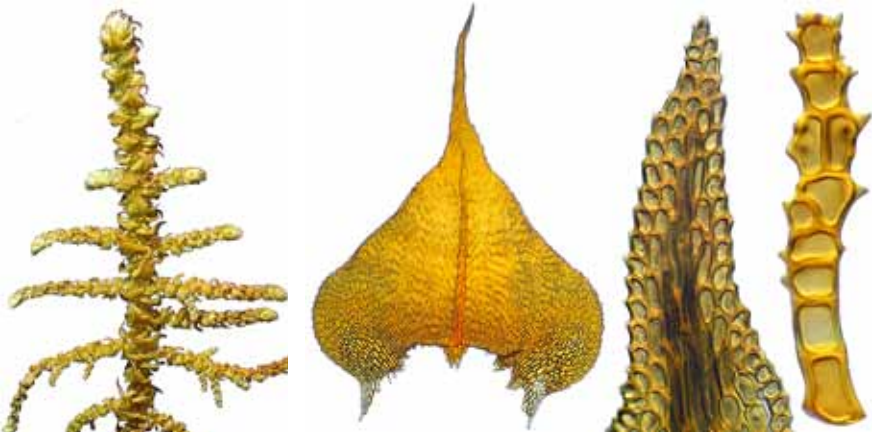
**costa:** failing below the acumen

**border:** not differentiated

**margin:** denticulate or crenulate above, plane to ± recurved

**cells:** 10 μm, isodiametric, firm-walled, unipapillose

**capsule:** 2–2.5 mm, oblong-cylindric, long-exserted, ± curved, cernuous, pale brown; seta 20–30 mm, flexuose, red; operculum obliquely long-rostrate; calyptra cucullate, naked, smooth; peristome double; spores 10–12 μm, smooth



vegetative shoot, leaf outline, leaf apex, and paraphyllum  
 5 mm, 0.25 mm, 50 μm, 10 μm



margin in upper leaf, costa at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

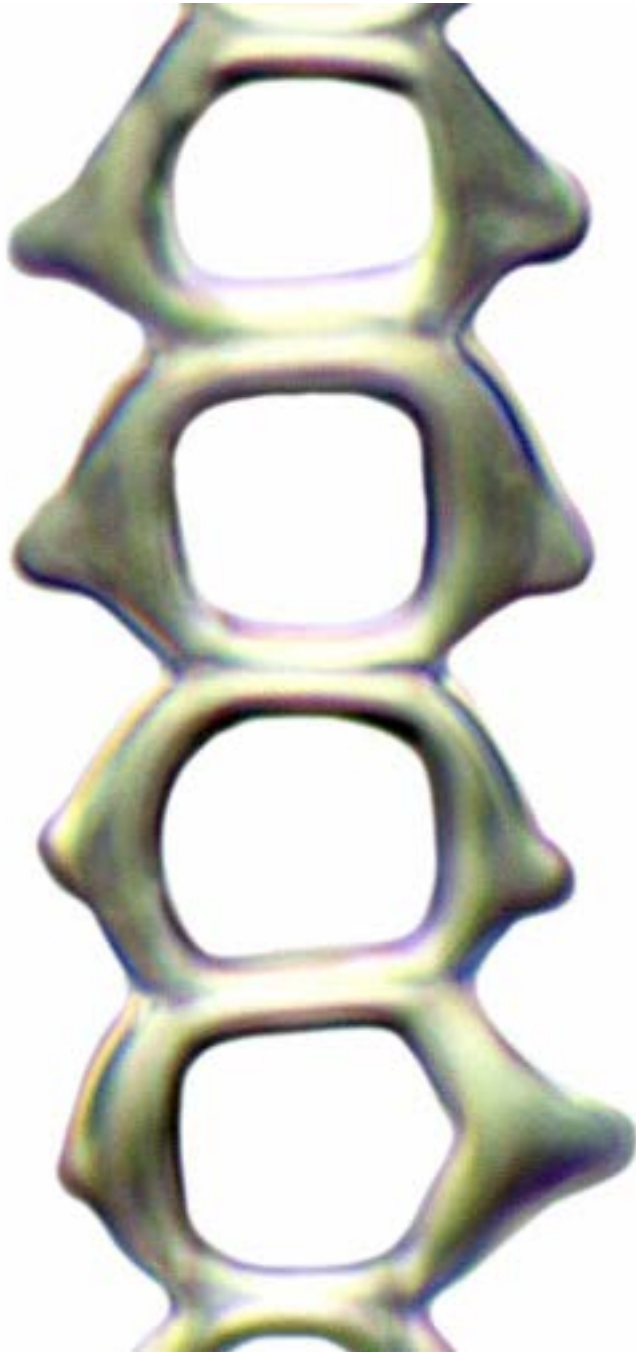
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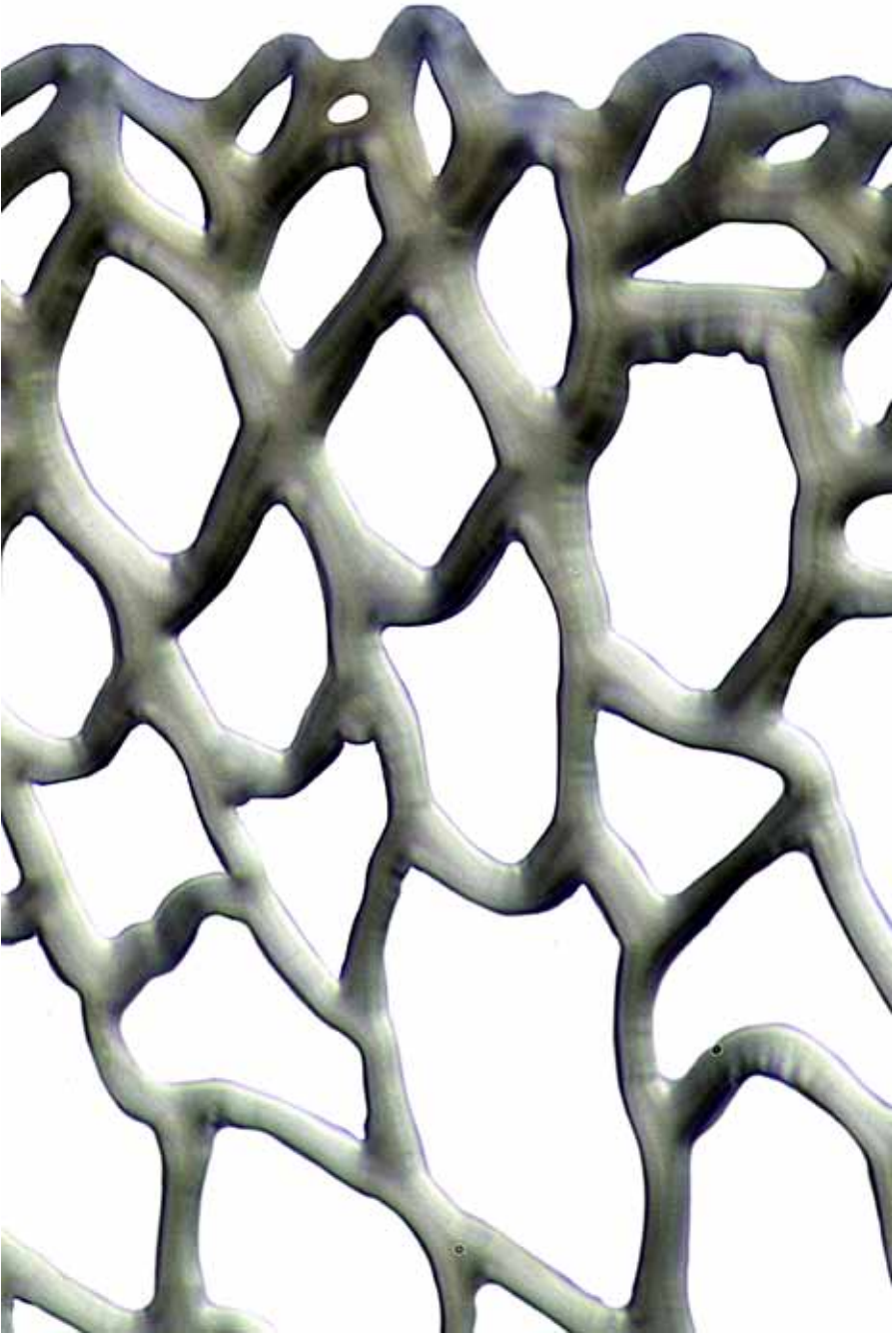
*Thuidiopsis furfurosa* vegetative shoot (dry)  
1 mm

continued next page



*Thuidiopsis furfurosa* leaf cross-section showing strongly unipapillose cells  
10  $\mu\text{m}$

continued next page



*Thuidiopsis furfurosa* stem cross-section  
10  $\mu$ m

continued next page

**Thuidiopsis sparsa** (Hook.f. & Wilson) Broth.

**form:** matted, pinnately branched, paraphylliate stems, to 60 mm long,  
leaves yellow to pale green, branches not paraphylliate

**habitat:** rock, damp forest

**leaf:** *size:* branch leaves  $0.5\text{--}0.7 \times 0.3\text{--}0.4$  mm; stem leaves  $1 \times 0.6$  mm

*shape:* branch leaves  $\pm$  ovate; stem leaves cordate-ovate to deltoid-ovate

*tip:* branch leaves acute; stem leaves acuminate

*base:* basal juxtacostal cells longer than the other laminal cells

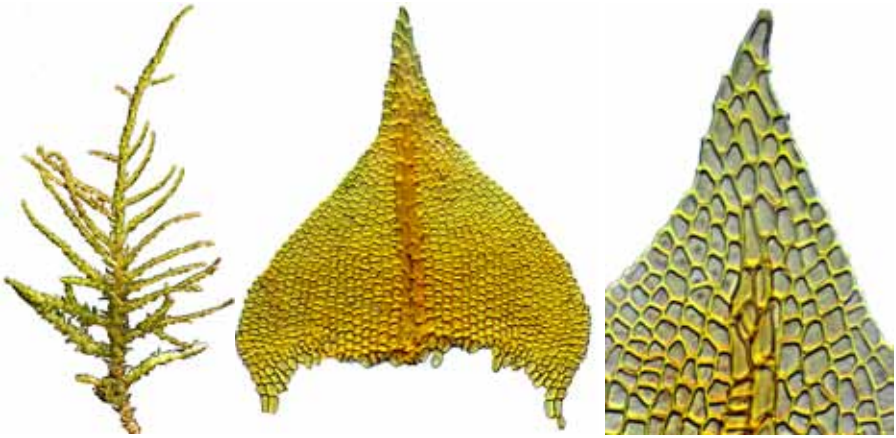
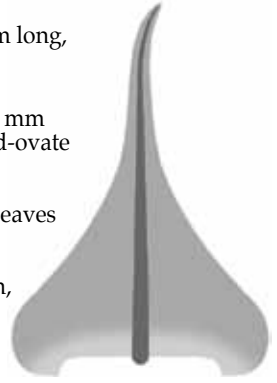
*costa:* failing below the apex, prominent on abaxial side of stem leaves

*border:* not differentiated

*margin:* entire to serrulate, plane

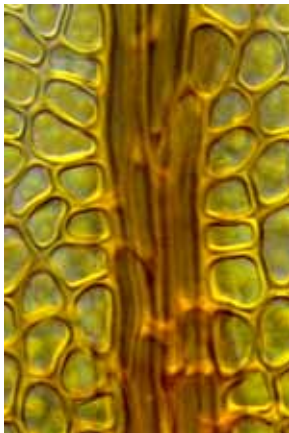
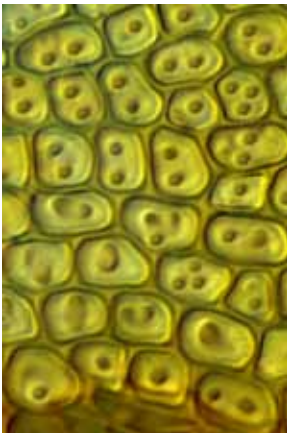
*cells:* midleaf cells  $6\text{--}10\ \mu\text{m}$ ,  $\pm$  isodiametric; tip cells to  $20 \times 10\ \mu\text{m}$ ,  
firm-walled, mostly 2–4-papillose

**capsule:** to 2.5 mm, oblong-cylindric, exserted, inclined to pendent, red-brown; seta to 20 mm, reddish, smooth; calyptra cucullate, hairy; operculum long-rostrate; spores  $8\text{--}16\ \mu\text{m}$  in diam.



vegetative shoot (dry), stem leaf outline, and stem leaf apex

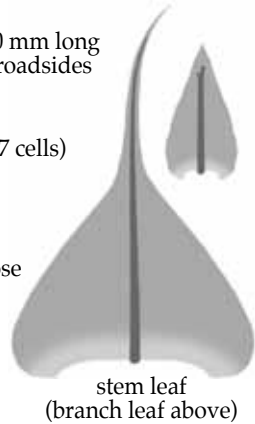
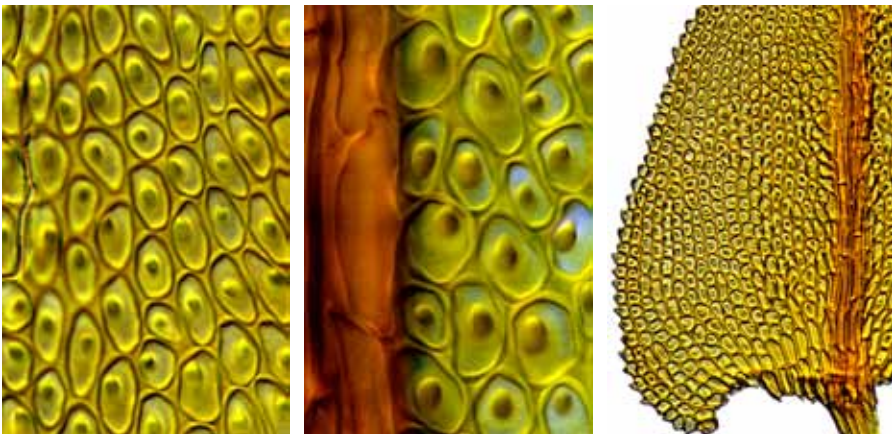
1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$



papillose cells at midleaf, costa at midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page

**Thuidium cymbifolium** (Dozy & Molk.) Dozy & Molk.**form:** matted, bi- or tripinnately branched, arched stems, to 150 mm long**habitat:** soil, rotting logs, or rock in forest and grassland or on roadsides**leaf: size:** branch: to 0.2, stem: to 1.6 mm**shape:** branch: ovate, stem:  $\pm$  triangular**tip:** branch: acute, with truncate terminal cell, stem: filiform (3–7 cells)**base:** not differentiated**costa:** reaching 2/3 up the blade, spinose on the back above**border:** not differentiated**margin:** serrulate throughout, plane**cells:** 6–10  $\mu\text{m}$ , isodiametric to elongate, firm-walled, unipapillose or strongly mammillose**capsule:** to 6 mm, ellipsoid to cylindric, inclined to horizontal, exserted, brown; seta to 40 mm, reddish, smooth, peristome double, endostome segments narrowly perforate, cilia nodulose, in groups of 2–4; spores 9–12  $\mu\text{m}$  in diam.vegetative shoot (dry), branch leaf outline, branch leaf apex, and branch leaf margin  
 1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ branch leaf cells, branch leaf costa, and branch leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$ 

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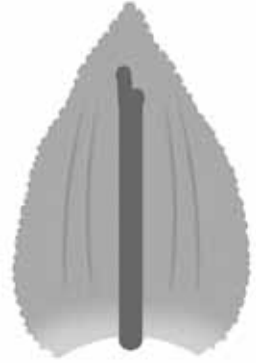
*Thuidium cymbifolium* branch leaf costa  
10  $\mu\text{m}$

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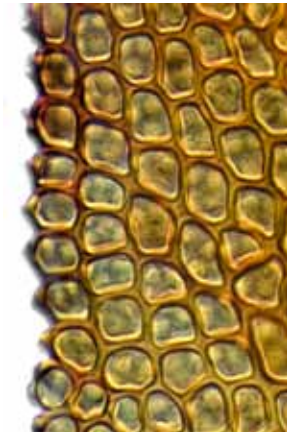


*Thuidium cymbifolium* paraphyllium and filiform apex of stem leaf  
 10  $\mu$ m, 50  $\mu$ m, 10  $\mu$ m

continued next page

**Thuidium laeviusculum** (Mitt.) A. Jaeger**form:** matted, creeping, paraphylliate stems, to 150 mm long**habitat:** damp rotting logs, humus, or rock in shaded forest**leaf:** *size:* stem leaves 1 mm; branch leaves 0.3 mm*shape:* ovate to cordate-ovate or wide-triangular*tip:* acute to obtuse*base:* basal cells longer than the blade cells*costa:* failing below the apex, crested on the back*border:* not differentiated*margin:* finely crenulate, plane*cells:* 7–8  $\mu\text{m}$ , isodiametric, firm-walled, pluripapillose**capsule:** 3–4 mm; cylindric, arcuate, long-exserted, horizontal to cernuous, brown; seta 20–35 mm, stout, red; operculum obliquely long-rostrate, red; calyptra cucullate, naked, smooth; exostome teeth joined at the base, endostome cilia 2–3, nodulose; spores 10–12  $\mu\text{m}$  in diam., smooth

habit, branch leaf outline, and branch leaf apex showing crested costa

5 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$ 

margin at midleaf, costa at midleaf (abaxial surface), and stem paraphyllia

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$ 

continued next page





*Thuidium laeviusculum* vegetative shoot

1 mm

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*Thuidium laeviusculum* vegetative shoot detail showing costae  
50  $\mu\text{m}$

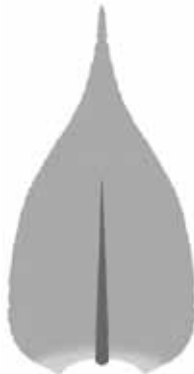
**Key\* to the New Zealand species of Brachytheciastrum and Brachythecium (10)**

- 1 Leaves strongly falcate ..... ● **Brachytheciastrum paradoxum**  
 1: Leaves straight or only weakly falcate.....2
- 2(1:) Leaf apex piliform .....3  
 2: Leaf apex not piliform .....7
- 3(2) Stem leaves < 1.5 mm long..... ● **Brachytheciastrum velutinum**  
 3: Stem leaves > 1.5 mm long .....4
- 4(3:) Stem leaves 1.5–2.5 mm long, not or only slightly decurrent; capsules 0.6–1.5 mm long; spores 11–20  $\mu\text{m}$  in diam.....5  
 4: Stem leaves 2.8–3.1 mm long, decurrent; capsules 2.6 mm long; spores 18–22  $\mu\text{m}$  in diam..... ● **Brachythecium fontanum**
- 5(4) Capsules < 1.5 mm long; spores 11–16  $\mu\text{m}$  in diam.....  
 ..... ● **Brachythecium albicans**  
 5: Capsules 1.3–2.5 mm long; spores 15–20  $\mu\text{m}$  in diam.....6
- 6(5:) Leaves < 2.8 mm long,  $\pm$  triangular ..... **Brachythecium subpilosum**  
 6: Leaves > 2.8 mm long, ovate-lanceolate ..... **Brachythecium allisonii**
- 7(2:) Leaves plicate.....8  
 7: Leaves not or only weakly plicate .....9
- 8(7) Branch leaves slightly falcate; seta lightly papillose.....  
 ..... ● **Brachythecium campestre**  
 8: Branch leaves straight; seta smooth ..... ● **Brachythecium salebrosum**
- 9(7:) Seta papillose in only the upper half..... ● **Brachythecium plumosum**  
 9: Seta papillose throughout..... ● **Brachythecium rutabulum**

\* based partly on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*. RSNZ Bulletin 5, 436.



*Brachythecium  
salebrosum*



*Brachythecium  
rutabulum*



*Brachythecium  
fontanum*



*Brachythecium  
albicans*



*Brachythecium  
subpilosum*



*Brachythecium  
plumosum*



*Brachytheciastrum  
velutinum*



*Brachythecium  
allisonii*



*Brachythecium  
campestre*



*Brachytheciastrum  
paradoxum*

**Brachytheciastrum paradoxum** (Hook.f. &Wilson) Ignatov & Huttunen

**form:** tufted, creeping, radiculose, pinnately branched stems, 25–40 mm long, tips hooked, leaves falcate-secund, golden, glossy

**habitat:** moist soil, wet rock or damp logs in boggy sites

**leaf:** size: 1–1.5 mm

*shape:* lanceolate, striate, ± circinate

*tip:* long-acuminate

*base:* alar cells subquadrate, ± nodulose, decurrent

*costa:* reaching above midleaf

*border:* not differentiated

*margin:* denticulate, plane

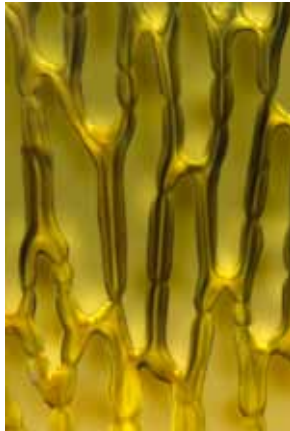
*cells:* 60–90 × 5–6 μm, linear, firm-walled, ± porose, smooth

**capsule:** 2 mm, oblong, exserted, inclined to horizontal, brown; seta 10–15 mm, reddish, papillose throughout; operculum conic, obtuse; calyptra cucullate, naked, smooth; annulus of 2 cell rows; peristome double, cilia in 2s or 3s; spores 12–16 μm in diam.



vegetative shoots (dry) (2), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, cells near leaf base, and margin near leaf base

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



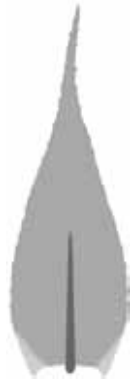
*Brachytheciastrum paradoxum* vegetative shoot (dry)  
1 mm

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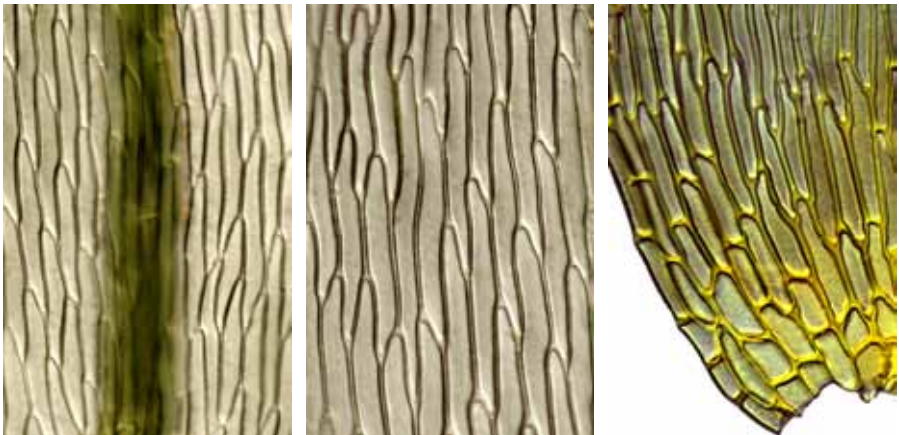
**Brachytheciastrum velutinum** (Hedw.) Ignatov & Huttunen**form:** procumbent, ± pinnately branched, radiculose stems, to 30 mm long**habitat:** bark of tree trunks, stumps, rock, and walls in shady sites**leaf: size:** stem:  $1.5 \times 0.4$  mm; branch: narrower**shape:** stem: lanceolate-triangular; branch: lanceolate**tip:** gradually acuminate**base:** angle cells quadrate to oblong**costa:** faint, failing about midleaf**border:** not differentiated**margin:** denticulate, plane to narrowly recurved**cells:**  $50\text{--}80 \times 5\text{--}8$   $\mu\text{m}$ , narrowly linear, firm-walled, smooth**capsule:** 1.4–1.7 mm, ellipsoid, asymmetric, exserted, inclined, reddish

brown, ± constricted below the mouth when dry, annulus large, detachable;

seta 15 mm, flexuose, red, papillose; operculum high-conic, long-rostrate;

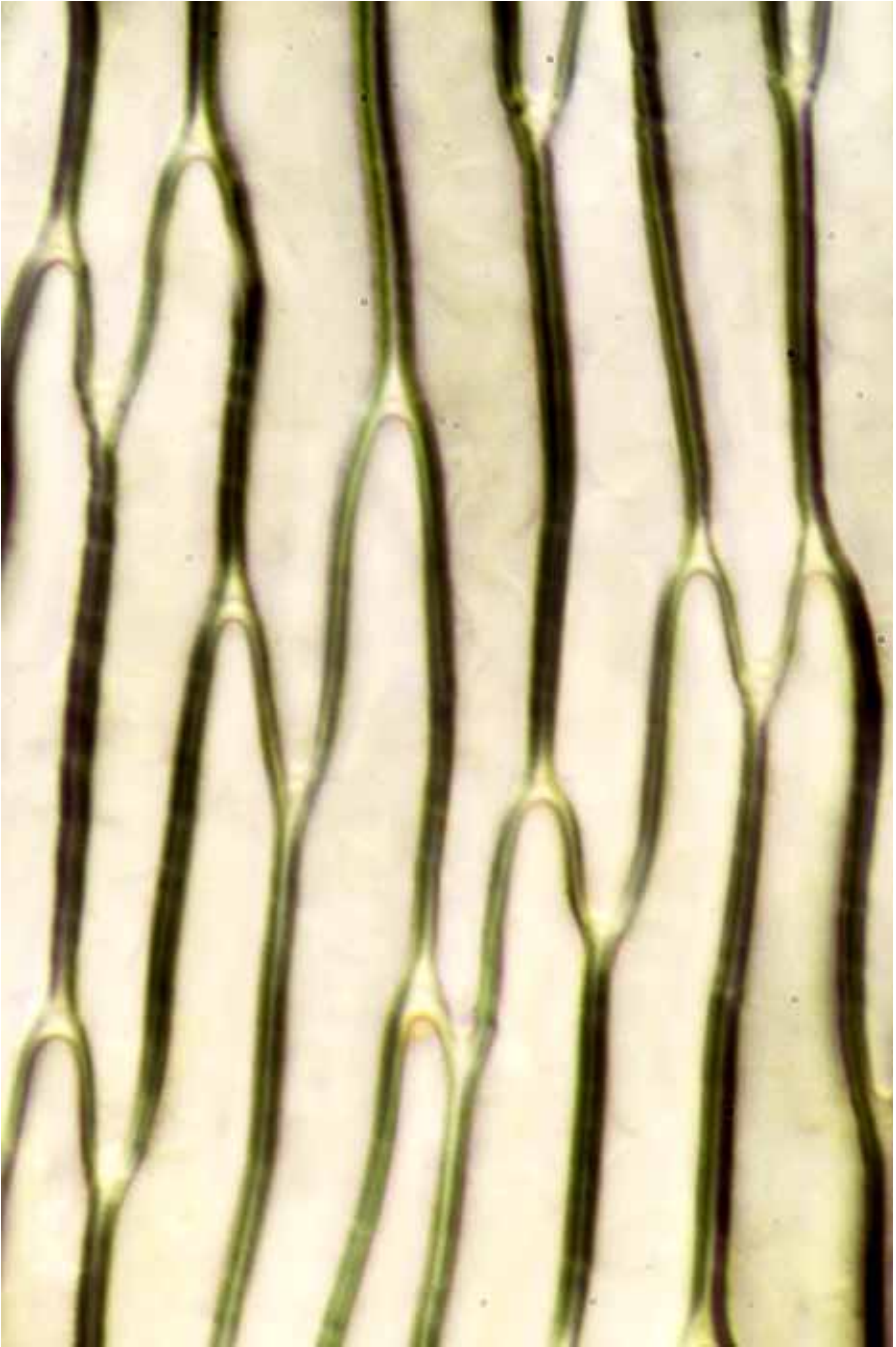
peristome double, the exostome teeth yellow, the endostome  $2/5$  height of teeth, cilia 2; spores 13–16  $\mu\text{m}$  in diam.

vegetative shoot (dry) (2), branch leaf outline, leaf apex, and margin midleaf  
 1 mm, 1 mm, 0.5 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$



costa at midleaf, cells at midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Brachytheciastrum velutinum* cells at midleaf  
10  $\mu$ m

continued next page



**Brachythecium albicans** (Hedwig) Bruch & W.P.Schimper

**form:** matted, creeping, branched stems, to 40 mm long, leaves pale, glossy  
**habitat:** damp to dry soil, rock, or bases of trees in shady sites

**leaf:** size: 2.2–3.0 × 0.7–1.2 mm

**shape:** ovate-lanceolate, plicate; stem leaves decurrent, branch leaves not

**tip:** narrowly acuminate, sometimes filiform

**base:** alar cells numerous, quadrate to short-oblong

**costa:** reaching 2/3 up the blade

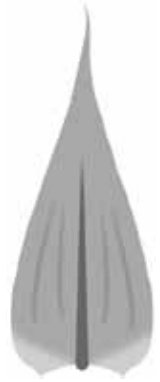
**border:** not differentiated

**margin:** entire to minutely serrulate toward the tip, narrowly recurved

**cells:** 50–80 × 6–9 μm, linear to rhombic, firm-walled, smooth

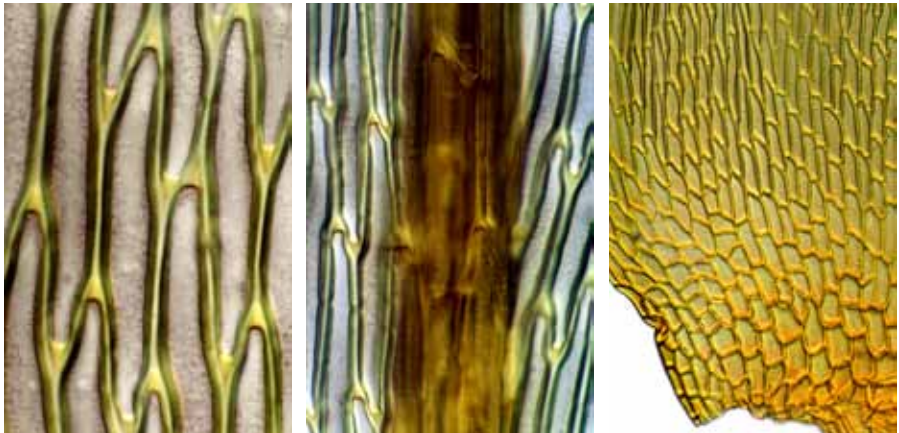
**capsule:** 1–1.5 mm, oblong, asymmetric, exerted, inclined to horizontal;  
 seta 15–22 mm, reddish brown, smooth; operculum conic, acute; peri-  
 stome double; spores 11–16 μm in diam., papillose

**note:** differs from *Brachythecium salebrosum* in having acuminate and more strongly plicate leaves with entire margins and smaller alar cells



vegetative shoots (2), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



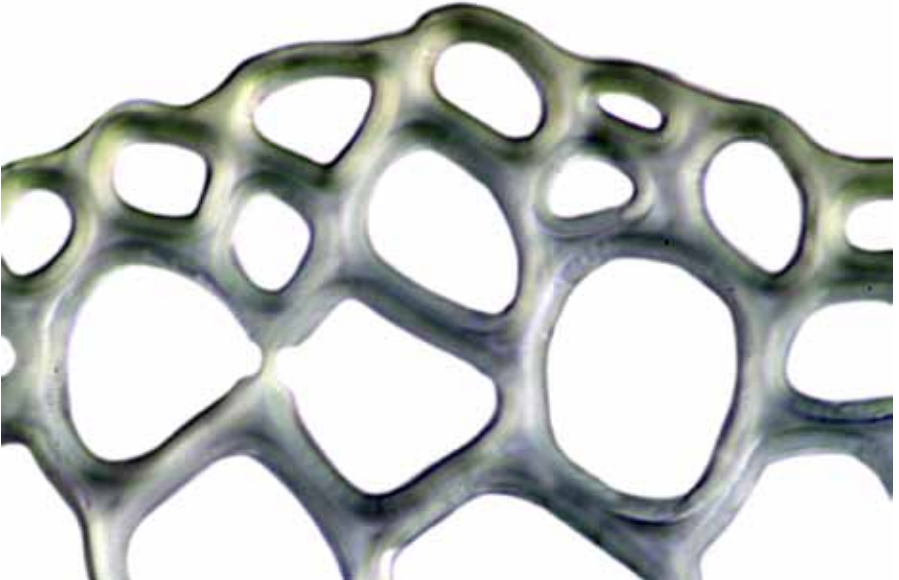
cells at midleaf, costa at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

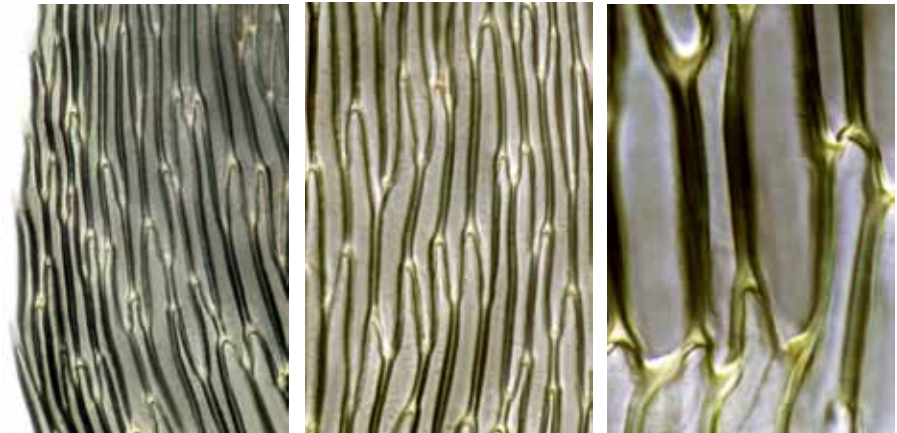
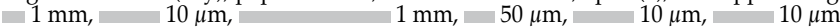
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*Brachythecium albicans* costa cross-section  
10  $\mu\text{m}$



*Brachythecium albicans* stem cross-section (fragment)  
10  $\mu\text{m}$

**Brachythecium campestre** (Müll.Hal.) Bruch & Schimp.**form:** mats of branched golden to green shoots 30–60 mm long, ± stoloniform**habitat:** on soil, rock, tree bases, or fallen logs, in shaded forest or meadows**leaf: size:** stem leaves  $1.5\text{--}3 \times 0.6\text{--}1.2$  mm; branch leaves  $1.5\text{--}2 \times 0.6\text{--}1$  mm**shape:** stem leaves ovate-lanceolate, acuminate, plicate, ± falcate; branch leaves lanceolate, acuminate, weakly plicate**tip:** ending in a single linear cell**base:** alar cells few, shorter and wider than other lamina cells**costa:** narrow, to  $3/4$  the leaf length**border:** not differentiated**margin:** entire to serrulate, narrowly revolute**cells:** 7–9  $\mu\text{m}$  wide, linear, ± sinuose, thin-walled, smooth**capsule:** to 2 mm long, ovoid to cylindrical, asymmetric, ± curved, red-brown, inclined to horizontal; seta 10–20 mm, papillose; operculum short-apiculate; spores 12–16  $\mu\text{m}$  in diam., brownish, minutely papillose**note:** adventivebranch  
leafvegetative shoot (dry), papillose seta, branch leaf outline, apex (2), and upper margin  
branch leaf lower margin, lamina cells, and cells near base of leaf  


continued next page



*Berachythecium campestre* margin near base of branch leaf  
10 mm

**Brachythecium fontanum** Fife

**form:** matted, branched stems, to 200 mm long, leaves yellow-green

**habitat:** soil in montane to subalpine springs and seeps, 700–1450 m

**leaf:** *size:* stem leaves 2.5–3.2 × 1.3–1.7 mm; branch leaves smaller

*shape:* ovate-oblong

*tip:* abruptly tapered to a piliferous acumen

*base:* basal cells porose, shorter and wider than other lamina cells

*costa:* reaching to 70% of the blade

*border:* not differentiated

*margin:* entire below, ± denticulate above, plane to inrolled below

*cells:* 80–120 × 7–8 μm, linear, firm-walled, smooth

**capsule:** 2.6 mm, oblong-cylindric, exserted, horizontal, curved, brown;

seta 15–25 mm; calyptra cucullate, smooth; operculum short-conic;

exostome teeth yellowish brown, cross-striolate, endostome segments

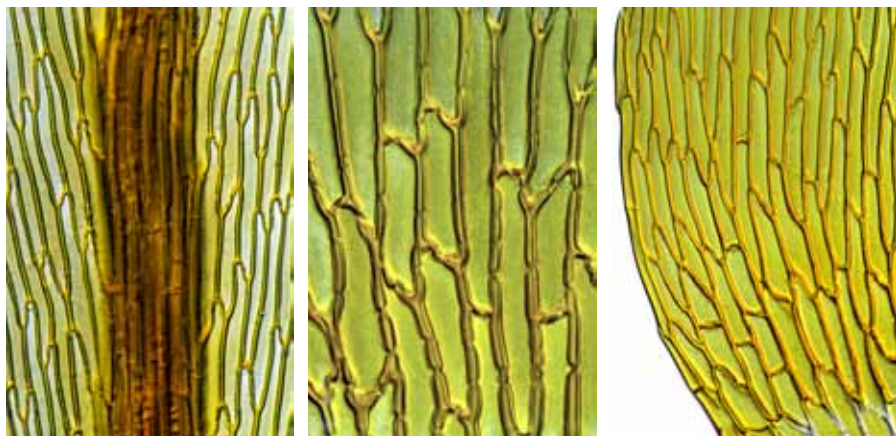
perforate; cilia paired, nodose; spores 18–22 μm in diam., green, ±

smooth



vegetative shoots (dry) (2), leaf outline, acumen apex, and upper leaf margin

5 mm, 1 mm, 0.5 mm, 10 μm, 50 μm



costa in lower leaf, porose basal leaf cells, and leaf basal angle

50 μm, 10 μm, 50 μm

continued next page

**Brachythecium plumosum** (Hedw.) Bruch & Schimp.

**form:** matted, pinnately branched stems, to 40 mm tall, leaves dark green to yellow-green

**habitat:** tree trunk bases, rotting logs, stumps, soil, or rock in moist forest

**leaf: size:** stem: 1.0–1.2 mm; branch: 0.6–0.9 mm

**shape:** stem: ± deltoïd; branch: lanceolate, rounded to the insertion, decurrent

**tip:** gradually acuminate

**base:** alar cells short-rectangular to subquadrate

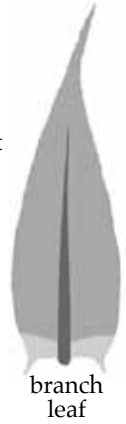
**costa:** ending below the acumen

**border:** not differentiated

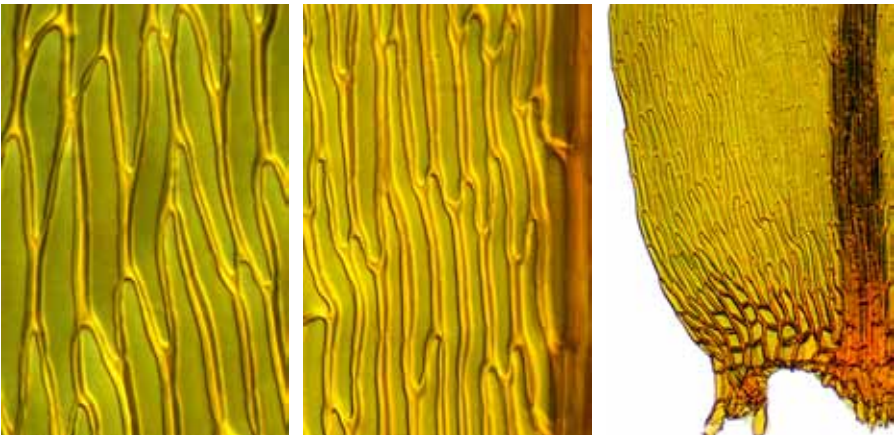
**margin:** serrate above, serrulate below, plane

**cells:** 50–90 × 10 μm, rhombic to linear, firm-walled, smooth

**capsule:** 1.5–1.8 mm, shortly ovoid, asymmetric, exserted, ± horizontal, brown; seta 7–13 mm, orange to dark red, rough; annulus two-rowed; operculum conic, mammillate to apiculate; peristome double, endostome with 2–3 cilia; spores 11–16 μm in diam., finely papillose



vegetative branch shoots (dry) (2), branch leaf outline, leaf apex, and margin midleaf  
 1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



cells at midleaf, juxtacostal cells in lower leaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

continued next page

**Brachythecium rutabulum** (Hedw.) Bruch & Schimp.

**form:** tufted, creeping, branched, ascending stems, to 120 mm long;

leaves dark to bright green or yellow-green, glossy

**habitat:** soil in lawns or grass, rarely on bark, in damp, shady forest

**leaf:** size: 2.5–3.5 × 1.2–1.8 mm

*shape:* cordate-ovate, concave, ± decurrent, weakly plicate when dry

*tip:* acuminate

*base:* decurrent, not forming distinct auricles

*costa:* thin, narrow, reaching above midleaf

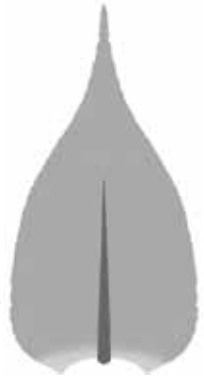
*border:* not differentiated

*margin:* denticulate, mostly plane but slightly reflexed toward the base

*cells:* 55–100 × 6–10 μm, linear-rhombic, firm-walled, smooth

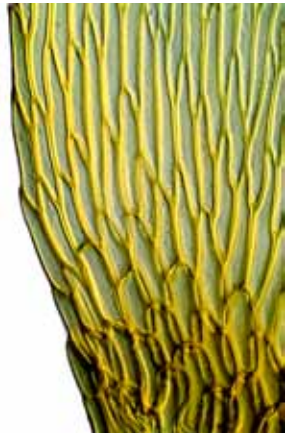
**capsule:** 2.5–3 mm, oblong, asymmetric, ± curved, exserted, horizontal, dark brown; seta 25–30 mm, strongly papillose throughout; operculum conic; peristome double; spores 16–24 μm in diam.

**note:** possibly introduced



vegetative shoots (dry) (2), leaf outline, and leaf apex (2)

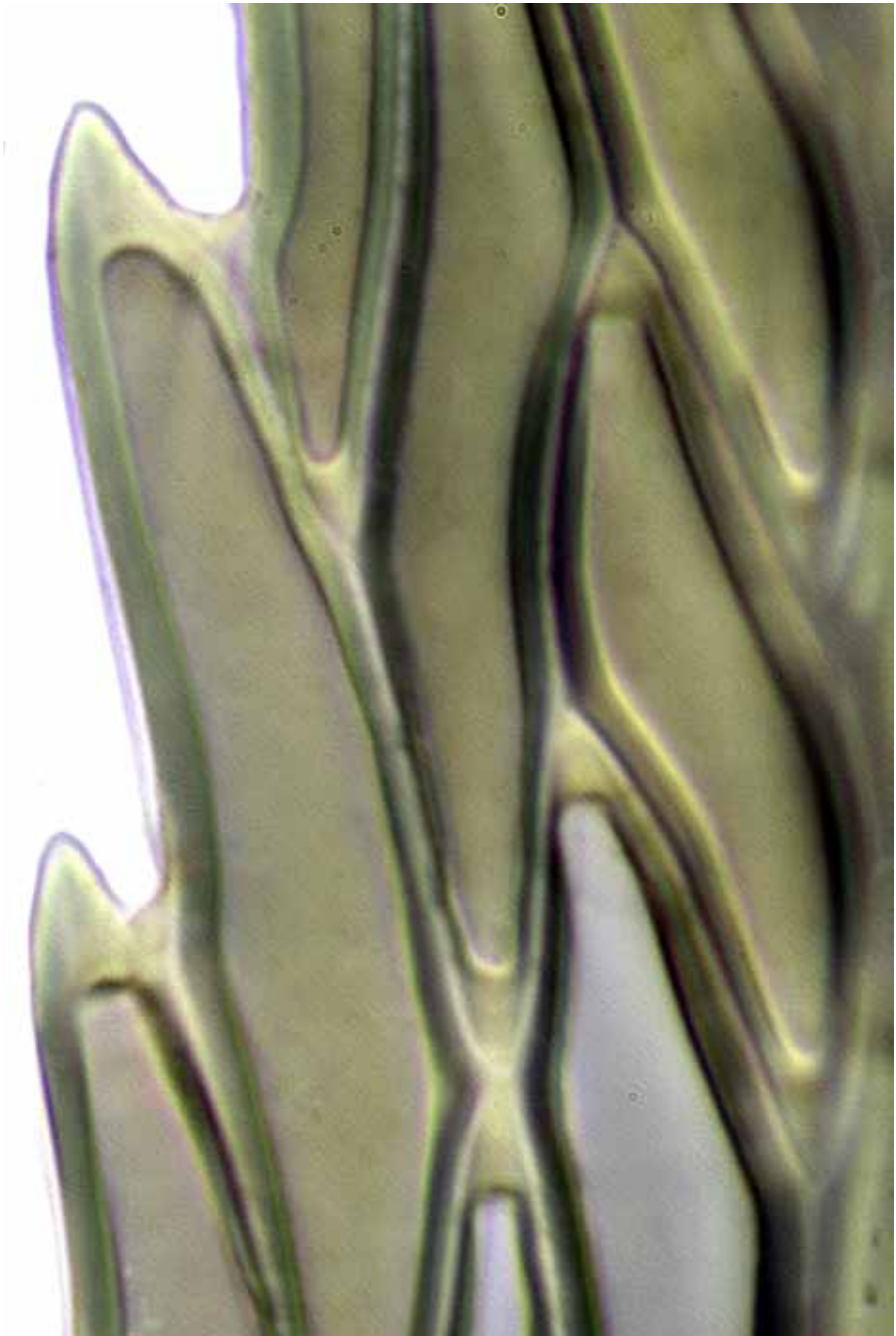
■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page



*Brachythecium rutabulum* leaf margin  
10  $\mu$ m

continued next page



**Brachythecium salebrosum** (F.Weber & D.Mohr) Bruch & Schimp.

**form:** matted, creeping,  $\pm$  pinnately branched stems, 100–150 mm tall, leaves glossy, yellowish green

**habitat:** damp or wet soil, rotten logs, rock, or tree bases in shady sites

**leaf:** *size:* stem leaves  $2.0\text{--}2.5 \times 1.0\text{--}1.3$  mm; branch leaves smaller

*shape:* stem leaves lanceolate to ovate-lanceolate, plicate,  $\pm$  decurrent

*tip:* acuminate, sometimes twisted

*base:* alar cells subquadrate, not thick-walled

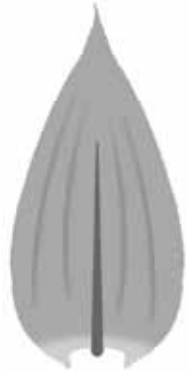
*costa:* reaching about  $2/3$  the leaf length

*border:* not differentiated

*margin:* entire, mostly plane but irregularly recurved below

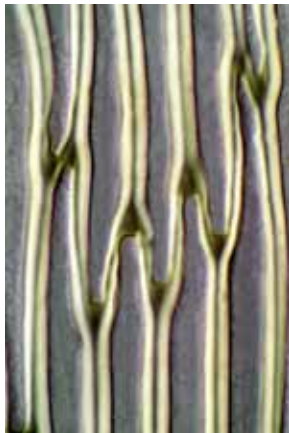
*cells:*  $50\text{--}100 \times 6\text{--}10$   $\mu\text{m}$ , linear, firm-walled,  $\pm$  porose, smooth

**capsule:** 2–2.5 mm, oblong-cylindric, asymmetric, exserted, inclined to horizontal, blackish; seta 10–20 mm, smooth; operculum apiculate; peristome double, endostome cilia 2, nodulose; spores 15–20  $\mu\text{m}$  in diam., finely punctate



vegetative shoots (dry) (2), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

continued next page



*Brachythecium salebrosum* peristome tooth  
50  $\mu\text{m}$

**Eriodon cylindritheca** (Dixon) Dixon & Sainsbury

**form:** slender, tufted, creeping, ± pinnately branched stems, to 60 mm long, flattened, leaves pale green, glossy

**habitat:** bark of shrubs or small trees in damp forest or subalpine scrub

**leaf:** size: 1.5–5 × 0.5–1.5 mm

*shape:* ovate-lanceolate

*tip:* acuminate

*base:* alar cells differentiated in only the extreme basal angles

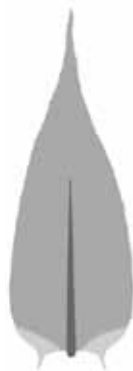
*costa:* variably reaching from midleaf to well up the acumen

*border:* not differentiated

*margin:* minutely and distantly serrulate throughout, plane

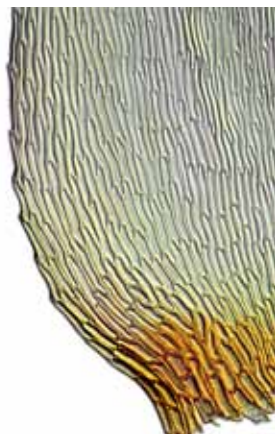
*cells:* 60–80 × 4–6 μm, linear, firm-walled, smooth

**capsule:** 1.5–2.5 mm, narrowly cylindrical, long-exserted, suberect, neck tapered, mouth reddish; seta 15–25 mm, thin, smooth; operculum long-rostrate; peristome double, endostome cilia absent; spores 14–20 μm in diam., smooth



vegetative habit (moist) and shoot (dry), leaf outline, and leaf apex (2)

■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 μm, ■ 10 μm



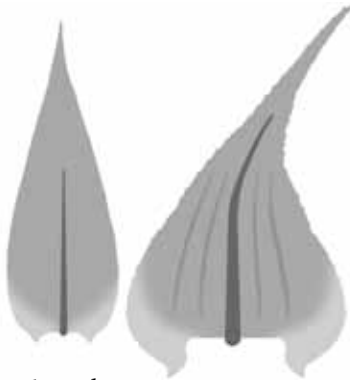
margin at midleaf, costa at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

Key\* to the New Zealand species of *Eurhynchium* (4)

- 1 Leaves dimorphic in shape and/or size .....2  
 1: Leaves not dimorphic .....3
- 2(1) Stems with vertical lamella-like ridges; branch leaf apex narrowly acute.....  
 ..... ● ***Eurhynchium praelongum***
- 2: Stems smooth; branch leaves broadly acute to obtuse ... ● ***Eurhynchium pulchellum***
- 3(1:) Branch leaves elliptic, acute ..... ● ***Eurhynchium speciosum***  
 3: Branch leaves ovate-cordate, abruptly long-acuminate..... ● ***Eurhynchium asperipes***

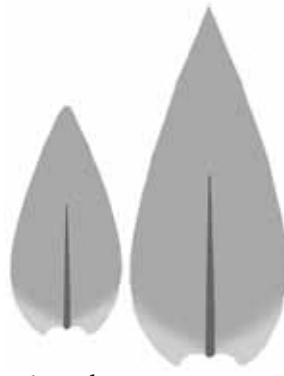
\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 447, and Crum, HA; Anderson, LE (1981): *Mosses of Eastern North America*. Columbia University Press, New York, 1014.



branch

stem

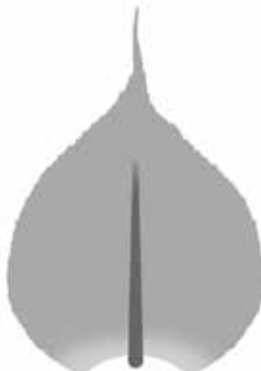
*Eurhynchium  
praelongum*



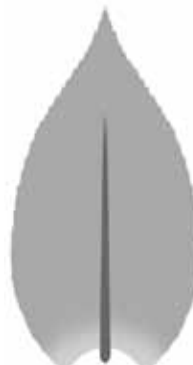
branch

stem

*Eurhynchium  
pulchellum*



*Eurhynchium  
asperipes*



*Eurhynchium  
speciosum*

continued next page

**Eurhynchium asperipes** (Mitt.) Dixon

**form:** tufted or matted, creeping, radiculose, branched stems,  
30–100 mm tall, leaves glossy, green or yellow-green

**habitat:** soil, logs, roots, or rock in forest

**leaf:** size: 1–1.7 × 0.7–1.0 mm

*shape:* cordate-ovate

*tip:* abruptly acuminate

*base:* undifferentiated

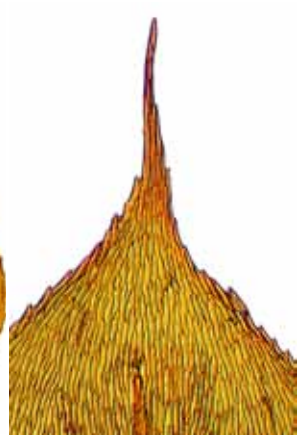
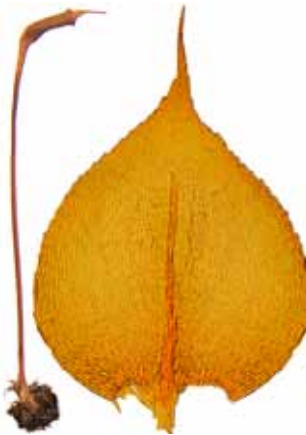
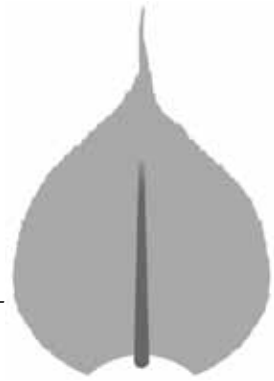
*costa:* reaching above midleaf

*border:* not differentiated

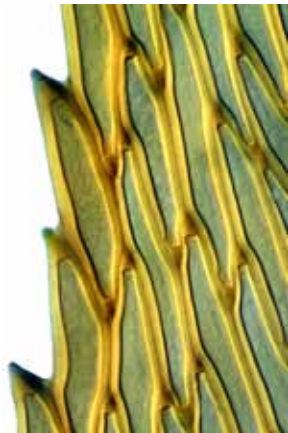
*margin:* serrulate, plane

*cells:* 50–100 × 8–10 μm, linear-rhombic to linear-fusiform, firm-  
to thick-walled, smooth

**capsule:** 1.5–2 mm, oblong-cylindric, ± gibbous, exserted,  
cernuous; seta 10–20 mm; operculum rostrate; peristome  
double; spores 8–12 μm in diam.

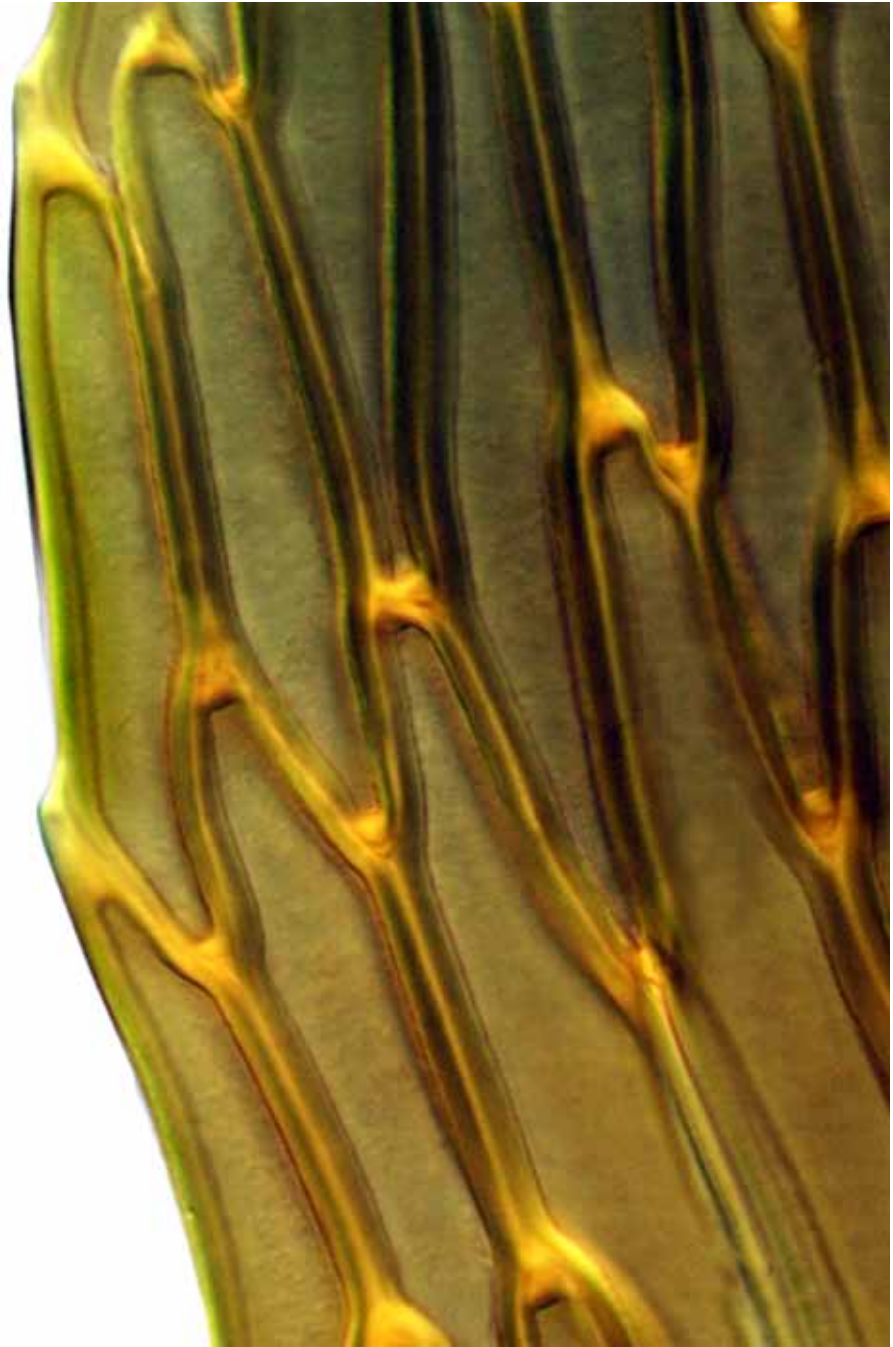


vegetative shoots, capsule (dry), leaf outline, and leaf apex  
 1 mm, 1 mm, 0.5 mm, 50 μm



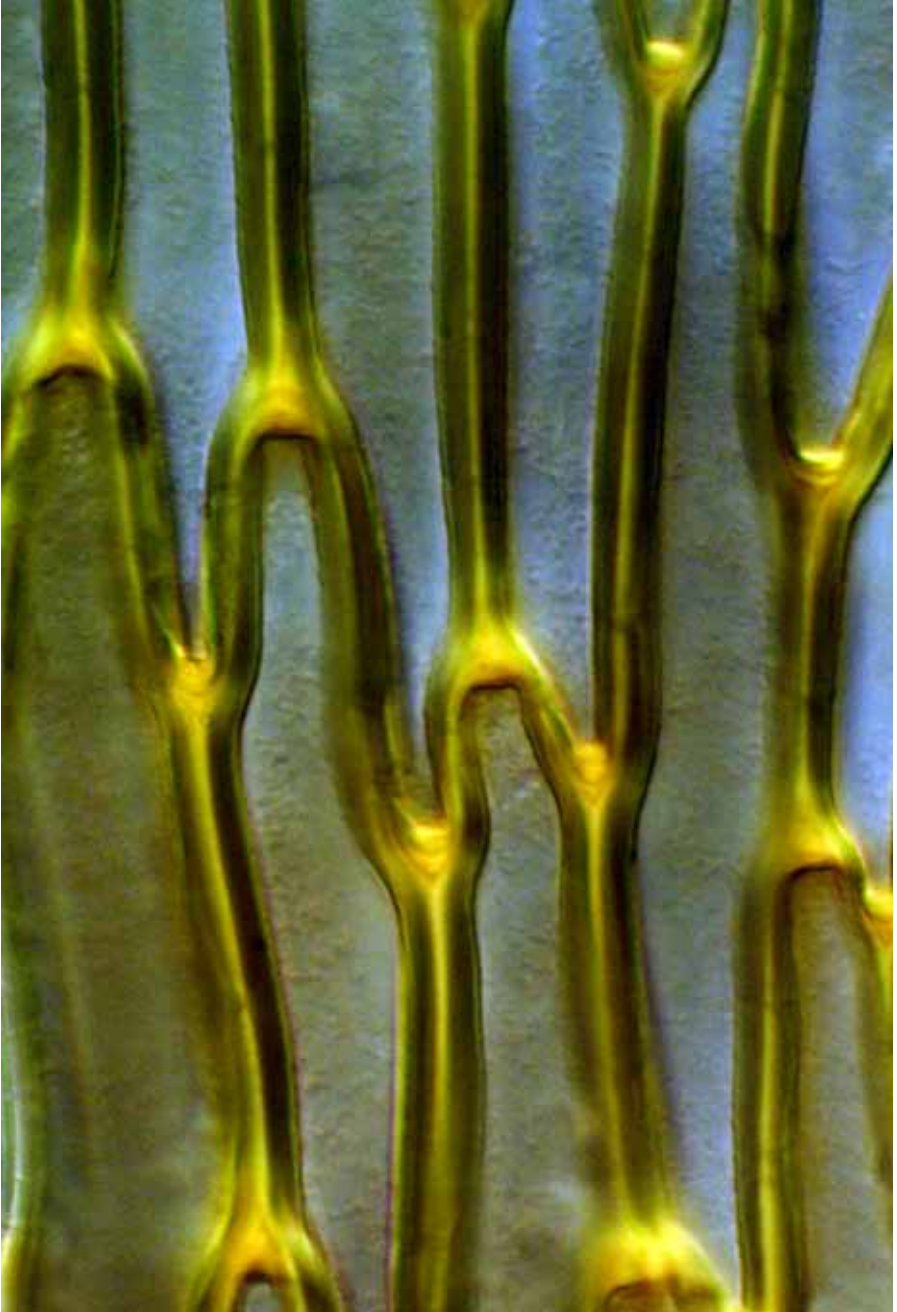
margin at midleaf, costa at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

continued next page



*Eurhynchium asperipes* margin lower leaf  
10  $\mu\text{m}$

continued next page



*Eurhynchium asperipes* cells midleaf  
10  $\mu\text{m}$

continued next page

**Eurhynchium praelongum** (Hedw.) Hook.

**form:** matted, bi- to tripinnately branched stems, to 80 mm long, leaves dull, yellowish

**habitat:** moist soil or rock near streams and seeps

**leaf: size:** stem: 1.0–1.4 × 1.0 mm; branch: smaller

**shape:** stem leaves triangular-cordate and decurrent;

branch leaves lanceolate, not decurrent

**tip:** short- to long-acuminate

**base:** basal cells wider and laxer than the blade cells

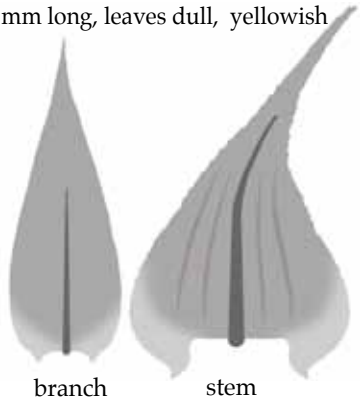
**costa:** ending above midleaf as a minute abaxial spine

**border:** not differentiated

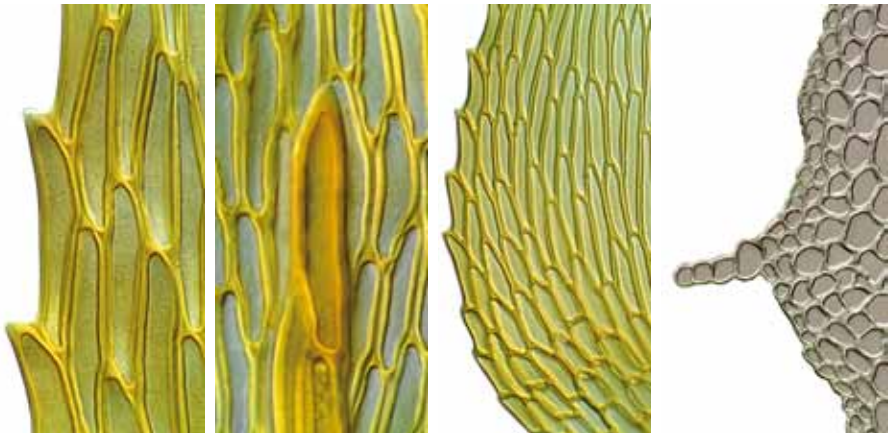
**margin:** sharply denticulate, plane

**cells:** 30–60 × 6–10 μm, linear, firm-walled, smooth

**capsule:** 1.5 mm, ovate to cylindric, brown; seta 15 mm; operculum finely long-rostrate; peristome double; spores 12–16 μm in diam., smooth



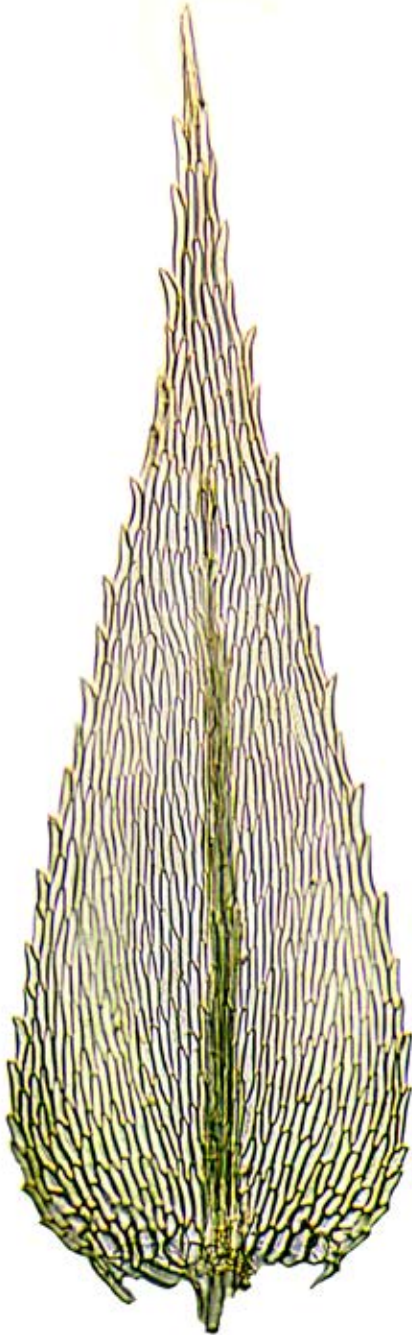
vegetative shoot (2), capsule (dry), branch and stem leaf outlines, and stem leaf apex  
 5 mm, 1 mm, 1 mm, 0.25 mm, 0.25 mm, 10 μm



margin at midleaf, costa terminus, margin of lower leaf, and lamellar stem ridge  
 10 μm, 10 μm, 10 μm, 10 μm

continued next page





*Eurhynchium praelongum* branch leaf whole-mount  
100  $\mu\text{m}$

**Eurhynchium pulchellum** (Hedw.) Jenn.

**form:** matted procumbent stems, ± pinnately branched, yellow-green  
**habitat:** soil, soil on rock, rotting logs, and root bark in moist forest

**leaf:** *size:* stem leaves 1–2.5 mm; branch leaves 0.6–1.5 mm

*shape:* stem: ± cordate-triangular; branch: ovate-lanceolate, concave

*tip:* stem: acute to acuminate; branch: mostly obtuse

*base:* alar cells quadrate, rectangular, or irregular, thick-walled

*costa:* reaching to 7/8 up the lamina, abaxial terminus spinose

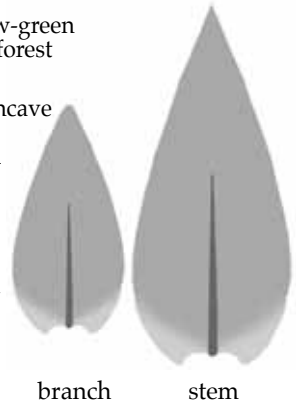
*border:* not differentiated

*margin:* serrulate, plane above, ± recurved below

*cells:* 30–70 × 4–7 μm, ± linear, firm- to thick-walled, smooth

**capsule:** 1.3–2.5 mm, oblong-cylindric, inclined to horizontal,  
 long-exserted, brown; seta 7–20 mm, smooth; operculum  
 long-beaked; peristome double

**note:** male plants minute, on leaves or stems of females

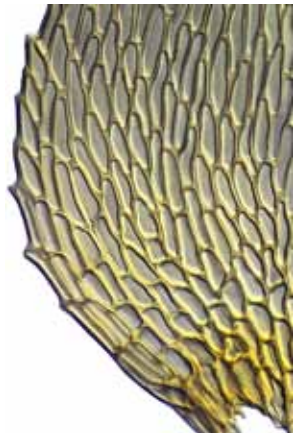
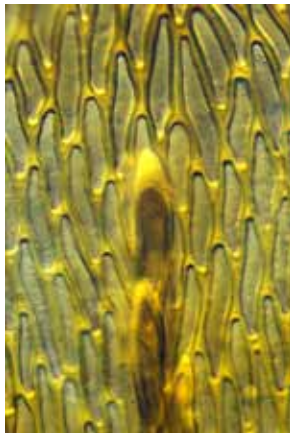
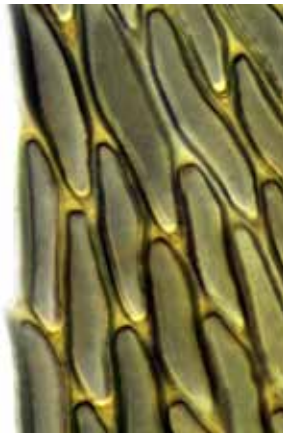


branch

stem



vegetative shoot (dry), mature capsule (dry), branch leaf outline, and branch leaf apex  
 5 mm, 1 mm, 0.1 mm, 10 μm



branch leaf margin at midleaf, branch leaf costa terminus, and branch leaf basal angle  
 10 μm, 10 μm, 50 μm

continued next page

**Eurhynchium speciosum** (Brid.) Jur.

**form:** patchy, irregularly branched stems, the branches 10–20 mm, leaves dull, sordid green

**habitat:** soil and bark of tree bases in wet sites

**leaf:** *size:* stem leaves 1.5–1.7 × 0.8 mm; branch leaves shorter, wider

*shape:* stem leaves ovate; branch leaves elliptic

*tip:* stem leaves acute to acuminate; branch leaves acute or apiculate

*base:* angle cells rectangular, decurrent

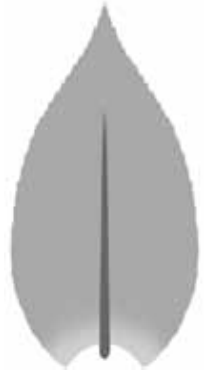
*costa:* to 4/5 up the lamina, ending in a sharp abaxial spicule

*border:* not differentiated

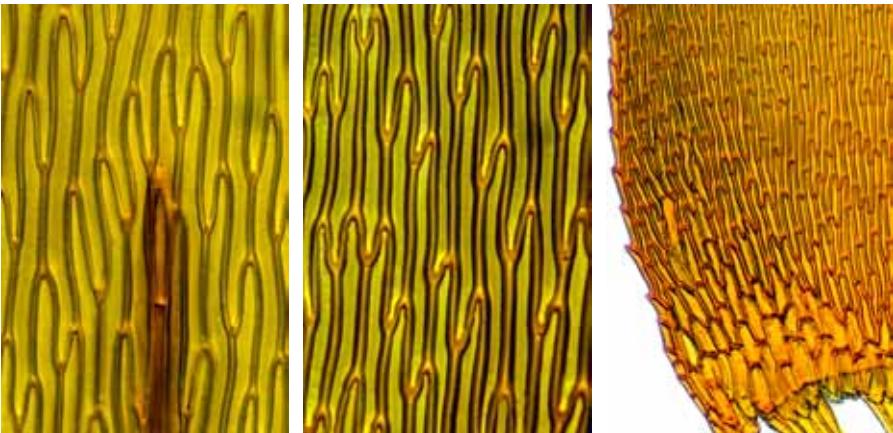
*margin:* sharply denticulate, plane

*cells:* 40–90 × 6–9 μm, narrowly linear, ± flexuose, firm-walled, smooth

**capsule:** to 2 mm, ellipsoid, ± asymmetric, exserted, horizontal, brown; seta to 20 mm, red, slender, flexuose; operculum finely long-rostrate; exostome teeth yellow-brown, cross-striolate; endostome pale yellow, cilia 2–3, nodulose; spores 12–16 μm in diam., smooth

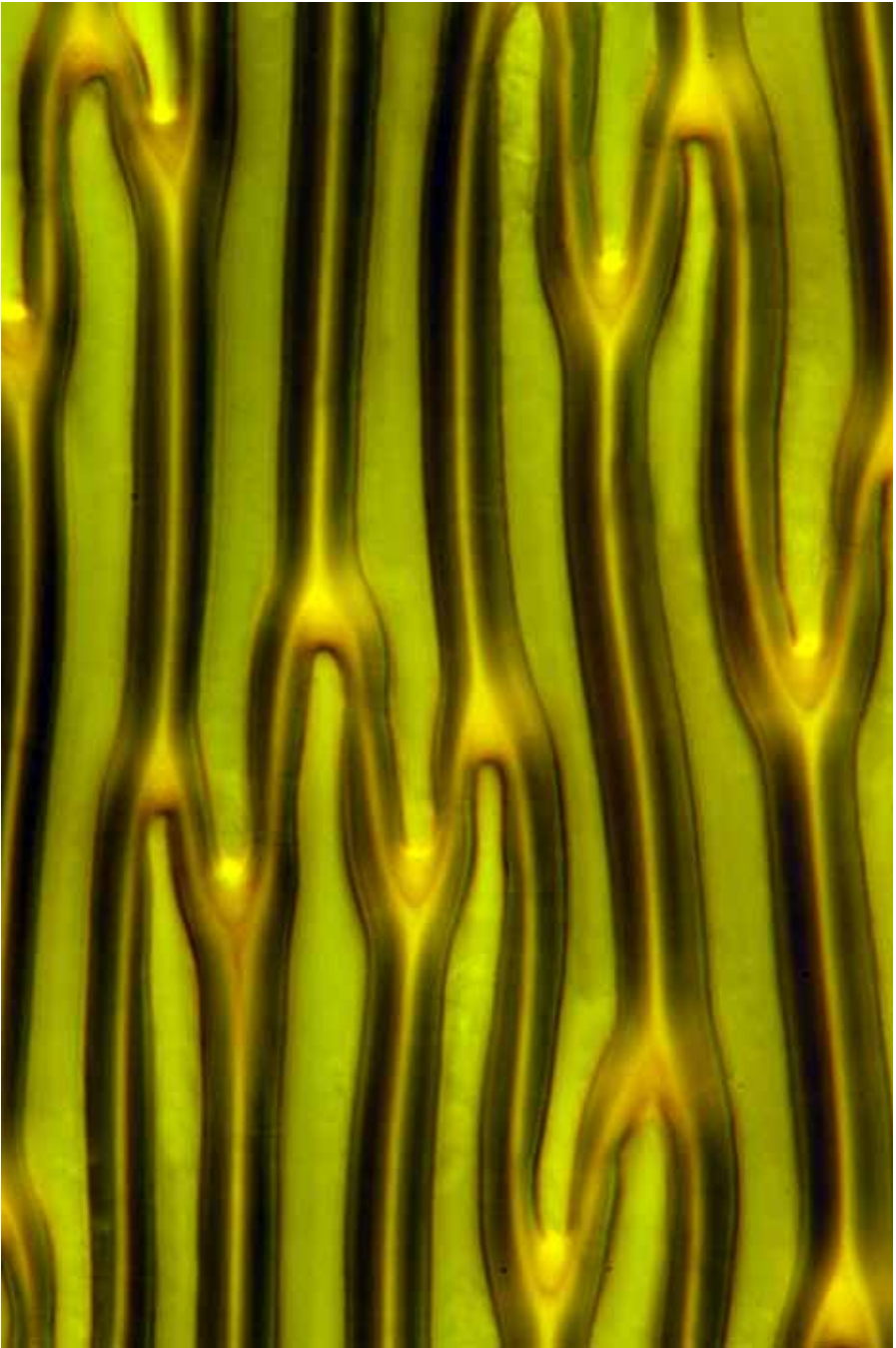


vegetative branch (dry), capsule (dry), branch leaf outline, apex, and margin upper leaf  
 1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



abaxial costa spicule, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

continued next page



*Eurhynchium speciosum* cells midleaf  
10  $\mu$ m

**Palamocladium leskeoides** (Hook.) E.Britt.

**form:** matted or tufted, sparsely branched stems, to 50 mm long, creeping at first, later erect, leaves golden, glossy

**habitat:** soil, bark, rotting logs, or rock, roadbanks and moist forest

**leaf:** size: stem 1.5–3 × 0.5–1.1 mm; branch 0.8–2.4 × 0.3–0.9 mm

*shape:* triangular-lanceolate, plicate

*tip:* acuminate

*base:* ± decurrent; alar cells numerous, ± quadrate, pigmented

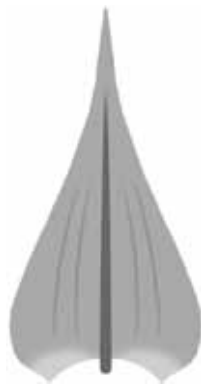
*costa:* reaching to three-quarters up the blade

*border:* not differentiated

*margin:* serrulate to coarsely toothed above, plane

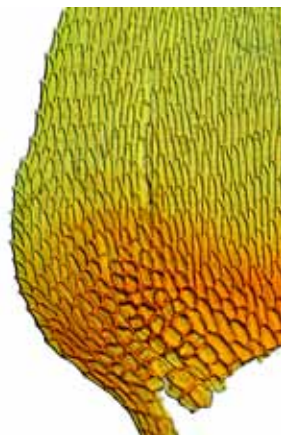
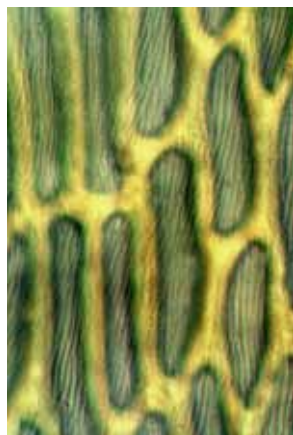
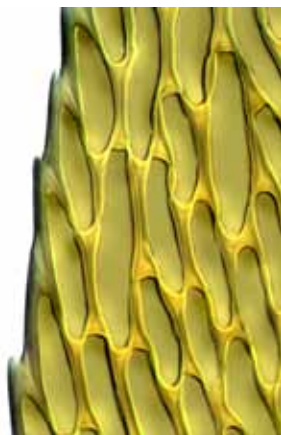
*cells:* 30–55 × 3–5 μm, linear-vermicular, thick-walled, striolate

**capsule:** 2–3 mm, ovoid-cylindric, exserted, erect, stomatose at the base, annulus two-layered, cells inflated; seta 12–22 mm; peristome double, endostome cilia none; spores 9–20 μm in diam., finely papillose



vegetative shoot (dry), leaf outline, leaf apex, and leaf subapex

1 mm, 0.5 mm, 10 μm, 10 μm



margin at midleaf, surface striations, and leaf basal angle

10 μm, 5 μm, 50 μm

**Platyhypnidium austrinum** (Hook.f. & Wilson) M.Fleisch.

**form:** primary stems tufted, creeping, leafless, ± filiform, to 80 mm long,  
secondary stems stout, simple, foliose-pseudoparaphylliate, leaves dull

**habitat:** wet rock, often submerged in streams

**leaf:** size:  $2 \times 1$  mm

*shape:* ovate to ovate-cordate

*tip:* short-acuminate

*base:* basal cells thinner-walled than the blade cells, not auricled

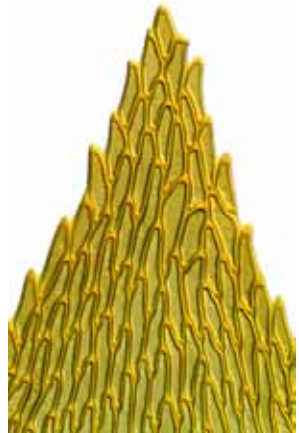
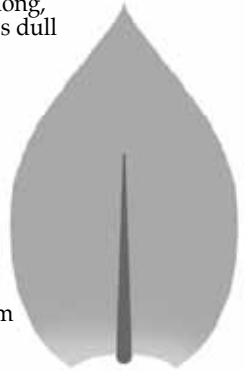
*costa:* faint, reaching above midleaf, sometimes ending in spicule

*border:* not differentiated

*margin:* entire to serrulate, plane

*cells:*  $50\text{--}90 \times 6\text{--}7$   $\mu\text{m}$ , linear-rhombic, firm-walled, smooth

**capsule:** 2 mm, ovoid, asymmetric, curved, exserted, inclined to nearly erect; seta 20–30 mm, slender, reddish, papillose; operculum obliquely long-rostrate; exostome teeth cross-striolate, endostome cilia 2; spores 15–20  $\mu\text{m}$  in diam., smooth to papillose



vegetative shoot, leaf outline, and leaf apex

■ 5 mm, ■ 0.5 mm, ■ 10  $\mu\text{m}$



leaf apex detail, margin at midleaf, and costa at midleaf

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Pseudoscleropodium purum** (Hedw.) M.Fleisch.

**form:** matted, pinnately branched stems, 50–150 mm long, leaves pale green to yellowish brown, glossy

**habitat:** exposed soil or rock in lawns and pasture or along tracks

**leaf:** size: 1–1.2 × 0.6–0.7 mm

**shape:** widely cordate, concave, ± plicate

**tip:** rounded to obtuse, abruptly apiculate

**base:** alar region of ± rectangular, incrassate, porose cells

**costa:** thin, reaching 2/3 up leaf blade

**border:** not differentiated

**margin:** finely denticulate throughout, plane

**cells:** 50–100 × 4–8 μm, vermicular, firm-walled, smooth

**capsule:** not seen in NZ; 1.5 mm, cylindric, curved, asymmetric, exserted, inclined to pendent; seta 9–13 mm, smooth, red; operculum conic short-rostrate; endostome cilia 2–3.

**notes:** probably introduced from Europe



vegetative habit (2), leaf outline, and leaf cross-section

■ 10 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm



leaf apex, margin at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

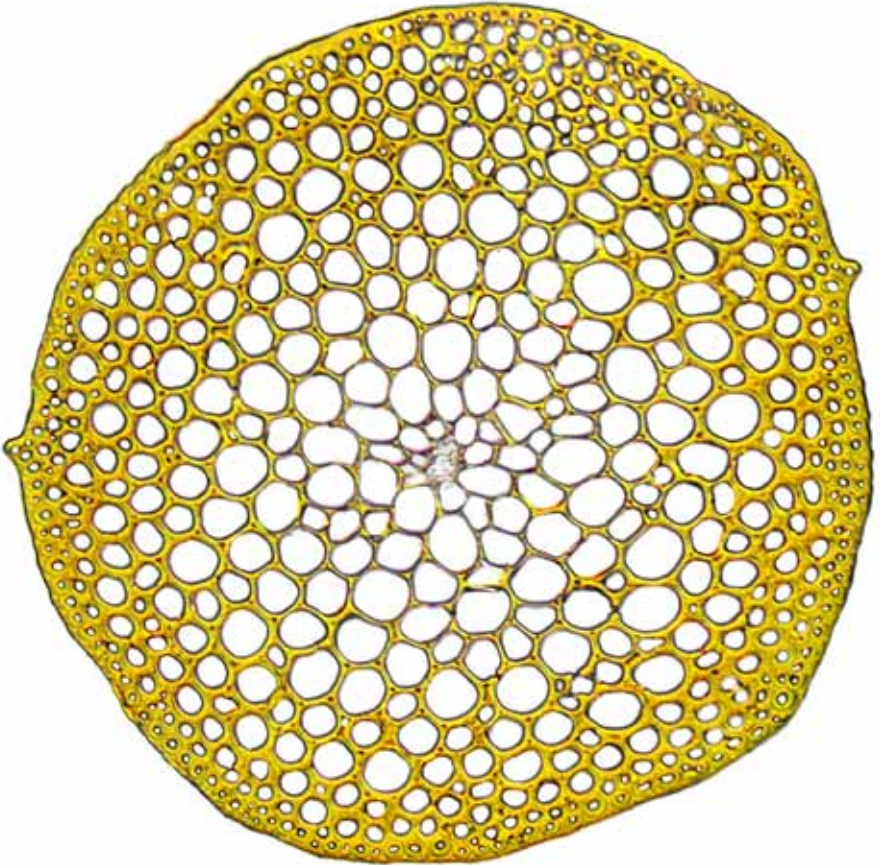
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*Pseudoscleropodium purum* vegetative habit  
10 mm

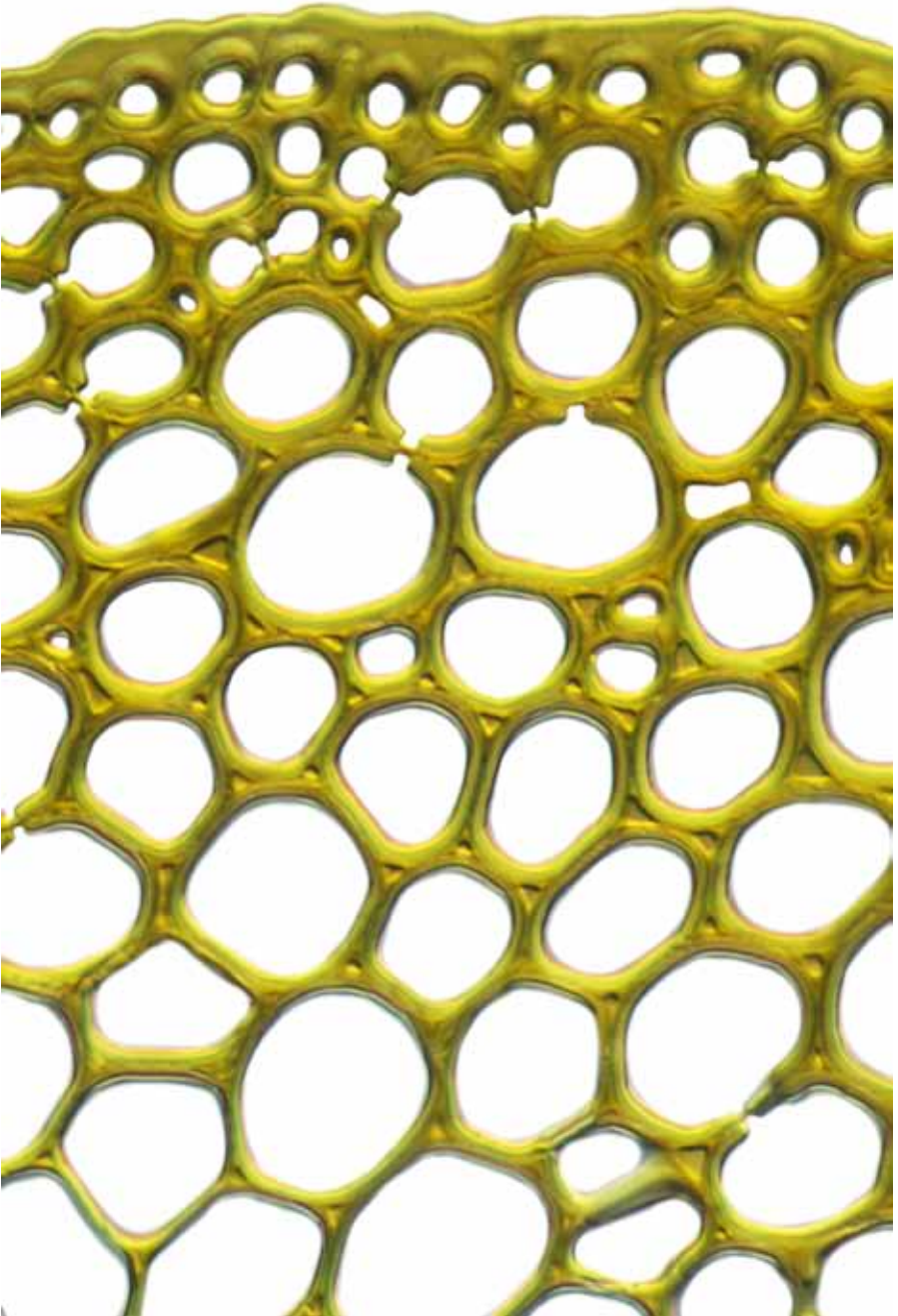
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*Pseudoscleropodium purum* stem cross-section  
10  $\mu\text{m}$

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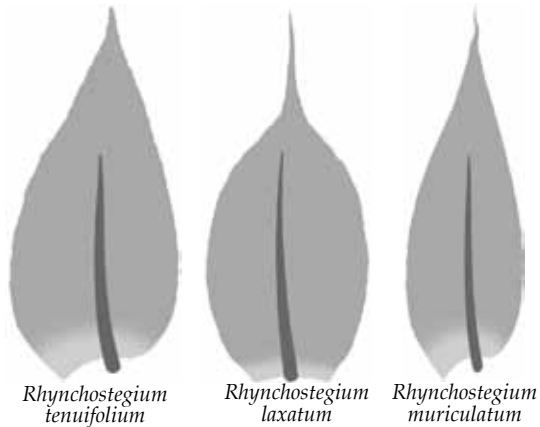


*Pseudoscleropodium purum* stem cross-section (detail)  
10  $\mu$ m

**Key\* to the New Zealand species of *Rhynchostegium* (3)**

- 1 Seta smooth..... 2  
 1: Seta rough..... ● ***Rhynchostegium muriculatum***
- 2(1:) Leaf cells 50–80  $\mu\text{m}$  long, chlorophyllous; apex piliferous.....  
 ..... ● ***Rhynchostegium laxatum***
- 2: Leaf cells 80–140  $\mu\text{m}$  long, pellucid; apex acute ..... ● ***Rhynchostegium tenuifolium***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 436, 442.



**Rhynchostegium laxatum** (Mitt.) Paris

**form:** tufted, slender, ± pinnately branched, radiculose stems, to 30 mm long, leaves yellow-green to yellow-brown, not glossy

**habitat:** soil, humus, rotting logs, or rock

**leaf:** size: stem leaves 1–1.4 × 0.5–0.9 mm; branch leaves smaller

*shape:* ovate, slightly asymmetric

*tip:* usually piliferous, the tip sometimes twisted

*base:* basal cells subrectangular, firm-walled, not in auricles

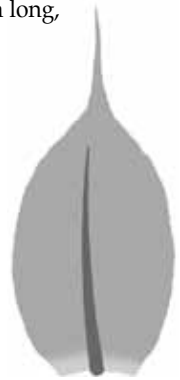
*costa:* slender, reaching well above midleaf

*border:* not differentiated

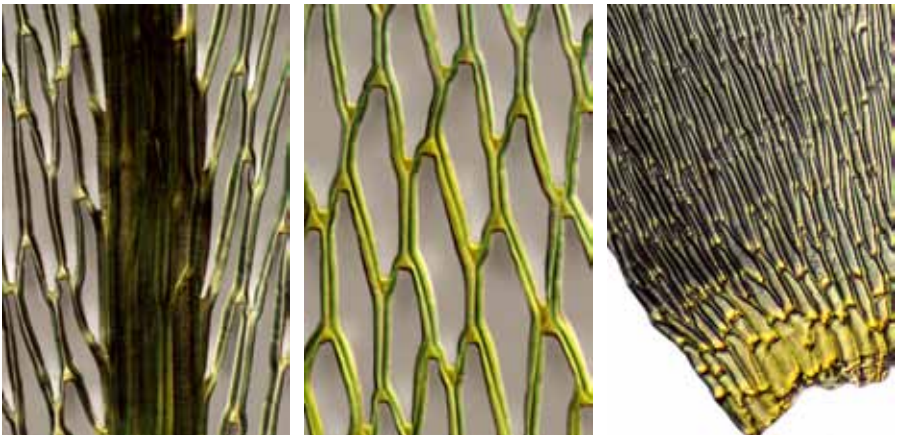
*margin:* ± denticulate, plane

*cells:* 50–80 × 7–10 μm, fusiform, firm-walled, smooth

**capsule:** 1.5–2 mm, reddish; ovoid to cylindric, ± curved, exserted, horizontal to cernuous, dark brown; seta 7–10 mm, slender, flexuose; operculum rostrate; exostome teeth striolate below, papillose above; endostome cilia 1–3, nodulose; spores 12–14 μm in diam.



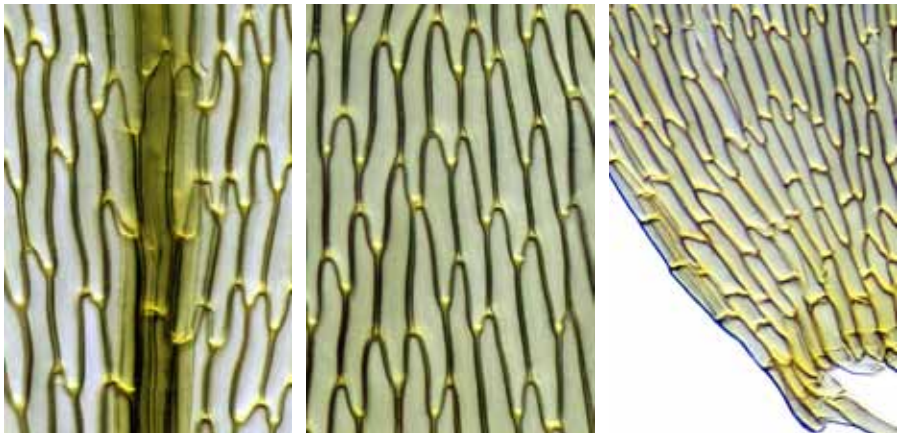
vegetative shoot (dry) (2), leaf outline, leaf apex, apex hair-point, and margin midleaf  
 1 mm, 1 mm, 0.1 mm, 50 μm, 10 μm, 10 μm



costa at midleaf, cells of upper leaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

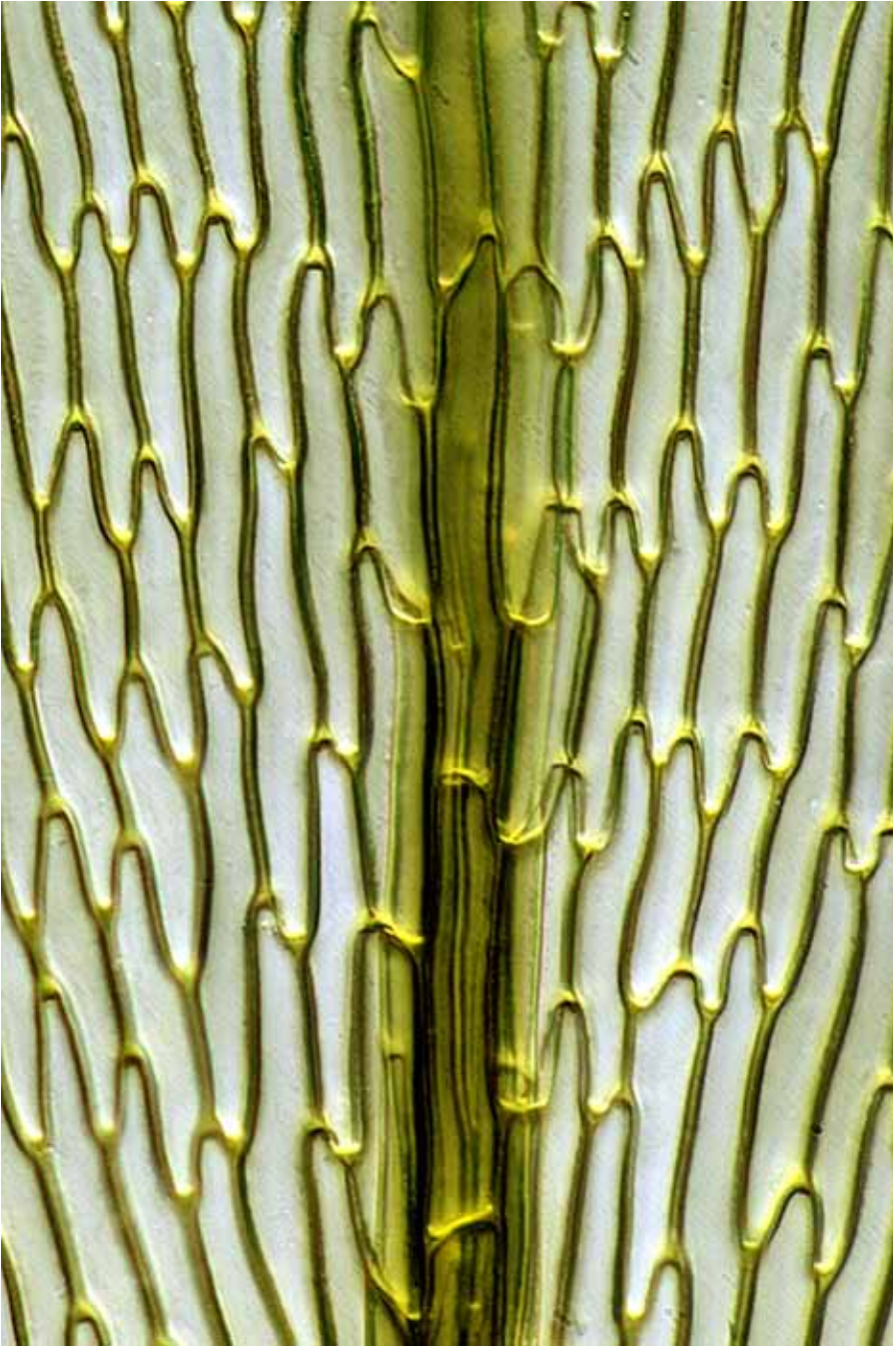
**Rhynchostegium muriculatum** (Hook.f. & Wilson) Reichardt**form:** dense tufts or mats of creeping, ± pinnate, glossy, radiculose stems**habitat:** on bark of trunks and roots, or on rotting logs**leaf:** size: 1–1.5 × 0.4–0.7 mm**shape:** ovate-lanceolate, asymmetric toward the base**tip:** acuminate to ± piliferous**base:** alar cells none; basal cells wider and shorter than other lamina cells**costa:** weak, narrow, reaching to two-thirds up lamina**border:** not differentiated**margin:** ± denticulate, plane**cells:** 40–80 × 6–8 μm, linear-rhombic, firm-walled, smooth**capsule:** 1–2 mm, oblong, curved, horizontal to cernuous, long-exserted, brown; seta 6–12 mm, densely papillose; ± strangulate when dry; operculum beak long, curved; peristome double**note:** differs from *Rhynchostegium laxatum* in its densely papillose seta

vegetative shoots (dry), mature capsule (dry), leaf outline, leaf apex, and margin midleaf  
 1 mm (2), 1 mm, 0.1 mm, 50 μm, 50 μm, 10 μm



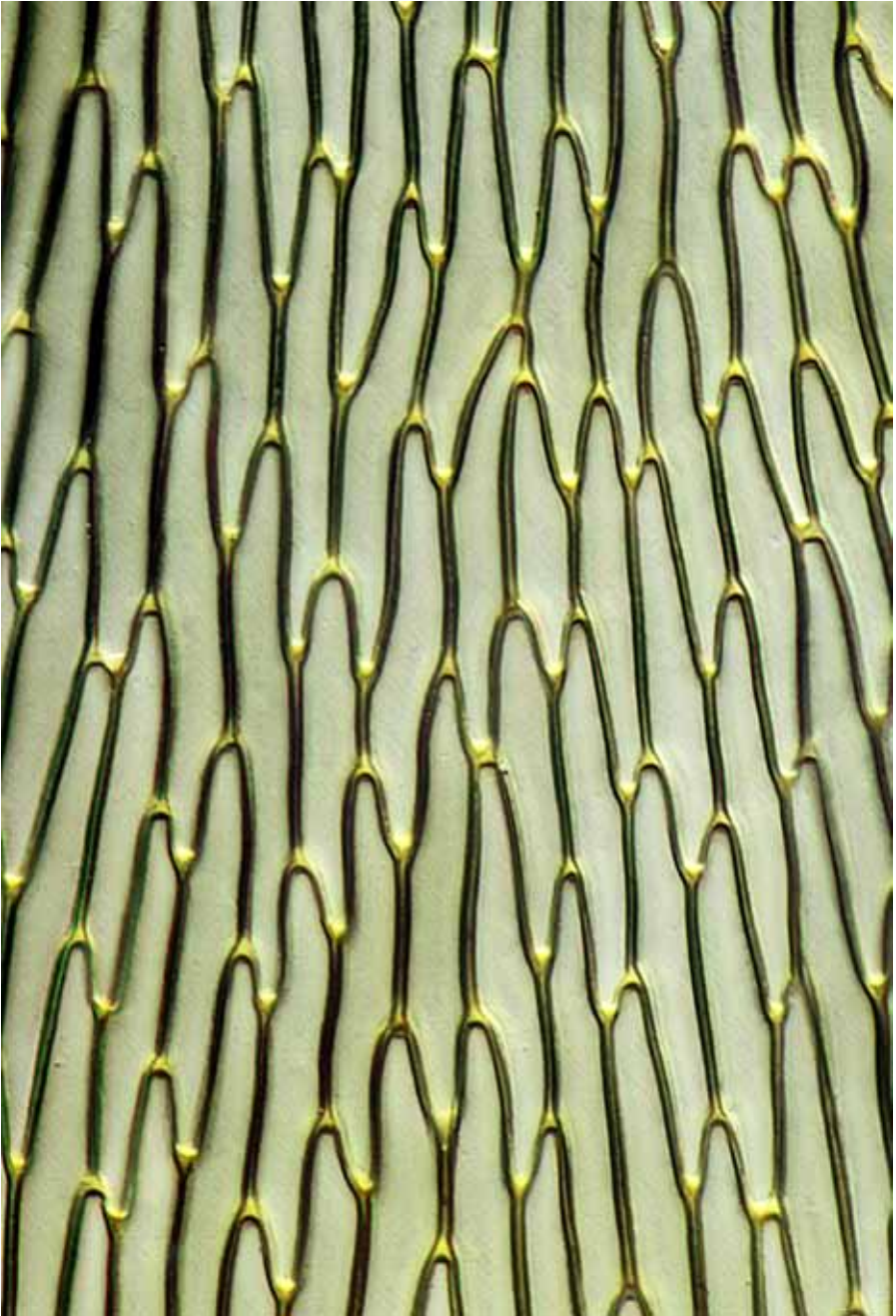
costa at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

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*Rhynchoszegium muriculatum* costa midleaf  
10  $\mu$ m

continued next page



*Rhynchoszegium muriculatum* cells midleaf  
10  $\mu$ m

continued next page

**Rhynchostegium tenuifolium** (Hedw.) Reichenbach

**form:** straggling or tufted, radiculose, branched stems, to 80 mm long,  
leaves pale to dark green or yellow-green, ± glossy

**habitat:** soil, humus, rotting logs, or rock

**leaf:** size: stem leaves  $1.5\text{--}5 \times 0.5\text{--}1.4$  mm; branch leaves smaller

**shape:** ovate-cordate, concave, slightly asymmetric

**tip:** acuminate to ± piliferous, the tip often twisted

**base:** basal cells subrectangular, thin-walled, not in auricles

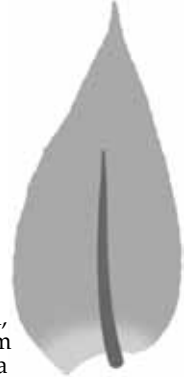
**costa:** slender, reaching above midleaf

**border:** not differentiated

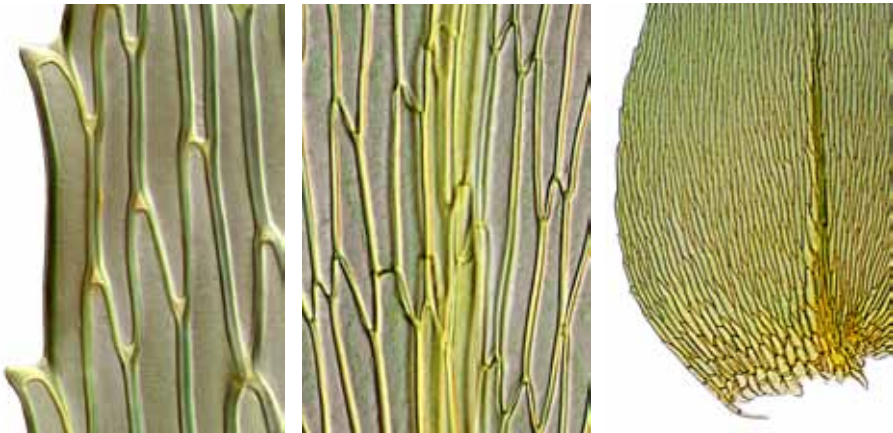
**margin:** ± serrulate, plane

**cells:**  $80\text{--}140 \times 7\text{--}10$  μm, linear-fusiform, firm-walled, smooth

**capsule:** 2–2.5 mm, slender, flexuose, reddish; ovoid to cylindrical, ± curved, exserted, horizontal to cernuous, dark brown; seta 10–15 mm; operculum rostrate; exostome teeth striolate below, papillose above; endostome cilia 1–3, nodulose; spores 12–14 μm in diam.



vegetative shoot (2), mature capsule (dry), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 μm



margin at midleaf, costa at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm



**Scleropodium touretii** (Brid.) Koch

**form:** matted, curved, irregularly branched stems, to 80 mm long,  
leaves green, olive-green, or yellowish

**habitat:** soil or rock in shady disturbed sites (gardens, quarries)

**leaf:** size: 1.2–1.5 × 0.8–1.0 mm

**shape:** triangular-ovate, ovate, or ovate-cordate, concave

**tip:** abruptly narrowed to an acuminate or obtuse apex

**base:** alar cells long-rectangular in a distinct triangular group

**costa:** reaching 3/4 up the leaf blade, often ending in a spine

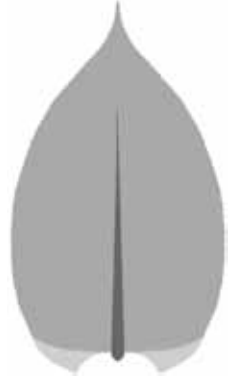
**border:** not differentiated

**margin:** minutely denticulate

**cells:** 40–100 × 4–6.5 μm, vermicular, firm-walled, smooth

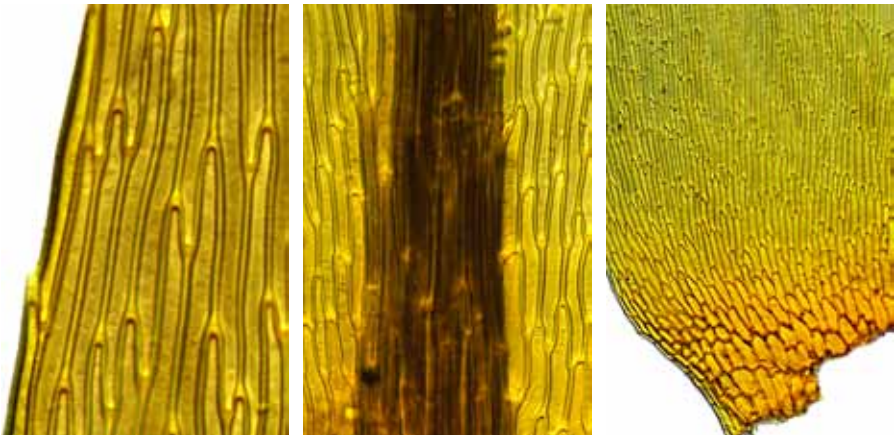
**capsule:** capsules not yet found in New Zealand

**notes:** endemic; differs from *Pseudoscleropodium purum* in having a larger alar group, stems and branches that curve strongly when dry, and a leaf apex that's not reflexed



shoots (dry) (2), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, costa near leaf base, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

**Scorpiurium cucullatum** (Mitt.) Hedenäs

**form:** tufted, creeping, ± pinnately branched, rhizomatous stems with pale green leaves

**habitat:** bark, often near water in silty, occasionally inundated sites

**leaf:** size: 0.8–1.0 × 0.3–0.4 mm

*shape:* ovate to ovate-lanceolate, concave, strongly inrolled when dry

*tip:* acuminate to broadly acute, ± cucullate

*base:* 3–4 rows of oblate to ± quadrate cells extending far up the margin

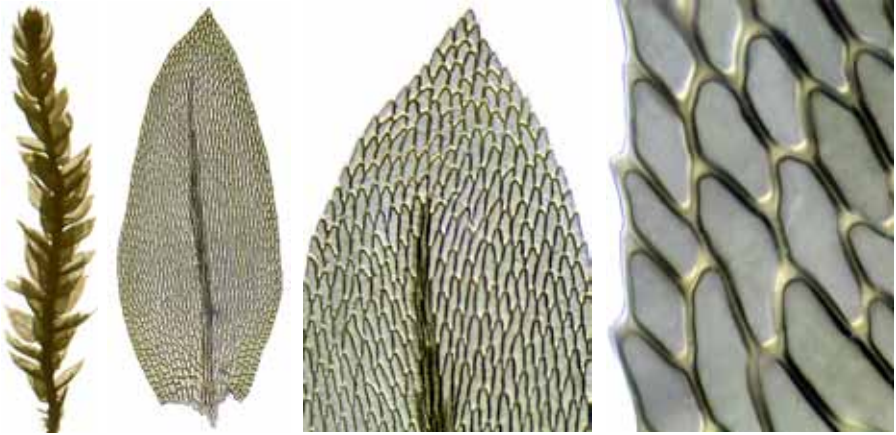
*costa:* reaching about 2/3 up the leaf blade, ± spinose at the tip

*border:* not differentiated

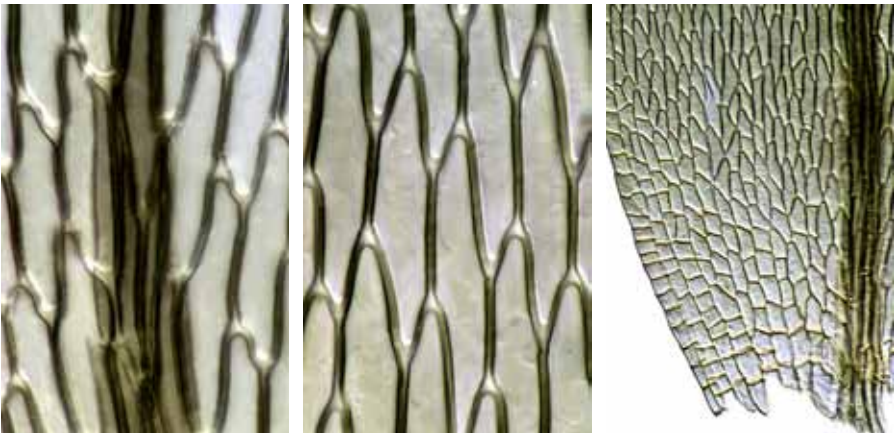
*margin:* minutely denticulate, plane

*cells:* 25–80 × 6–9 μm, linear-rhombic, firm-walled, smooth

**capsule:** 1.2 mm, short-cylindric, curved, inclined; seta 5–11 mm, mammillose, purple; operculum beak long, oblique; peristome double; endostome cilia vestigial or absent; spores 13–18 μm in diam.

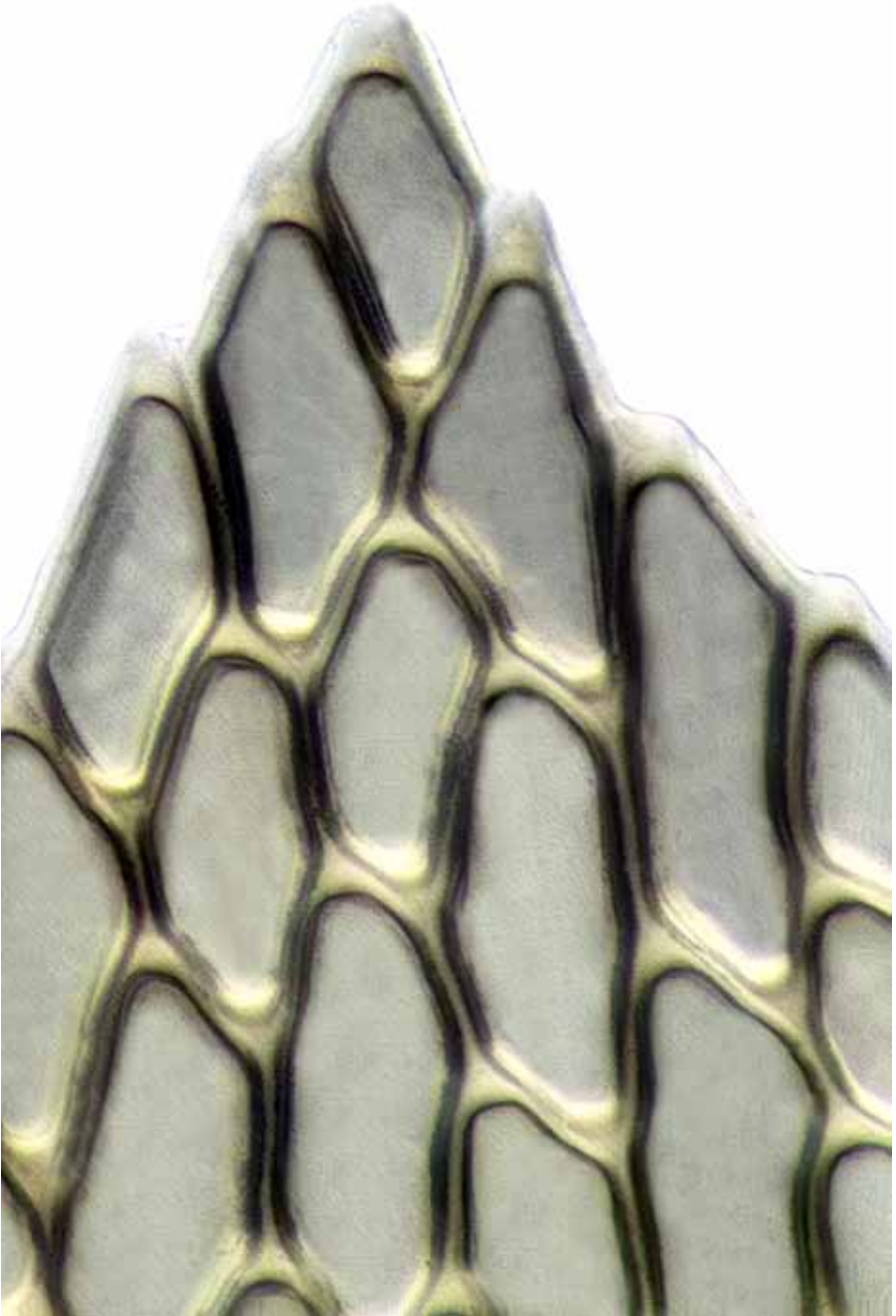


vegetative shoot (moist), leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.1 mm, 50 μm, 10 μm



costa at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm

continued next page



*Scorpiurium cucullatum* leaf apex  
10  $\mu\text{m}$

**Meteoriopsis reclinata** (Müll.Hal.) M.Fleisch. ex Broth.

**form:** primary stems creeping, branched; secondary stems pendent, to 200 mm long, leaves yellow-green to yellow-brown,  $\pm$  glossy

**habitat:** tree trunk and branch bark, rarely rock and logs, in humid forest

**leaf:** size: 2–2.5 mm

*shape:* ovate to ovate-oblong,  $\pm$  clasping at the base

*tip:* tapering to a long,  $\pm$  canaliculate acumen

*base:* alar cells weakly delimited

*costa:* reaching to about midleaf

*border:* not differentiated

*margin:* serrulate, plane

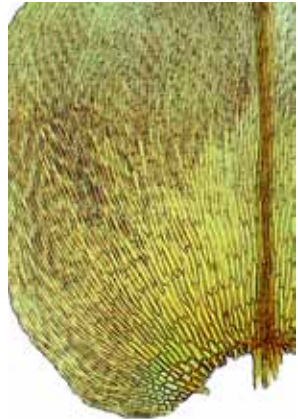
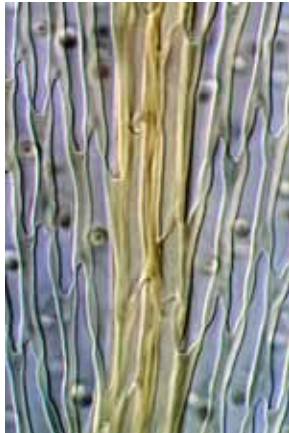
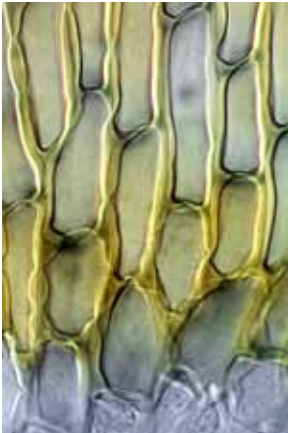
*cells:* 40–50  $\times$  10  $\mu$ m, linear-rhombic, firm-walled, unipapillose

**capsule:** 1.5–2 mm, oblong-ovoid, symmetric, erect, emergent, brown, dark with age; seta 1–2 mm; calyptra mitrate, pilose; operculum conic-rostrate; exostome teeth cross-striolate, endostome reduced; spores 20–30  $\mu$ m in diam., scabrate



vegetative shoots (dry) (2), leaf outline, leaf apex, and margin midleaf

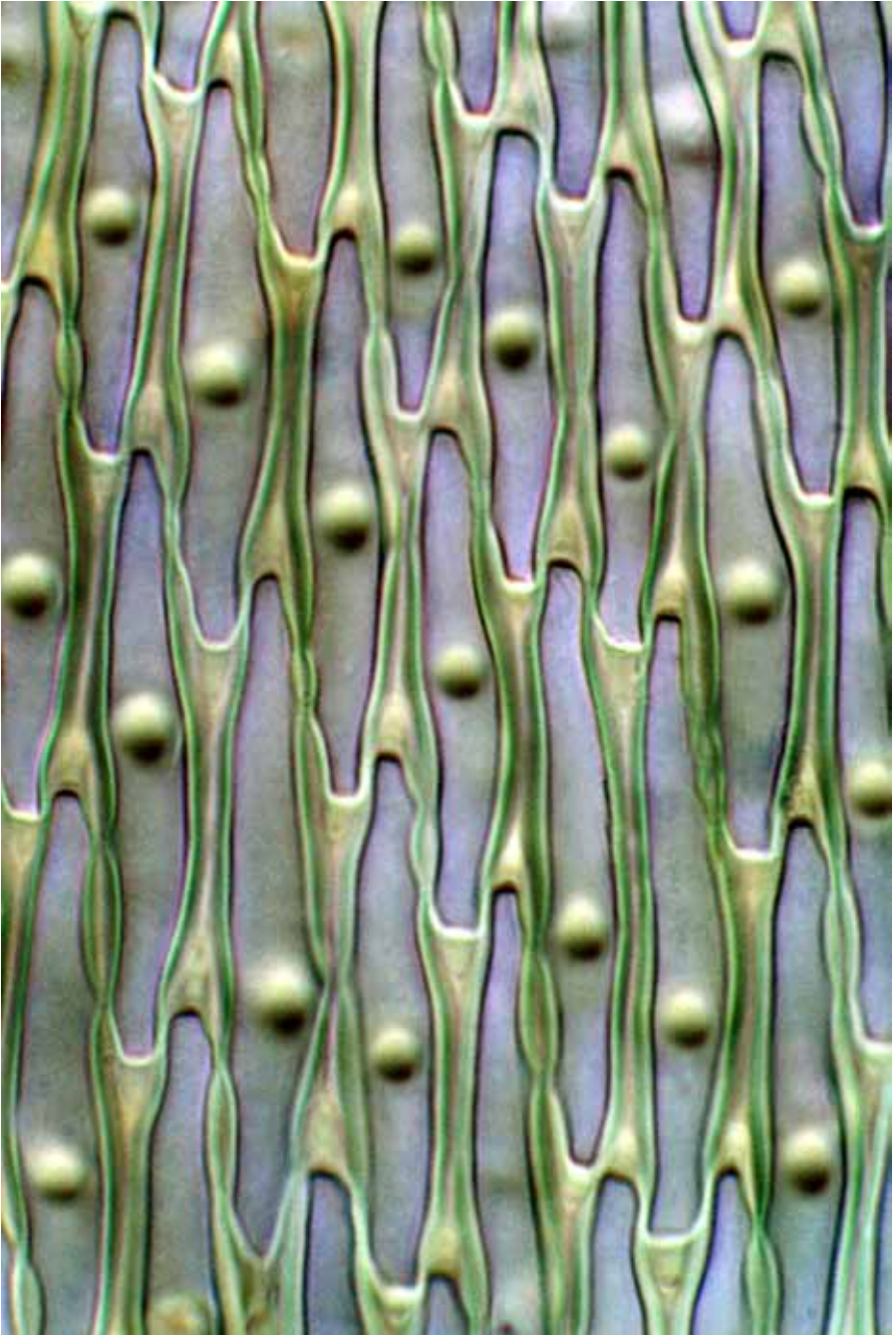
■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu$ m, ■ 10  $\mu$ m



alar cells, costa at midleaf, and leaf basal angle

■ 10  $\mu$ m, ■ 10  $\mu$ m, ■ 50  $\mu$ m

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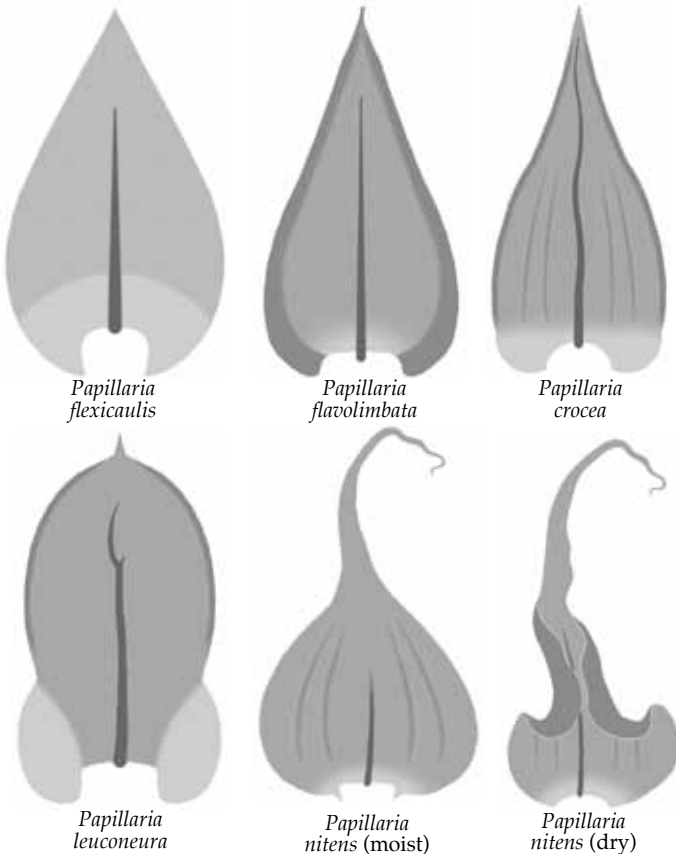


*Meteoropsis reclinata* cells midleaf  
10  $\mu\text{m}$

Key\* to the New Zealand species of *Papillaria* (5)

- 1 Leaves not or only weakly bordered; plants soft ..... 2  
 1: Leaves bordered at least in part; plants rigid.....3
- 2 (1) Upper lamina cells sparsely papillose; leaf apex long-acuminate, the tip often filiform; cells in the auricle  $\pm$  parallel to the margin..... ● **Papillaria nitens**  
 2: Upper lamina cells densely papillose; leaf apex acute, never filiform; cells in the auricle meeting the margin  $\pm$  at a right angle ..... ● **Papillaria flexicaulis**
- 3 (1:) Margin recurved; auricle with a broad border of long narrow cells..... ● **Papillaria flavolimbata**  
 3: Margin straight; auricle without a broad border of long narrow cells.....4
- 4 (3:) Leaves smoothly curved when dry; costa straight or if flexuose then forked ... ● **Papillaria leuconeura**  
 4: Leaves undulate and long-grooved when dry; costa  $\pm$  flexuose, never forked ..... ● **Papillaria crocea**

\* based on Streimann, H (1991): Taxonomic studies on Australian Meteoriaceae (Musci) 3: *Papillaria nitens* (Hook.f. & Wilson) Sainsb. *Journal of the Hattori Botanical Laboratory* 70, 220, plus Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bulletin 5, 354.



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**Papillaria crocea** (Hampe) A.Jaeger

**form:** primary stems trailing, to 200 mm long; secondary stems to 100 mm long, leaves imbricate, dull, yellowish green

**habitat:** bark, rotting logs, tree roots, or rock in forest or other moist sites

**leaf:** size: branch leaves 1–1.5 mm; stem leaves slightly longer

*shape:* cordate to broadly lanceolate

*tip:* acute or rarely acuminate

*base:* strongly auriculate, juxtacostal cells rectangular, smooth

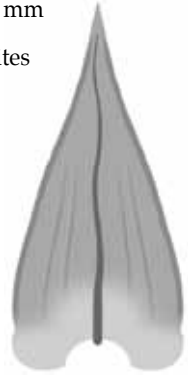
*costa:* reaching nearly to the apex

*border:* 1–2 rows of  $\pm$  smooth, quadrate cells

*margin:* irregularly denticulate-prurulose, undulate

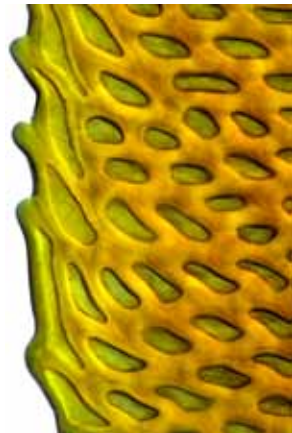
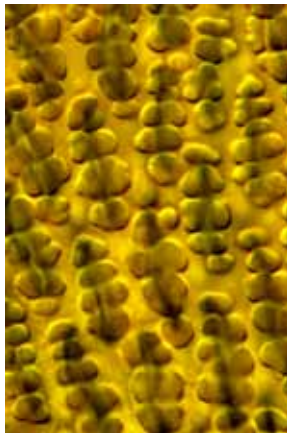
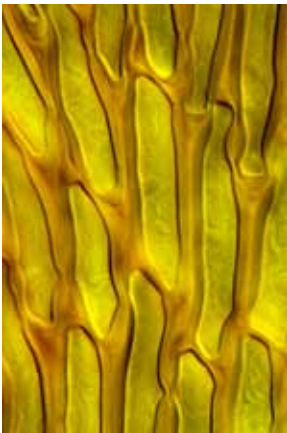
*cells:* 9–13  $\times$  2–6  $\mu\text{m}$ , upper cells oval to rhombic, thick-walled, multipapillose

**capsule:** rare; 1.3–1.6 mm, ovoid, symmetric, exserted, erect, brown; seta 4–5 mm; peristome double, endostome cilia lacking or only rudimentary



vegetative shoots (4), leaf outline, and leaf apex

10 mm, 5 mm, 1 mm, 1 mm, 0.1 mm, 10  $\mu\text{m}$



basal juxtacostal cells, leaf papillae, and auricle margin

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page



*Papillaria crocea* habit  
10 mm

continued next page



**Papillaria flavolimбата** (Müll.Hal. & Hampe) A.Jaeger

**form:** primary stems creeping, flexuose, branched, to 300 mm long; secondary

stems  $\pm$  pinnately branched, a few filiform, to 100 mm long, leaves dull

**habitat:** bark of tree trunks and canopy branches in moist forest, often in pendent festoons, rarely also on rock

**leaf:** size: 2–2.5  $\times$  1.2–1.5 mm

*shape:* lanceolate from a broadly auricled base, not plicate

*tip:* acuminate, ending in a flexuose, papillose, forked point

*base:* outer base: many rows of border cells; inner base: rows of cells diverging at an angle from the costa

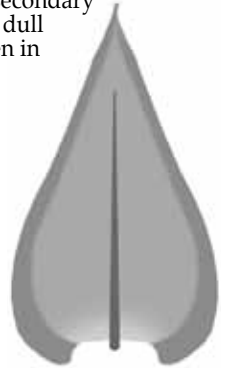
*costa:* prominent at the back, vanishing below the apex

*border:* several to many rows of pale, elongate, incrassate cells

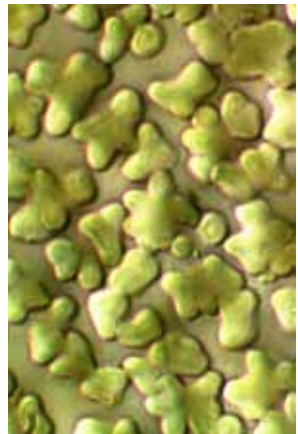
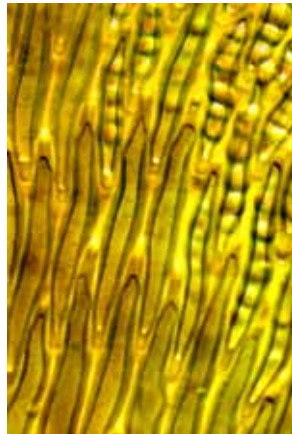
*margin:* serrulate below, plane to  $\pm$  recurved below,  $\pm$  undulate

*cells:* 12–20  $\times$  4–5  $\mu\text{m}$ , narrow-rhombic, firm-walled, papillose

**capsule:** not found in New Zealand



vegetative shoots (4), margin cross-section, leaf outline, and papillose forked leaf apex  
 ■ 10 mm, ■ 5 mm, ■ 1 mm, ■ 1 mm, ■ 5  $\mu\text{m}$ , ■ 0.1 mm, ■ 10  $\mu\text{m}$

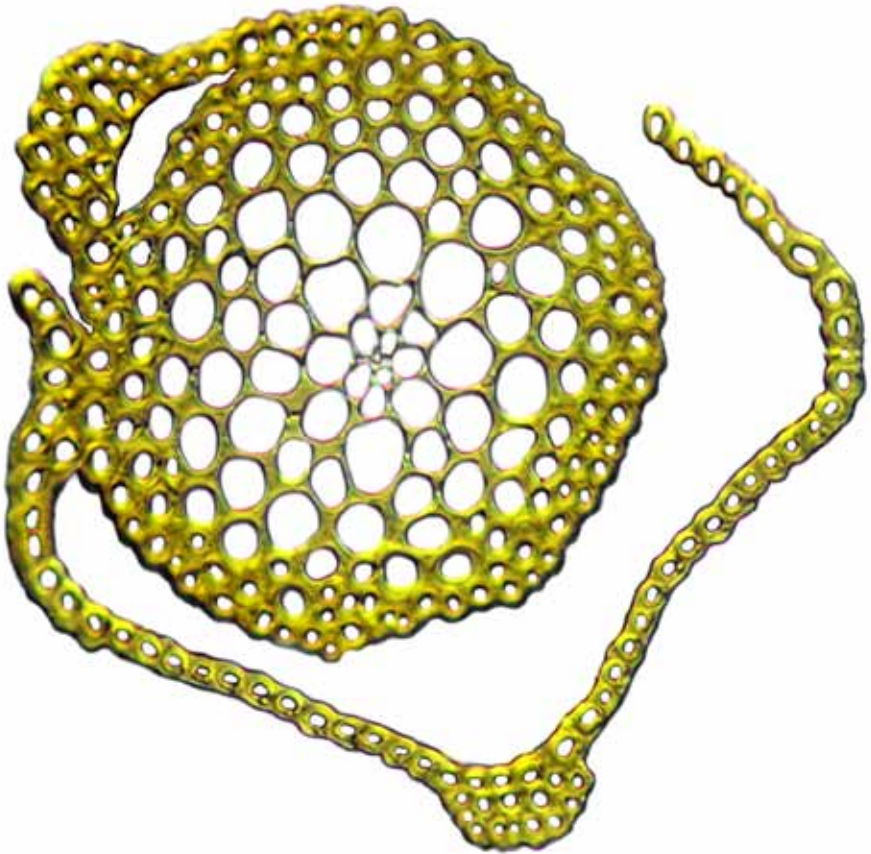


border of lower leaf, cells of inner leaf base, and leaf papillae  
 ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$



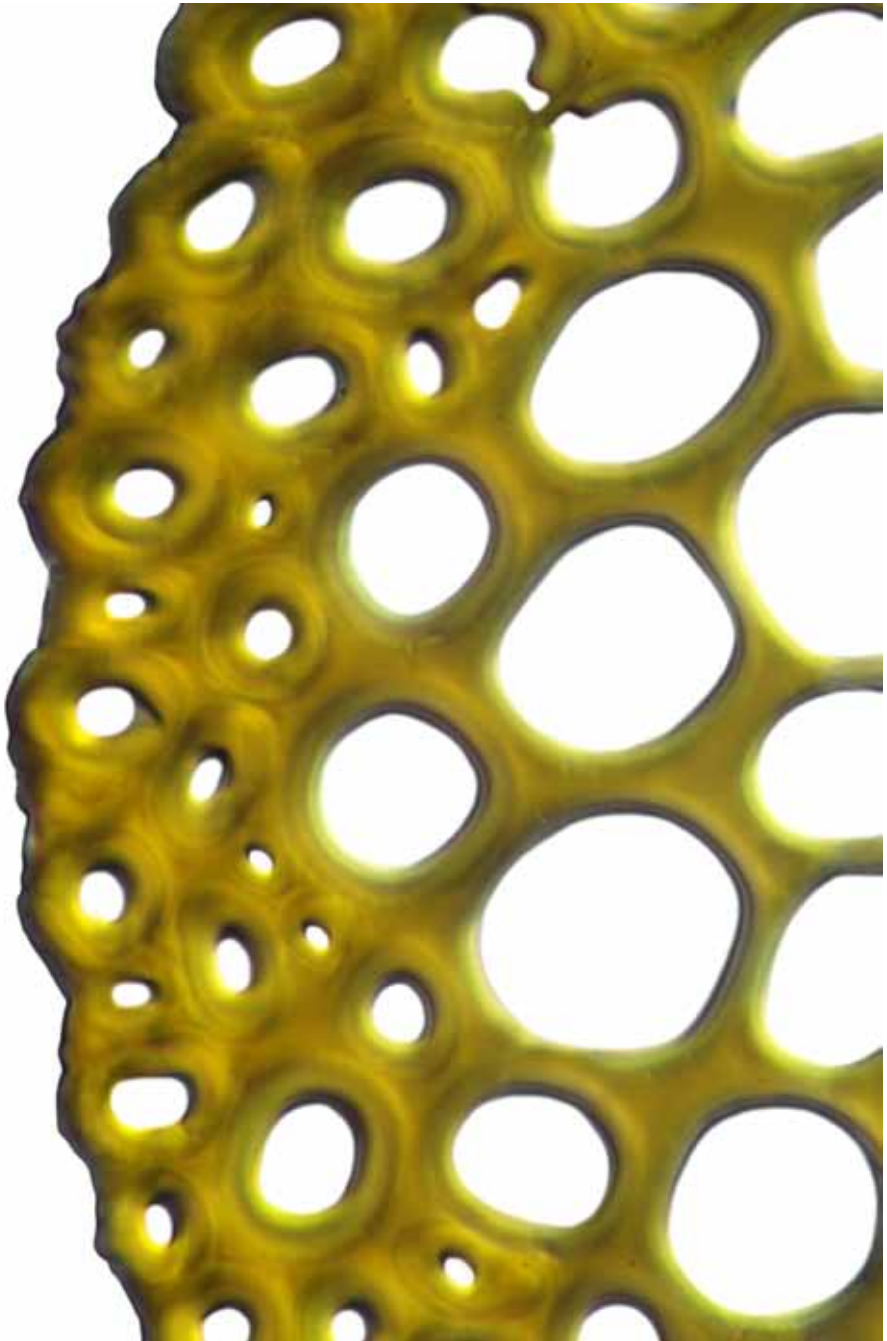
*Papillaria flavolimbata* vegetative pendent shoot tip  
1 mm

continued next page



*Papillaria flavolimbata* stem and leaf cross-section  
10  $\mu\text{m}$

continued next page



*Papillaria flavolimbata* stem cross-section (portion)  
10  $\mu$ m

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**Papillaria flexicaulis** (Wilson) A.Jaeger

**form:** primary stems pinnate; secondary stems long-pendent, to 300 mm, flexuose, pinnate branches to 10 mm, leaves dark to yellow-green

**habitat:** shrub or tree bark or rarely limestone in damp forest

**leaf:** size: 0.8–2.0 mm

*shape:* triangular-ovate, concave, not plicate

*tip:* acute

*base:* cells in the auricle meeting the margin  $\pm$  at a right angle

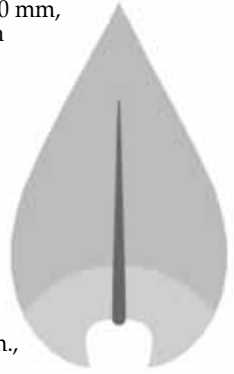
*costa:* reaching 3/4 up lamina, straight, not forked

*border:* not or only weakly differentiated

*margin:*  $\pm$  crenulate from papillae or projecting cells, plane

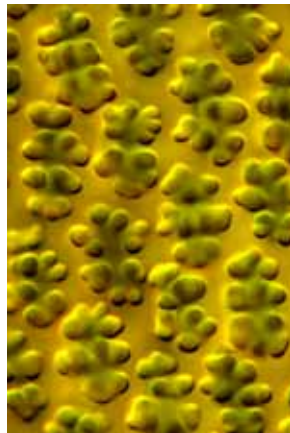
*cells:* 8–15  $\times$  3–5  $\mu\text{m}$ , rhombic to oval, incrassate, papillose

**capsule:** to 1.2 mm, ovoid, exserted, erect, brown; seta 3–9 mm, smooth; operculum obliquely subulate; calyptra hairy; exostome teeth 16, endostome segments perforate; spores 16–20  $\mu\text{m}$  in diam., brownish green,  $\pm$  papillose



habit (moist), leaf outline, and leaf apex (2)

10 mm, 0.1 mm, 10  $\mu\text{m}$ , 5  $\mu\text{m}$



margin at midleaf, leaf papillae, and margin of lower leaf

5  $\mu\text{m}$ , 5  $\mu\text{m}$ , 5  $\mu\text{m}$

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*Papillaria flexicaulis* exostome teeth (lanceolate) and endostome processes (linear)  
50  $\mu\text{m}$

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**Papillaria leuconeura** (Müll.Hal.) A.Jaeger

**form:** primary stems to 20 mm long; secondary stems foliate, terete, pinnately branched, to 300 mm long, leaves yellowish, julaceous  
**habitat:** tree bark in damp forest and in urban areas, also in bogs and on rock, from sea level to 1200 m

**leaf:** size: 1–2 mm

*shape:* ovate-oblong to panduriform, the base cordate to auriculate

*tip:* ± cucullate with a short recurved mucro or cusp

*base:* auricle cells ± parallel to the border

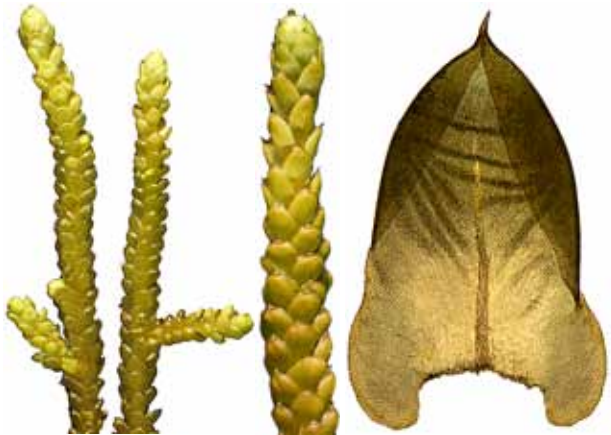
*costa:* pale, reaching 3/4 up lamina, ± forked and flexuose above

*border:* a few rows of elongate cells

*margin:* entire above, denticulate in the auricles, plane

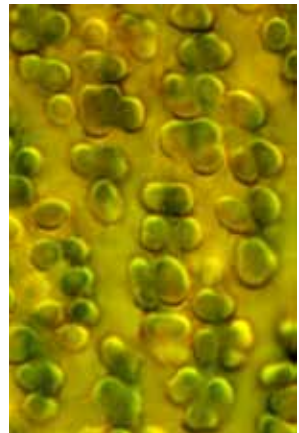
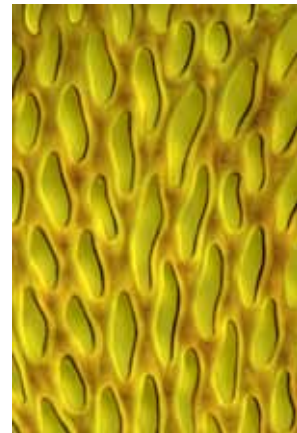
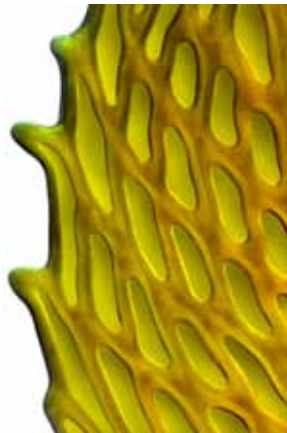
*cells:* 10–20 × 3–8 μm, elliptic to rhombic, incassate, low-papillose

**capsule:** 1.5–3.5 mm, ovoid, exserted, erect, brown; seta 2–6 mm; operculum short-rostrate; peristome double; spores 13–24 μm in diam.



habit (moist), vegetative shoots (dry) (3), and leaf outline (coverslipped)

■ 5 mm, ■ 5 mm (2), ■ 1 mm, ■ 0.1 mm



margin of lower leaf, cells at midleaf, and leaf papillae

■ 10 μm, ■ 10 μm, ■ 10 μm

**Papillaria nitens** (Hook.f. & Wilson) Sainsbury

**form:** primary stems creeping or pendent, to 120 mm long; secondary stems pendent, to 200 mm long, leaves yellow-green,  $\pm$  glossy

**habitat:** bark in moist forest

**leaf:** size: stem leaf 1.5–2.0 mm; branch leaf smaller

*shape:* lanceolate from an ovate to broadly triangular base

*tip:* acuminate, in the upper leaves ending in a filiform hair-point

*base:* auriculate, the auricle cells nearly parallel with the margin

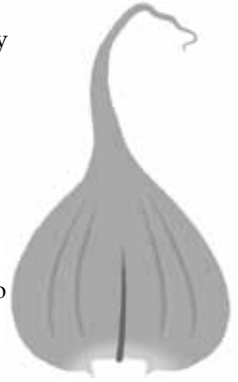
*costa:* reaching about halfway up the blade

*border:* not differentiated

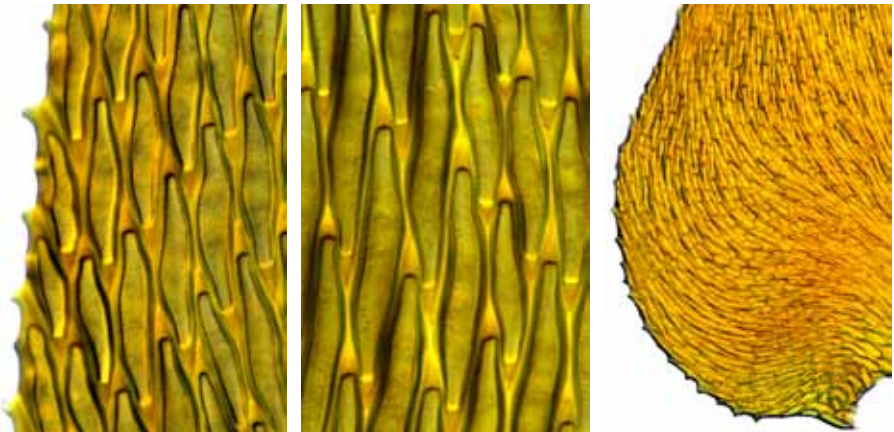
*margin:* denticulate throughout but more strongly below, plane

*cells:*  $25\text{--}60 \times 4\text{--}5 \mu\text{m}$ , linear-rhombic, firm- to thick-walled, smooth to sparsely papillose

**capsule:** 1.5 mm, ovoid-oblong, exserted, erect, symmetric, pale brown; seta 4 mm; calyptra mitriform, hairy; endostome hyaline; spores smooth,  $20 \mu\text{m}$  in diam.



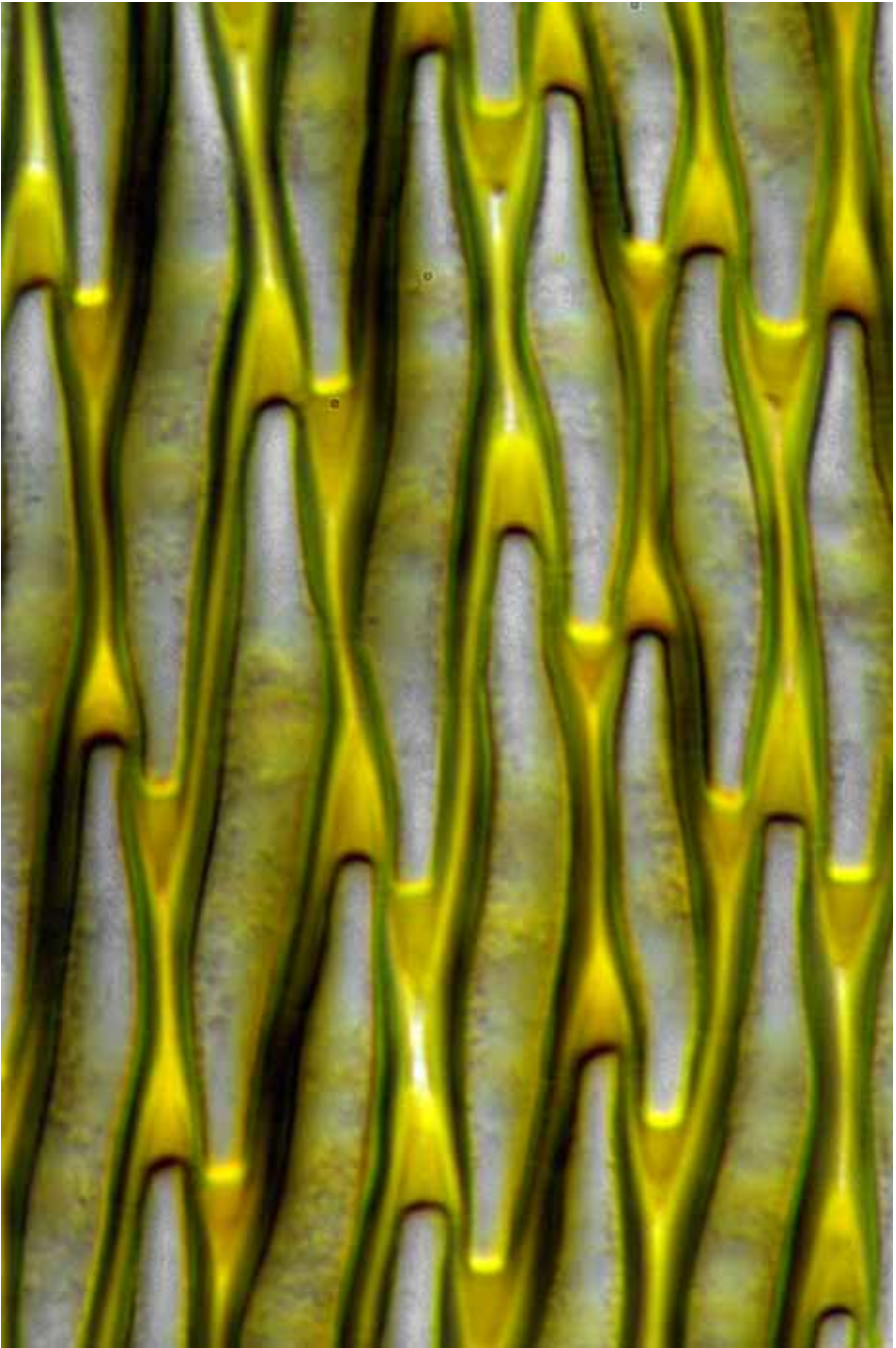
vegetative shoot (dry), stem and branch leaf outlines, branch leaf apex (2) and subapex  
 5 mm, 1 mm, 0.1 mm (2), 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 5  $\mu\text{m}$



margin at midleaf, cells at midleaf, and auricle in leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page





*Papillaria nitens* cells midleaf  
10  $\mu\text{m}$

**Fabronia australis** Hook.

**form:** tufts of creeping, branched stems, 5–15 mm, leaves pale, ± glossy

**habitat:** soil, bark, rock, or concrete, dry habitats, urban to montane, to 800 m

**leaf:** size: 0.4–0.8 × 0.2–0.3 mm

*shape:* ovate to ovate-lanceolate

*tip:* tapering to an acumen or hair-point

*base:* quadrate cells 12–14 μm arranged obliquely up the margin

*costa:* reaching about midleaf

*border:* not differentiated

*margin:* variable, from entire to sharply serrate (unicellular), plane

*cells:* 25–50 × 5–9 μm, rhombic, thin-walled, smooth

**capsule:** 0.6–0.8 mm, ovoid or cylindric with a tapered neck, exserted, erect, red-brown; seta 3–6 mm, yellow, twisted when dry; calyptra narrowly cucullate, smooth; operculum conic, apiculate; peristome exostome only, teeth triangular, brown, papillose; walls of exothecial cells wavy; spores 13–26 μm in diam., papillose, green



habit, vegetative shoot (moist), mature capsule (2) (dry), leaf outline, and leaf apex

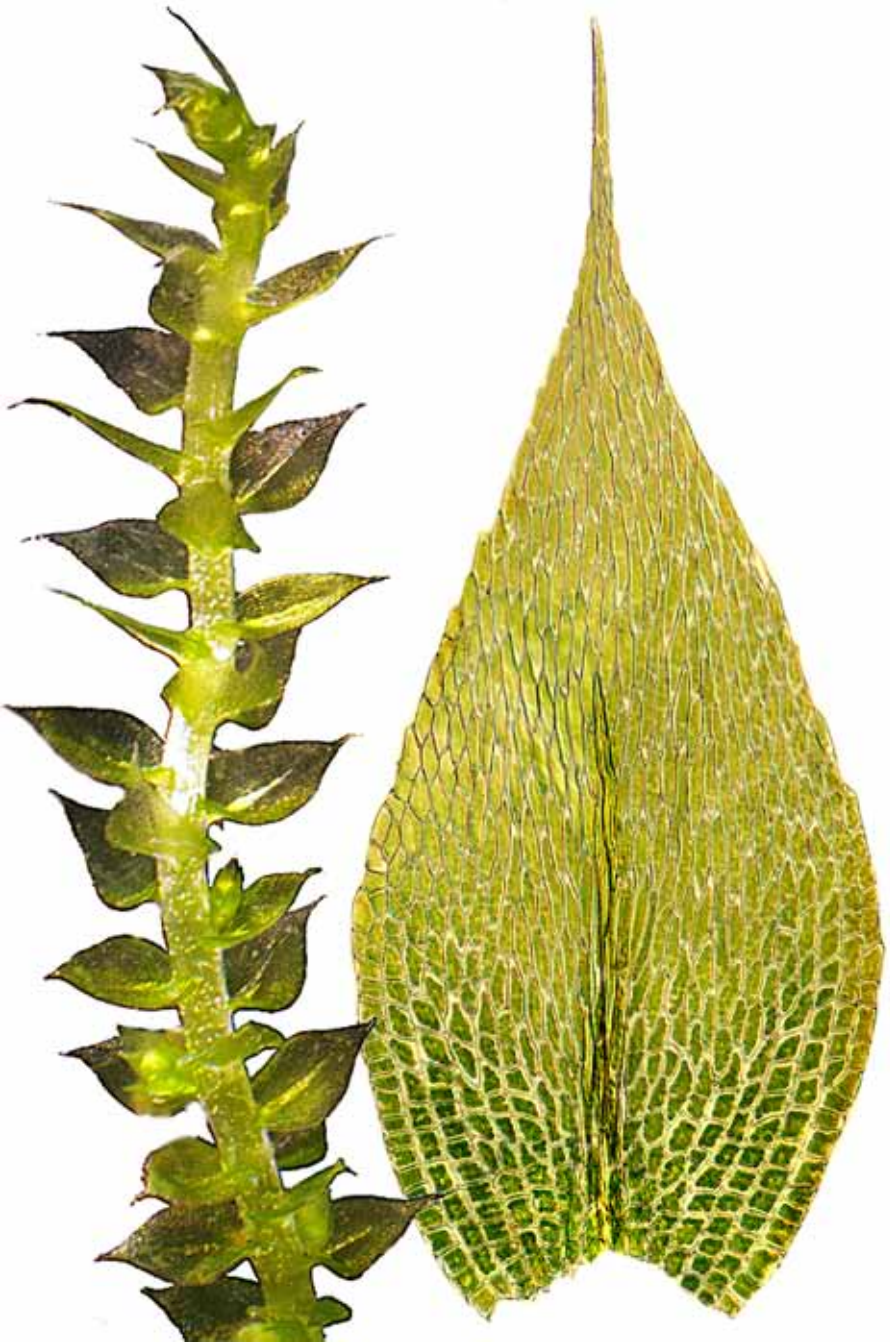
1 mm, 1 mm, 1 mm, 1 mm, 0.1 mm, 50 μm



margin at midleaf plus costa terminus, leaf basal angle, and margin near leaf base

50 μm, 10 μm, 10 μm

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*Fabronia australis* vegetative shoot and leaf outline  
1 mm, 10  $\mu$ m

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*Fabronia australis* fertile shoots showing calyptrae

1 mm

**Ischyrodon lepturus** (Taylor) Schelpe

**form:** loose mats of creeping, rhizomatous, variously branched stems, to 50 mm long, the branches erect, 10–20 mm, flexuose-curved, leafy, glossy

**habitat:** coastal rock in damp sheltered sites

**leaf:** *size:* stem: 1.2–2.0 × 0.5–0.8 mm; branch: 0.8–1.4 × 0.4–0.5 mm

*shape:* ovate-lanceolate, concave, narrowed at the base

*tip:* gradually narrowing to an acuminate tip

*base:* alar region concave, cells subquadrate, 10–12 μm in diam.

*costa:* reaching beyond midleaf, broad base overgrown by alar cells

*border:* not differentiated

*margin:* entire to weakly crenulate, plane to reflexed toward base

*cells:* 45–90 × 6–7 μm, long-rhombic, firm-walled, smooth

**capsule:** no capsules in NZ; 1.5 mm, lateral, broadly oval, exerted, erect, brown; seta 6–7 mm, thick, reddish; operculum conic, bluntly rostrate; calyptra cucullate, naked, smooth; exostome teeth paired, endostome reduced; spores 14–18 μm in diam., green, verrucose

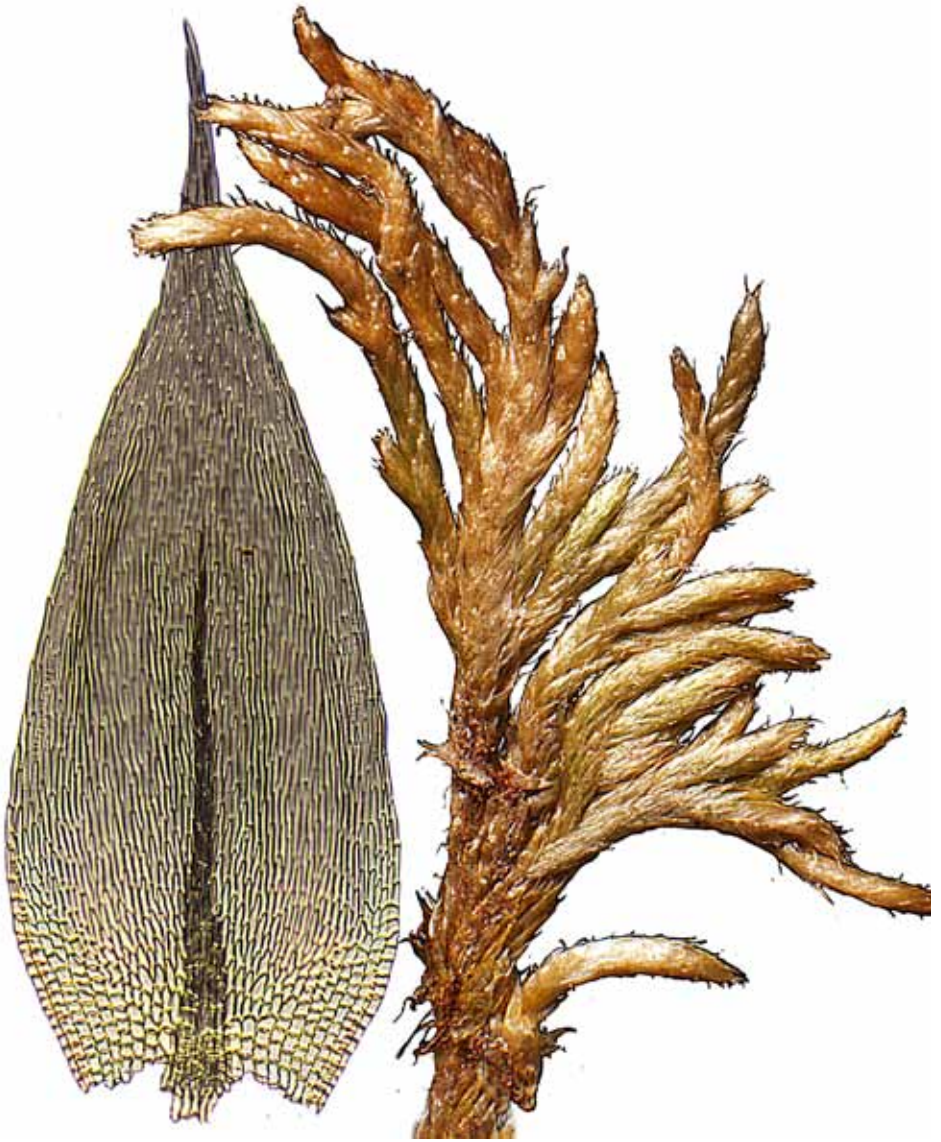


vegetative shoot and branch tip (dry) (2), leaf outline, leaf apex, and margin midleaf  
 1 mm, 0.1 mm, 0.5 mm, 50 μm, 10 μm

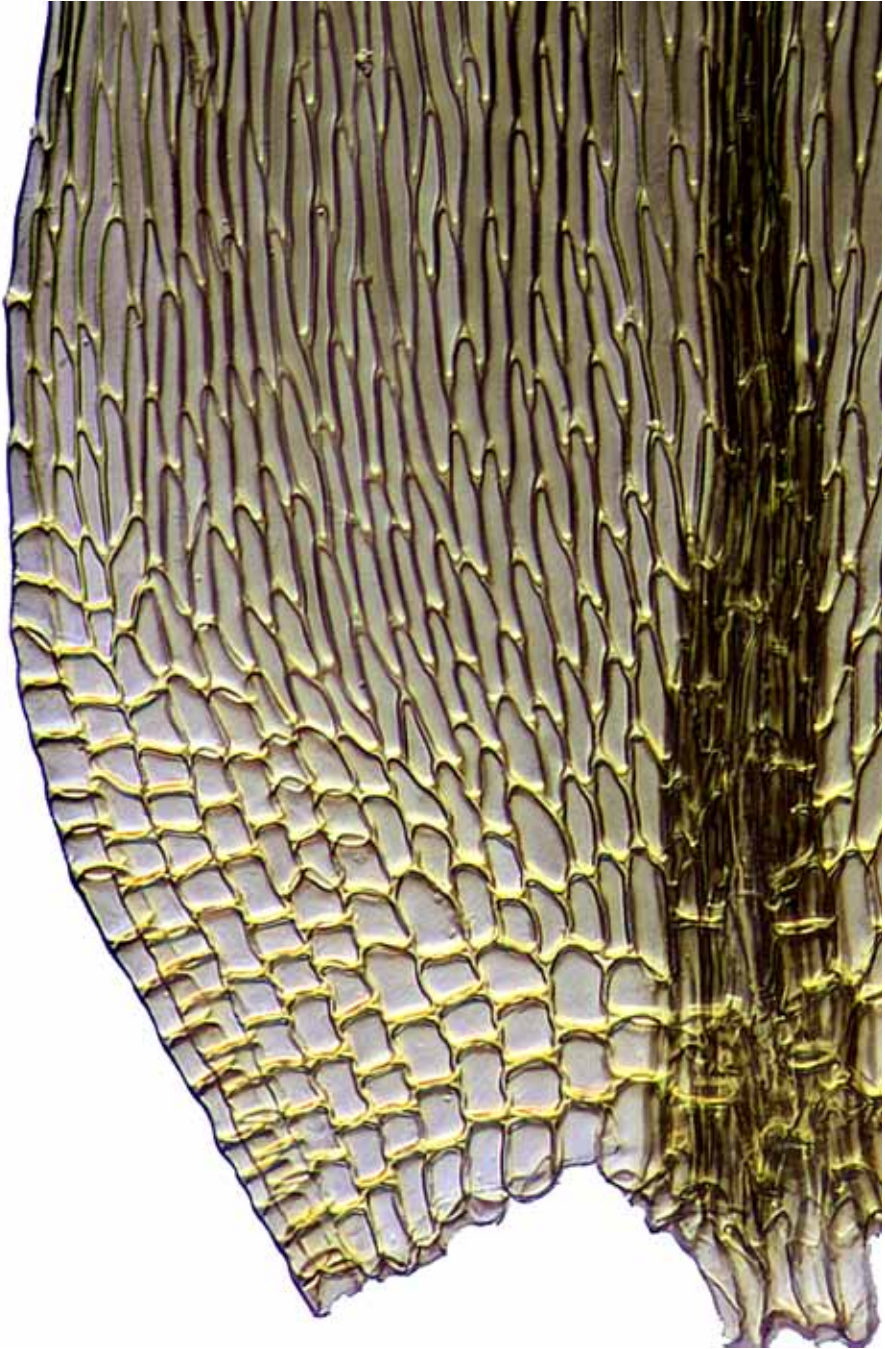


leaf subapex, costa at midleaf, and leaf basal angle (alar cells overgrow adaxial costa base)  
 10 μm, 50 μm, 50 μm

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*Ischyrodon lepturus* leaf outline and vegetative shoot (dry)  
0.1 mm, 1 mm



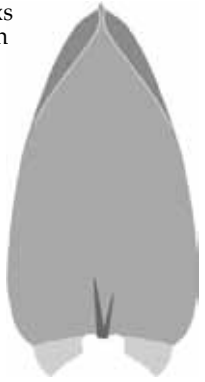
*Ischyrodon lepturus* alar cells overgrowing the adaxial surface of the base of the costa  
50  $\mu$ m

**Calliergonella cuspidata** (Hedw.) Loeske

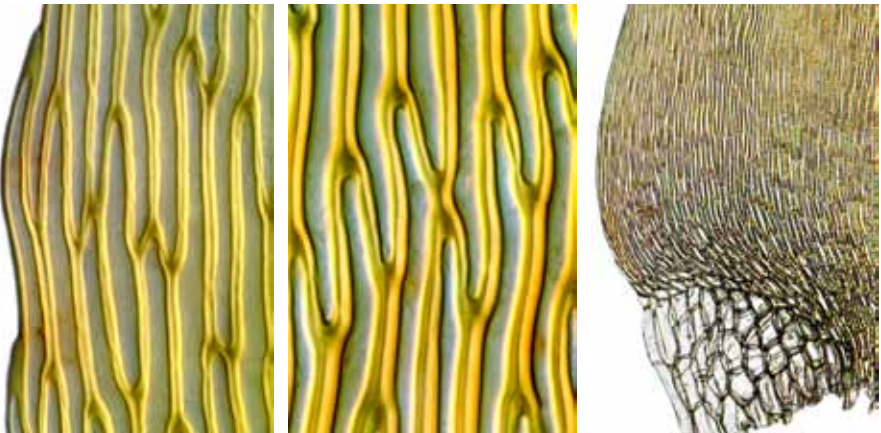
**form:** loosely tufted, ± pinnately branched stems, 70–100 mm long, in xs with a well-developed hyaloderm; leaves glossy, pale green to golden  
**habitat:** damp soil in marshy or boggy disturbed sites (ditches, verges)

**leaf:** *size:* stem leaves 2.0–2.5 × 0.9–1.2 mm; branch leaves smaller  
*shape:* broadly ovate from a wide sheathing base  
*tip:* obtuse to rounded, concave-cucullate, often with a short apiculus  
*base:* angle cells large, hyaline, thin-walled, in decurrent auricles  
*costa:* absent or faint, short, and double  
*border:* not differentiated  
*margin:* entire, ± inrolled toward apex, otherwise plane  
*cells:* 60–100 × 5–6 μm, linear-vermicular, firm to incrassate, smooth

**capsule:** 3 mm, subcylindric, exserted, ± horizontal; seta 50–75 mm, reddish, smooth; annulus triseriate; operculum minutely apiculate; exostome teeth yellow; endostome cilia in threes; spores 18–21 μm in diam., yellowish, rough



vegetative shoot, cuspidate branch apex, leaf outline, and leaf apex  
 ■ 5 mm, ■ 1 mm, ■ 0.5 mm, ■ 50 μm



margin at midleaf, cells at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

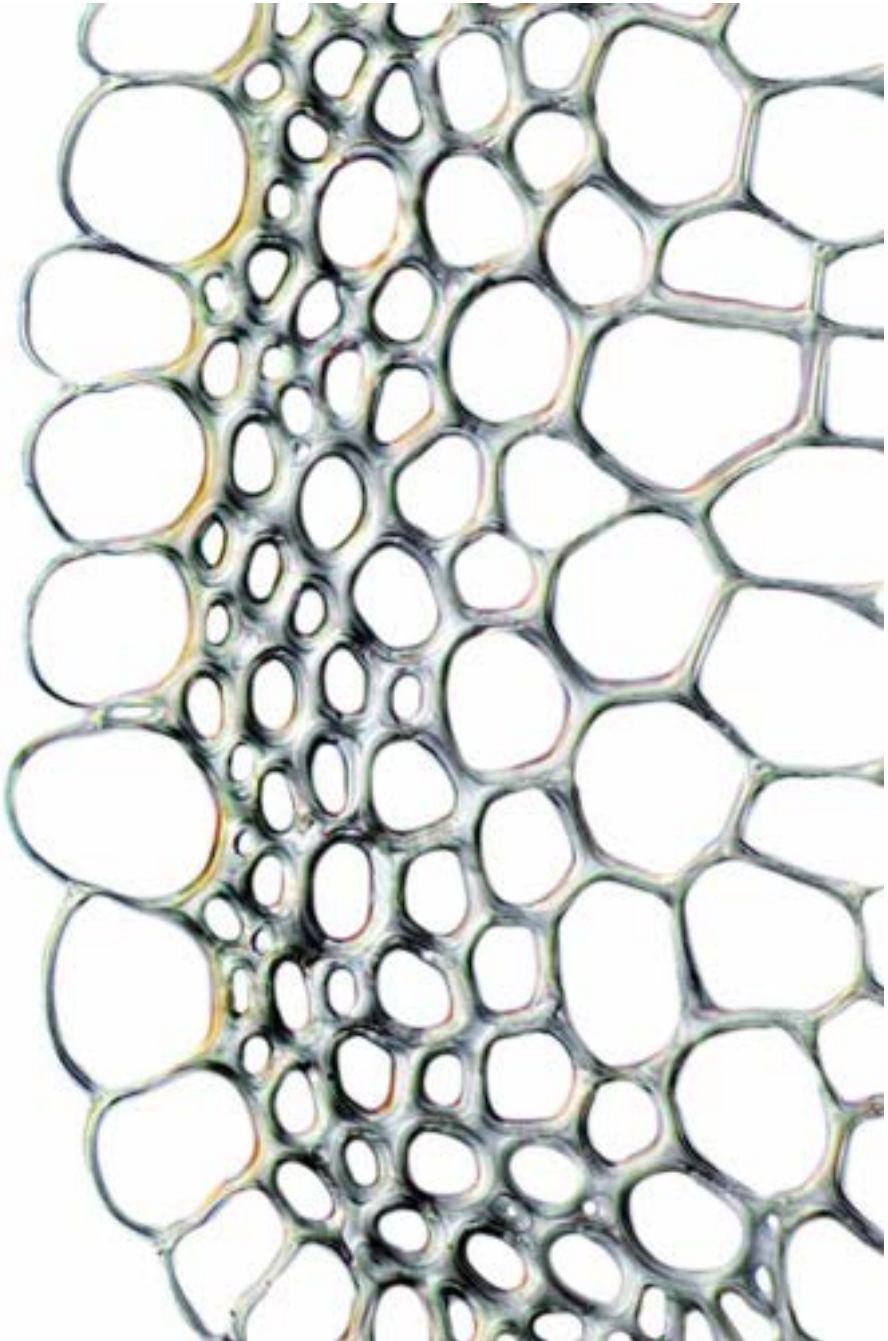
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*Calliergonella cuspidata* vegetative shoots  
1 mm

continued next page



*Calliergonella cuspidata* stem cross-section showing hyaloderm  
10  $\mu\text{m}$

**Ctenidium pubescens** (Hook.f. & Wilson) Broth.

**form:** densely tufted, creeping, pinnately branched stems, 20–80 mm long, pseudoparaphylliate, leaves soft, yellow-green, glossy

**habitat:** soil, bark, tree bases, and rock in moist montane forests

**leaf:** size: stem leaves 1–1.4 mm; branch leaves narrower

*shape:* triangular-cordate, ± curved

*tip:* long-acuminate

*base:* decurrent, basal cells rectangular to rounded, not auriculate

*costa:* faint, double

*border:* not differentiated

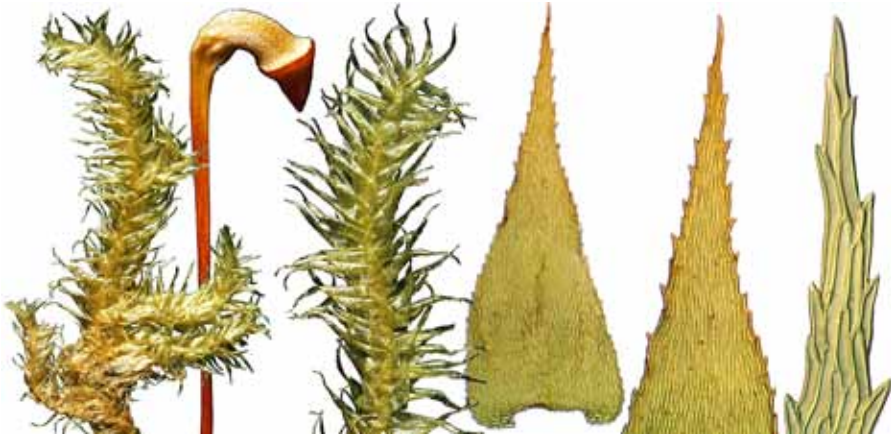
*margin:* sharply dentate or denticulate, plane

*cells:* 45–70 × 6–8 μm, linear to rhombic, firm-walled, smooth

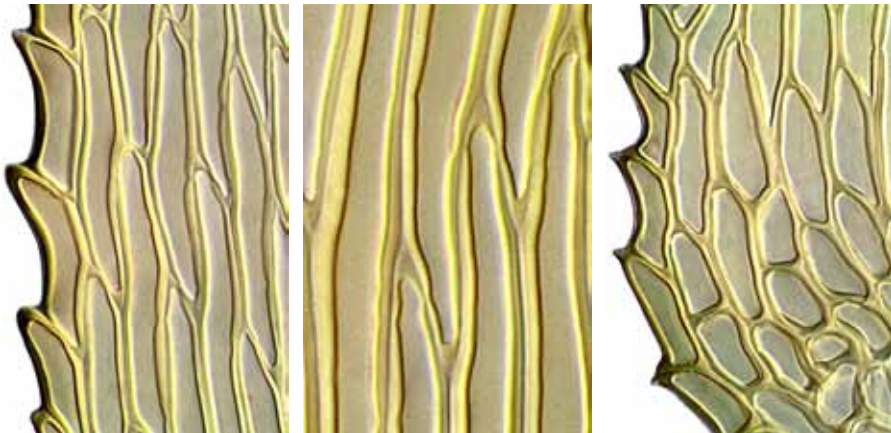
**capsule:** 1.5 mm, ovoid, curved, exserted, inclined to pendent, brown; seta 10–15 mm, brownish, smooth; operculum long-conic; calyptra hairy; exostome teeth cross-striolate, endostome segments keeled and perforate, cilia 1–2; spores weakly papillose



branch leaf



vegetative shoots (dry) (2), immature capsule, branch leaf outline, branch leaf apex (2)  
 1 mm, 1 mm, 1 mm, 0.5 mm, 50 μm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

**Ectropothecium sandwichense** (Hook. & Arnott) Mitt.

**form:** primary stems matted, radiculose, creeping; secondary stems  $\pm$  pinnately branched, to 50 mm long, complanate, pseudoparaphylliate, leaves glossy  
**habitat:** soil, humus, or rotting logs, wet lowland to high-montane, 2800 m

**leaf:** size: 1–1.5 mm

*shape:* ovate-lanceolate,  $\pm$  falcate-secund,  $\pm$  decurrent

*tip:* short- to long-acuminate

*base:* basal cells smaller than the other blade cells,  $\pm$  porose

*costa:* absent or short and double

*border:* not differentiated

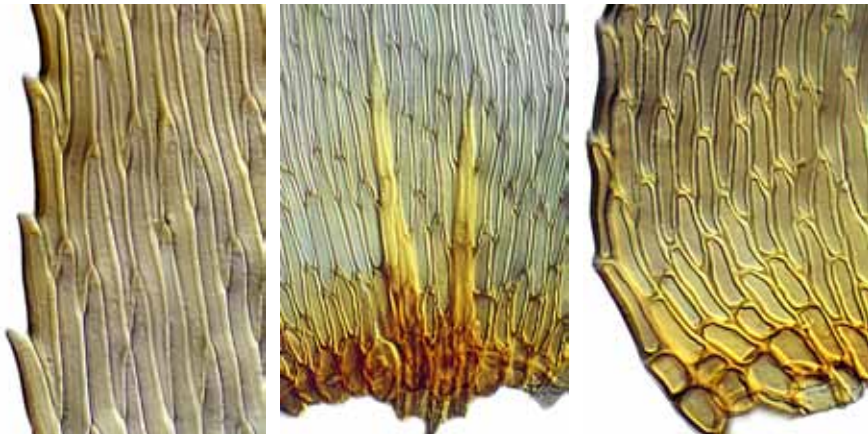
*margin:* serrulate, plane to reflexed

*cells:* 50–90  $\times$  8–10  $\mu$ m, linear, firm-walled, prorulose

**capsule:** 1 mm, ovoid-cylindric, exserted, inclined to pendent, strangulate when empty; seta 12–20 mm, red below, pale above; calyptra  $\pm$  hairy; operculum apiculate; exostome teeth cross-striate, endostome cilia 1–2; spores papillose



vegetative shoots (dry) (2), leaf outline, leaf apex, and leaf subapex  
 1 mm, 1 mm, 0.1 mm, 10  $\mu$ m, 10  $\mu$ m

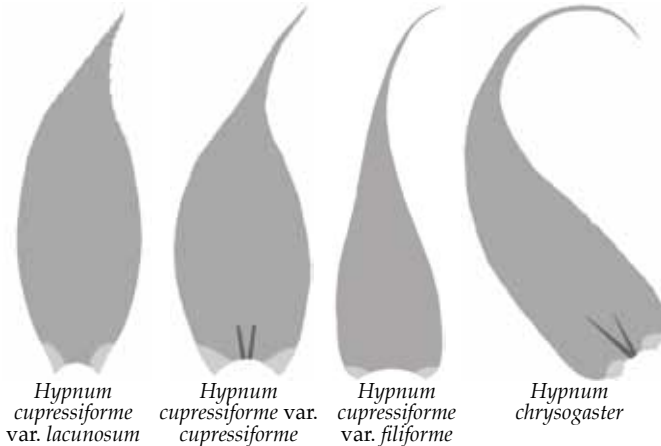


margin at midleaf, short and double costa, and leaf basal angle  
 10  $\mu$ m, 10  $\mu$ m, 10  $\mu$ m

Key\* to the New Zealand species and varieties of *Hypnum* (4)

- 1 Alar cells few; central strand absent..... ● *Hypnum chrysogaster*  
 1: Alar cells many; central strand present ..... 2
- 2(1:) Leaves > 2 mm long ..... 3  
 2: Leaves < 1.5 mm long..... ● *Hypnum cupressiforme* var. *filiforme*
- 3(2) Leaves gradually tapering to apex. ● *Hypnum cupressiforme* var. *cupressiforme*  
 3: Leaves abruptly narrowed to apex..... ● *Hypnum cupressiforme* var. *lacunosum*

\* based on Smith, AJE; Smith, R (1978): *The Moss Flora of Britain and Ireland*. Cambridge University Press, Cambridge. 646.



**Hypnum chrysogaster** Müll.Hal.

**form:** matted, regularly pinnately branched stems, to 50 mm long, golden  
**habitat:** rotting wood or bark in damp to high-rainfall forest

**leaf:** size: 1–1.5 × 0.3–0.5 mm

*shape:* ovate-lanceolate, strongly falcate

*tip:* narrowed to a long acumen

*base:* alar cells inflated, angle cells orange or yellow

*costa:* absent or short and double

*border:* not differentiated

*margin:* faintly denticulate above, plane to ± recurved below

*cells:* 60–90 × 4–7 μm, linear, firm-walled, smooth

**capsule:** 1–1.5 mm, cylindrical, exserted, horizontal to pendent, red-brown;  
 seta 6–18 mm; calyptra cucullate, naked, smooth; operculum apiculate;  
 exostome teeth striolate, endostome perforate, cilia 1–3, nodulose; spores  
 13–20 μm in diam., papillose

**note:** *Hypnum cupressiforme* has a rostrate operculum and stronger alar cells



vegetative habit, pinnate branches, capsules (mature, young), peristome, and leaf outline  
 — 5 mm, — 1 mm, — 1 mm (2), — 0.1 mm



margin at midleaf, cells at midleaf, and leaf basal angle  
 — 10 μm, — 10 μm, — 50 μm

continued next page



*Hypnum chrysogaster* vegetative frond  
1 mm

continued next page

**Hypnum cupressiforme** Hedw. var. **cupressiforme**

**form:** tufted or matted, procumbent, ± pinnately branched stems, 60–120 mm long, central strand present, pseudoparaphylliate, leaves golden, glossy

**habitat:** soil, bark, rotten logs, or rock, in diverse sites, lowland to high-montane

**leaf:** size: 2–3 × 0.8–1.0 mm

**shape:** variable, ovate-lanceolate, ± falcate-secund, concave

**tip:** ± abruptly acuminate

**base:** far-angle cells inflated, hyaline; near-angle cells ± quadrate in 10 rows

**costa:** absent to thin and rudimentary or short and double

**border:** not differentiated

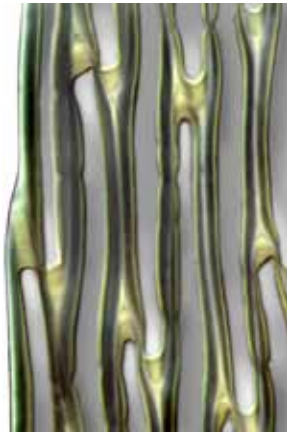
**margin:** entire or minutely denticulate above, plane

**cells:** 50–80 × 5–8 μm, linear-rhombic, firm-walled, smooth

**capsule:** 2 mm, oblong-cylindric, curved, exserted, suberect, brown; seta 20–30 mm, reddish; calyptra cucullate, naked, smooth; operculum erect-rostrate; endostome cilia 1–2, nodulose; spores 14–24 μm in diam., smooth



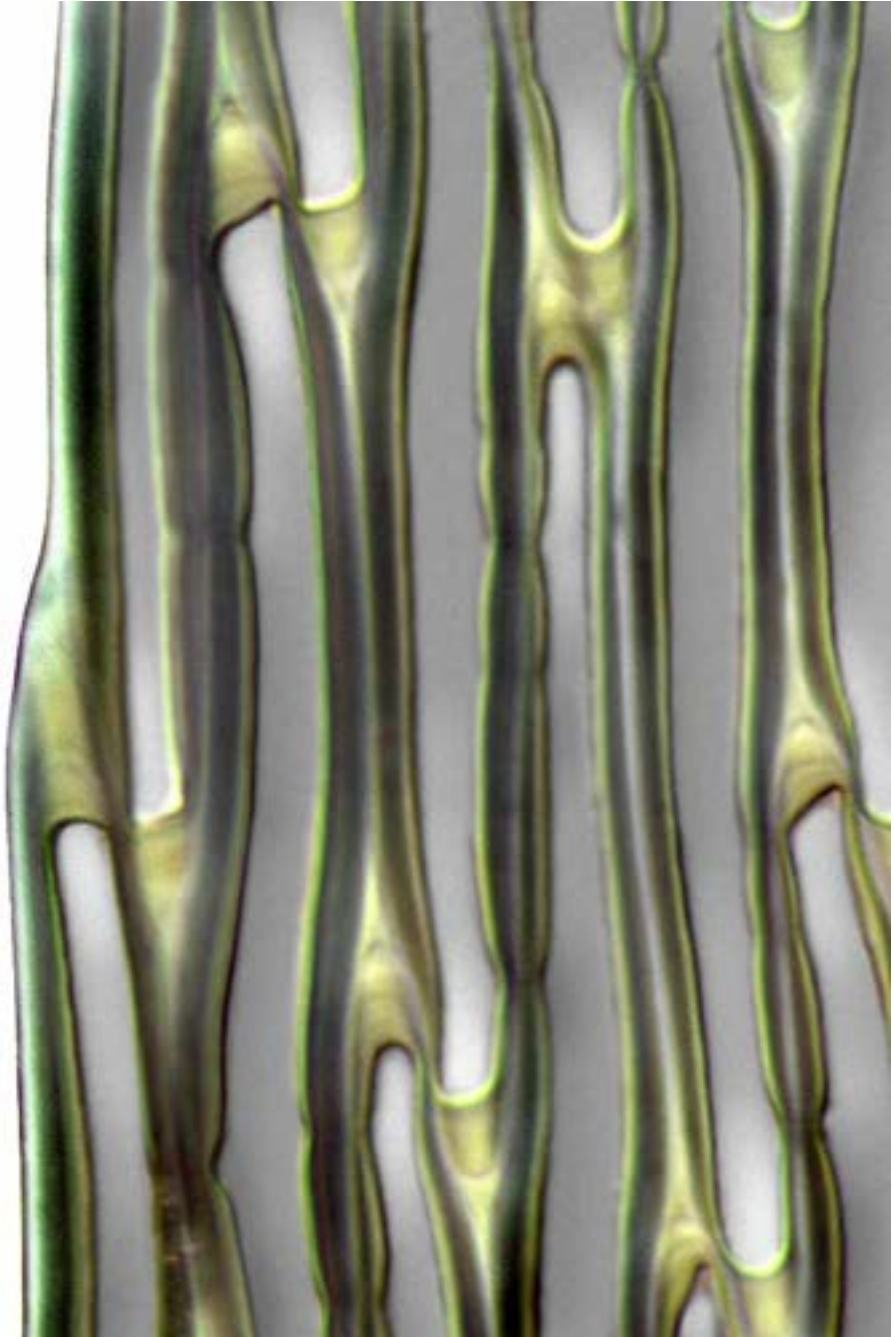
habit (moist), vegetative shoots (dry) (2), leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 50 μm



margin at midleaf, leaf basal angle, and capsules  
 ■ 10 μm, ■ 50 μm, ■ 0.5 mm

continued next page





*Hypnum cupressiforme* var. *cupressiforme* margin midleaf  
10  $\mu$ m

continued next page

**Hypnum cupressiforme** var. **filiforme** Brid.

**form:** matted, pendent to procumbent, filiform stems, to 100 mm long, leaves light green to pale yellowish green or bronze

**habitat:** bark of trunks and twigs, or rotting logs, (rarely rock), in damp forest

**leaf:** size: to 1.5 mm

*shape:* narrowly lanceolate, falcate-secund

*tip:* tapering to a long channelled acumen

*base:* distinct group of pigmented, irregularly shaped cells in basal angles

*costa:* none or short and double

*border:* not differentiated

*margin:* entire to faintly denticulate, plane

*cells:* 30–60 × 5–7 μm, linear, firm-walled, smooth

**capsule:** 2 mm, oblong-ellipsoid, slightly curved, long-exserted, inclined to horizontal; seta 20–30 mm; calyptra cucullate, naked, smooth; operculum short-rostrate; endostome cilia 1–2, nodulose; spores 14–24 μm in diam., smooth



vegetative shoots (dry) (3), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm



leaf subapex, margin at midleaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm

continued next page

**Hypnum cupressiforme** var. **lacunosum** Brid.

**form:** matted, creeping stems, dull green to glossy yellow-green or bronze  
**habitat:** calcareous soil or rock, rarely rotting logs, open forest to grassland

**leaf:** *size:* to 3 mm

*shape:* ovate to ovate-oblong, ± abruptly narrowed to the apex, concave

*tip:* acuminate

*base:* alar cells ± quadrate, thick-walled, not porose, orange-pigmented

*costa:* weak or absent

*border:* not differentiated

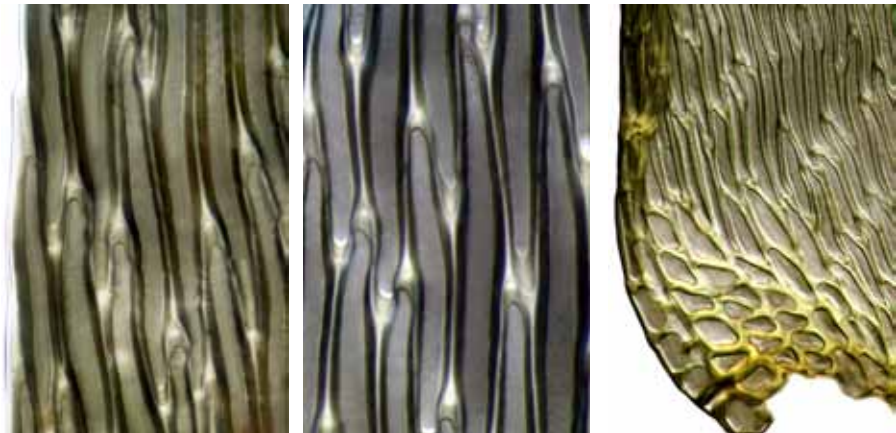
*margin:* entire below, denticulate above, plane above, recurved below

*cells:* 50–80 × 5–8 μm, linear, thick-walled, smooth

**capsule:** 2 mm, cylindric, ± curved, inclined to horizontal, exerted, brown; seta 30–40 mm; calyptra cucullate, naked, smooth; operculum conic-rostrate; peristome double; exostome teeth papillose above; endostome segments broad, keeled, narrowly perforate; cilia 1–3



vegetative shoots (dry) (2), leaf outline, leaf apex, and leaf subapex  
 ■ 5 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 μm, ■ 10 μm



margin midleaf, cells midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 50 μm

***Isopterygiopsis pulchella*** (Hedw.) Z.Iwats.

**form:** matted, creeping, irregularly branched stems, to 15 mm long, the branches ascending, leaves glossy, appearing to be flattened into two rows

**habitat:** damp soil, humus, rock, or bark of trees in deep shade

**leaf:** size: 0.7–1.2 × 0.2–0.4 mm

**shape:** narrowly lanceolate, ± curved and homomallous

**tip:** acuminate

**base:** a few subquadrate angle cells

**costa:** absent or short and double

**border:** not differentiated

**margin:** entire, plane

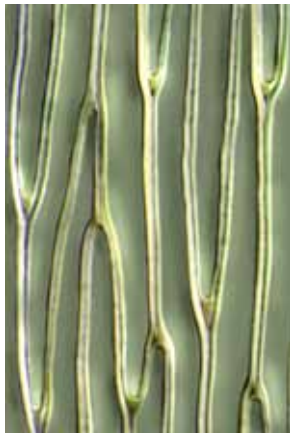
**cells:** 60–120 × 5–8 μm, linear-flexuose, firm-walled, smooth

**capsule:** 1–1.6 mm, oblong-cylindric, ± asymmetric, exserted, suberect to horizontal; seta 8–16 mm, orange or red; annulus biseriate; calyptra cucullate, naked, smooth; operculum obliquely rostrate; peristome hypnoid, cilia 1; spores 9–13 μm in diam., minutely roughened



vegetative habit, branchlet (dry), mature capsule, leaf outline, and leaf apex

1 mm, 1 mm, 1 mm, 0.1 mm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm

**Orthothecium strictum** Lor.

**form:** tufted, ± erect, unbranched stems, 10–60 mm tall, leaves orange-pink, glossy

**habitat:** moist to wet tundra, humus, soil, or rock ledges and crevices

**leaf:** *size:* about 1 mm

*shape:* ovate-lanceolate to narrowly lanceolate, slightly plicate

*tip:* short, flexuose, subhyaline acumen

*base:* proximal basal cells short, brownish yellow

*costa:* none, single and weak, or short and double

*border:* not differentiated

*margin:* serrulate above, partially recurved

*cells:* 48–64 × 8 μm, oblong-linear, thick-walled, porose, smooth

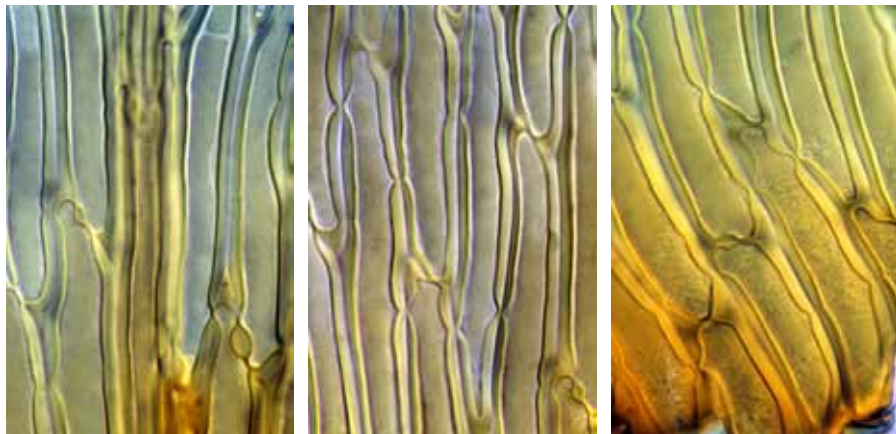
**capsule:** not seen in New Zealand

**note:** asexual reproduction by clusters of claviform, multicellular propagula in leaf axils (rare)



vegetative habit and shoots (dry) (3), leaf outline, and leaf apex (2)

1 mm, 1 mm, 1 mm, 0.1 mm, 50 μm, 10 μm



costa near leaf base, porose midleaf cells, and porose cells near leaf base

10 μm, 10 μm, 10 μm

### Key to the New Zealand species of *Pseudotaxiphyllum* (2)

- 1 Leaves < 2 mm long, distant on the stem; costa usually strong but sometimes short and double ..... ● ***Pseudotaxiphyllum distichaceum***
- 1: Leaves > 2 mm, crowded on the stem; costa absent ..... ● ***Pseudotaxiphyllum falcifolium***



*Pseudotaxiphyllum  
distichaceum*



*Pseudotaxiphyllum  
falcifolium*

**Pseudotaxiphyllum distichaceum** (Mitt.) Z.Iwats.

**form:** loose, glossy, yellow-green mats of creeping,  $\pm$  branched, flattened stems, up to 20 mm  $\times$  1–3.5 mm; gemmae sometimes in leaf axils

**habitat:** soil, humus, or soil over rock in shady montane forest

**leaf:** 1–1.8 0.3–0.6 mm, distant on the stem; stem and branch leaves similar in size and shape

**shape:** ovate to oblong-lanceolate, asymmetric, folded on one side

**tip:** acuminate

**base:** alar cells variable, 0–3, quadrate to short-rectangular

**costa:** single or unevenly forked, reaching 1/3 the lamina length

**border:** not differentiated

**margin:**  $\pm$  entire below, serrate to serrulate above, plane,  $\pm$  reflexed below

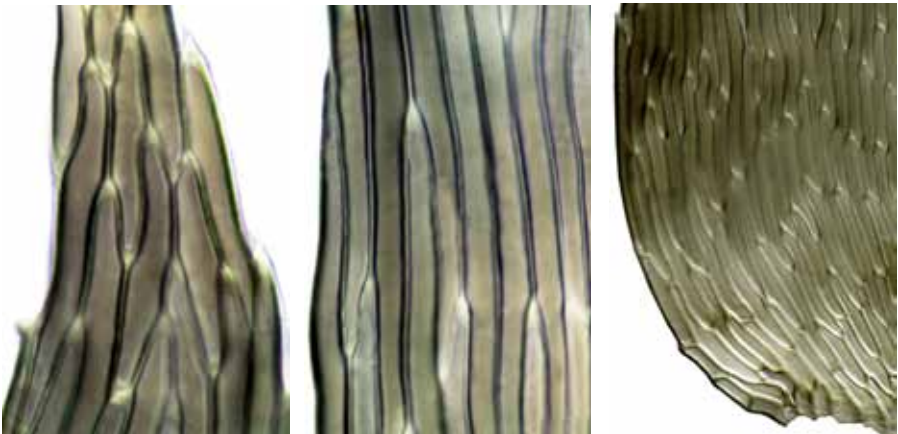
**cells:** 60–120  $\times$  4–7  $\mu$ m, linear-fusiform, firm-walled, smooth

**capsule:** sporophytes unknown



vegetative shoots (wet) (2), leaf outline, and leaf apex (2)

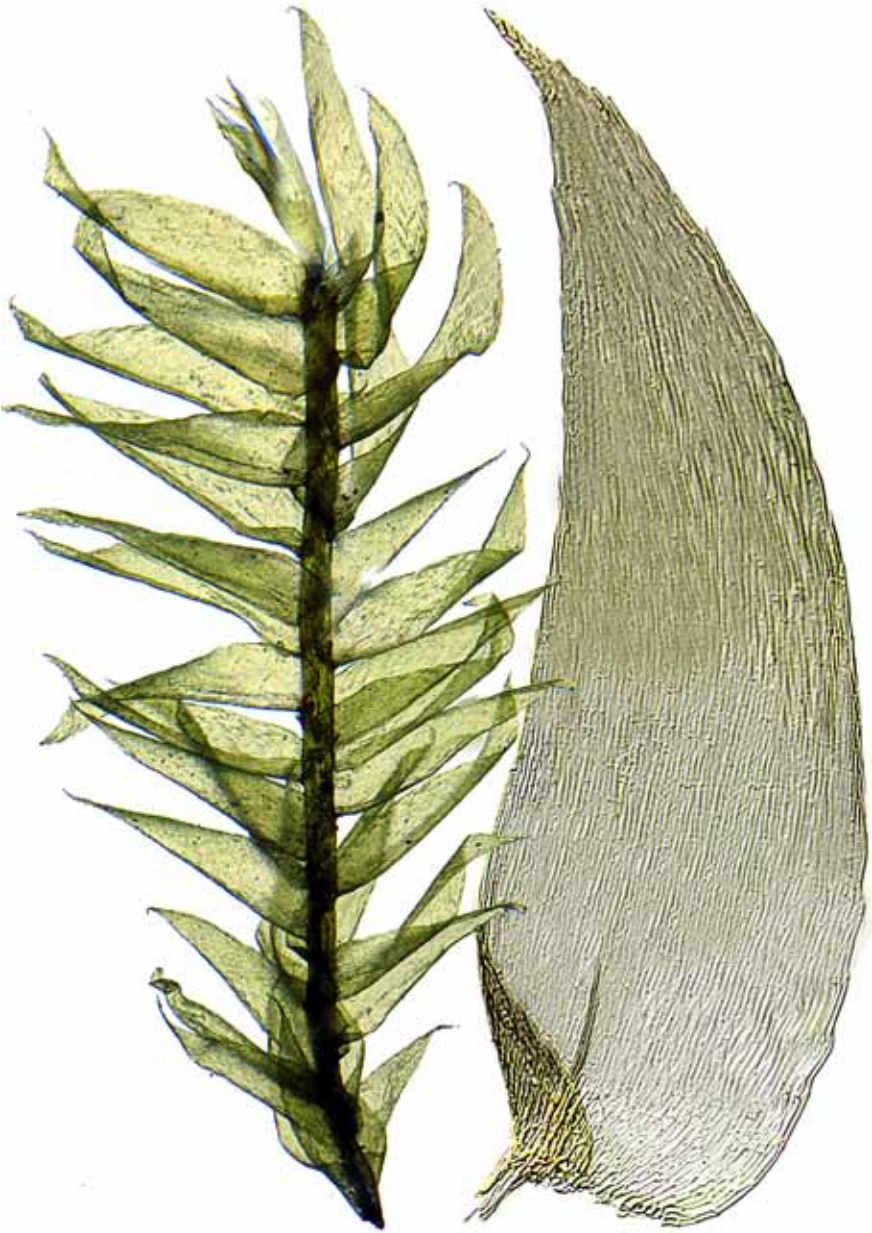
5 mm, 1 mm, 0.1 mm, 10  $\mu$ m, 10  $\mu$ m



subapex, midleaf margin and lamina cells, and leaf basal angle

10  $\mu$ m, 10  $\mu$ m, 10  $\mu$ m

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*Pseudotaxiphyllum distichaceum* vegetative shoot (moist) and leaf whole-mount  
1 mm, 50  $\mu$ m



**Pseudotaxiphyllum falcifolium** (Hook.f. & Wilson) S.He

**form:** primary stem matted, creeping, branched; secondary stem 20–70 mm long, pinnately branched, leaves crowded, flattened, glossy  
**habitat:** moist soil, humus, or soil over rock in shaded lowland to montane forest

**leaf:** size: > 2 mm

*shape:* ovate to oblong-lanceolate, asymmetric, ± falcate

*tip:* broadly acute

*base:* two rows of cells near the insertion oval or short-oblong

*costa:* none

*border:* not differentiated

*margin:* ± serrulate above, entire below, inflexed on one side below

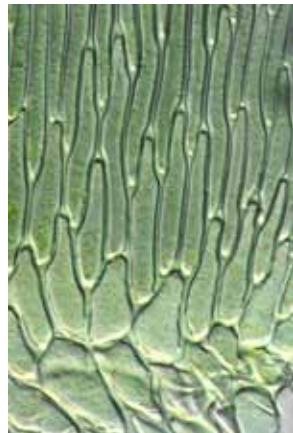
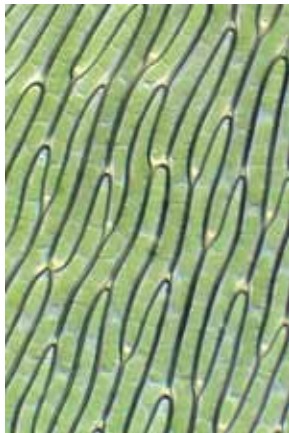
*cells:* 80–100 × 4–5 μm, linear-vermicular, firm-walled, smooth

**capsule:** 1.3–2 mm, ovoid, exserted, inclined to horizontal, dark brown, annulate; seta 10–20 mm, reddish brown, smooth; operculum short-rostrate; peristome double; spores 12–15 μm in diam., yellow



vegetative shoots (dry) (2), capsule, leaf outline, and leaf apex

1 mm, 1 mm, 1 mm, 0.1 mm, 10 μm



margin at midleaf, cells at midleaf, and leaf base cells

50 μm, 10 μm, 10 μm



*Pseudotaxiphyllum falcifolium* vegetative shoot and capsule  
1 mm (foreground), 1 mm (background)

**Vesicularia inflectens** (Brid.) Müll.Hal.

**form:** stems creeping, irregularly short-branched, to 15 mm tall, leaves pale to dark green or yellowish brown, glossy

**habitat:** soil, rotting logs, bark, and rock, moist shaded sites, to 2000 m

**leaf:** size: 1.6–1.8 × 0.8–0.9 mm

*shape:* ovate, ± asymmetric

*tip:* acute

*base:* alar cells not differentiated

*costa:* none or short and double

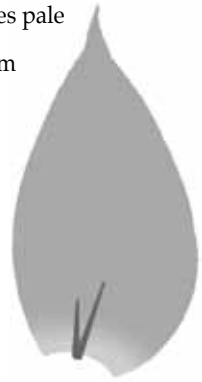
*border:* not differentiated

*margin:* entire below to ± crenulate above, plane

*cells:* 60–90 × 15–18 μm, rhombic, thin-walled, smooth

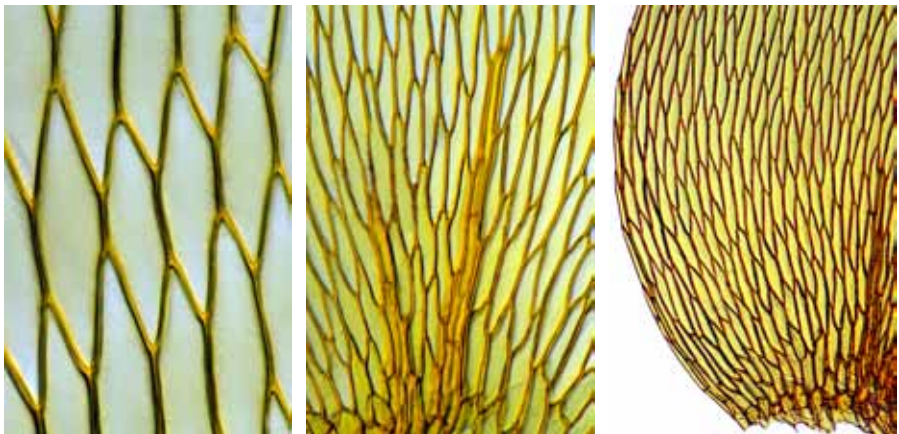
**capsule:** 1 mm, oblong-cylindric, exserted, horizontal, brown; seta 9–15 mm; operculum obliquely short-rostrate; peristome double, endostome cilia 1–3; spores 12–17 μm in diam.

**note:** currently known from only Raoul Island



vegetative shoot (dry), leaf outline, leaf apex, and margin midleaf

■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm



cells at midleaf, double costa near leaf base, and leaf basal angle

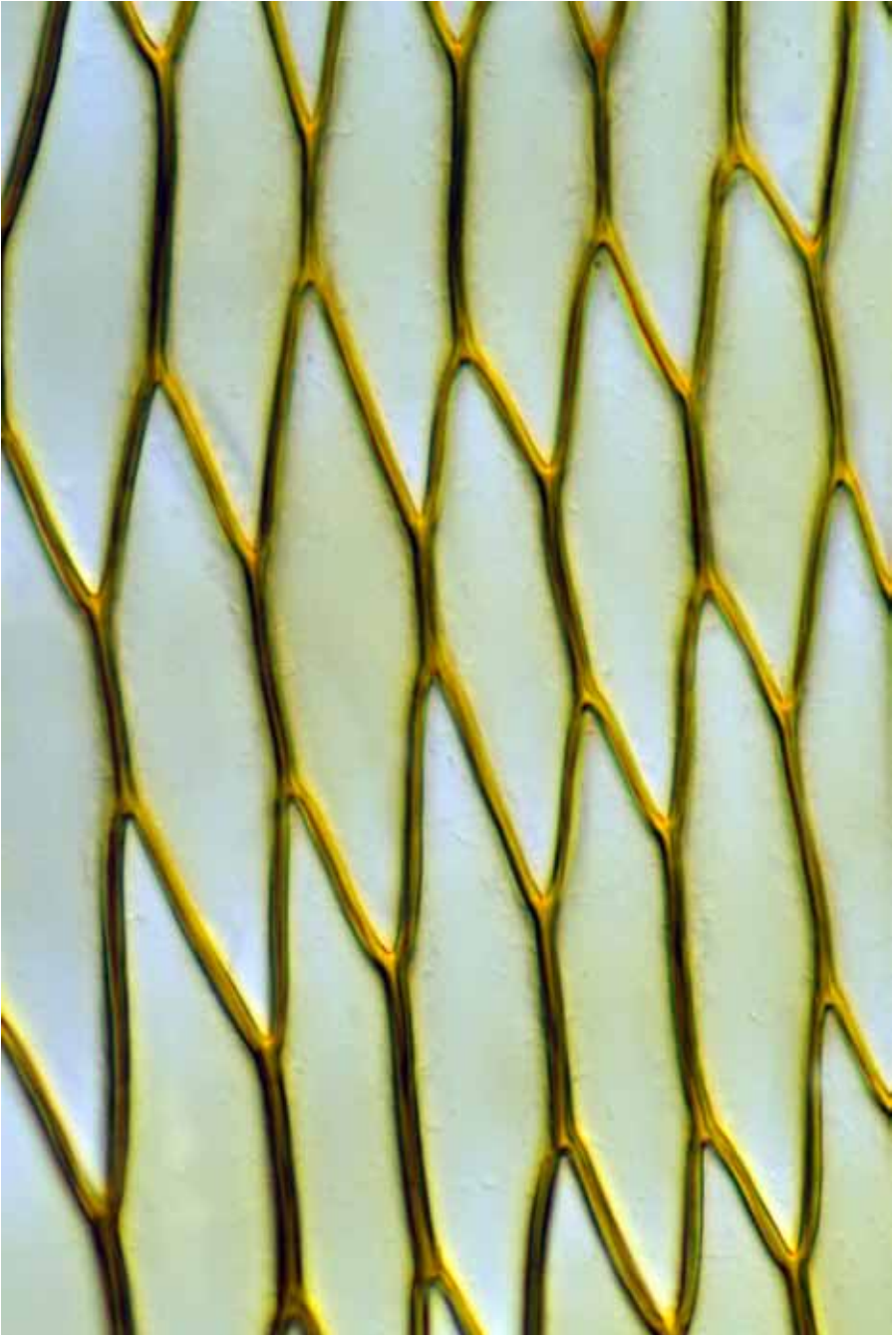
■ 10 μm, ■ 50 μm, ■ 50 μm

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*Vesicularia inflectens* margin midleaf  
10  $\mu\text{m}$

continued next page



*Vesicularia inflectens* cells midleaf  
10  $\mu\text{m}$

**Catagonium nitens** (Brid.) Card. subsp. **nitens**

**form:** tufted, prostrate, branched stems, to 20 mm long, leaves soft, delicate, pale yellow to yellow-green, glossy

**habitat:** soil and dry earthen banks, or rock, lowland to montane

**leaf:** size: 1.0–1.5 × 0.3–0.5 mm

**shape:** oblong, concave, conduplicate, shoots distichous

**tip:** reflexed mucro

**base:** basal cells shorter and wider than the blade cells; no distinct alar region

**costa:** absent or faint and double

**border:** not differentiated

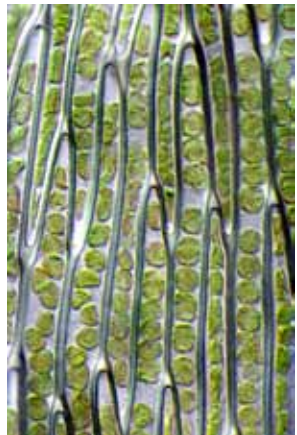
**margin:** entire, plane

**cells:** 60–100 × 3–4 μm, linear-vermicular, firm-walled, smooth

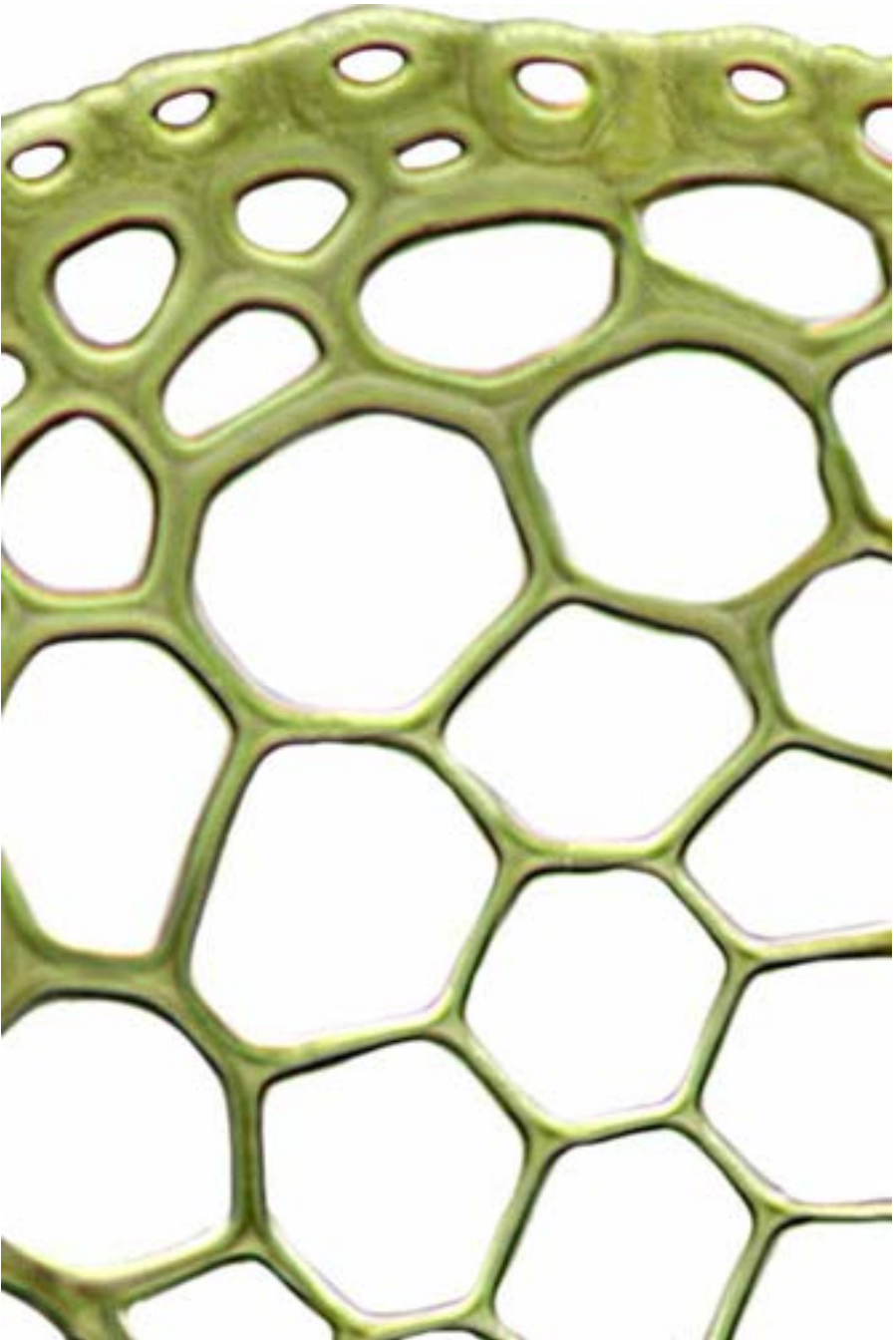
**capsule:** 2–2.5 mm; oblong, inclined to erect, ± curved, apophysate; seta 12–20 mm; calyptra cucullate, smooth; operculum conico-rostrate; exostome teeth joined at the base; endostome cilia 2, nodulose; spores 12–16 μm in diam., smooth



vegetative habit, cleared shoot, leaf outlines (2), and leaf apex  
 1 mm, 1 mm, 0.25 mm (2), 10 μm



mucronate leaf tips, margin at midleaf, and cells at midleaf  
 0.25 mm, 10 μm, 10 μm

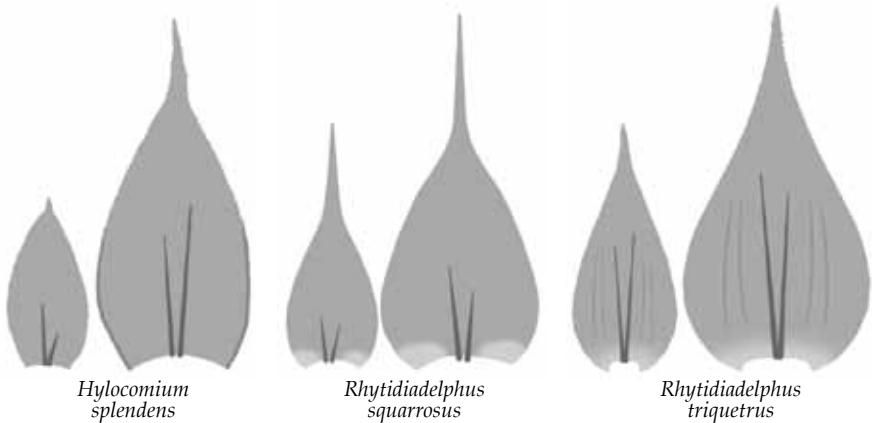


*Catagonium nitens* stem cross-section showing stiffening collar  
10  $\mu$ m

**Key\* to the New Zealand species of *Hylocomium* (1) and *Rhytidiadelphus* (2)**

- 1 Stems and branches densely covered with paraphyllia; branch leaf apex rounded or broadly acute ..... ● ***Hylocomium splendens***  
 1: Paraphyllia absent; branch leaf apex narrowly acute ..... 2
- 2 Leaf plicate, gradually narrowed to a broad flat acumen; costa reaching 2/3 up the leaf blade ..... ● ***Rhytidiadelphus triquetrus***  
 2: Leaf not plicate, abruptly narrowed to a slender channelled acumen; costa reaching 1/3 up the leaf blade ..... ● ***Rhytidiadelphus squarrosus***

\* based on Crum, HA; Anderson, LE (1981): *Mosses of Eastern North America*. Columbia University Press, New York, 1211.





**Hylcomium splendens** (Hedw.) Bruch & Schimp.

**form:** loose mats of wiry, 2–3-pinnately branched stems, to 120 mm, in stepped fronds, densely covered with branched filamentous paraphyllia; leaves dull, olive-green to golden, stem leaves erect and overlapping

**habitat:** soil, humus, or logs in bogs and streambeds, to 1900 m

**leaf:** size: stem 1.5–1.8 × 8–1.1 mm; branch 0.8–1.0 × 0.5–0.7 mm

**shape:** stem leaves ± ovate, concave, ± plicate; branch leaves elliptic

**tip:** stem leaves abruptly narrowed to a short channelled acumen;

branch leaves abruptly narrowed to a bluntly acute apex

**base:** basal cells little differentiated

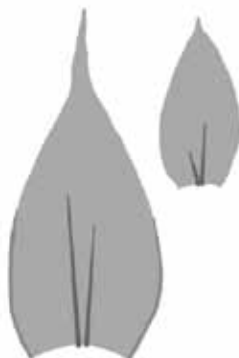
**costa:** double, reaching halfway up the blade

**border:** not differentiated

**margin:** serrulate above, recurved below, ± inflexed near acumen

**cells:** 40–50 × 5–7 μm, linear, ± sinuose, incrassate, prorate, ± porose

**capsule:** capsules not known in New Zealand



vegetative habit (dry), leaf outlines (2), and branch leaf apex

5 mm, 0.5 mm (2), 10 μm



margin at midleaf, costa near leaf base and branched paraphyllium

5 μm, 10 μm, 50 μm

continued next page

**Rhytidiadelphus squarrosus** (Hedw.) Warnst.

**form:** matted, reddish, decumbent, branched stems, to 150 mm tall; leaves papery, translucent, glossy, yellowish

**habitat:** soil or gravel in damp, grassy, or disturbed sites, to 600 m

**leaf:** size: 2.5–3.5 × 1.2–1.6 mm; branch leaves smaller

*shape:* ovate-lanceolate sheathing base, papery, concave, not plicate

*tip:* narrowing to a long, squarrose-recurved, channelled acumen

*base:* alar cells oblong, weakly porose, ± enlarged, pigmented

*costa:* double, reaching 1/4 up the leaf blade

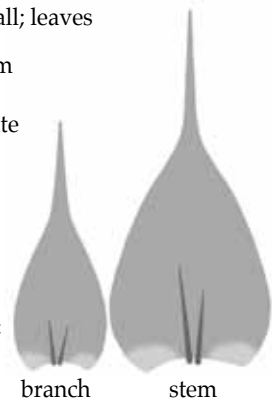
*border:* not differentiated

*margin:* serrulate toward the apex, plane

*cells:* 40–70 × 6–9 μm, elliptic-linear, firm-walled, prorate, porose

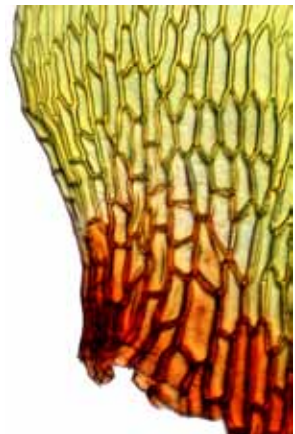
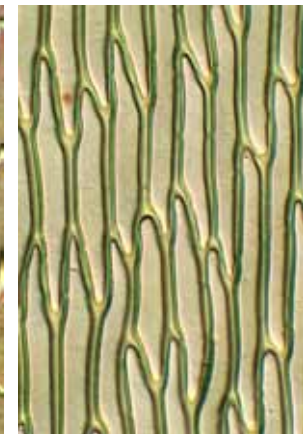
**capsule:** males only in New Zealand; 1.8–2.5 mm, ovoid, exerted, horizontal, asymmetric with a short apophysis; seta 17–33 mm; peristome hypnoid, cilia in 3s; spores 11–17 μm in diam.

**note:** adventive, spread along roads by verge-mowing



habit (moist), vegetative shoots (dry) (2), and leaf outlines (2)

5 mm, 5 mm, 1 mm, 0.5 mm (2)



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page

**Rhytidiadelphus triquetrus** (Hedw.) Warnst.

**form:** loose wefts of rigid, irregularly branched stems, to 100 mm, leaves

papery, yellowish, translucent, glossy; a weedy adventive being eradicated

**habitat:** soil, sand, humus, or rotting logs on grassy banks or in forest clearings

**leaf:** *size:* stem leaves  $4\text{--}5 \times 2$  mm; branch leaves  $1.5\text{--}3 \times 1.5$  mm

*shape:* ovate-lanceolate,  $\pm$  plicate,  $\pm$  rugose, papery, clasping

*tip:* acute to acuminate

*base:*  $\pm$  decurrent, alar cells weakly differentiated, porose

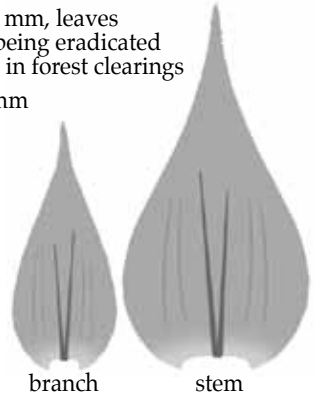
*costa:* double, nearly parallel, reaching two-thirds up blade

*border:* not differentiated

*margin:* densely serrate above, serrulate below, plane

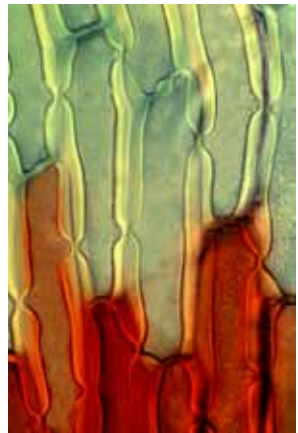
*cells:*  $38\text{--}50 \times 5\text{--}7$   $\mu\text{m}$ , linear, firm-walled,  $\pm$  prorate,  $\pm$  porose

**capsule:** no capsules in New Zealand; 1.5–3 mm; obloid, asymmetric, gibbous, exserted, horizontal, hypophysis short; seta 15–45 mm; operculum sharply conic; peristome hypnoid, endostome cilia 1–3; spores 14–21  $\mu\text{m}$  in diam.



vegetative shoots (2) (dry), leaf outlines, and leaf apex

5 mm, 1 mm, 1 mm (2), 10  $\mu\text{m}$



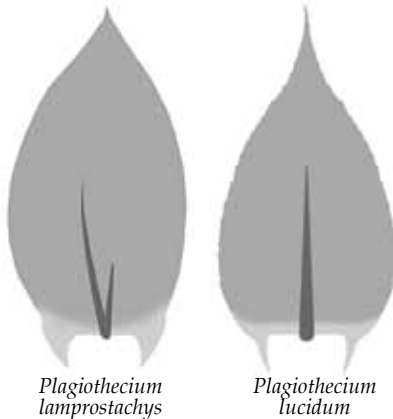
margin at midleaf, costa at midleaf, and cells at leaf base

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 5  $\mu\text{m}$

**Key\* to the New Zealand species of *Plagiothecium* (2)**

- 1 Median cells 9–18  $\mu\text{m}$  wide; decurrencies broad, auriculate; flagelliferous branches usually present ..... ● ***Plagiothecium lamprostachys***  
 1: Median cells 5–9  $\mu\text{m}$  wide; decurrencies narrow, triangular; flagelliferous branches lacking ..... ● ***Plagiothecium lucidum***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 154.



**Plagiothecium lamprostachys** (Hampe) A. Jaeger

**form:** tufted, prostrate, branched, 20–40 mm long, complanate, leaves glossy, soft, bright green or yellow-green

**habitat:** soil, tree trunk bases, rotting logs, or rock, lowland to montane

**leaf:** size: 1.8–2 × 0.9–1.0 mm

**shape:** broadly ovate to oblong-ovate, complanate, decurrent; lateral leaves ± asymmetric; dorsal and ventral leaves symmetric

**tip:** acute or short-acuminate to obtuse and apiculate

**base:** decurrent angle cells subrectangular, hyaline

**costa:** double, unevenly forked, reaching 1/3 up leaf blade

**border:** not differentiated

**margin:** entire to faintly toothed toward the apex, ± recurved below

**cells:** 80–180 × 5–12 μm, elongate-linear, firm-walled, smooth

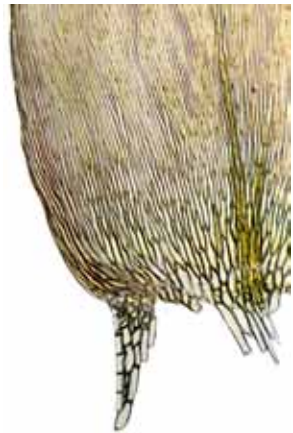
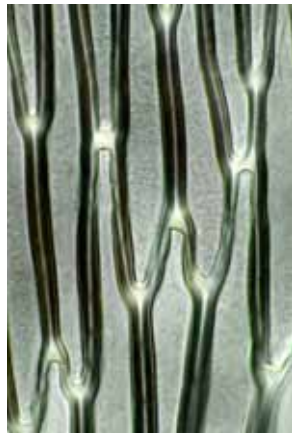
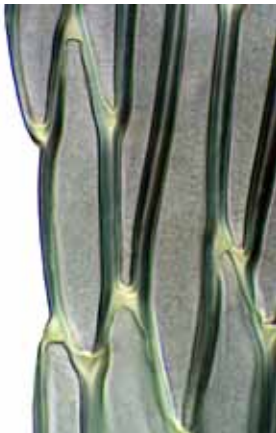
**capsule:** 1.5–2 mm, cylindric, necked, ± curved, exserted, suberect to cernuous, brown, striate; seta 20–25 mm, slender, red; operculum conic; peristome hyponoid, cilia 1–2; spores 9–14 μm in diam.



lateral leaf



vegetative habit, shoot (dry) (2), leaf outline, mature capsule (dry), and leaf apex  
 1 mm (2), 0.5 mm, 1 mm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle with decurrency  
 10 μm, 10 μm, 50 μm

**Plagiothecium lucidum** (Hook.f. & Wilson) Paris

**form:** matted, ascending,  $\pm$  unbranched stems, 20–80 mm tall, complanate, leaves  $\pm$  glossy, sordid pale green

**habitat:** soil, humus, bark, rotting logs, or rock

**leaf:** size: 1–2.5 mm

*shape:* ovate to ovate-lanceolate,  $\pm$  complanate, slightly asymmetric

*tip:* acuminate

*base:* narrowly decurrent; basal cells shorter than the other blade cells

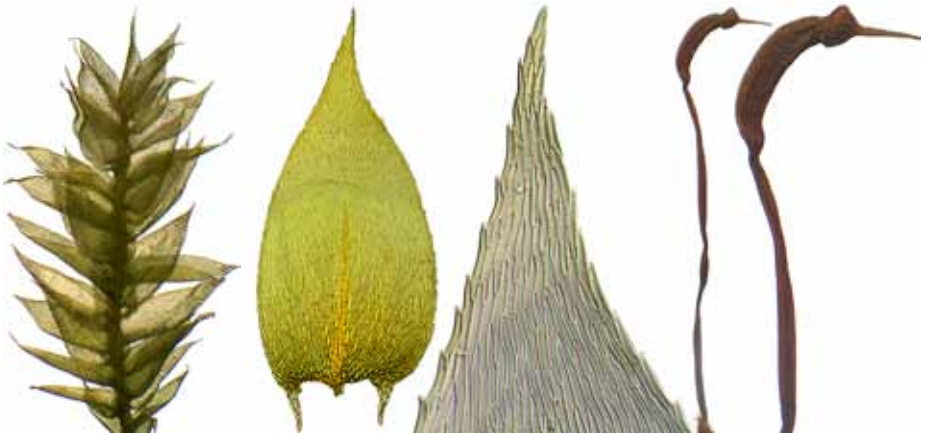
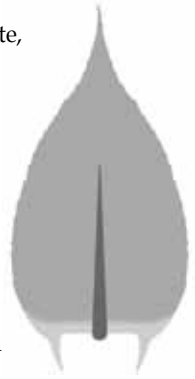
*costa:* reaching about two-thirds up the blade

*border:* not differentiated

*margin:* serrulate above, plane

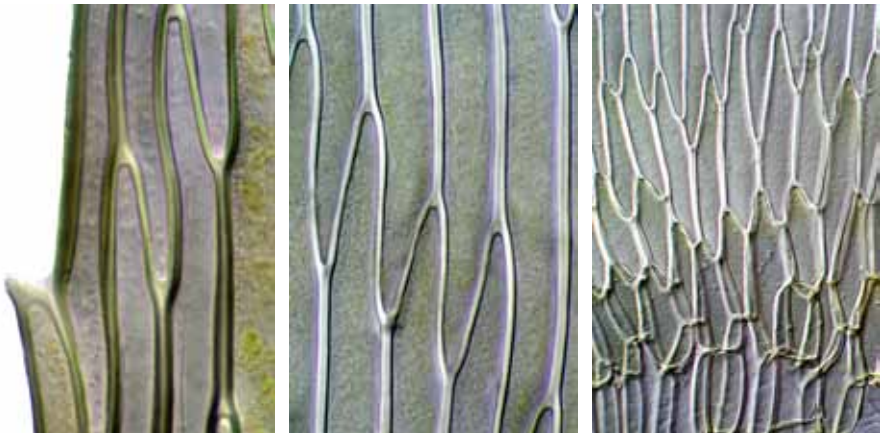
*cells:* 50–90  $\times$  5–9  $\mu\text{m}$ , vermicular, firm-walled, smooth

**capsule:** 1.5–2.5 mm, oblong-cylindric, exserted, suberect to horizontal, short-necked; seta 10–25 mm, red, twisted distally, smooth; operculum high-conic; exostome teeth cross-striolate below, endostome segments perforate, cilia 1–2, nodulose; spores 9–14  $\mu\text{m}$  in diam., papillose



vegetative shoot (dry), leaf outline, leaf apex, and mature capsules

■ 0.5 mm, ■ 0.1 mm, ■ 50  $\mu\text{m}$ , ■ 1 mm, ■ 1 mm



margin at midleaf, cells at midleaf, and lower leaf cells

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Entodon plicatus** Müll.Hal.

**form:** mats of prostrate, radiculose, pinnately branched stems, complanate, with cuspidate tips, 40–80 mm tall, leaves yellow-green to golden, glossy  
**habitat:** exposed roots, calcareous rock in damp montane forests, to 1100 m

**leaf:** size: 1.8–2.2 × 0.9 mm

*shape:* oblong-ovate to oblong-lanceolate, concave, ± auriculate

*tip:* acute or acuminate

*base:* alar cells hyaline, inflated, thin-walled, not porose

*costa:* none or short and double

*border:* not differentiated

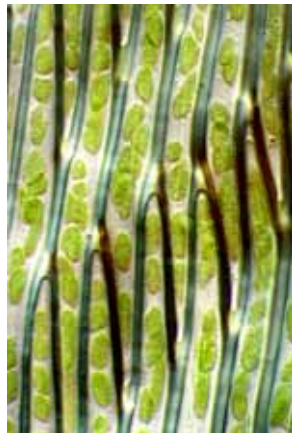
*margin:* entire below, ± serrulate above, plane

*cells:* 80–120 × 5–6 μm, narrowly linear, flexuose, firm-walled, smooth

**capsule:** 3.5 × 0.7–0.9 mm, narrowly cylindric, lateral, ± curved, exserted, erect, pale brown; stomata superficial; seta 10–15 mm; operculum short-rostrate, oblique; exostome double; teeth vertically striolate, endostome segments perforate, keeled, cilia none; spores 15–18 μm in diam., green



vegetative shoots (dry) (2), leaf outlines (2), and leaf apex  
 2 mm (2), 0.5 mm (2), 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

**Key\* to *Austrohondaella* and *Isopterygium* in New Zealand**

- 1 Leaf strongly curved; seta 10–15 mm long; capsule suberect..... ● ***Austrohondaella limata***  
 1: Leaf not strongly curved; seta < 9 mm long; capsule horizontal to pendent..... ● ***Isopterygium minutirameum***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 457.





**Austrohondaella limata** (Hook.f. & Wilson) Z.Iwats., H.P.Ramsay & Fife  
formerly *Isopterygium limatum*

**form:** creeping, ± pinnately branched, ± radiculose stems, 10–20 mm long, leaves yellow or golden green, glossy

**habitat:** damp to dry rock, less often bark, from sea level to 1600 m

**leaf:** size: 1.2–1.5 × 0.5–0.6 mm

**shape:** triangular-lanceolate, falcate-secund, concave, asymmetric

**tip:** acumen narrowed to a piliform point

**base:** basal cells shorter and wider than the blade cells, ± porose

**costa:** none

**border:** not differentiated

**margin:** entire, plane

**cells:** 75–100 × 6–8 μm, linear-vermicular, firm-walled, smooth

**capsule:** 2 mm, subcylindric, exserted, erect, reddish brown; seta 10–15 mm, dark red, smooth; operculum bluntly conic; peristome hypnoid, endostome cilia 1–2, nodose; spores spherical, 10–18 μm in diam.



vegetative shoots (dry) (2), leaf outline, leaf subapex, and leaf apex  
 1 mm, 0.5 mm, 0.1 mm, 10 μm (2)



margin at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm



*Austrohondaella limata* mature capsules and an exostome tooth

1 mm (2)

0.1 mm

50  $\mu$ m

**Isopterygium minutirameum** (Müll.Hal.) A.Jaeger

**form:** creeping stems, ± pinnately branched, forming dense green mats  
**habitat:** soil, bark, rotting logs, or rarely rock in forests and plantations

**leaf:** size:  $1.2 \times 0.3$  mm

*shape:* branch leaves lanceolate to ovate-lanceolate; stem leaves broader

*tip:* long-acuminate

*base:* alar cells irregularly quadrate

*costa:* absent or faint

*border:* not differentiated

*margin:* entire or nearly so, plane

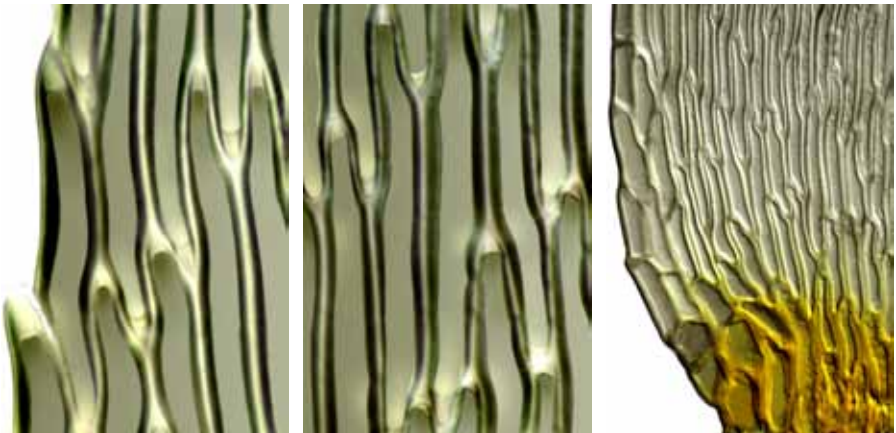
*cells:* midleaf cells to  $90 \times 9$   $\mu\text{m}$ , linear to vermicular, firm-walled, smooth

**capsule:** to 1 mm, narrowly ovoid, horizontal to pendent, exerted, brownish;  
 seta to 9 mm, smooth; constricted below the mouth when dry; calyptra  
 cucullate, naked; operculum conic; peristome hypnoid



vegetative shoot (dry) (2), leaf outline, and leaf apex (2)

1 mm, 1 mm, 0.5 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



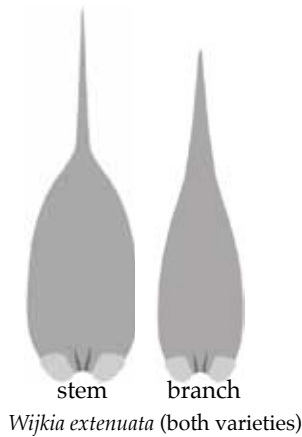
margin at midleaf, cells at midleaf, and leaf basal angle

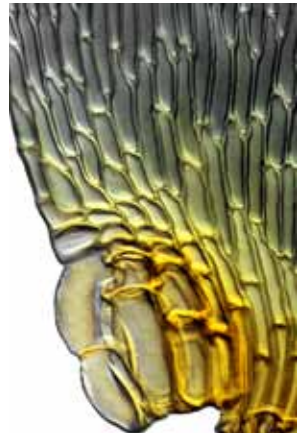
10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

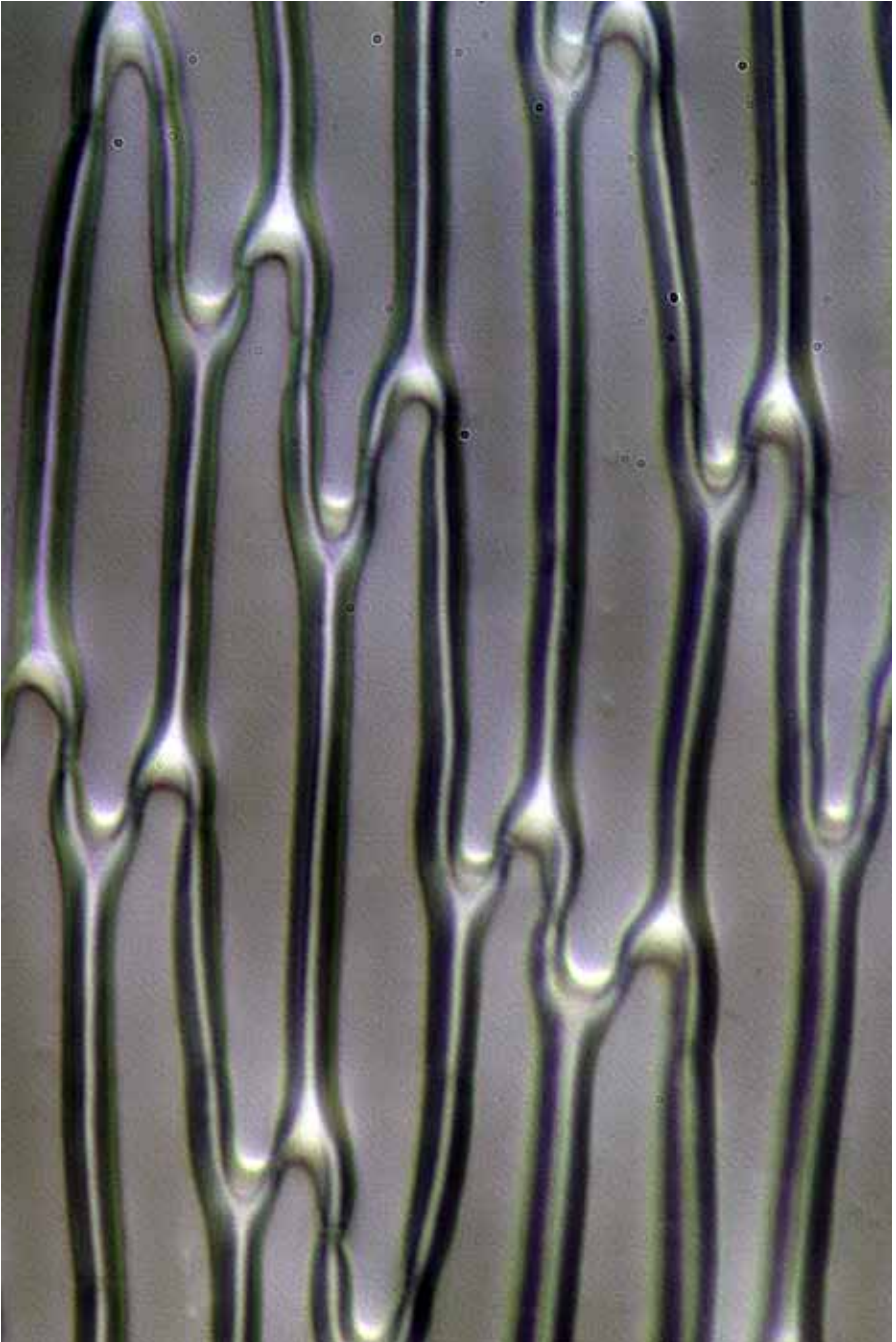
**Key\* to the New Zealand varieties of *Wijkia extenuata* (2)**

- 1 Flagelliferous-microphyllous branchlets numerous near branch tips; branch leaves 0.7–1.0 mm long, sharply serrulate near the apex..... ● ***Wijkia extenuata* var. *caudata***  
 1: No flagelliferous branchlets near tips; branch leaves 1.1–1.4 mm long, entire or crenulate near the apex ..... ● ***Wijkia extenuata* var. *extenuata***

\* based on Fife, AJ (2012): New taxa of *Sematophyllum* and *Wijkia* (Musci: Sematophyllaceae), with a key to New Zealand Sematophyllaceae. *New Zealand Journal of Botany* 50, 435–447.



**Wijkia extenuata** var. **caudata** Fife**form:** mats of glossy, branched, yellowish, radiculose stems, to 40 mm**habitat:** bark, fallen logs, and rarely rock, in forest and scrub, to 520 m**leaf: size:** stem leaves 1.2–1.4 × 0.4–0.5 mm; branch leaves 0.7–1.0 × 0.2–0.4 mm**shape:** broadly ovate to ovate-lanceolate**tip:** tapered to an acumen**base:** alar cells hyaline, thin-walled, inflated**costa:** none or short and double**border:** not differentiated**margin:** entire below, sharply serrulate above, plane**cells:** 30–60 × 4–6 μm, linear to linear-rhombic, firm-walled, smooth, not porose**capsule:** 2 mm, oblong, horizontal, gibbous, short-necked; seta 15–40 mm, flexuose, smooth, dark red; peristome double**note:** var. *caudata* differs from var. *extenuata* in having many microphyllous branches, only weak pinnate branching, similar stem and branch leaves, entire branch leaf margins, and eporose lamina cellsvegetative shoot (dry), branch leaf outline, branch leaf apex, and margin midleaf  
 1 mm, 0.5 mm, 10 μm, 10 μmcells at midleaf (2), and leaf basal angle  
 10 μm, 10 μm, 10 μm



*Wikia extenuata* var. *caudata* cells at midleaf  
10  $\mu$ m

continued next page

**Wijkia extenuata** (Brid.) H.A.Crum var. **extenuata**

**form:** mats of 1–2-pinnately branched, ± radiculose stems, to 120 mm,  
leaves green, yellowish, or grey, glossy, lacking flagelliform branchlets

**habitat:** bark, tree ferns, rotting logs, soil, and rock, in forests to 1400 m

**leaf:** size: stem: 1.1–1.4 × 0.3–0.4 mm; branch: 0.9–1.2 × 0.9–0.1 mm

**shape:** stem leaves oblong-ovate; branch leaves lanceolate

**tip:** stem leaves abruptly piliferous; branch leaves gradually tapered

**base:** alar cells hyaline, thin-walled, inflated, 40 × 15 μm

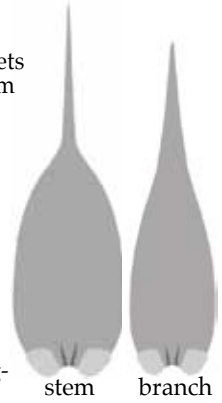
**costa:** absent or short and double

**border:** not differentiated

**margin:** entire below, crenulate near the apex, plane

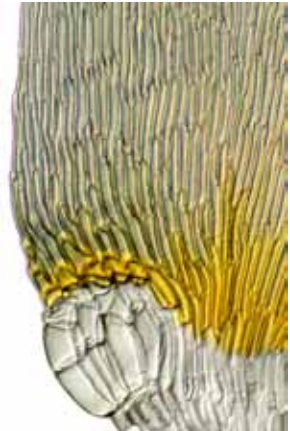
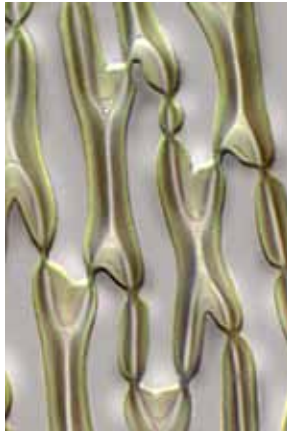
**cells:** 30–60 × 4–6 μm, linear to linear-rhombic, firm-walled, smooth  
to seriatly papillose

**capsule:** 2 mm, oblong, long-exserted, horizontal, gibbous, short-necked; seta 15–40 mm, flexuose, smooth, dark red; operculum long-conic, red; peristome hypnoid; spores 12–16 μm in diam.



vegetative habit, mature capsule, leaf outline, and peristome (top and side views)

1 mm, 1 mm, 0.1 mm, 0.1 mm, 0.1 mm



branch leaf subapex, branch leaf cells, and alar cells in leaf basal angle

5 μm, 5 μm, 50 μm

continued next page



*Wijkia extenuata* var. *extenuata* habit  
5 mm

continued next page



**Rhaphidorrhynchium amoenum** (Hedw.) M.Fleisch.

**form:** mats of creeping, branched stems, 10–35 mm long, leaves glossy, yellow-green to yellow-brown

**habitat:** rotting logs and stumps, exposed roots and twigs, to 1200 m

**leaf:** size: 1.3–1.7 × 0.2–0.3 mm

*shape:* ovate-lanceolate from an oblong base, falcate or circinate

*tip:* narrowed to a long, curved acumen

*base:* alar cells inflated, hyaline, thin-walled

*costa:* none or short and double

*border:* not differentiated

*margin:* faintly denticulate above, plane to ± recurved above

*cells:* 60–90 × 3–5 μm, linear-vermicular, firm-walled, smooth

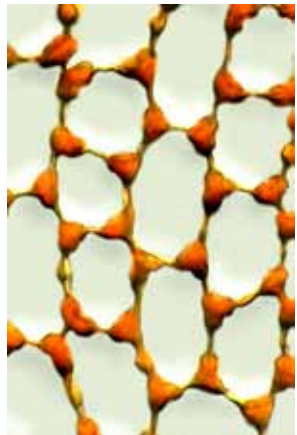
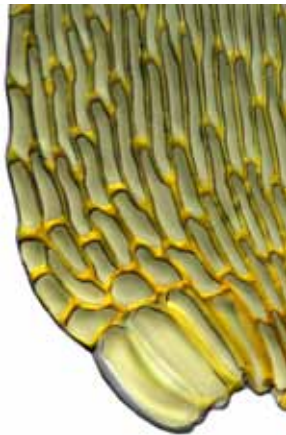
**capsule:** 1–1.5 mm, cylindric, elliptic or ovoid, exserted, horizontal to pendent, orange; seta 8–20 mm, smooth, red; operculum long-rostrate; peristome hypnoid, exothecium cells strongly trigonous; spores 12–18 μm in diam., papillose, green



costa can be absent



vegetative habit, shoot (dry), immature and mature capsules, leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 0.5 mm (2), ■ 0.1 mm, ■ 10 μm



margin at midleaf, leaf basal angle, and trigonous capsule wall cells  
 ■ 10 μm, ■ 10 μm, ■ 20 μm

continued next page



*Rhipidorrhynchium amoenum* habit  
1 mm

**Key\* to the New Zealand species of *Sematophyllum* (6) and *Warburgiella* (1)**

- 1 Inflated alar cells in a single row *and* leaves strongly falcate-secund ..... ● ***Warburgiella leucocyta***  
 1: Inflated alar cells in more than one row *or* leaves straight or nearly so *or* both ..... 2
- 2(1): Leaf tips of the ultimate branches pointing up away from the substratum ..... 3  
 2: Leaf tips of the ultimate branches not pointing up away from the substratum ..... 4
- 3(2) Cells in extreme basal angle opaque; plant restricted to coastal sites ..... ● ***Sematophyllum homomallum***  
 3: Cells in extreme basal angle not opaque; plant not restricted to coastal sites ..... ● ***Sematophyllum subhumile* var. *contiguum***
- 4(2): Leaf apex tapering to a long, filiform acumen ..... 5  
 4: Leaf apex not tapering to a long, filiform acumen ..... 6
- 5(4) Midleaf cells 75–115 × 4 μm, not porose; distal leaf margin serrate-spinose ..... ● ***Sematophyllum fiordensis***  
 5: Midleaf cells 60–75 × 4 μm, porose; distal leaf margin denticulate ..... ● ***Sematophyllum kirkii***
- 6(4): Leaves highly glossy; branches flattened, cuspidate; leaves elliptic, gradually tapered to an acute apex ..... ● ***Sematophyllum jolliffii***  
 6: Leaves usually dull; branches not flattened or cuspidate; leaves ovate, abruptly tapered to an acuminate apex ..... ● ***Sematophyllum uncinatum***

\* based on Scott, GAM; Stone, IG; Rosser, C (1976): *The Mosses of Southern Australia*. Academic Press, London. 441, and Buck, WR; Tan, BC (1989): The Asiatic genera of Sematophyllaceae associated with *Trichosteleum*. *Acta Bryolichenologica Asiatica* **1**, 5–19, and Fife, AJ (2012): New taxa of *Sematophyllum* and *Wijkia* (Musci: Sematophyllaceae), with a key to New Zealand Sematophyllaceae. *New Zealand Journal of Botany* **50**, 435–447.



*Sematophyllum  
homomallum*



*Sematophyllum  
jolliffii*



*Sematophyllum  
uncinatum*



*Sematophyllum  
subhumile* var.  
*contiguum*



*Warburgiella  
leucocyta*



*Sematophyllum  
kirkii*



*Sematophyllum  
fiordensis*

**Sematophyllum fiordensis** Fife

**form:** dense mats of branched, shiny, golden,  $\pm$  pendent stems 15–20 mm long, with smooth rhizoids in the leaf axils

**habitat:** streamside rocks and wet rock faces in forest, sea level to 600 m

**leaf:** size: 3.5–4.5  $\times$  0.3–0.4 mm

*shape:* falcate-secund, narrowly lanceolate, little altered when dry

*tip:* acuminate, long-filiform

*base:* alar groups strong, 12–15 inflated cells, unistratose, the largest to 40  $\times$  20  $\mu$ m, thin-walled, and hyaline, and the smallest firm-walled and red or brown-pigmented

*costa:* not differentiated

*border:* not differentiated

*margin:* entire below, serrate to spinose near the apex, plane

*cells:* 80–110  $\times$  4  $\mu$ m, linear, thick-walled (but the transverse walls thin),  $\pm$  porose below, smooth to weakly prorate

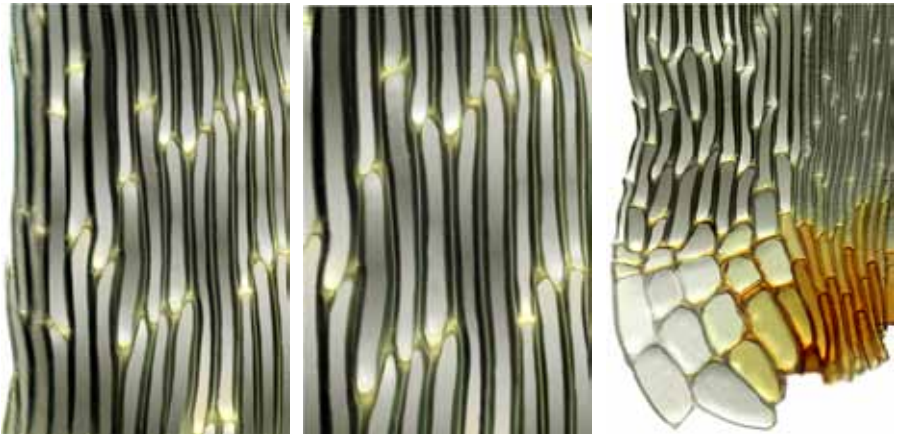
**capsule:** sporophytes unknown

**note:** a rare New Zealand endemic



vegetative shoot (dry), leaf outline, apex (2), and subapex

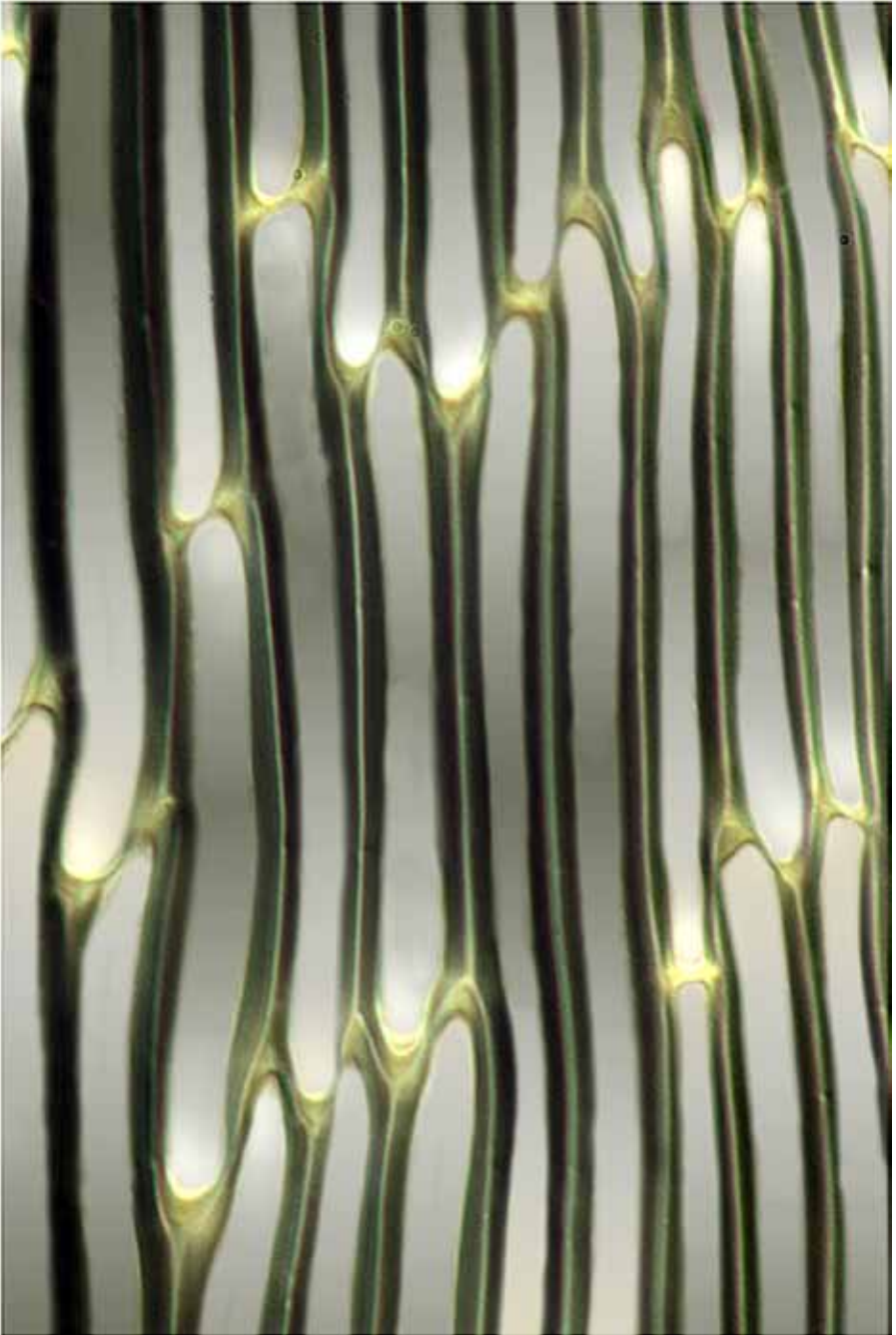
1 mm, 1 mm, 10  $\mu$ m, 10  $\mu$ m, 10  $\mu$ m



margin, lamina cells, and leaf basal angle

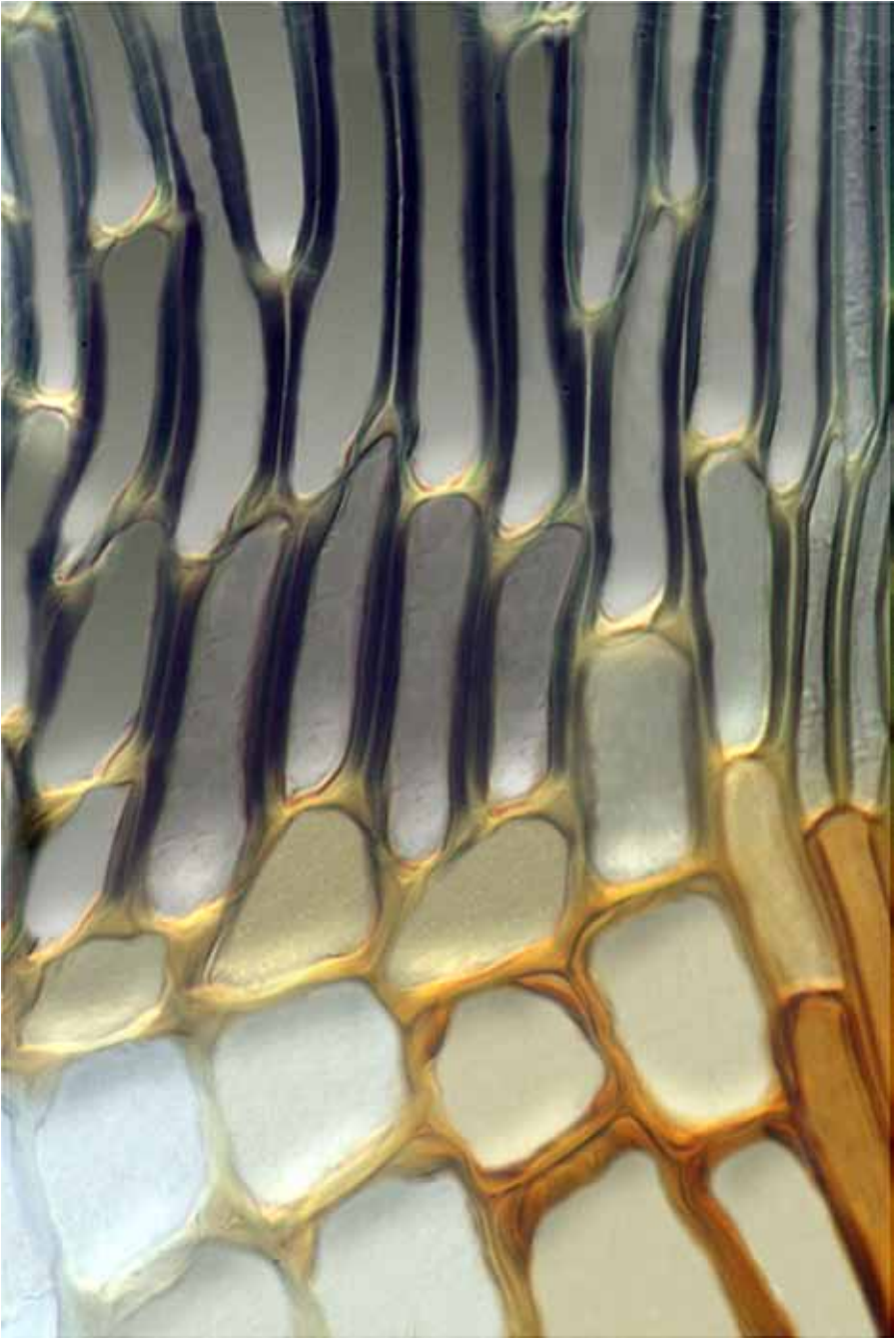
10  $\mu$ m, 10  $\mu$ m, 50  $\mu$ m

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*Sematophyllum fiordensis* lamina cells  
10  $\mu\text{m}$

continued next page



*Sematophyllum fiordensis* cells near base of leaf  
10  $\mu\text{m}$

**Sematophyllum homomallum** (Hampe) Broth.

**form:** densely matted, creeping, irregularly branched, radiculose stems, to 30 mm long, leaves yellow-green to bronze or dark red, glossy

**habitat:** dry coastal rock, rarely tree trunk bases, damp forest to coastal dunes

**leaf:** size: 1.5–2 × 0.5–0.7 mm

*shape:* ovate to oblong, concave, strongly secund

*tip:* bluntly acuminate, tapering to a short point

*base:* alar cells orange, incrassate, quadrate above, longer below

*costa:* absent or short and double

*border:* not differentiated

*margin:* entire, plane or widely recurved

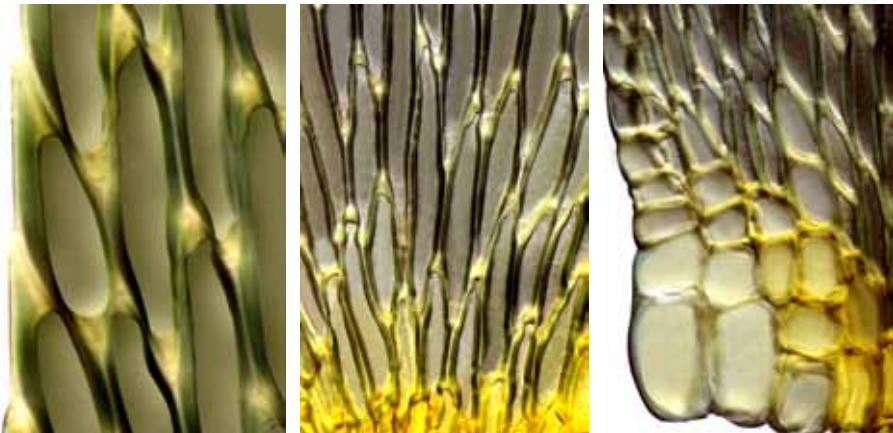
*cells:* 40–80 × 5 μm, linear to vermicular, incrassate, ± porose, smooth

**capsule:** 1.5–2 mm, ovate to oblong, exserted, erect, neck shortly tapered; seta 10 mm; operculum finely long-rostrate; exostome teeth cross-striolate, hyaline-bordered, endostome segments equalling exostome teeth, cilia 0–1



vegetative shoots (dry) (2), leaf outline, and leaf apex (2)

1 mm (2), 0.5 mm, 50 μm, 10 μm



margin at midleaf, cells at leaf base, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page





*Sematophyllum homomallum* leaf apex  
10  $\mu\text{m}$

continued next page

**Sematophyllum jolliffii** (Hook.f. & Wilson) Dixon

**form:** densely matted, ± pinnately branched stems, cuspidate, ± hooked,  
leaves metallic-glossy, sordid yellow-green, ± secund but not falcate  
**habitat:** wet rock or rarely soil in swamps or occasionally submerged  
sites close to watercourses

**leaf:** size: 1.5–1.8 × 0.8 mm

*shape:* ovate-lanceolate

*tip:* widely acuminate

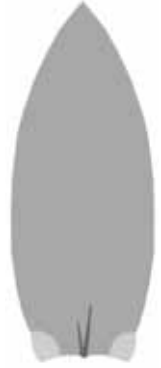
*base:* angle cells large, inflated, hyaline or yellowish

*costa:* short and double

*border:* not differentiated

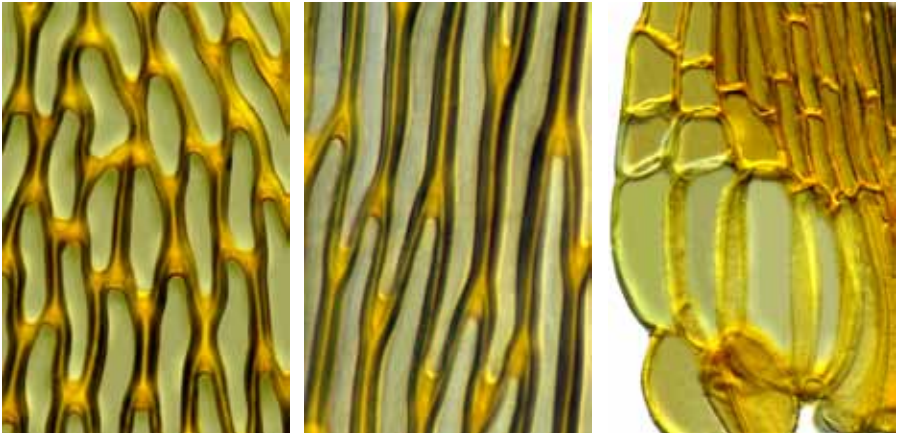
*margin:* entire to slightly denticulate, plane to inflexed on one side below  
*cells:* 40–80 × 4–5 μm, linear-rhombic, firm-walled, smooth to prorse

**capsule:** about 1 mm, ovoid, exserted, cernuous to horizontal, brown;  
seta 10–15 mm, roughened above; operculum long-rostrate; peristome  
hypnoid



vegetative branch (dry), leaf outline, apex, and margin midleaf

1 mm, 0.1 mm, 50 μm, 10 μm



cells in upper leaf, cells at midleaf, and inflated alar cells

10 μm, 10 μm, 10 μm



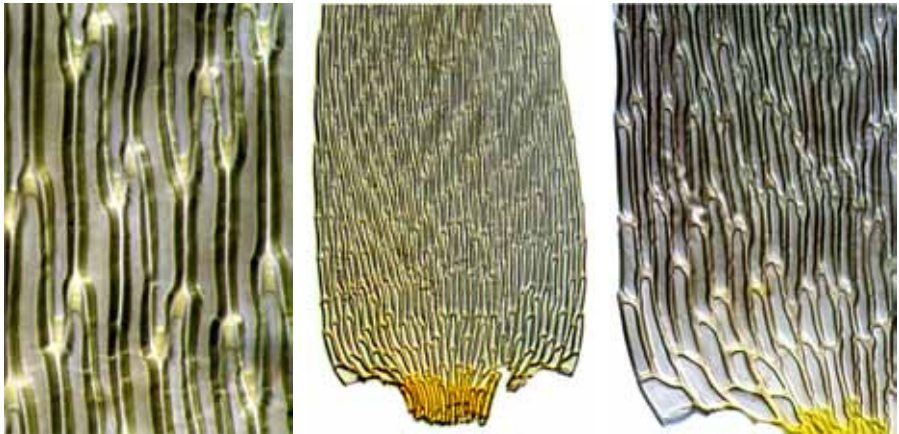
*Sematophyllum jolliffii* margin midleaf  
10  $\mu$ m

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**Sematophyllum kirkii** (Müll.Hal. ex Beckett) Paris**form:** pendent yellow-green, branched stems, 10–30 mm, with sparse rhizoids**habitat:** rotting logs, exposed roots, or rock in native or exotic forests, to 500 m**leaf:** size: 1.0–3.0 × 0.3–0.6 mm*shape:* narrowly lanceolate, curved, ± homomalous, little altered when dry*tip:* slenderly acuminate*base:* alar cells 2–3, hyaline, inflated, thin-walled, to 45 × 15 μm*costa:* not differentiated*border:* not differentiated*margin:* sharply denticulate above, plane*cells:* 60–75 × 4 μm, linear, thick-walled, ± porose, smooth**capsule:** 1–2 mm, oblong-cylindric, short-necked, stragulate when dry, red-brown when mature, inclined to horizontal; seta 6–8 mm, reddish; calyptra cucullate and naked; operculum slender-beaked; peristome double, pale; exostome teeth 16; endostome segments perforate, as tall as the exostome teeth; cilia 0–2; spores green

vegetative shoot (moist), leaf outline, leaf apex (3), subapex, and margin at midleaf

1 mm, 0.5 mm, 50 μm, 10 μm, 5 μm, 10 μm, 5 μm



lamina cells, leaf base, and leaf basal angle

5 μm, 50 μm, 10 μm

**Sematophyllum subhumile** var. **contiguum** (Mitt.) B.C.Tan, W.B.Schofield & H.P.Ramsay

**form:** tufts or mats of creeping, ± pinnately branched, light green stems

**habitat:** rock and rotting logs

**leaf:** size: 1–1.5 mm × 0.3–0.4 mm

**shape:** ovate-lanceolate to lanceolate, concave

**tip:** acuminate

**base:** 2–4 inflated, hyaline alar cells; supra-alar cells subquadrate, ± yellow

**costa:** short or none

**border:** not differentiated

**margin:** entire to minutely denticulate, plane

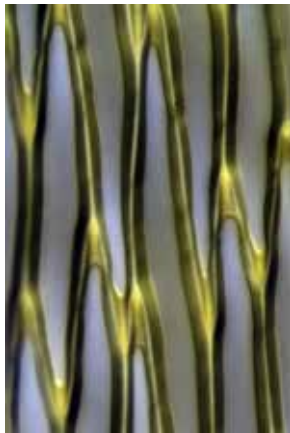
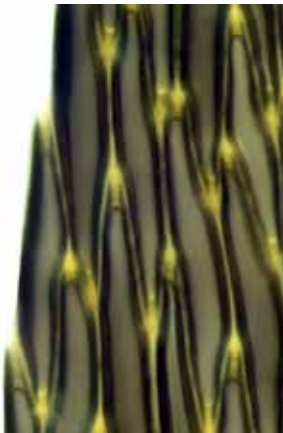
**cells:** 60–90 × 6–9 μm, narrowly linear-rhombic, thick-walled, smooth

**capsule:** 1–1.3 mm, elliptic to oblong, short-necked, inclined to horizontal, exserted, brown; seta 5–10 mm, reddish, smooth; operculum long-beaked; peristome double



vegetative shoot (dry), mature capsule, leaf outline, and leaf apex and subapex

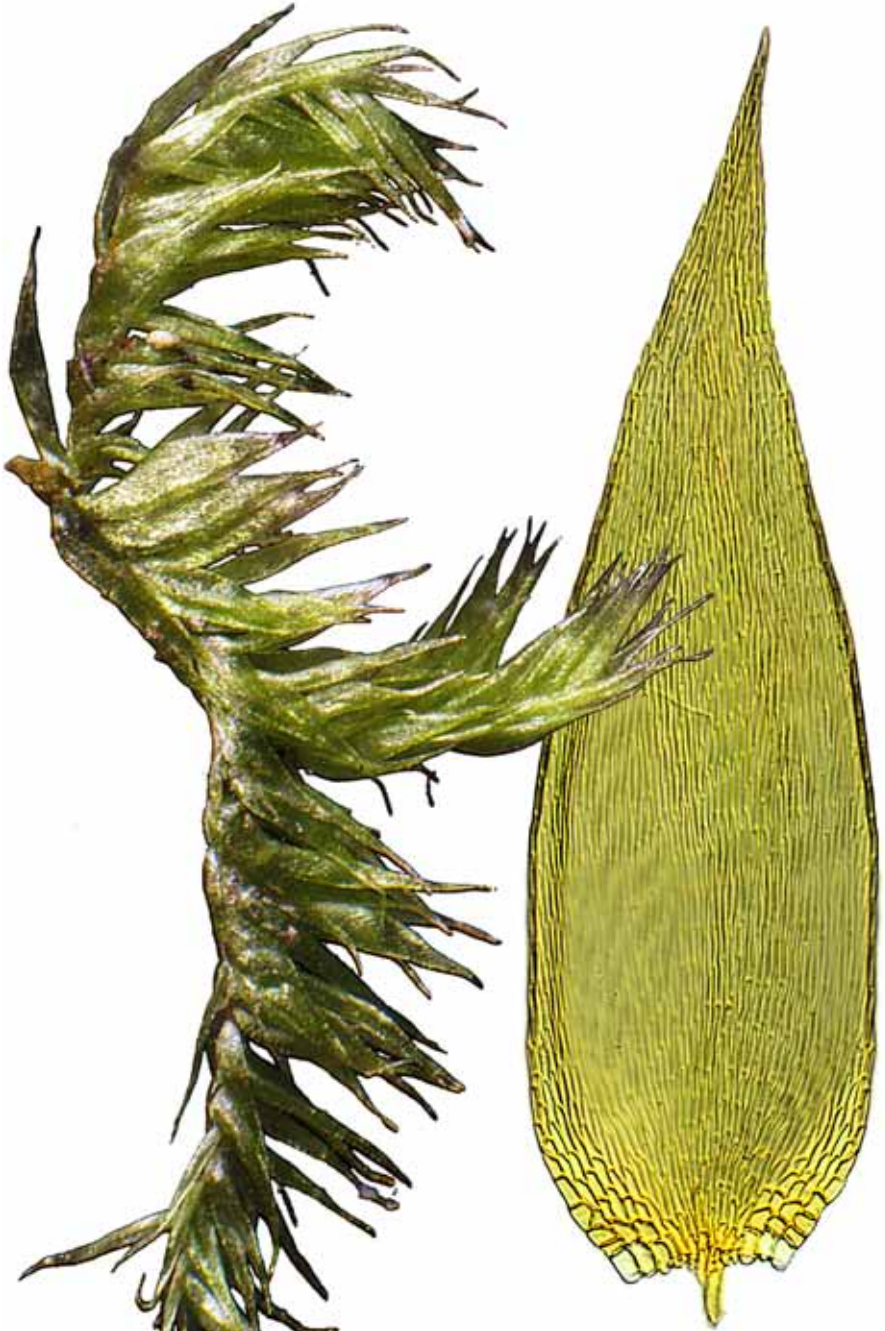
1 mm, 1 mm, 0.5 mm, 0.1 mm, 10 μm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm

continued next page



*Sematophyllum subhumile* var. *contiguum* vegetative shoot (dry) and leaf outline  
1 mm, 0.1 mm

continued next page

**Sematophyllum uncinatum** I.G.Stone & G.A.M.Scott

**form:** matted, ± pinnately branched stems, to 50 mm long, falcate, hooked at the ends, leaves reddish bronze, glossy

**habitat:** wet rock in montane springs and bogs, semi-squatic

**leaf:** size: 1.5–2.7 mm

*shape:* ovate-lanceolate, concave, slightly falcate

*tip:* widely acuminate, acute at the tip

*base:* alar cells large, inflated, thin-walled

*costa:* none

*border:* not differentiated

*margin:* entire to obscurely denticulate, plane to narrowly recurved

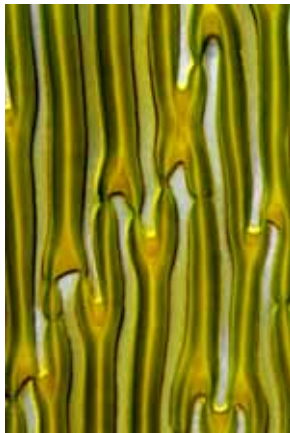
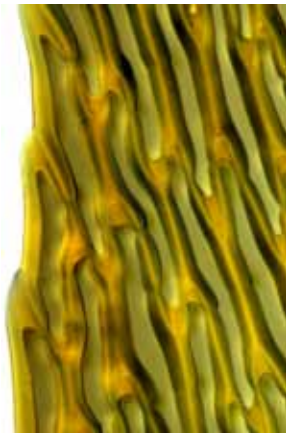
*cells:* 70–90 × 8–10 μm, linear, incrassate, ± porose, smooth

**capsule:** 1.5–2 mm, oblong, exserted, horizontal to pendent, brown; seta to 20 mm, red, smooth; operculum obliquely long-rostrate; calyptra cucullate, smooth, naked; peristome hypnoid; spores 15–20 μm in diam., smooth



vegetative shoot (dry) (2), leaf outline, and leaf apex (2)

5 mm, 1 mm, 0.1 mm, 50 μm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

continued next page



*Sematophyllum uncinatum* cells midleaf  
10  $\mu$ m

continued next page



**Warburgiella leucocyta** (Müll.Hal.) B.C.Tan, W.B.Schofield & H.P.Ramsay

**form:** matted, creeping, pinnately branched stems, to 40 mm long, leaves pale green to yellow-brown, glossy or not

**habitat:** bark, rotting logs, and humus in damp shady forest and rainforest

**leaf:** size: 1.0–1.5 × 0.3–0.4 mm

**shape:** ovate-lanceolate, tapering to a ± piliform apex, ± falcate-secund

**tip:** long-acuminate

**base:** 2–4 angle cells inflated, thin-walled, and hyaline, uniseriate; a few supra-alar cells subquadrate, firm-walled; central basal cells ± porose

**costa:** absent or short and double

**border:** not differentiated

**margin:** entire or faintly denticulate, plane

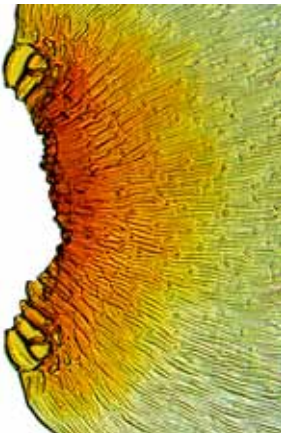
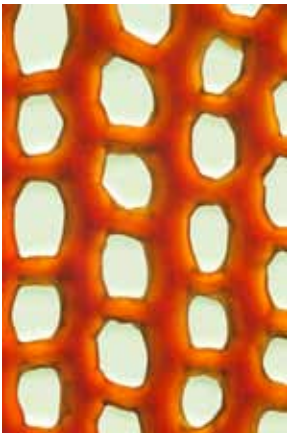
**cells:** 60–90 × 4–7 μm, narrowly linear, firm-walled, smooth

**capsule:** 1.3–1.5 mm, oblong to elliptic, exserted, horizontal to pendent, brown; seta 10–15 mm, red, papillose above; operculum long-subulate; peristome hypnoid; spores 12–24 μm in diam.



fertile shoot (dry), leaf outline, leaf apex (2), and margin midleaf

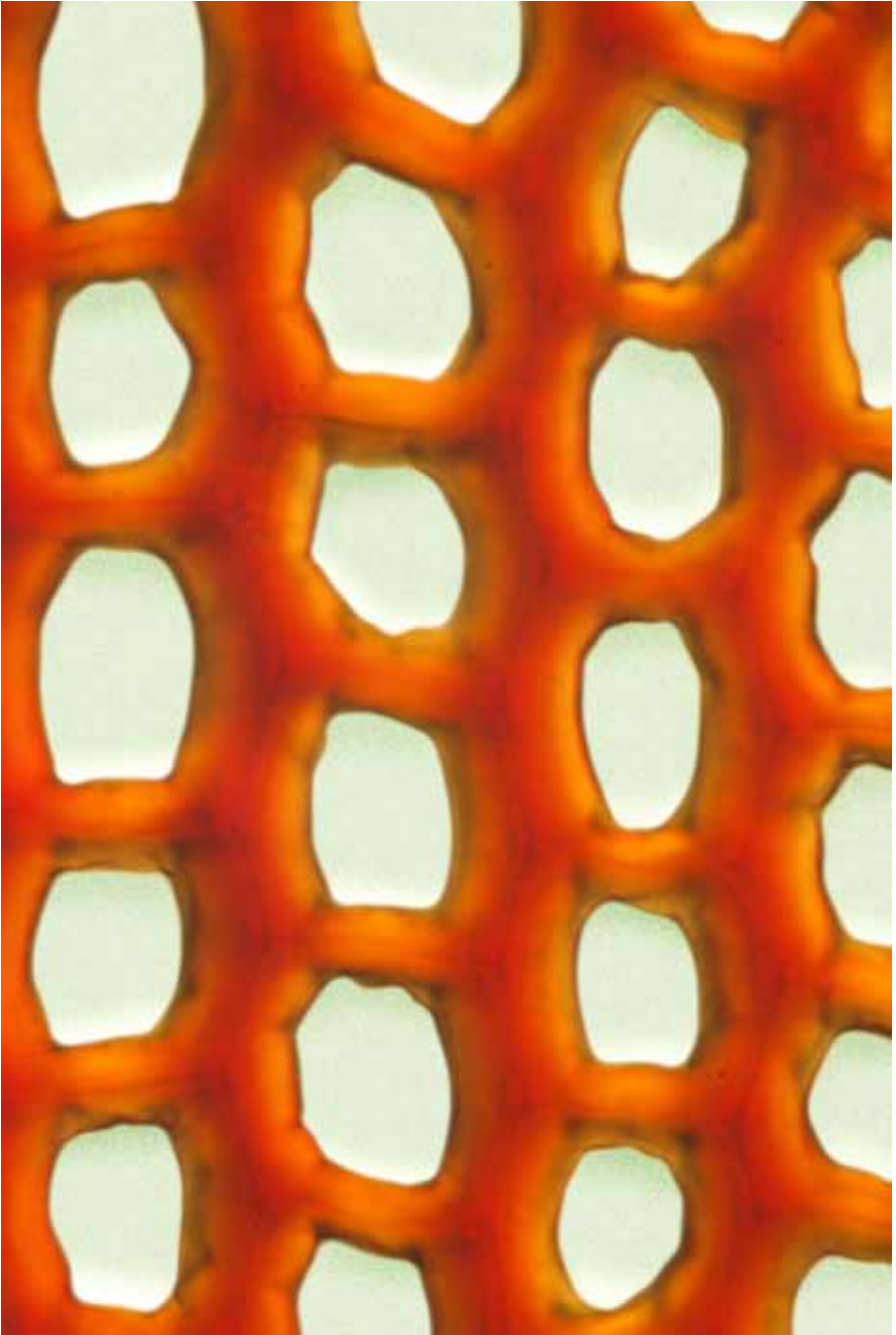
■ 1 mm, ■ 0.1 mm, ■ 10 μm, ■ 10 μm, ■ 10 μm



capsule wall cells, leaf base, and uniseriate inflated alar dells

■ 10 μm, ■ 50 μm, ■ 10 μm

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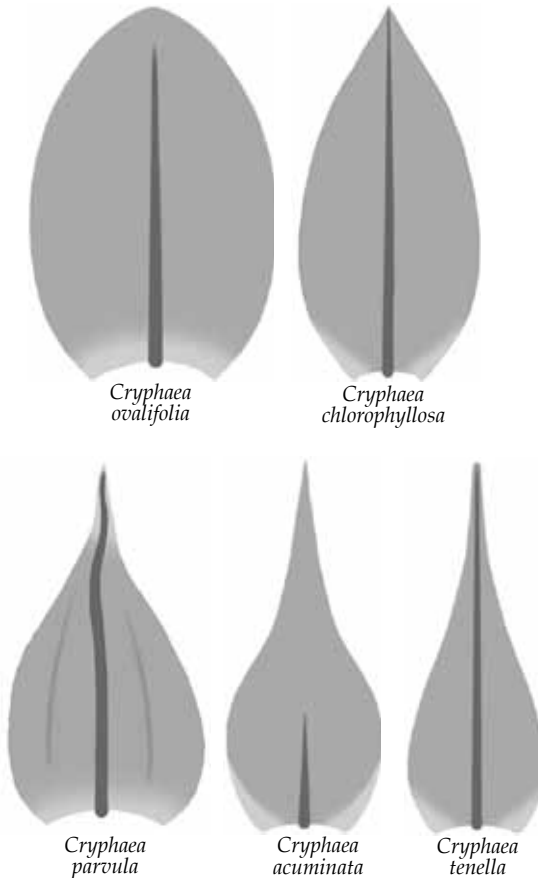


*Warburgiella leucocyta* capsule wall cells  
10  $\mu\text{m}$

Key\* to the New Zealand species of *Cryphaea* (5)

- 1 Leaf apex obtuse..... ● *Cryphaea ovalifolia*  
 1: Leaf apex acute, acuminate, or setaceous..... 2
- 2(1:) Costa of stem leaves < 70% of blade length..... ● *Cryphaea acuminata*  
 2: Costa of stem leaves excurrent or > 80% of blade length..... 3
- 3(2:) Costa excurrent in a hyaline arista..... ● *Cryphaea parvula*  
 3: Costa subpercurrent to percurrent, not hyaline..... 4
- 4(3:) Upper lamina cells of stem leaves narrowly rhombic.. ● *Cryphaea chlorophyllosa*  
 4: Upper lamina cells of stem leaves oval..... ● *Cryphaea tenella*

\* based on Pengcheng Rao (2001): Monographic studies on *Cryphaea* (Bryopsida) *Bryobrothera* 7, 27.



continued next page

**Cryphaea acuminata** Hook.f. & Wilson

**form:** primary stems creeping; secondary stems erect, branched, curved  
**habitat:** bark of tree trunks and branches in mesic forest

**leaf:** size: 0.8–1.1 mm

*shape:* ovate

*tip:* long-acuminate

*base:* basal cells oval to oblong; alar cells poorly developed

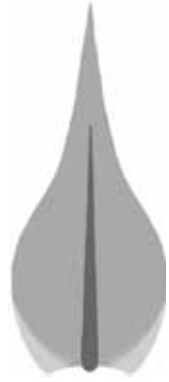
*costa:* failing above midleaf

*border:* not differentiated

*margin:* entire, plane above, recurved below

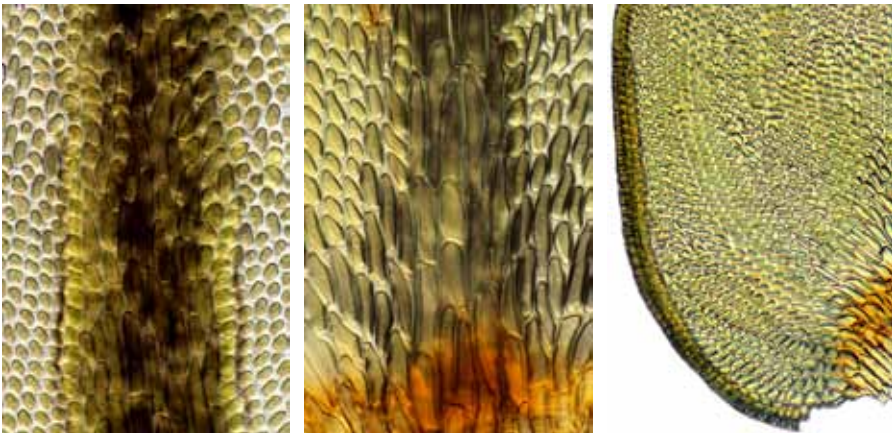
*cells:* 8–12  $\mu\text{m}$  and isodiametric above; 20–30  $\times$  8–12  $\mu\text{m}$  and oval below, firm-walled, smooth

**capsule:** 1.5–2 mm,  $\pm$  cylindric, erect, immersed, on short branches, brown; seta 0.2 mm; operculum conic-rostrate; peristome double, exostome teeth 16, papillose; calyptra cucullate, endostome segments 16, filiform; cilia absent



fertile shoot (dry), leaf outline, leaf apex (2), and margin midleaf

1 mm, 0.1 mm, 0.1 mm, 50  $\mu\text{m}$ , 50  $\mu\text{m}$



costa at midleaf, costa at leaf base, and leaf basal angle

50  $\mu\text{m}$ , 50  $\mu\text{m}$ , 100  $\mu\text{m}$

continued next page

**Cryphaea chlorophyllosa** Müll.Hal.

**form:** primary stems creeping; secondary stems pinnately branched, 40–120 mm long, leaves light or yellow-green, dull to glossy

**habitat:** bark of twigs and small branches along forest margins

**leaf:** size: 1.3–1.8 × 0.5–0.8 mm

*shape:* ovate

*tip:* bluntly acute

*base:* cells at the basal angles subquadrate or rhombic

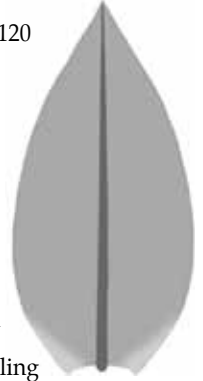
*costa:* slender, failing below the apex

*border:* not differentiated

*margin:* entire below, serrulate above, plane above, ± reflexed below

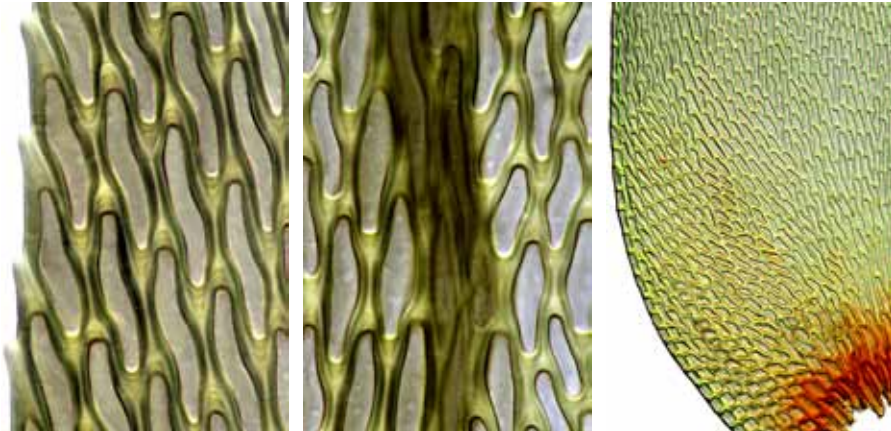
*cells:* 10–15 × 5 μm, oval to rounded-rhombic, thick-walled, smooth

**capsule:** 1.3–1.6 mm, oblong, erect, immersed, brown, red-mouthed; seta < 2 mm; calyptra cucullate, lacinate below; operculum acutely conic; exostome teeth pale, inserted below the rim, endostome filiform, equalling the teeth in length, cilia none



fertile shoots (dry) (3), leaf outline, and leaf apex

■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, costa in upper leaf, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 50 μm

continued next page

**Cryphaea ovalifolia** (Müll.Hal.) A.Jaeger

**form:** primary stems creeping, secondary stems pinnately branched, 50–120 mm long, leaves light to yellow-green, dull or glossy

**habitat:** bark of twigs and small branches in scrub or forest

**leaf:** size: 1.3–1.8 × 0.6–0.8 mm

*shape:* widely lanceolate to ovate

*tip:* obtuse to subacute

*base:* angle cells subquadrate to rhombic, juxtacostal cells ± linear

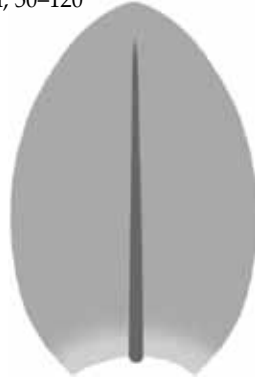
*costa:* failing well below the leaf apex

*border:* not differentiated

*margin:* entire below, irregularly denticulate near the apex, plane

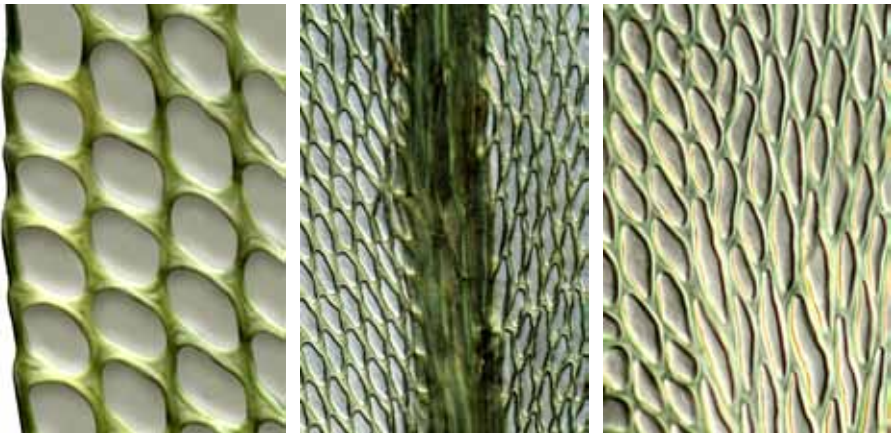
*cells:* 12–15 μm, oval to rounded rhombic, thick-walled, smooth

**capsule:** 1.3–1.6 mm, oblong, erect, immersed, brown, mouth red, thickened; seta < 2 mm; calyptra cucullate, laciniate; exostome teeth pale, endostome segments filiform, equalling the exostome teeth, cilia absent



fertile shoots (dry) (2), capsule (dry), leaf outline, and leaf apex

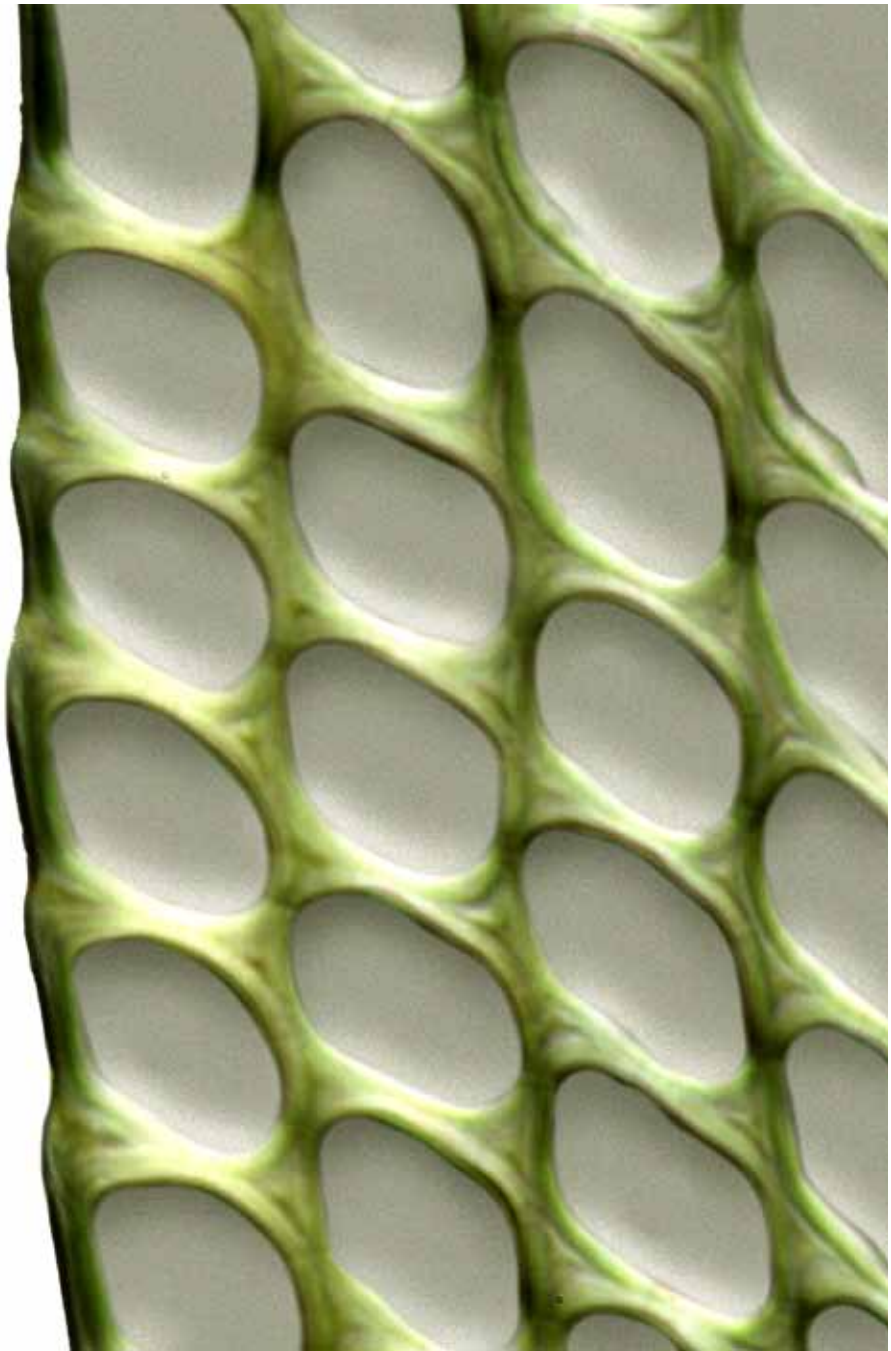
■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, costa at midleaf, and cells near leaf base

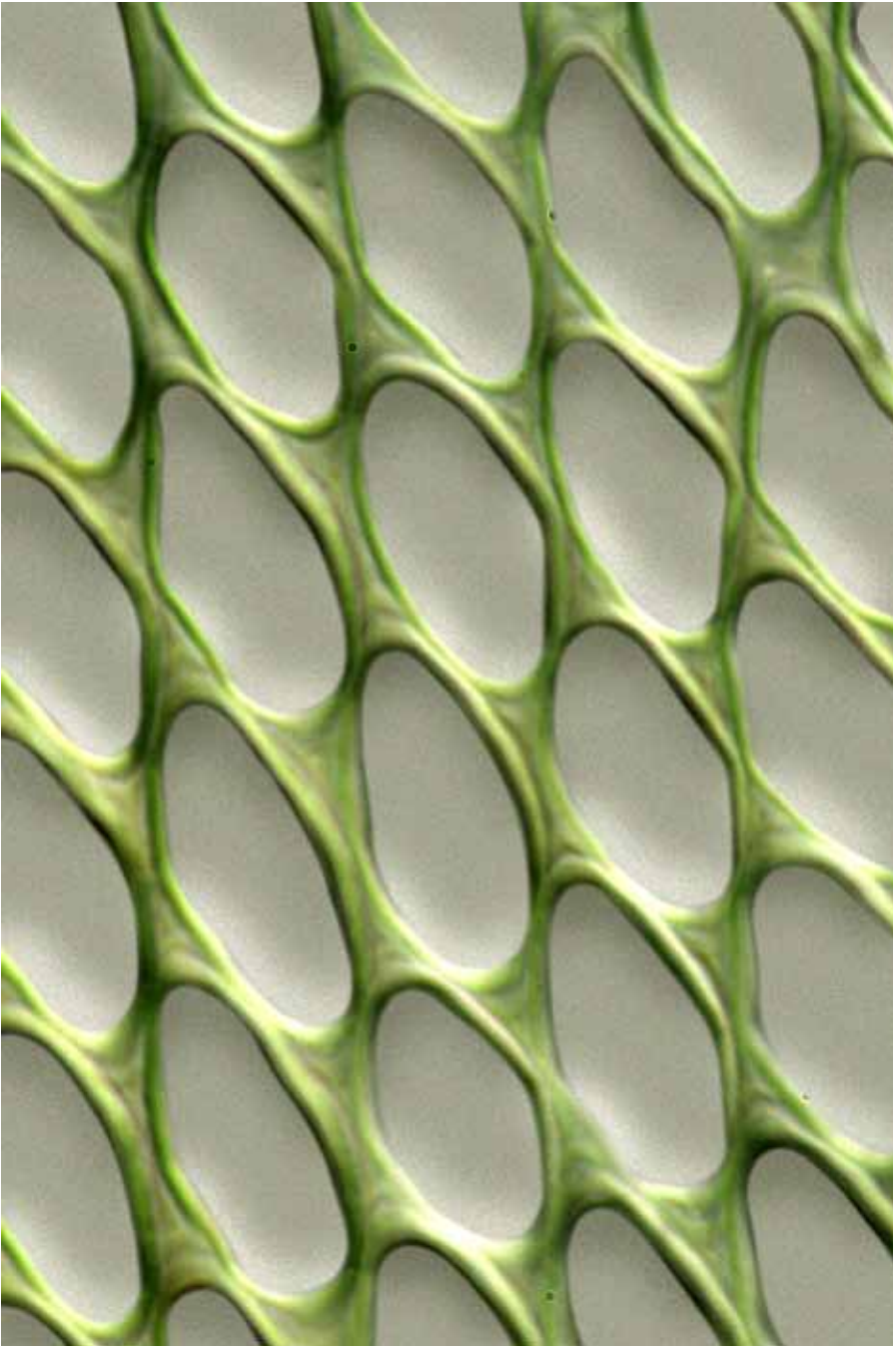
■ 10 μm, ■ 50 μm, ■ 50 μm

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*Cryphaea ovalifolia* margin midleaf  
10  $\mu\text{m}$

continued next page



*Cryphaea ovalifolia* cells midleaf  
10  $\mu\text{m}$

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**Cryphaea parvula** Mitt.

**form:** tufted, creeping, curved, branched, pendent stems, 30–50 mm long, leaves yellowish to dark green

**habitat:** bark of tree trunks and branches in moist forest

**leaf:** size: 1–1.5 × 0.5–0.8 mm

*shape:* ovate

*tip:* acuminate

*base:* alar cells round to subquadrate, 10–14 μm diam., smooth

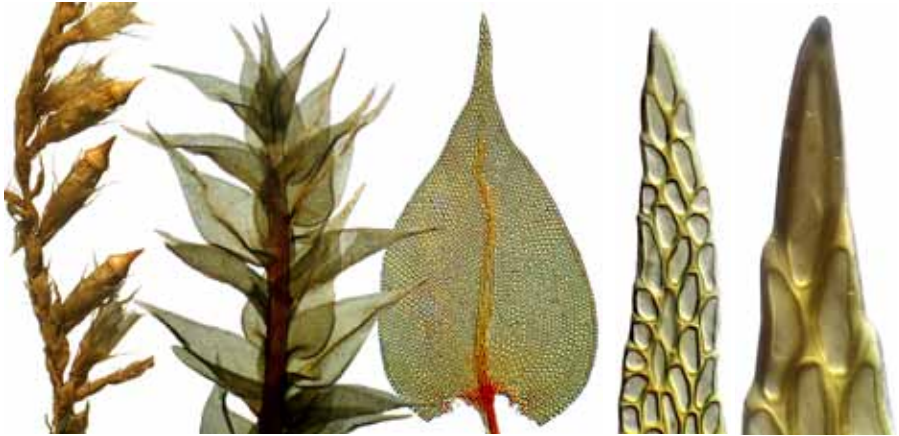
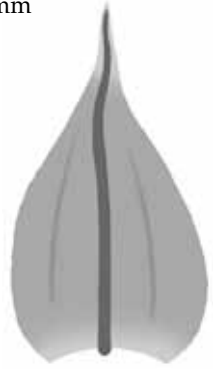
*costa:* ending below the acumens, ± sinuose above

*border:* not differentiated

*margin:* entire, plane

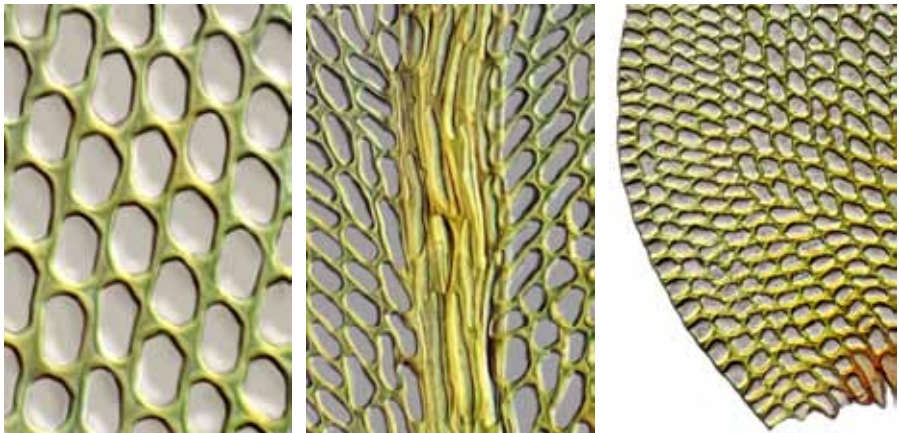
*cells:* 8–14 μm, oval, firm-walled, smooth

**capsule:** 1.5–2 mm, obloid, straight, immersed, brown; seta 0.2 mm; annulus 1–2-seriate; operculum rostrate, smooth; calyptra mitriform, prorate above; peristome double, pale; spores 18–20 μm in diam., papillose



fertile shoot, shoot apex (cleared), leaf outline, and leaf apex (2)

1 mm, 1 mm, 0.1 mm, 10 μm, 10 μm



cells at midleaf, costa at midleaf, and leaf basal angle

10 μm, 50 μm, 50 μm

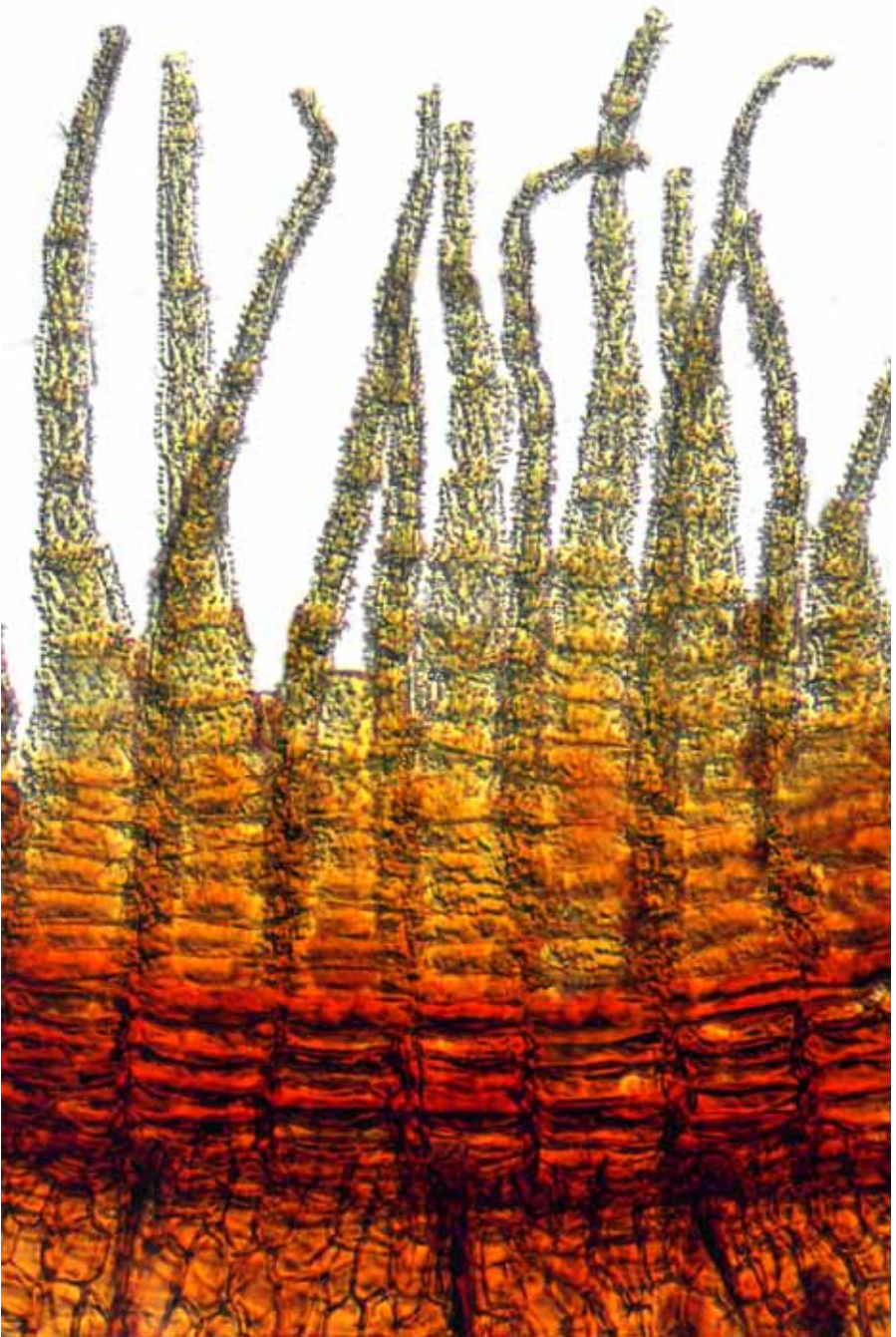
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*Cryphaea parvula* capsules

1 mm

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*Cryphaea parvula* peristome  
50  $\mu$ m

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**Cryphaea tenella** Hornsch. ex C.Muell.

**form:** primary stems creeping; secondary stems irregularly branched, 20–50 mm long, stiff, pseudoparaphylliate

**habitat:** bark of trunks and twigs of shrubs and trees in mesic forest

**leaf:** size: 1–3 × 1.5 mm

*shape:* ovate-lanceolate, concave

*tip:* long-acuminate to ± piliferous

*base:* basal cells nearly isodiametric, forming a ± distinct group

*costa:* vanishing in the acumen

*border:* not differentiated

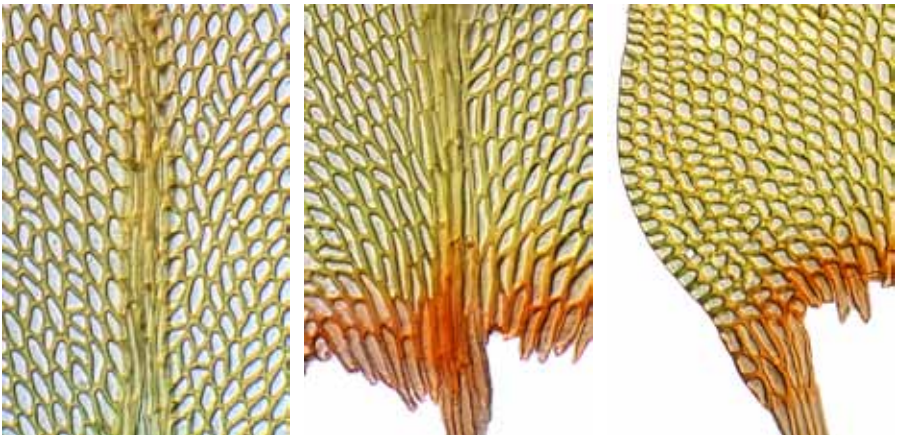
*margin:* entire, narrowly recurved below

*cells:* 8–14 μm, oval or rounded-rhombic, incrassate, smooth

**capsule:** 1–1.5 mm, oblong-oval, lateral, erect, immersed, light brown, mouth reddish; seta 0.2–0.3 mm; operculum high-conic; calyptra campanulate, reddish-brown, lobed; exostome teeth and endostome segments equal; spores 24–28 μm in diam.



immature capsules, exostome tooth, endostome segment, leaf outline, apex, and margin  
 0.5 mm, 100 μm (2), 0.5 mm, 10 μm, 10 μm



costa at midleaf, costa at leaf base, and leaf basal angle  
 50 μm, 50 μm, 50 μm

continued next page



*Cryphaea tenella* fertile shoot (moist)  
1 mm

**Cyrtodon dilatatus** (Hook.f. & Wilson) Paris & Schimp.

**form:** primary stem creeping; secondary stem tomentose, 40–80 mm long, pinnately branched, complanate, secund, leaves brownish green, glossy

**habitat:** rock or bark in or near streams, occasionally submerged

**leaf:** size: 1.5 × 0.8 mm

*shape:* ovate, slightly concave

*tip:* acute, blunt at the tip

*base:* cells at the basal margin subquadrate, longer near the costa

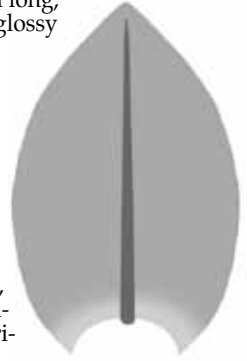
*costa:* failing below the apex

*border:* not differentiated

*margin:* faintly serrulate, plane

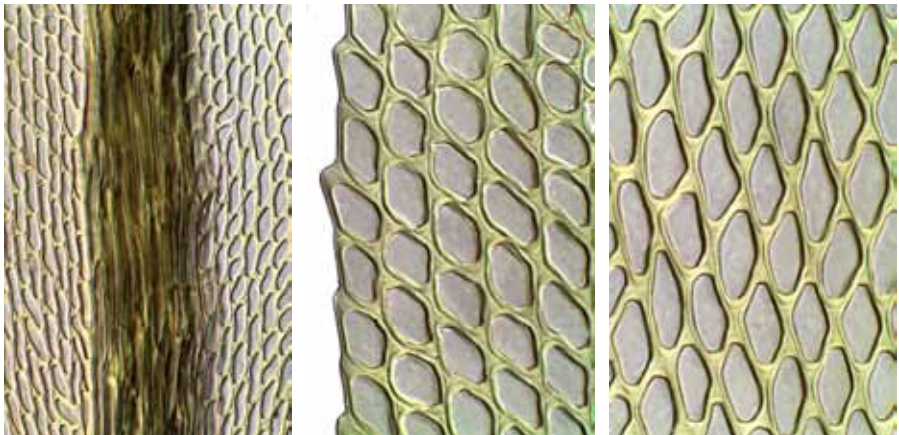
*cells:* 10–20 × 6–8 μm, oval, thick-walled, smooth

**capsule:** 1–1.5 mm, oblong, on short side-branches, erect, immersed, grooved and wide-mouthed when mature; seta very short; operculum conic, acute; calyptra cucullate, laciniate, papillose above; peristome double, cilia none



fertile shoots (dry) (2), leaf outline, and leaf apex

1 mm, 1 mm, 0.5 mm, 50 μm



costa at midleaf, margin at midleaf, and cells at midleaf

50 μm, 10 μm, 10 μm

continued next page



*Cyrtodon dilatatus* fertile shoots, immersed grooved capsules (dry)  
1 mm, 1 mm

**Dendrocryphaea tasmanica** (Mitt.) Broth.

**form:** primary stems creeping; secondary stems  $\pm$  unbranched, 50–80 mm long, naked below, leaves dull, green or yellow-green

**habitat:** wet rock in fast-flowing streams, often submerged, rheophytic

**leaf:** size: 1.5–2.5  $\times$  0.9–1.5 mm

*shape:* ovate-orbicular

*tip:* acute

*base:* basal cells subquadrate, in small auricles

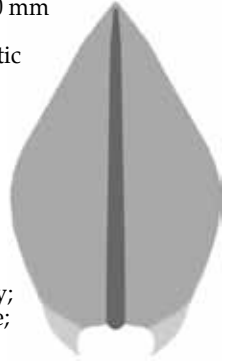
*costa:* reaching the apex or just below

*border:* not differentiated

*margin:* minutely crenulate, plane

*cells:* 12–15  $\mu$ m, oval to rhombic,  $\pm$  incrassate, smooth

**capsule:** 1.5 mm, oval-oblong, erect, immersed,  $\pm$  furrowed when dry; seta short; operculum conico-rostellate; calyptra cucullate, laciniate; peristome double, pale, cilia none; spores 12–16  $\mu$ m in diam.



fertile shoot (2), leaf outline, and margin midleaf

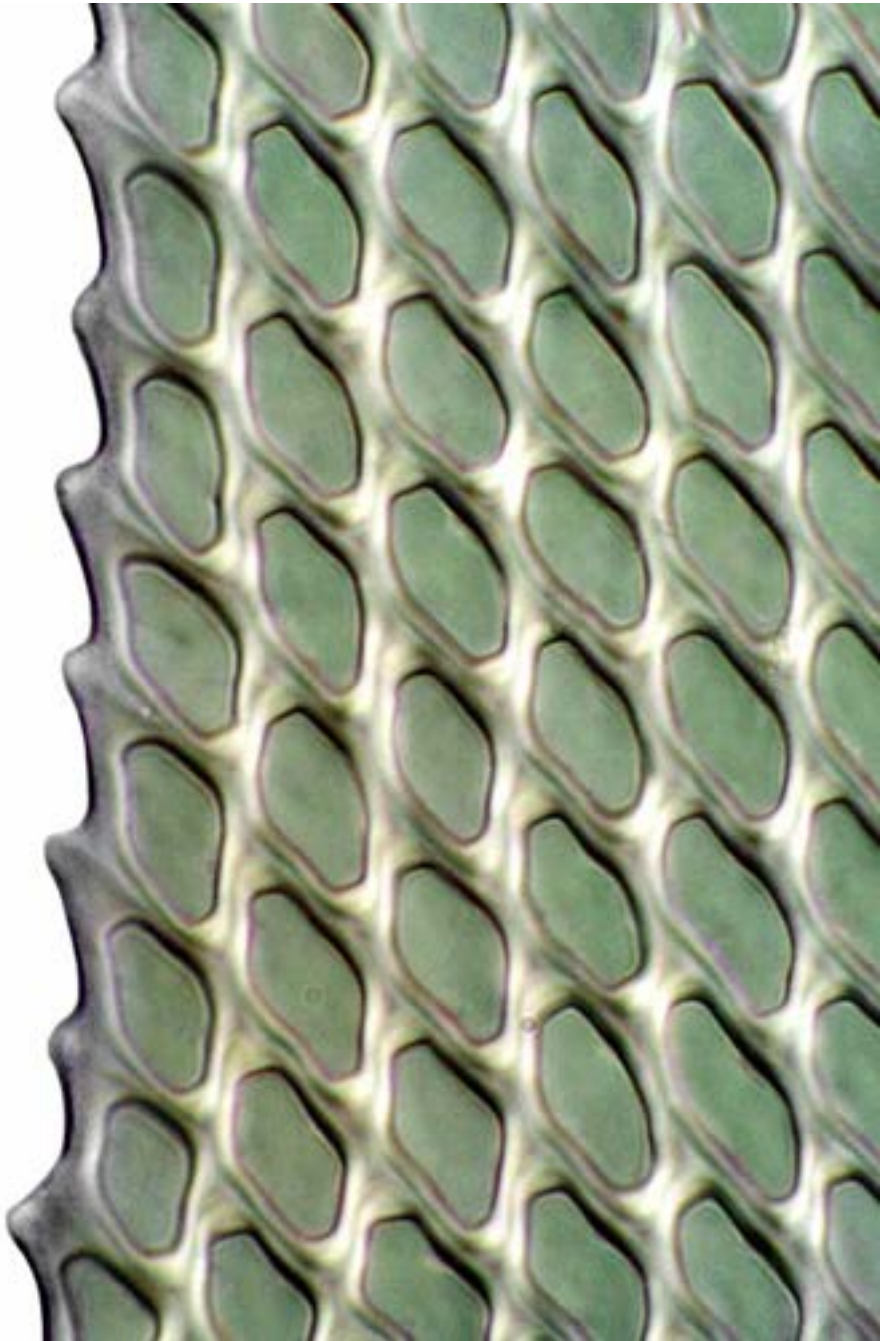
1 mm, 1 mm, 0.5 mm, 10  $\mu$ m



cells at midleaf, leaf basal angle, and peristome tooth surface

10  $\mu$ m, 50  $\mu$ m, 10  $\mu$ m





*Dendrocryphaea tasmanica* margin midleaf  
10  $\mu\text{m}$

**Cryptogonium phyllogonioides** (Sull.) Isov.

**form:** primary stems creeping; secondary stems strongly distichous, leaves dark green, glossy

**habitat:** bark or rock in shaded moist forest

**leaf:** size: 2–2.5 mm

*shape:* oblong-rhombic

*tip:* acute, ± recurved, especially in leaves near the shoot apex

*base:* basal cells shorter than other lamina cells; alar cells not differentiated

*costa:* none

*border:* not differentiated

*margin:* entire or nearly so, plane

*cells:* 50–90 × 4–7 μm, linear, firm-walled, smooth

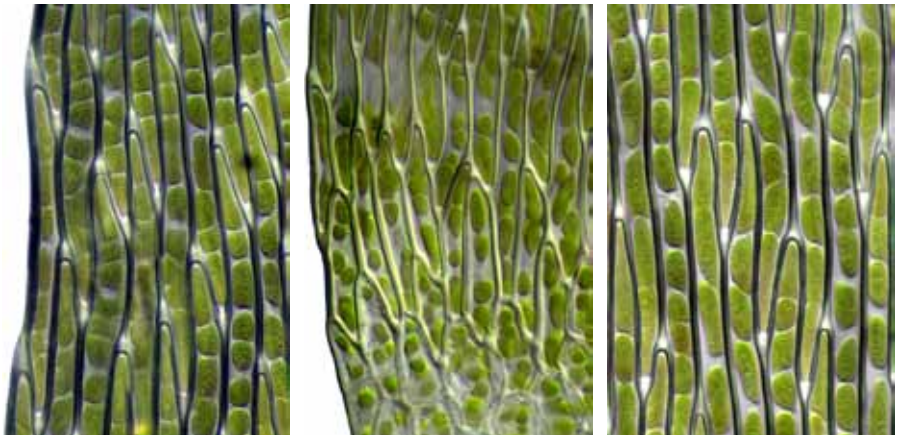
**capsule:** capsules not seen in New Zealand

**note:** known from only Raoul Island



vegetative shoots (dry) (4), leaf outline, and leaf apex

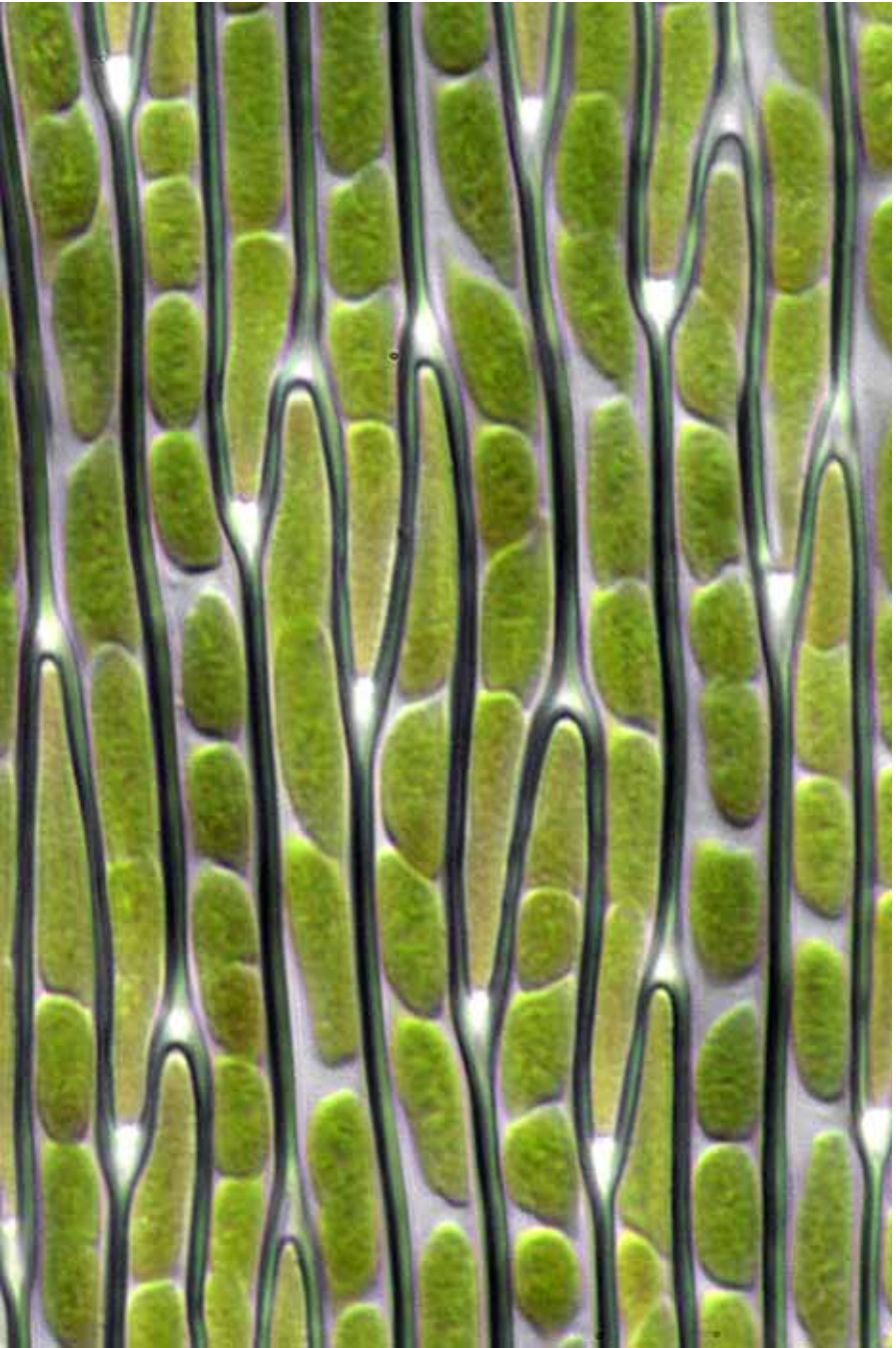
5 mm (2), 1 mm, 1 mm, 0.1 mm, 10 μm



margin at midleaf, near leaf basal angle, and cells at midleaf

10 μm, 10 μm, 10 μm

continued next page



*Cryptogonium phyllogonioides* cells midleaf  
10  $\mu\text{m}$

***Symphysodontella cylindracea*** (Mont.) Fleisch.

**form:** creeping, rhizomatous, leafless primary stem; secondary stems pale green, glossy, ± frondose

**habitat:** soil or bark

**leaf:** *size:* branch leaves 0.8–1.5 × 0.2–0.4 mm; stem leaves to 2.8 × 0.8 mm

*shape:* ovate-lanceolate, concave, abruptly acuminate

*tip:* acute

*base:* basal cells rectangular to quadrate, strongly porose

*costa:* absent or faint or short and double, the forks unequal

*border:* not differentiated

*margin:* entire to serrulate, plane

*cells:* branch leaf cells 30–60 × 5 μm; stem leaf cells to 100 × 8 μm, linear to vermicular, firm- to thick-walled, smooth

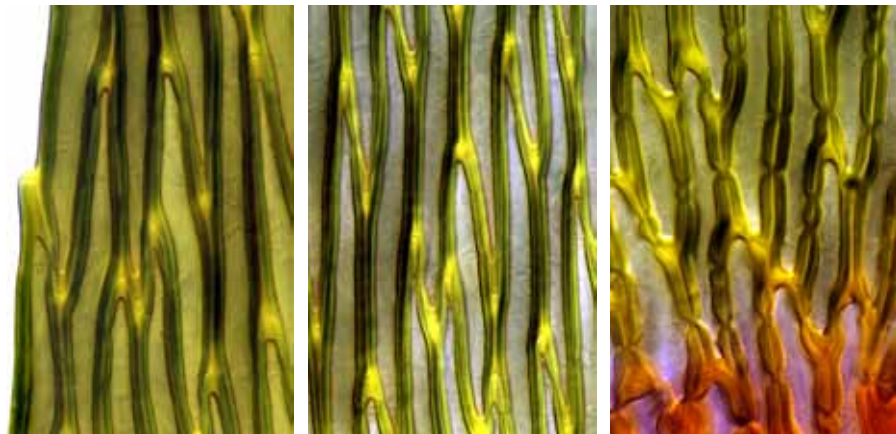
**capsule:** to 3 mm long, cylindric, erect, immersed; seta short; calyptra small, cucullate, naked; teeth 0.3 mm; endostome rudimentary

**notes:** known from only Raoul Island; capsules not seen in New Zealand



vegetative shoot (dry) (3), leaf outline, and leaf apex

5 mm, 5 mm, 1 mm, 0.5 mm, 10 μm



margin at midleaf, cells at midleaf, and cells at leaf base

10 μm, 10 μm, 10 μm

**Orthorrhynchium elegans** (Hook.f. & Wilson) Reich.

**form:** mats of creeping primary stems; secondary stems 20–40 mm long, distichous, closely pinnately branched, leaves dark green, glossy

**habitat:** bark or rarely rock in shady, damp forest

**leaf:** *size:* branch leaves to  $1.1 \times 0.4$  mm; stem leaves similar

*shape:* oblong-rhombic, conduplicate,  $\pm$  falcate, the insertion narrow

*tip:* obtuse to rounded and truncate, overlapping in a  $\pm$  straight edge

*base:* alar cells not differentiated

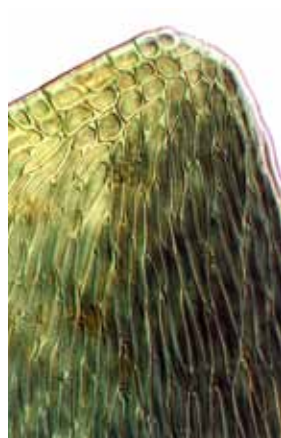
*costa:* none

*border:* not differentiated

*margin:* entire, plane

*cells:*  $40\text{--}70 \times 4\text{--}6$   $\mu\text{m}$ , subvermicular, firm-walled, smooth; uppermost apical cells rectangular in a distinct group (cucullus)

**capsule:** 6–1.1 mm, turbinate, erect, immersed, brown, wide-mouthed dry, columella exerted; seta 2–4 mm, reddish, straight, smooth; calyptra mitrate, hairy, covering capsule; peristome exostome only; spores 24–30  $\mu\text{m}$  in diam.



vegetative habit and shoot, leaf outline, and leaf apex showing cucullus

1 mm, 1 mm, 0.1 mm, 10  $\mu\text{m}$



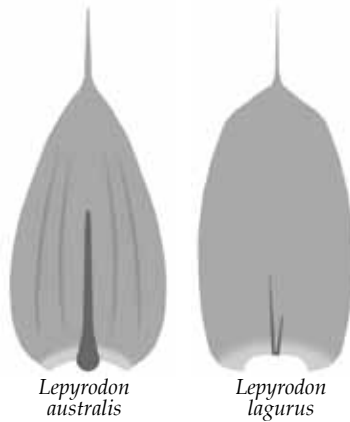
margin at midleaf, cells at midleaf, and margin near leaf base

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

**Key\* to the New Zealand species of Lepyrodon (2)**

- 1 Leaves deeply plicate, to 2.5 mm long; midleaf cells 4–5 mm wide; peristome single, endostome only..... ● **Lepyrodon australis**
- 1: Leaves rugose but not plicate, to 4 mm long; midleaf cells 6–9 μm wide; peristome double..... ● **Lepyrodon lagurus**

\* based on Allen, BH (1999): A revision of the moss genus *Lepyrodon* (Leucodontales, Lepyrodontaceae). *Bryobrothera* 5, 27.



**Lepyrodon australis** Broth.

**form:** mats of creeping, tomentose stems, 5–20(–50) mm tall,  
leaves pale to bright or yellow-green, glossy  
**habitat:** bark, rock, or logs in dryish upland forest, to 1600 m

**leaf:** size: 1.5–2.5 × 0.7–1.2 mm

*shape:* ovate-lanceolate, plicate, concave

*tip:* narrowly acuminate, ending in a hair-point

*base:* alar cells quadrate, dark, in small auricles

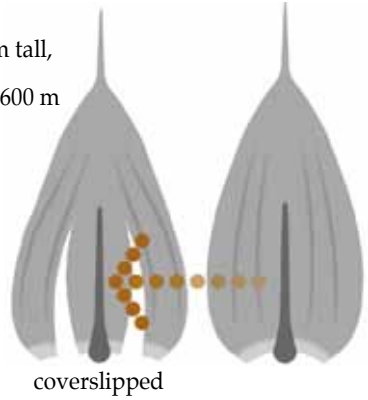
*costa:* reaching about midleaf

*border:* not differentiated

*margin:* serrulate above, plane

*cells:* 30–50 × 4–5 μm above, 40–80 × 4–5 μm below,  
linear, incrassate, ± porose, smooth

**capsule:** 2–3.5 mm, cylindric, exserted, erect, brown;  
seta 9–14 mm; calyptra naked, cucullate; operculum  
obliquely rostrate; endostome only; spores 13–24 μm

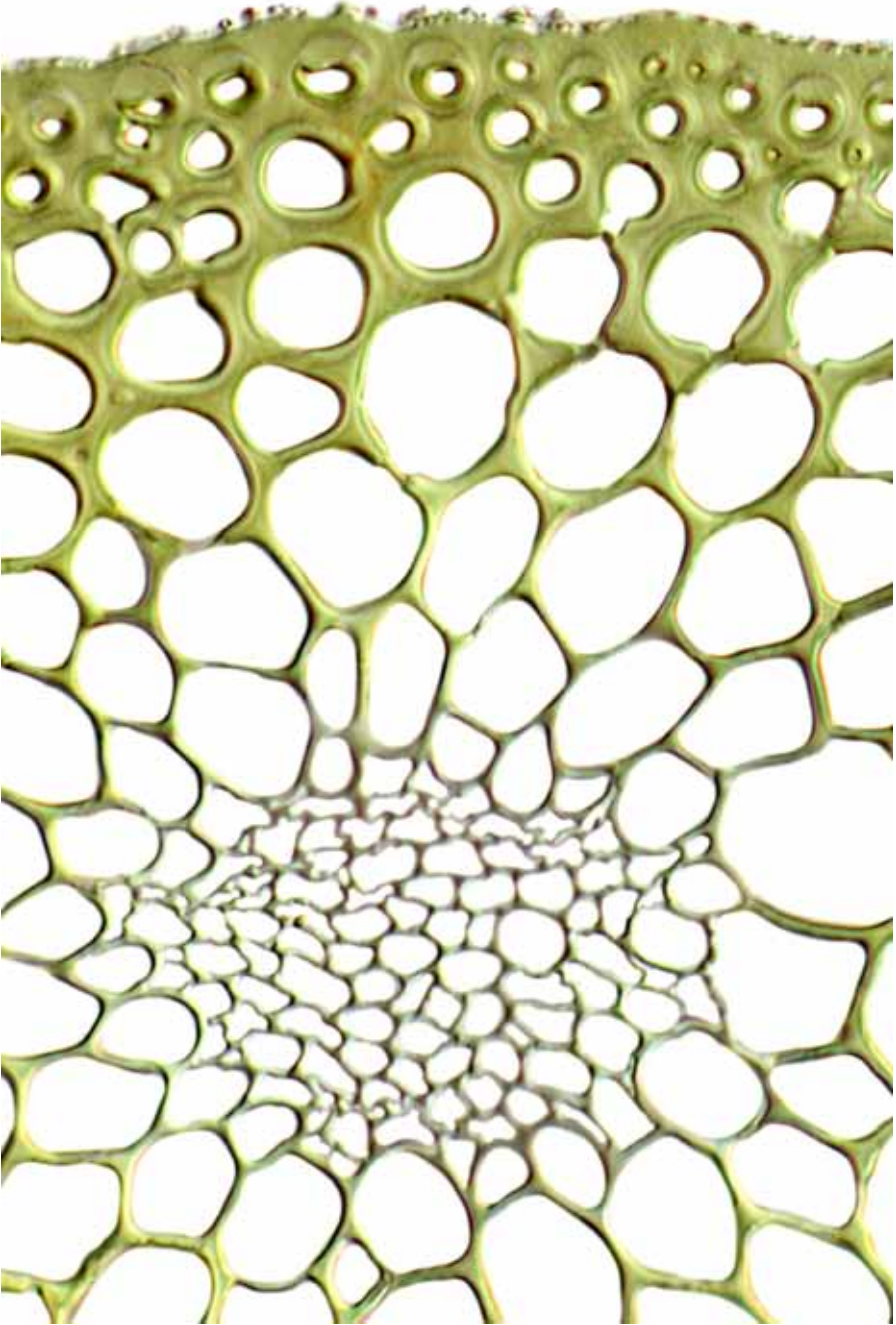


fertile and vegetative shoots, flagellate propagule, capsules, leaf outline, hair-point (2)  
■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 1 mm (2), ■ 0.1 mm, ■ 5 μm, ■ 5 μm



margin of upper leaf, cells at midleaf, and leaf basal angle  
■ 10 μm, ■ 10 μm, ■ 50 μm

continued next page



*Lepyrodon australis* stem cross-section showing thick-walled cells of outermost stiffening collar, porose cells of cortex, and thin-walled cells of well-developed central strand  
10  $\mu$ m

continued next page





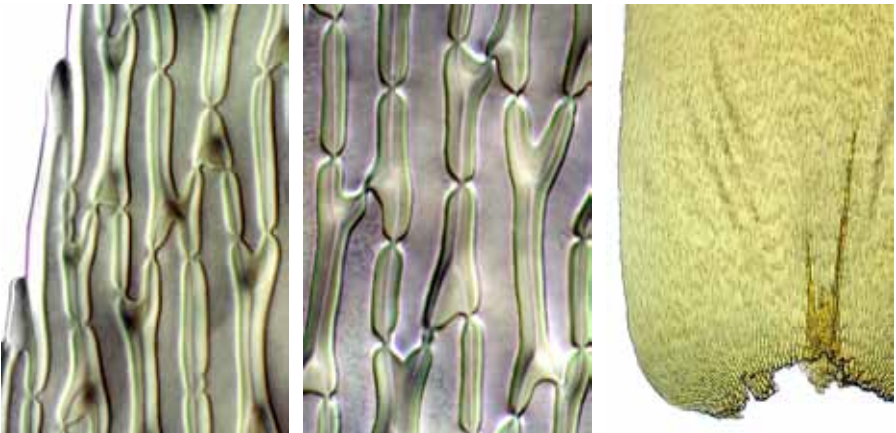
*Lepyrodon australis* (above) stem cross-section showing porose cells of cortex (detail), and (below) leaf cross-section showing thick-walled cells

10  $\mu\text{m}$  (above),

10  $\mu\text{m}$  (below)

**Lepyrodon lagurus** (Hook.) Mitt.**form:** mats of tomentose, branched stems, 10–50 mm, leaves pale green, glossy**habitat:** bark, rotting logs, or rock in damp montane forest, herbfields, and tussock**leaf:** size: 1.5–4 × 0.9–1.4 mm (minus acumen)*shape:* oblong to broadly ovate, concave, symmetric, rugose above, not plicate*tip:* narrowed to a short or long capillary hair-point*base:* alar cells not differentiated*costa:* broad below, short and double or single and reaching to midleaf*border:* not differentiated*margin:* weakly serrulate above, plane*cells:* 50–90 × 6–9 μm, linear-vermicular, ± porose, thick-walled, smooth**capsule:** 1.5–2.8 mm, cylindric, long-exserted, erect, brown; seta 13–23 mm; calyptra cucullate, naked to sparsely erect-hairy; operculum obliquely rostrate; peristome mostly endostome, segments 16, perforate, 400 μm tall, hyaline, papillose, cilia absent or rudimentary; spores spherical, 12–17 μm in diam., papillose

vegetative shoots (dry), capsules with calyptrae, leaf outline, leaf apex, and leaf subapex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 5 μm, ■ 5 μm

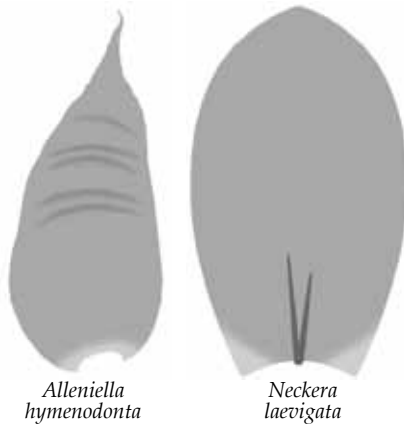


margin at midleaf, cells at midleaf, and leaf basal angle  
 ■ 10 μm, ■ 10 μm, ■ 100 μm

**Key\* to the New Zealand species of *Alleniella* and *Neckera* (2)**

- 1 Leaf blade strongly undulate; apex acuminate..... ● ***Alleniella hymenodonta***  
 1: Leaf blade ± rugose but not undulate; apex rounded or obtuse.. ● ***Neckera laevigata***

\* based on Ji, M-C; Enroth, J (2008): *Neckera hymenodonta* (Neckeraceae, Bryopsida) reinstated, with an emended description. *Annales Botanici Fennici* 45, 277–280.



**Alleniella hymenodonta** (Müll.Hal.) S.Ohlsson, Enroth & D.Quandt  
formerly *Neckera hymenodonta* Müll.Hal.

**form:** primary stem stoloniferous, secondary stem pinnately branched, to 150 mm  
long, complanate, paraphylliate, leaves olive-green to bronze, glossy

**habitat:** bark in damp forest, lowland to montane

**leaf:** size: 2–2.5 × 0.8–1.0 mm

**shape:** oblong-lanceolate to oblong-ovate, strongly undulate

**tip:** acute to acuminate

**base:** small alar groups of subquadrate cells

**costa:** absent, faint, or short and double

**border:** not differentiated

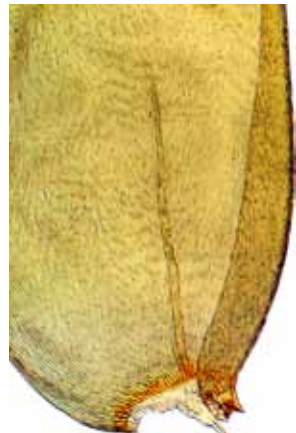
**margin:** serrulate at the apex, sinuose-serrulate below, plane

**cells:** 40–50 × 3–4.5 μm, oblong-linear, flexuose, incrassate, smooth

**capsule:** 1.5 mm, oblong-ovoid, erect, immersed to slightly exerted,  
brown; seta 1 mm; calyptra cucullate, glossy; operculum conic-rostrate;  
endostome rudimentary



fertile shoot (dry), mature capsule, peristome, paraphyllum, leaf outline, and leaf apex  
 1 mm, 0.5 mm, 0.1 mm, 50 μm, 0.1 mm, 0.1 mm



margin of upper leaf, cells at midleaf, and leaf base  
 10 μm, 10 μm, 0.25 mm

continued next page

**Neckera laevigata** Hook.f. & Wilson

**form:** primary stems creeping, secondary stems branched, trailing, to 60 mm long, flattened, leaves green to yellow-green, dull to  $\pm$  glossy

**habitat:** bark in shaded forest, lowland to montane

**leaf:** size: 1.3–2 mm

*shape:* widely oval to oblong, rugose but not transversely undulate

*tip:* widely obtuse to rounded, sometimes slightly apiculate

*base:* angle cells subquadrate, thick-walled

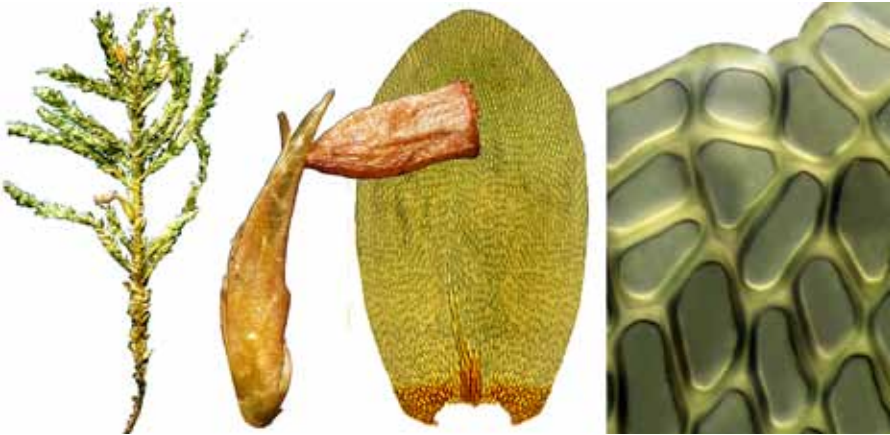
*costa:* absent, single to halfway up the lamina, or short and double

*border:* not differentiated

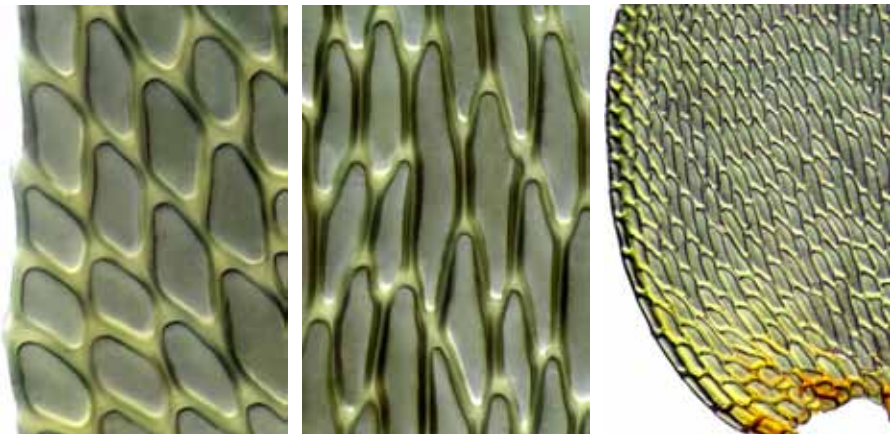
*margin:* entire below,  $\pm$  denticulate near apex; inflexed 1–2 sides

*cells:* 25–50  $\mu$ m  $\times$  8  $\mu$ m, rhombic (oval near tip), firm-walled, smooth

**capsule:** 1–1.5 mm, oblong, necked, exserted, erect to inclined, red-brown; seta 1.5 mm; calyptra cucullate, naked, smooth; operculum conico-rostrate; exostome teeth pale, subulate, endostome reduced; spores 24–28  $\mu$ m in diam., papillose

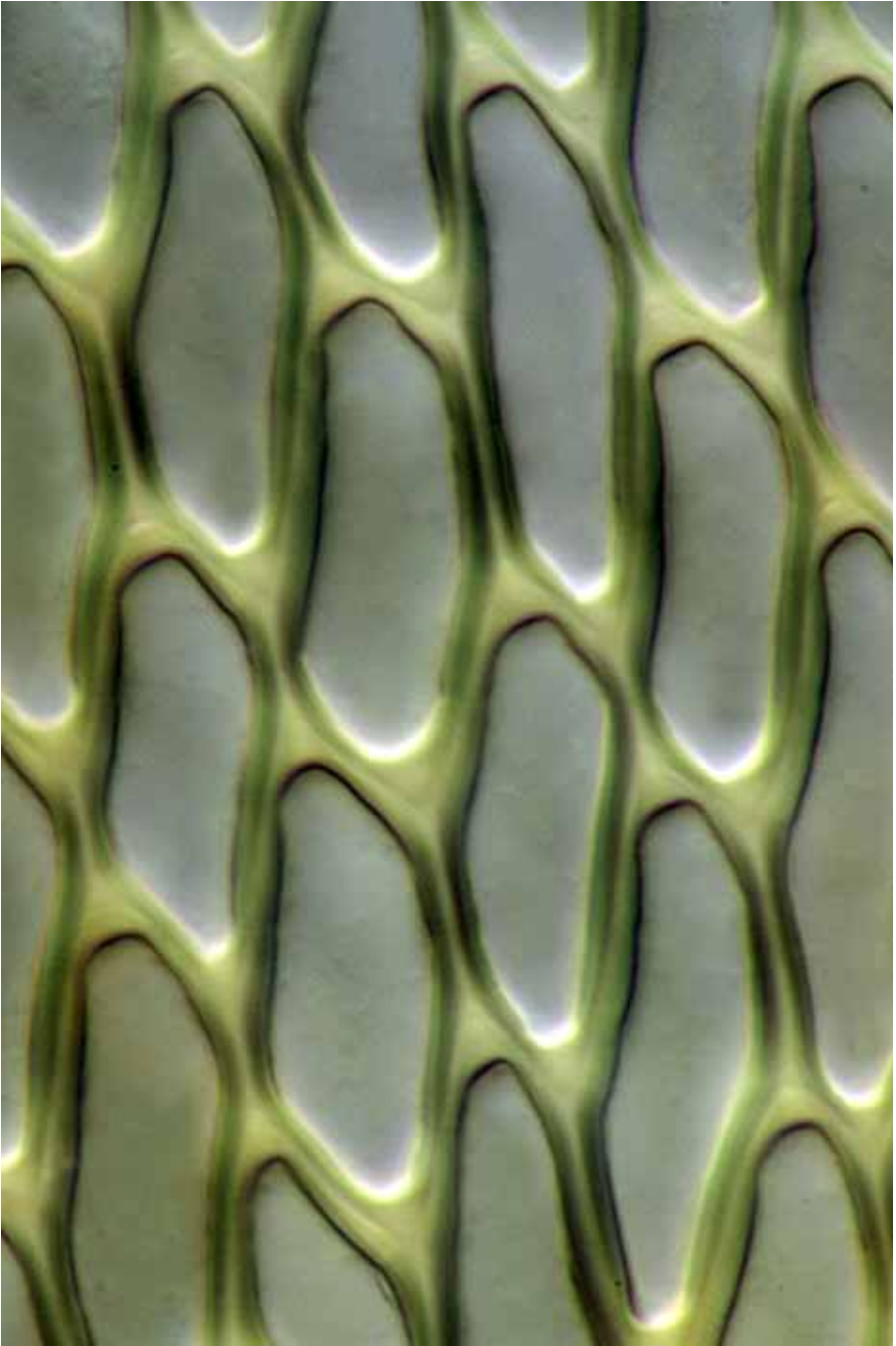


fertile shoot (dry), perichaetial branch and capsule, leaf outline, and margin near apex  
 5 mm, 1 mm, 0.1 mm, 10  $\mu$ m



margin of upper leaf, cells at midleaf, and leaf basal angle  
 10  $\mu$ m, 10  $\mu$ m, 50  $\mu$ m

continued next page



*Neckera laevigata* cells upper leaf  
10  $\mu\text{m}$

**Neckeropsis lepineana** (Mont.) Fleisch.

**form:** primary stem creeping; secondary stem branched, to 300 mm long, pendent, complanate, leaves yellowish green, glossy, undulate

**habitat:** trunk or twig bark, or less often soil, in damp montane forest

**leaf:** size: 1.5–3.5 mm long

*shape:* lingulate, asymmetric, strongly undulate, complanate

*tip:* rounded, truncate

*base:* clasping and decurrent on the distal side

*costa:* absent or unequally short and double, rarely triple

*border:* not differentiated

*margin:* faintly serrulate, inflexed on one side

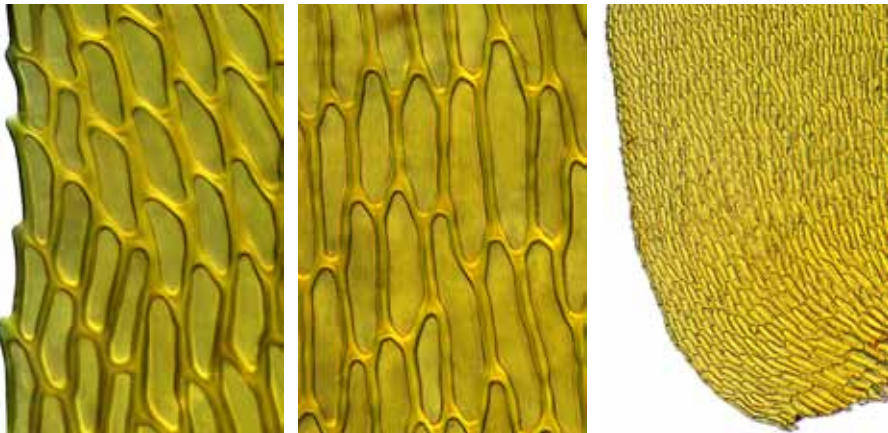
*cells:* 6–15 × 5–15 μm, rhombic, firm-walled, smooth

**capsule:** 2 mm, ellipsoid, lateral, erect, immersed, brown; seta 0.5 mm; calyptra cucullate, ± hairy; operculum obliquely short-rostrate; exostome teeth papillose, endostome segments yellow, perforate; spores 20–30 μm in diam., brown



vegetative shoots (dry) (3), leaf outline, and leaf apex

5 mm, 5 mm, 1 mm, 1 mm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 100 μm

continued next page



*Neckeropsis lepineana* margin midleaf  
10  $\mu$ m



**Key\* to the New Zealand species of *Pendulothecium* (3)**

- 1 Leaves distinctly undulate; branch leaf costa reaching > 80% up blade..... ● ***Pendulothecium oblongifolium***
- 1: Leaves not or only weakly undulate; branch leaf costa reaching only 50% up blade ...2
- 2(1:) Secondary stem leaves to 1.8 mm long; base auricled; margin entire to denticulate above; apical cells to 25  $\mu\text{m}$  long ..... ● ***Pendulothecium auriculatum***
- 2: Secondary stem leaves to 1.1 mm long; base not or only indistinctly auricled; margin strongly and irregularly dentate above; apical cells mostly 10–12  $\mu\text{m}$  long ..... ● ***Pendulothecium punctatum***

\* based on Enroth, J; He, S (1991): Notes on the Neckeraceae (Musci) 8: *Pendulothecium*, a new genus from New Zealand and Norfolk Island. *New Zealand Journal of Botany* 29, 10.



*Pendulothecium  
auriculatum*



*Pendulothecium  
punctatum*



*Pendulothecium  
oblongifolium*

**Pendulothecium auriculatum** (Hook.f. & Wilson) Enroth & He

**form:** primary stem creeping; secondary stem frondose,  $\pm$  bipinnately branched, brittle, leaves brownish or yellow-green,  $\pm$  glossy  
**habitat:** soil, rotting wood, or rock in wet ( $> 1250$  mm/year) forest

**leaf:** *size:* branch leaves to 1.8 mm; stem leaves slightly longer  
*shape:* stem leaves spatulate; branch leaves obovate-orbicular from a narrow base, with 1–2 lunate undulations, auriculate

*tip:* round or  $\pm$  mucronate

*base:*  $\pm$  auricled; juxtacostal cells to  $40 \times 5\text{--}6 \mu\text{m}$ , porose

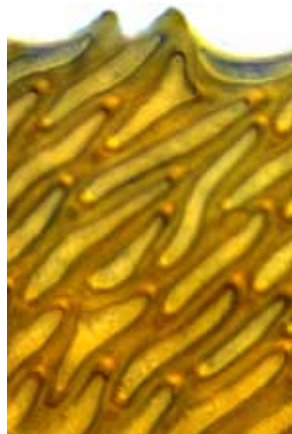
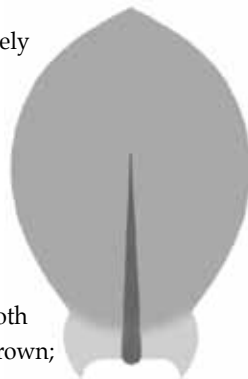
*costa:* reaching about halfway up the lamina

*border:* marginal cells shorter than the inner laminal cells

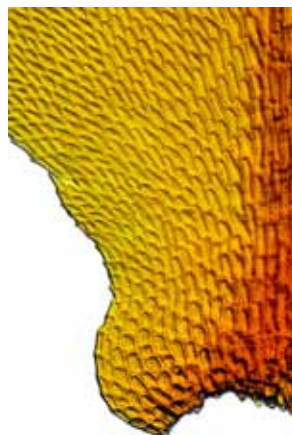
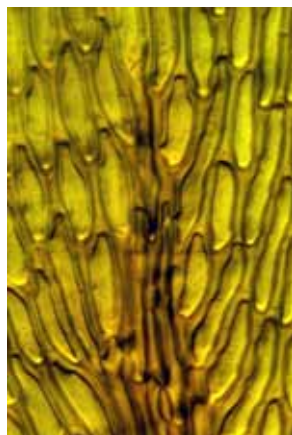
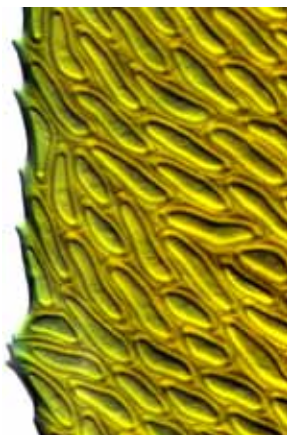
*margin:* irregularly denticulate above, entire below, plane

*cells:*  $12\text{--}25 \times 5\text{--}6 \mu\text{m}$ , oval to rhombic, thick-walled,  $\pm$  porose, smooth

**capsule:** to 1.5 mm; ellipsoid, lateral, exserted, cernuous, orange-brown; seta about 12 mm; operculum conic-rostrate; calyptra cucullate; peristome hypnoid; spores yellow

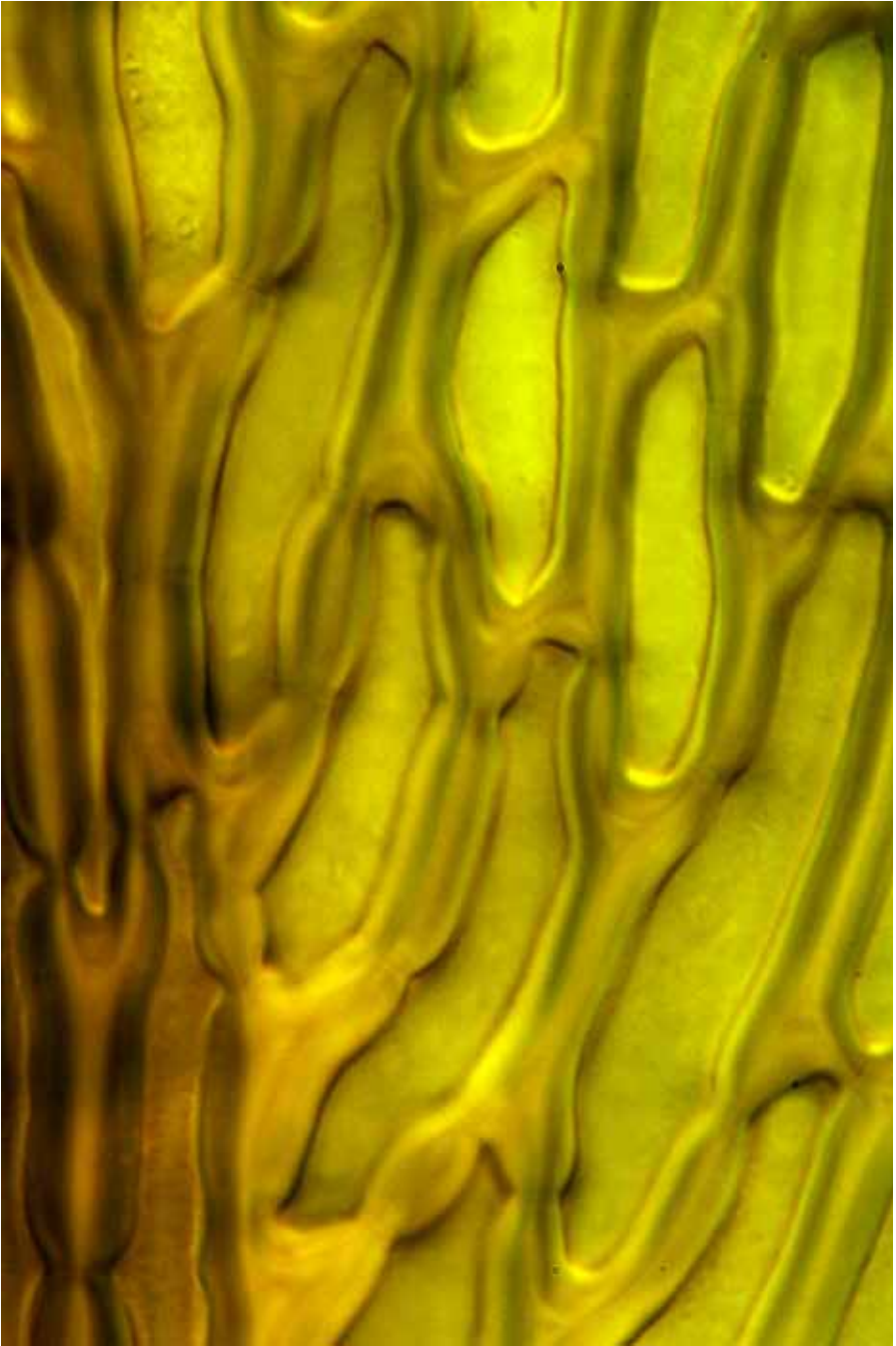


frondose vegetative shoot (dry), branch leaf outline, and branch leaf apex  
 5 mm, 0.1 mm, 10  $\mu\text{m}$



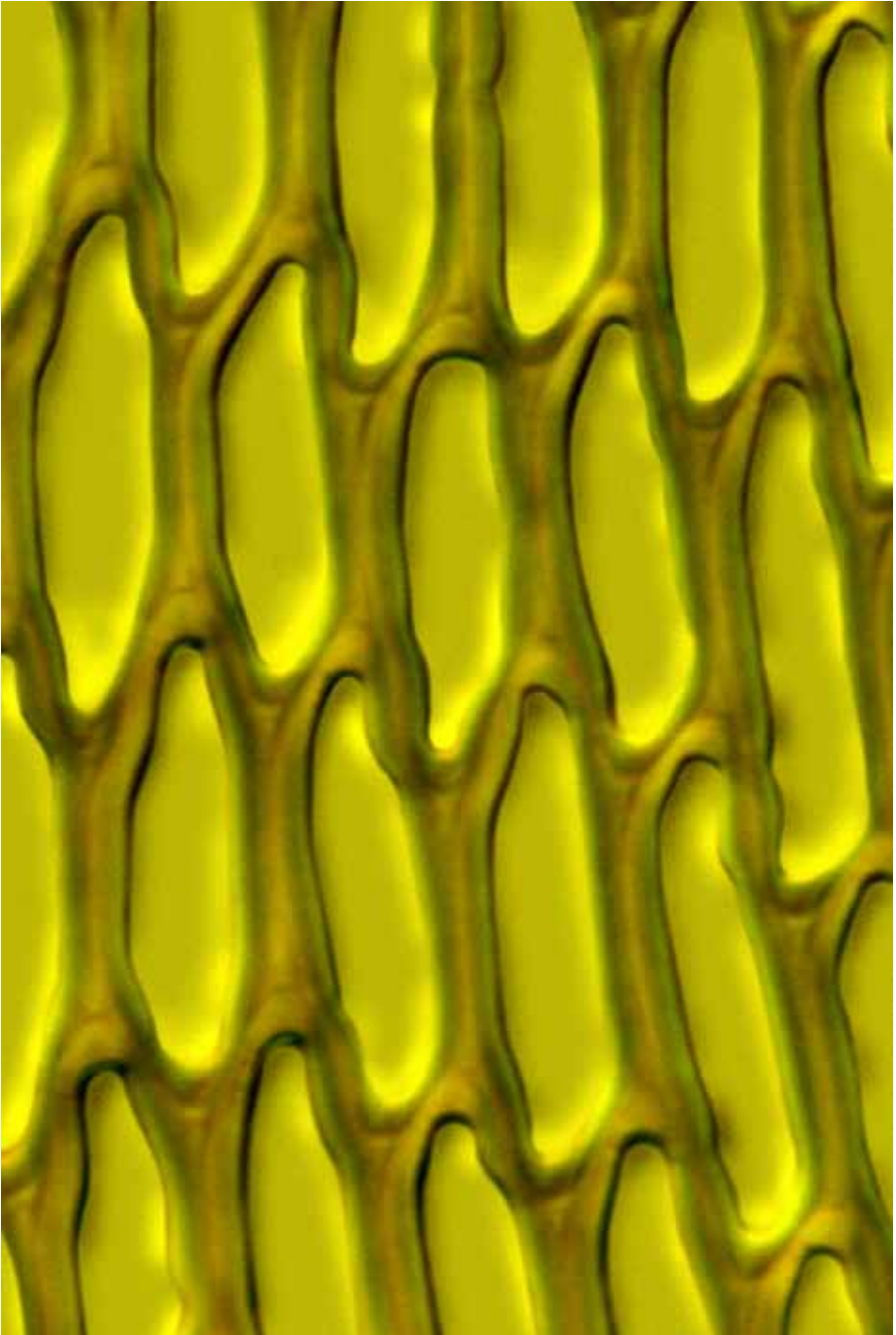
margin at midleaf, costa terminus, and auricle in leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Pendulothecium auriculatum* juxtacostal cells in lower leaf  
10  $\mu\text{m}$

continued next page



*Pendulothecium auriculatum* midleaf cells  
10  $\mu\text{m}$

continued next page

**Pendulothecium oblongifolium** (Hook.f. & Wilson) Enroth & S.He

**form:** primary stem creeping; secondary stem bipinnately branched, frondose, with flagelliform, microphyllous branches, leaves dull, sordid green

**habitat:** soil, bark, rotting wood, or rock in damp, shady forest

**leaf:** size: to 1.5 mm; subsidiary frond leaves to 0.8 mm

**shape:** oblong to lingulate or spatulate from a broad base, undulate

**tip:** broadly acute to obtuse, ± mucronate

**base:** sometimes auricled, basal cells ± rectangular, to  $30 \times 5-6 \mu\text{m}$

**costa:** strong, single, reaching 70% or more up the lamina

**border:** not differentiated

**margin:** entire below, irregularly toothed above, plane

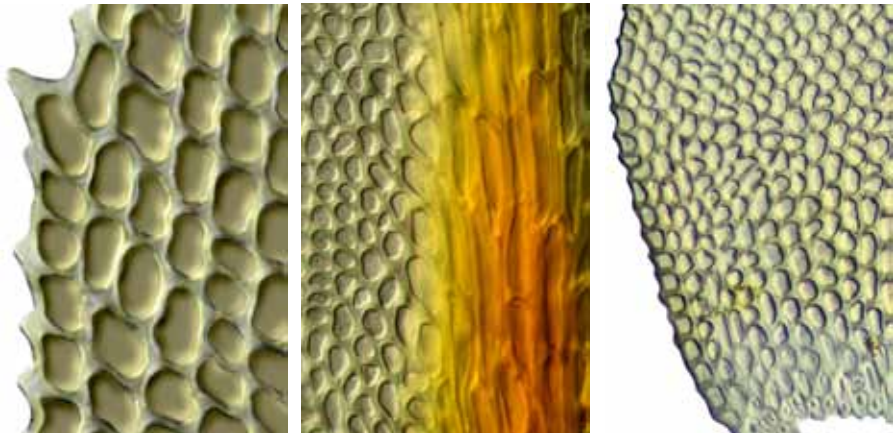
**cells:**  $10-12 \times 6-8 \mu\text{m}$ , isodiametric to oblong, thick-walled, ± papillose

**capsule:** to 1 mm, oblong, lateral, exserted, horizontal or pendent, light brown; seta 7-9 mm, slender, reddish; annulate; calyptra cucullate; operculum curved long-rostrate; peristome hypnoid; spores  $16-20 \mu\text{m}$  in diam., yellowish, smooth



vegetative and subsidiary fronds, leaf outlines (2), and leaf apex

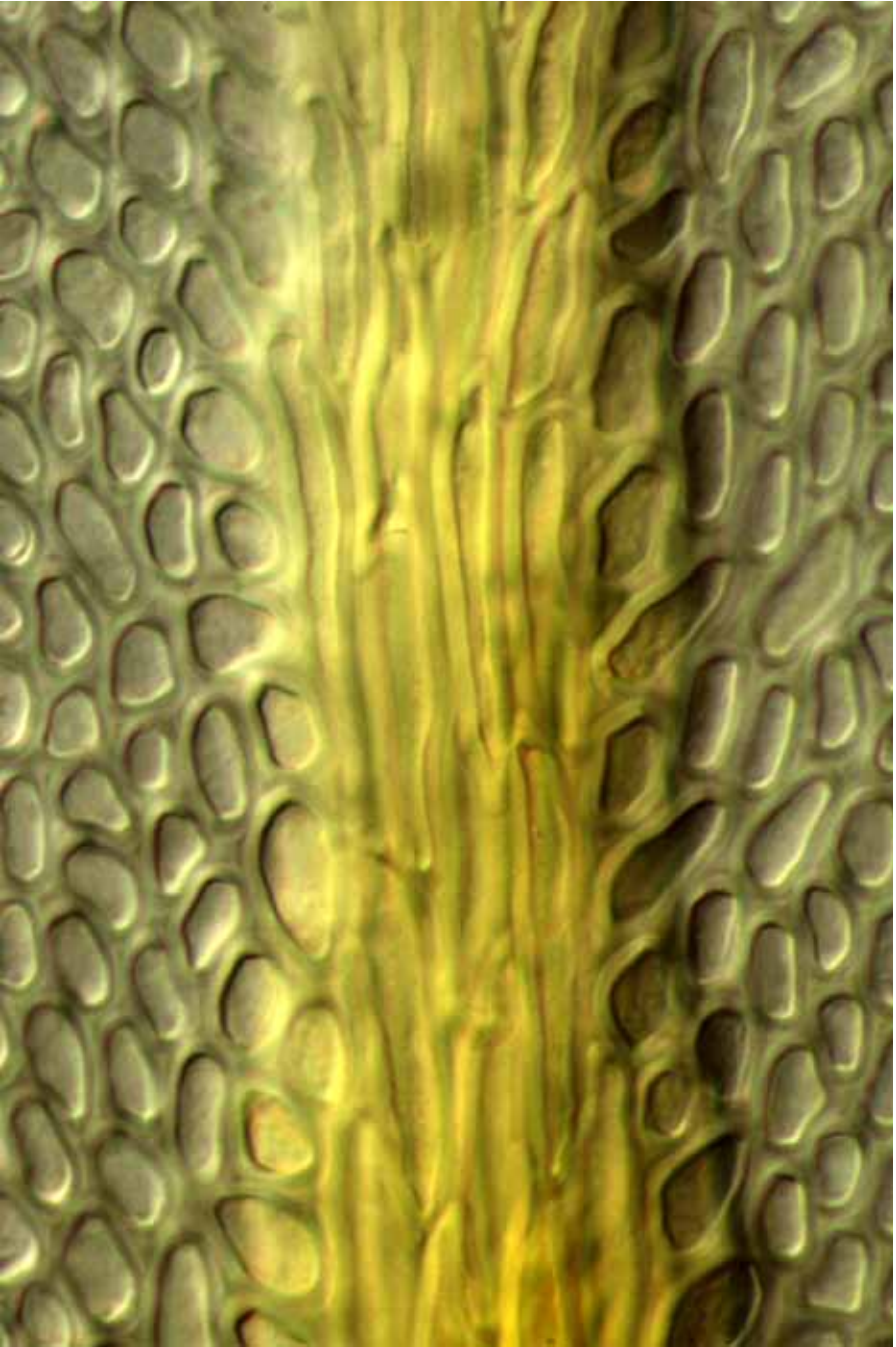
■ 1 mm, ■ 0.1 mm (2), ■  $10 \mu\text{m}$



margin at midleaf, costa near leaf base, and leaf basal angle

■  $10 \mu\text{m}$ , ■  $50 \mu\text{m}$ , ■  $50 \mu\text{m}$

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*Pendulothecium oblongifolium* costa midleaf  
10  $\mu$ m

continued next page

**Pendulothecium punctatum** (Hook.f. & Wils.) Enroth & S.He

**form:** primary stem creeping; secondary stem  $\pm$  unbranched, frondose, leaves yellowish or brownish, dull, dark green to sordid green

**habitat:** shaded bark, rock, or soil in damp to wet forest

**leaf:** size: to 1.8 mm

*shape:* obovate-orbicular

*tip:* obtuse to rounded,  $\pm$  mucronate

*base:* basal cells  $40 \times 5-7 \mu\text{m}$

*costa:* wide at the base, reaching above midleaf,  $\pm$  bifurcate

*border:* not differentiated

*margin:* irregularly dentate above, plane

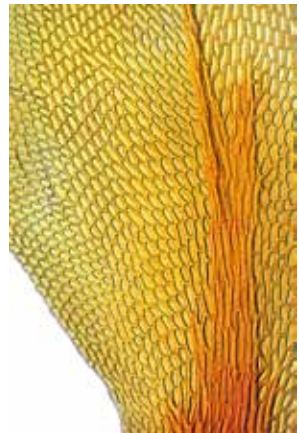
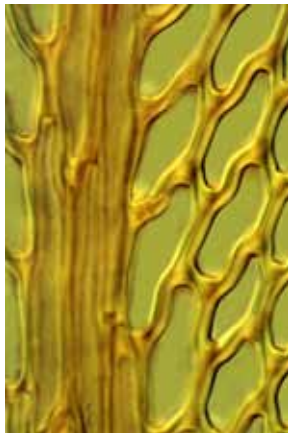
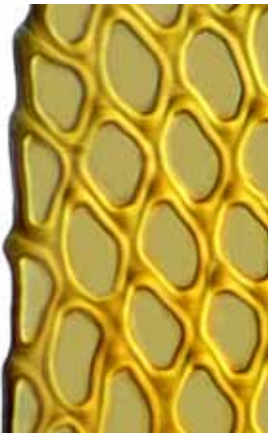
*cells:*  $10-20 \times 5-6 \mu\text{m}$ , quadrate to hexagonal, firm-walled, smooth

**capsule:** 1.3 mm; oblong to ellipsoid, exserted, cernuous to pendent, light brown; seta 13-15 mm, reddish, not twisted; calyptra cucullate; operculum curved conic-rostrate; peristome hypnoid; spores  $16-20 \mu\text{m}$  in diam., yellowish, smooth



vegetative habit, shoot, leaf outline, and leaf apex

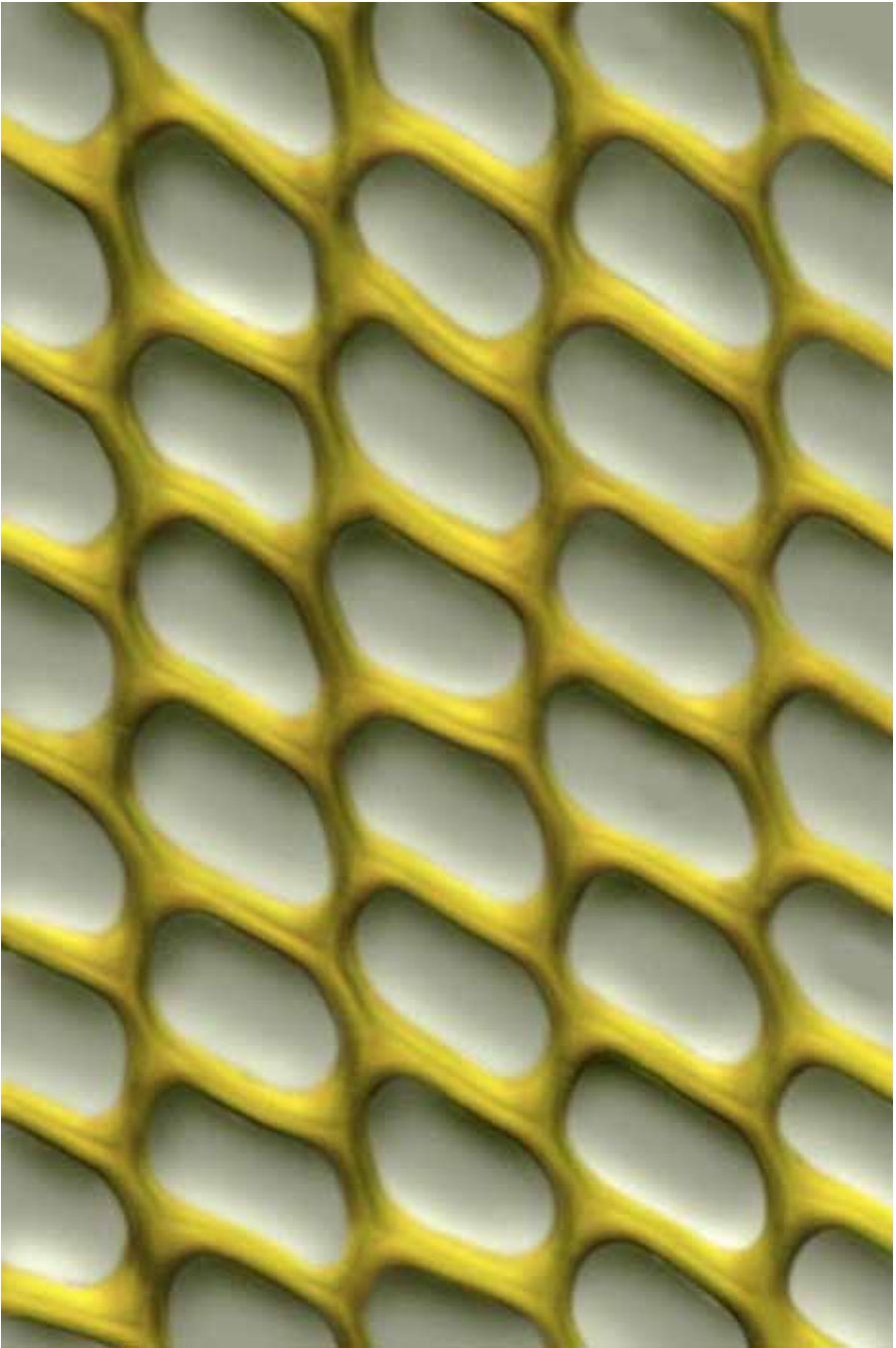
■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10  $\mu\text{m}$



margin at midleaf, costa at midleaf, and just above leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 50  $\mu\text{m}$

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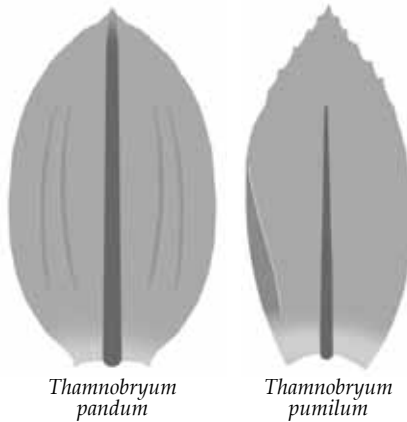
*Pendulothecium punctatum* cells midleaf  
10  $\mu\text{m}$



**Key\* to the New Zealand species of *Thamnobryum* (2)**

- 1 Leaves 1–2 mm long, ± plicate; costa failing just below the apex ..... ● ***Thamnobryum pandum***  
 1: Leaves < 1 mm long, not plicate; costa ending far below the apex ..... ● ***Thamnobryum pumilum***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 371.



**Thamnobryum pandum** (Hook.f. & Wilson) I.G.Stone & G.A.M.Scott

**form:** primary stem creeping, secondary stem wiry, arcuate, flexuose, frondose, to 100 mm long, leaves green to nearly black

**habitat:** soil (rarely bark) or rock, ± submerged in streams in damp forest

**leaf:** size: 1–2 mm

*shape:* oval to broadly oblong, concave below

*tip:* broadly acute

*base:* basal cells little differentiated

*costa:* stout, narrow above, failing below the apex

*border:* not differentiated

*margin:* irregularly coarsely serrulate, inflexed on one side

*cells:* 12–20 × 6–10 μm, 4–6-sided, firm-walled, smooth

**capsule:** 2–2.5 mm, broadly ovoid, symmetrical, exserted, inclined, brown; seta 10–20 mm, red, flexuose, smooth; calyptra cucullate, naked, smooth; operculum obliquely conic-rostrate; exostome teeth yellow, hyaline-bordered; endostome cilia 2–4; spores 10–12 μm in diam.



vegetative branch (2), leaf outline, and leaf apex

1 mm, 1 mm, 0.5 mm, 50 μm



margin at midleaf, cells at midleaf, and margin near leaf base

10 μm, 10 μm, 10 μm

continued next page

**Thamnobryum pumilum** (Hook.f. & Wilson) I.G.Stone & G.A.M.Scott

**form:** primary stem creeping; secondary stem complanate, stoloniferous, to 100 mm long, bipinnately branched, leaves dull green

**habitat:** rock in streams

**leaf:** size:  $0.8 \times 0.4$  mm

**shape:** elliptic-spathulate to oblong-spathulate,  $\pm$  asymmetric, concave

**tip:** acute to shortly acuminate

**base:** basal cells longer than the blade cells

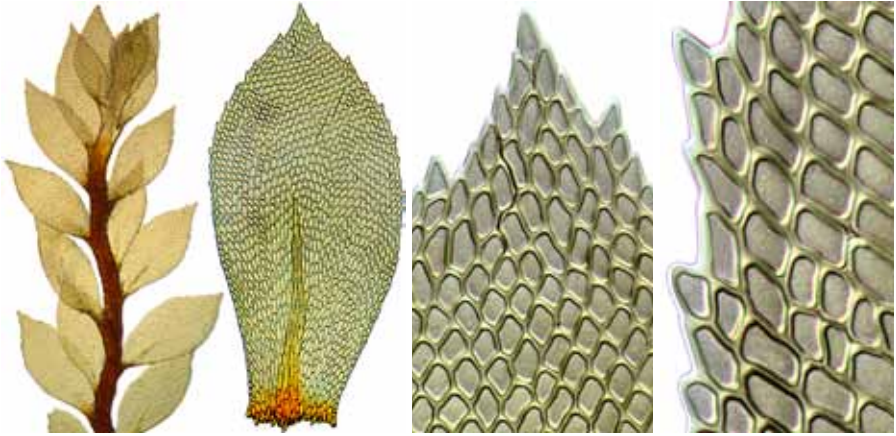
**costa:** stout below, failing far below the apex

**border:** not differentiated

**margin:** serrulate in upper half, plane to incurved on one side below

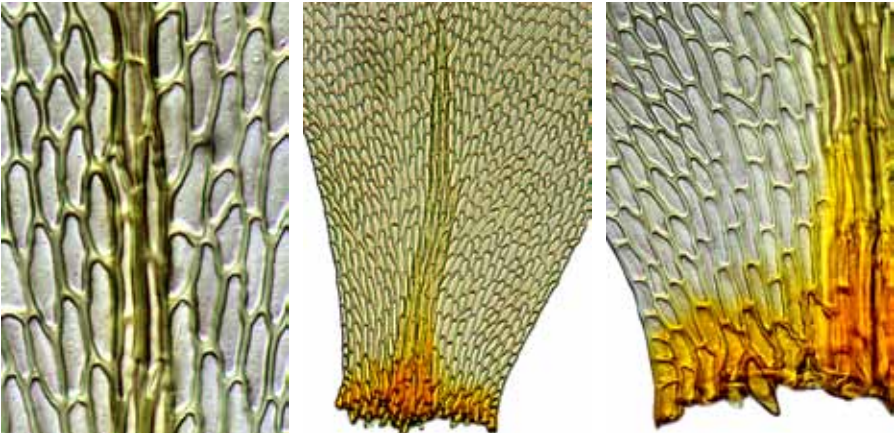
**cells:**  $12-16 \times 6-8 \mu\text{m}$ , irregularly 4-6-sided, firm-walled, smooth

**capsule:** 1.3-2 mm, ovoid,  $\pm$  asymmetric, gibbous, exserted, inclined, brown; seta 7-10 mm, curved, red; operculum erect conic-rostrate, calyptra cucullate, naked, smooth; exostome teeth cross-striolate, endostome cilia 2-4; spores 8-12  $\mu\text{m}$  in diam., green, smooth



shoot (cleared), leaf outline, leaf apex and margin midleaf

0.5 mm, 0.1 mm, 10  $\mu\text{m}$ , 10  $\mu\text{m}$

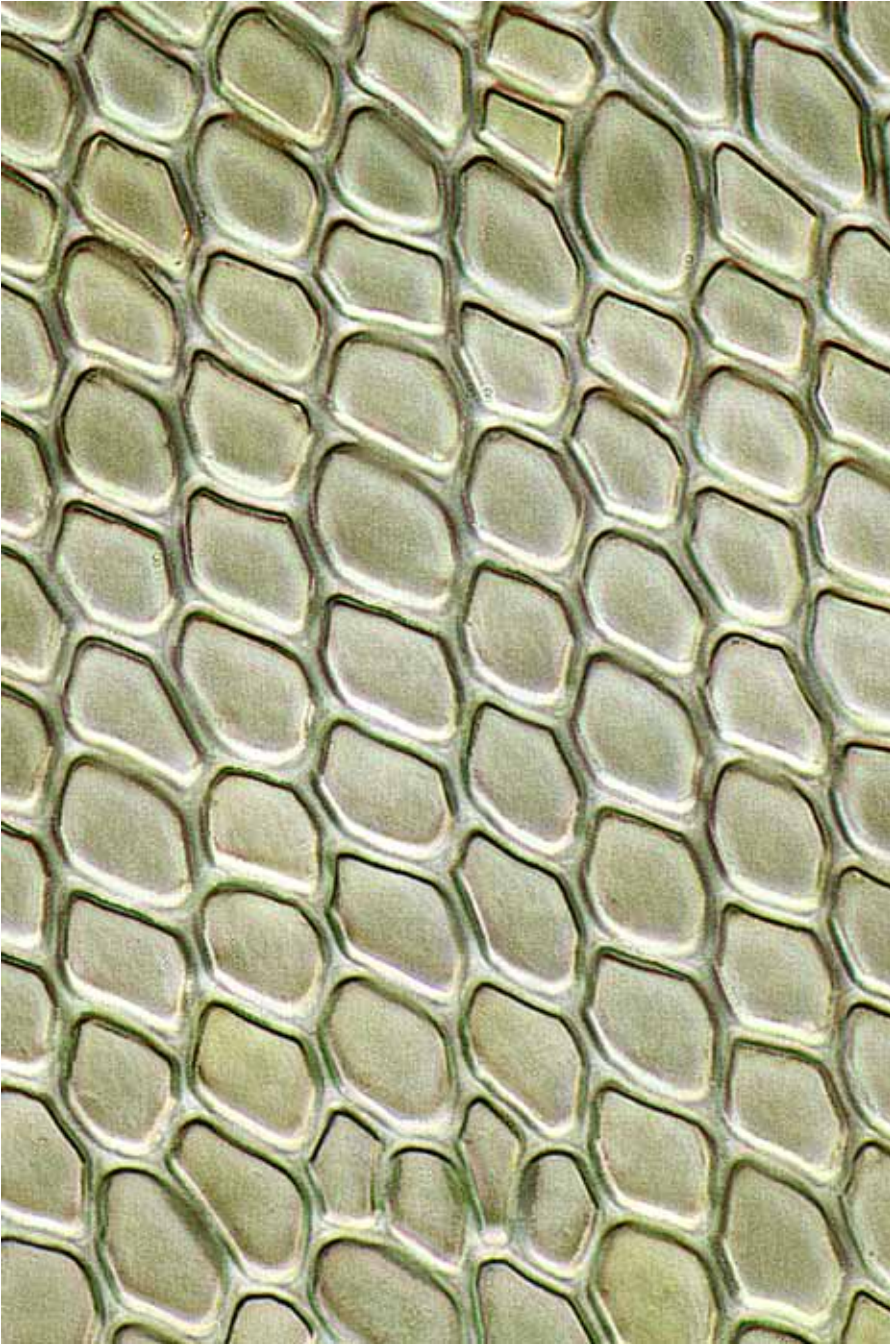


costa at midleaf, leaf base, and leaf basal angle

10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$



*Thamnobryum pumilum* costa terminus  
10  $\mu\text{m}$

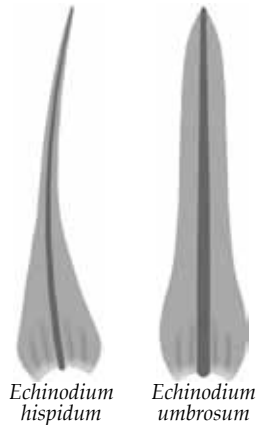


*Thamnobryum pumilum* lamina cells  
10  $\mu$ m

**Key\* to the New Zealand species of Echinodium (2)**

- 1 Plants robust; leaves 2.5–4 mm long, ovate-lanceolate; cells 8–15  $\mu\text{m}$  ..... ● **Echinodium hispidum**  
 1: Plants slender; leaves 1–2.5 mm long, ligulate or lingulate from a wider base; cells 6–8  $\mu\text{m}$  ..... ● **Echinodium umbrosum**

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 371.



**Echinodium hispidum** (Hook.f. & Wilson) Reichardt

**form:** primary stem wiry, creeping, ± leafless; secondary stem pinnately branched, rough, 40–100 mm long, leaves dull, dark green to yellow-green

**habitat:** soil, root bark, or rock, sometimes aquatic, in damp to wet forest

**leaf:** size: 3.5–5 × 0.9–1.3 mm

*shape:* subulate from a triangular base, ± plicate at the base

*tip:* long-acute

*base:* basal cells longer than the blade cells

*costa:* long-excurrent in a rigid arista

*border:* not differentiated

*margin:* entire, plane or recurved below on one side, variably bistratose above

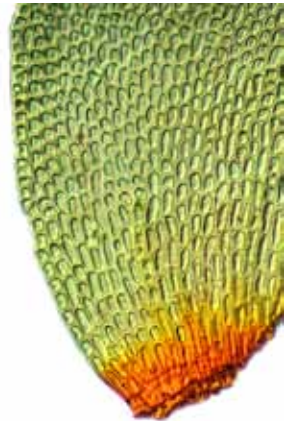
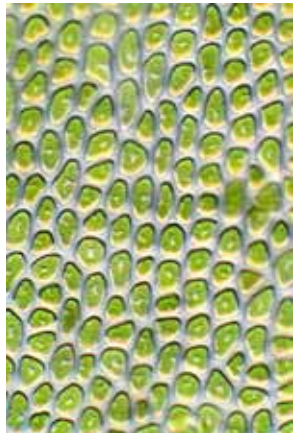
*cells:* 4–12 μm, quadrate to fusiform, incrassate, smooth

**capsule:** 1.5–2.0 mm, ± curved, reddish brown; oval, long-exserted, inclined to horizontal, dark brown; seta 10–25 mm; calyptra cucullate, smooth; operculum obliquely long-rostrate; exostome teeth orange, striate, endostome cilia 2; spores 12–14 μm in diam., papillose



shoots (moist on right) (3), mature capsule (2), leaf outline, and leaf apex

5 mm, 1 mm (2), 1 mm, 1 mm, 0.5 mm, 10 μm



leaf margin, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 50 μm

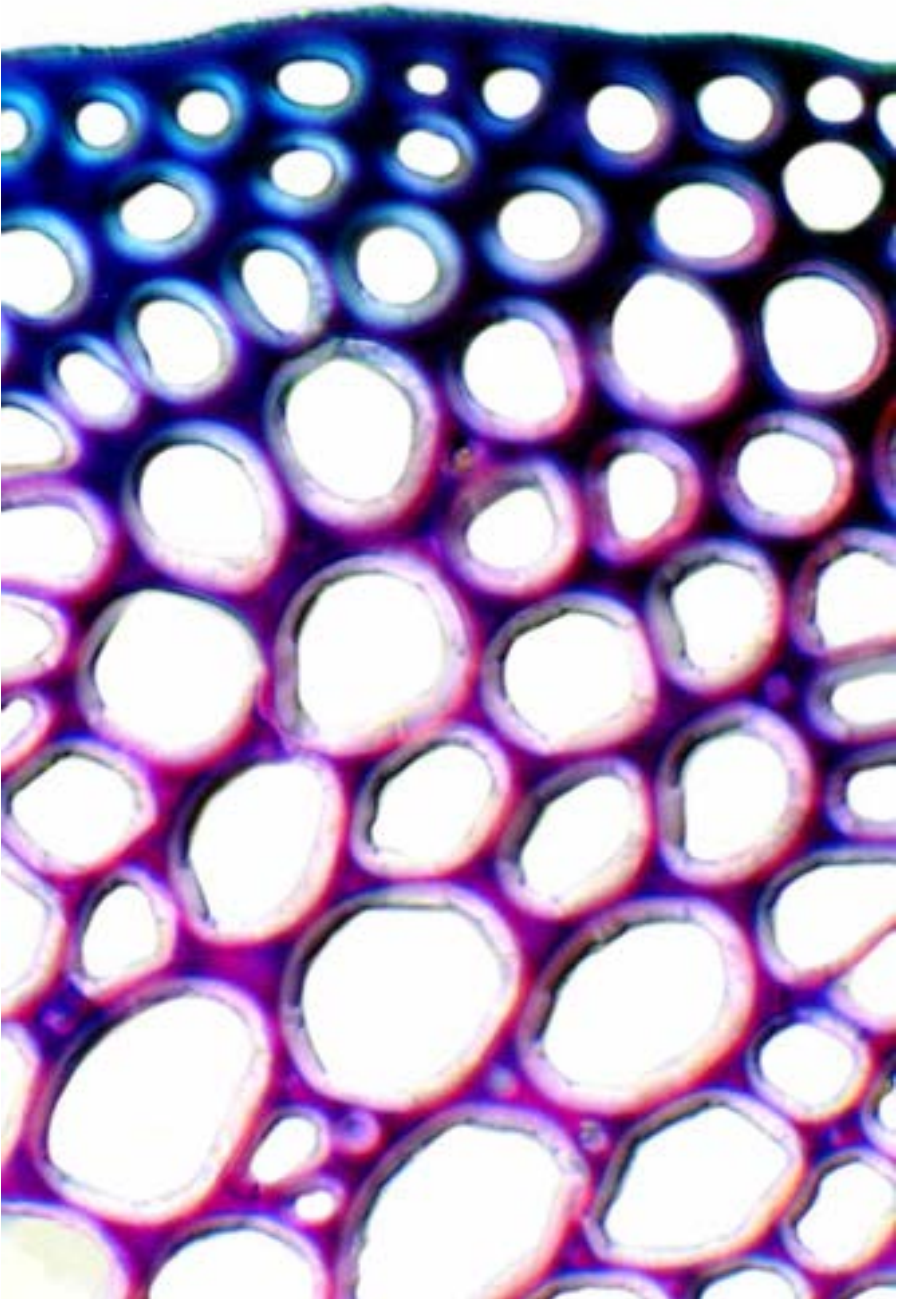
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*Echinodium hispidum* vegetative shoot  
5 mm

continued next page





*Echinodium hispidum* stem cross-section showing outermost stiffening collar  
10  $\mu\text{m}$

continued next page



*Echinodium hispidum* leaf cross-section showing prominent costa  
■ 50  $\mu\text{m}$  (above), ■ 10  $\mu\text{m}$  (below)

continued next page

**Echinodium umbrosum** (Mitt.) A. Jaeger

**form:** primary stem creeping; secondary stem to 30 mm long, pseudoparaphylliate, leaves dark green to blackish, dull or glossy

**habitat:** soil and rock in damp shady forest

**leaf:** size: 2–3 × 0.3–0.5 mm

*shape:* lanceolate from a narrowly ovate base, ± plicate below

*tip:* acute, ± curved

*base:* basal margin cells longer than other lamina cells, 12–22 μm

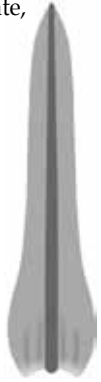
*costa:* stout and wide, percurrent to shortly excurrent

*border:* not differentiated

*margin:* denticulate to serrate above, plane

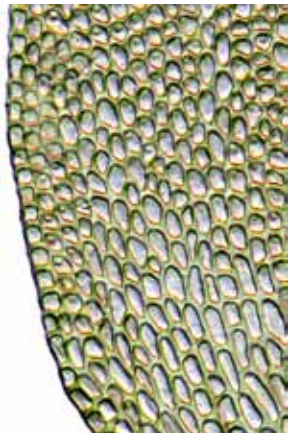
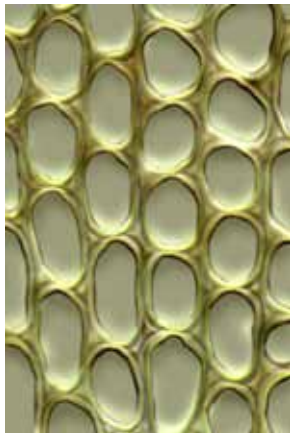
*cells:* 6–10 μm, rounded-quadrate to oblong, thick-walled, ± prorulose

**capsule:** 1.2 mm; subglobose, exserted, inclined, reddish-orange; operculum long-rostrate; annulus uniseriate; seta 12–20 mm, dark reddish orange; calyptra cucullate, smooth; exostome teeth 550 × 100 μm, endostome segments shorter, cilia 2; spores 12–14 μm in diam., papillose



vegetative habit, leaf outline, and leaf apex (2)

1 mm, 0.5 mm, 100 μm, 50 μm



margin at midleaf, cells at midleaf, and just above leaf basal angle

10 μm, 10 μm, 50 μm

continued next page



*Echinodium umbrosum* vegetative habit

1 mm

**Leptodon smithii** (Hedw.) F.Weber & D.Mohr

**form:** primary stems creeping, brittle; secondary stems to 30 mm long, ± pinnately branched, strongly incurled when dry, paraphylliate, leaves 8-ranked, lateral leaves spreading, dorsal and ventral leaves appressed

**habitat:** bark or limestone rock in dryish forest, sea level to 1360 m

**leaf:** size: stem leaves  $0.5\text{--}0.7 \times 0.3\text{--}0.5$  mm; branch leaves smaller

*shape:* orbicular-ovate to elliptic, ± asymmetric, weakly plicate

*tip:* obtuse to rounded

*base:* cells in mid-base slightly longer than the blade cells

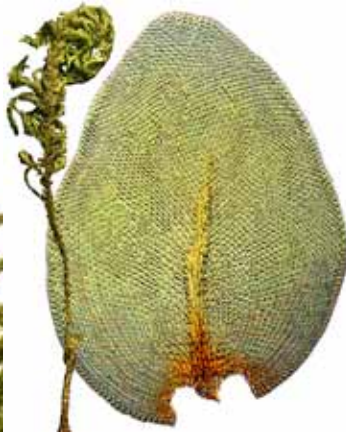
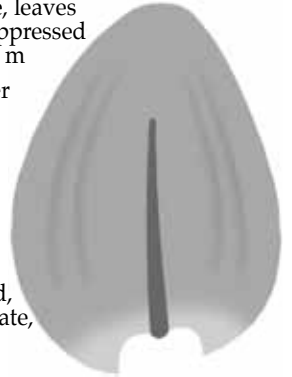
*costa:* wide below, reaching  $3/4$  up lamina, ± spurred

*border:* not differentiated

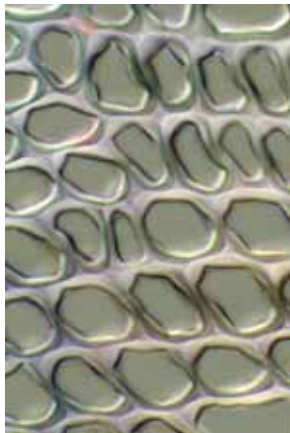
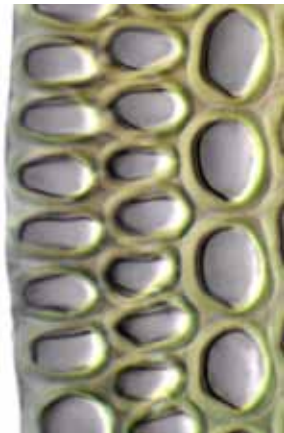
*margin:* entire, inrolled on one side below

*cells:*  $9\text{--}15 \times 5\text{--}7$   $\mu\text{m}$ , ± oval, thick-walled, smooth to ± papillose

**capsule:** 2 mm, ellipsoid, symmetrical, exserted, erect or inclined, orange; seta to 3 mm, lateral, curved, dark red; calyptra cucullate, erect-hairy; operculum acuminate; endostome reduced

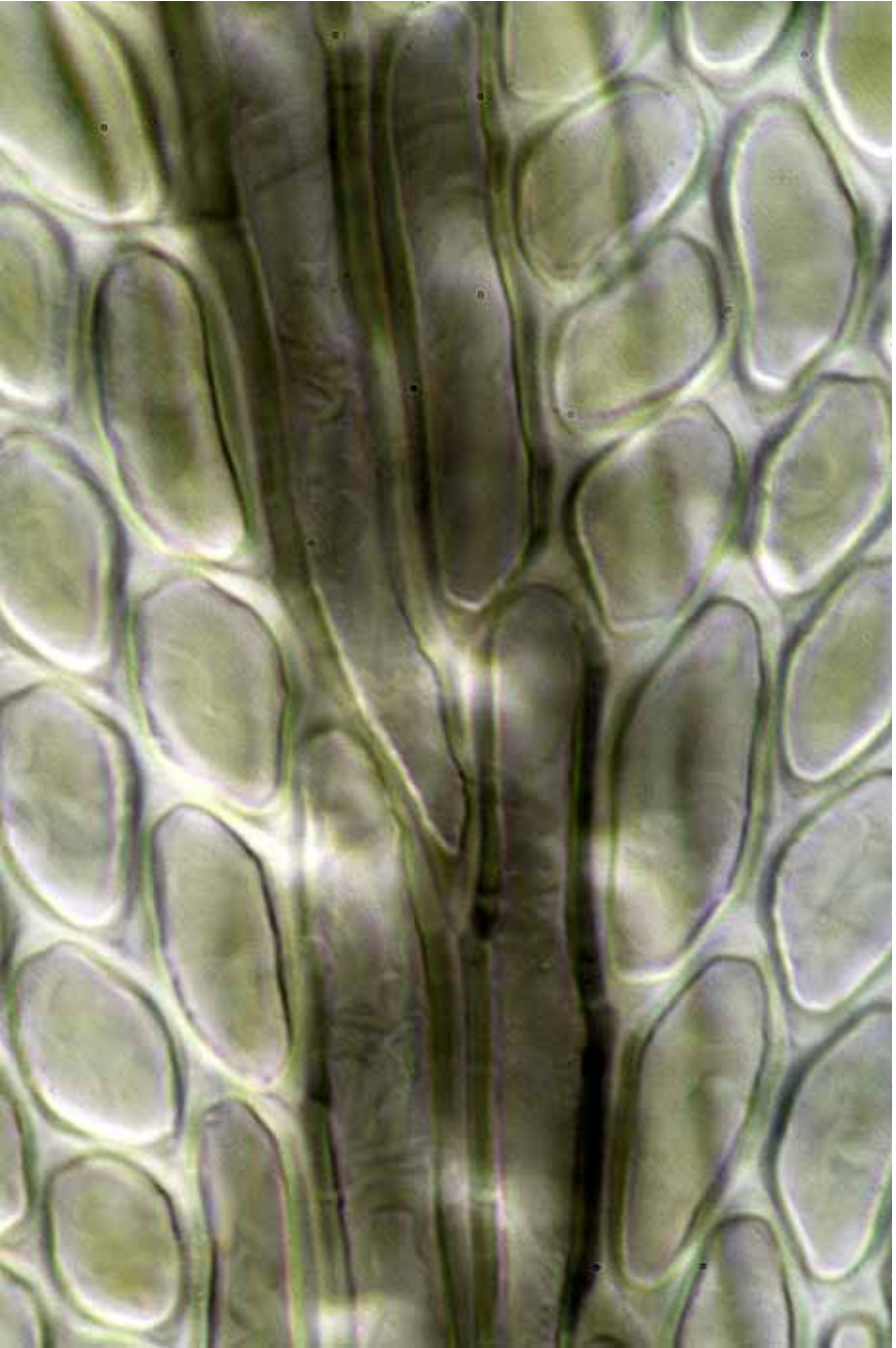


vegetative shoot apex (moist), shoot (dry), leaf outline, and leaf apex  
 5 mm, 5 mm, 0.25 mm, 50  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle  
 10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 50  $\mu\text{m}$

continued next page



*Leptodon smithii* costa midleaf  
10  $\mu$ m

**Acrocladium chlamydophyllum** (Hook.f. & Wilson) Müll.Hal. & Broth.

**form:** tufted, procumbent, branched stems, 30–60 mm long,  
leaves yellow or yellow-green, glossy

**habitat:** soil or rotting wood, rarely rock, ± aquatic

**leaf:** *size:* 1.3–1.5 × 1.4–1.6 mm (wider than long)

*shape:* elliptic, concave, decurrent at the base

*tip:* rounded or obtuse

*base:* alar cells large, thin-walled, and hyaline

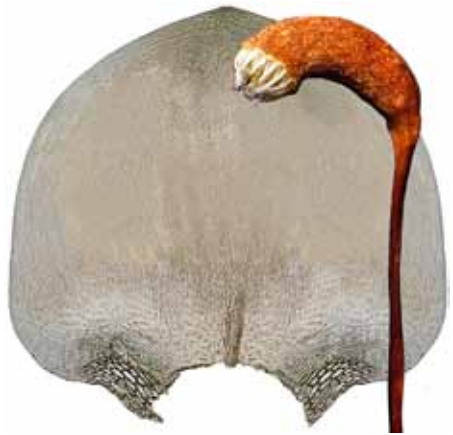
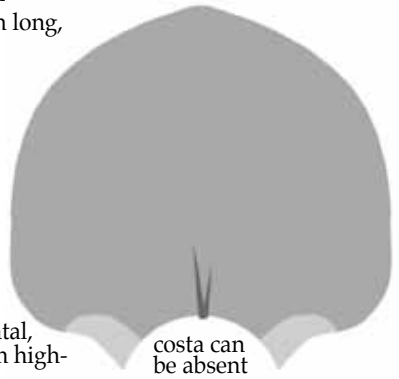
*costa:* absent, single and faint, or short and double

*border:* not differentiated

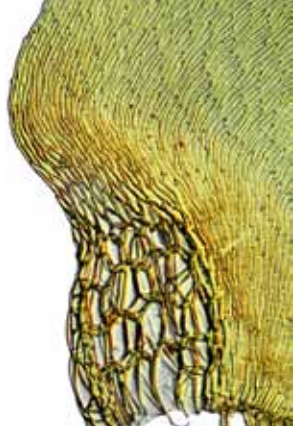
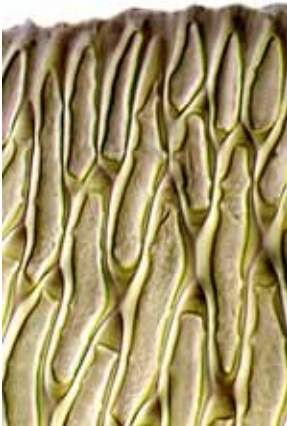
*margin:* entire, plane

*cells:* 50–80 × 4–6 μm, linear-vermicular, incrassate,  
smooth; cells near the leaf base porose

**capsule:** 1.5–2 mm; oblong, curved, exserted, horizontal,  
pale brown; seta 20–40 mm, slender, red; operculum high-  
conic, calyptra cucullate; peristome hypnoid



vegetative habit, shoot apex, leaf outline, and mature capsule  
 1 mm, 1 mm, 0.1 mm, 1 mm



rounded leaf apex, non-porose midleaf cells, and alar cells in leaf basal angle  
 5 μm, 5 μm, 50 μm



*Acrocladium chlamydophyllum* vegetative shoot (dry)  
5 mm (whole shoot),

1 mm (detail on left)

**continued next page**

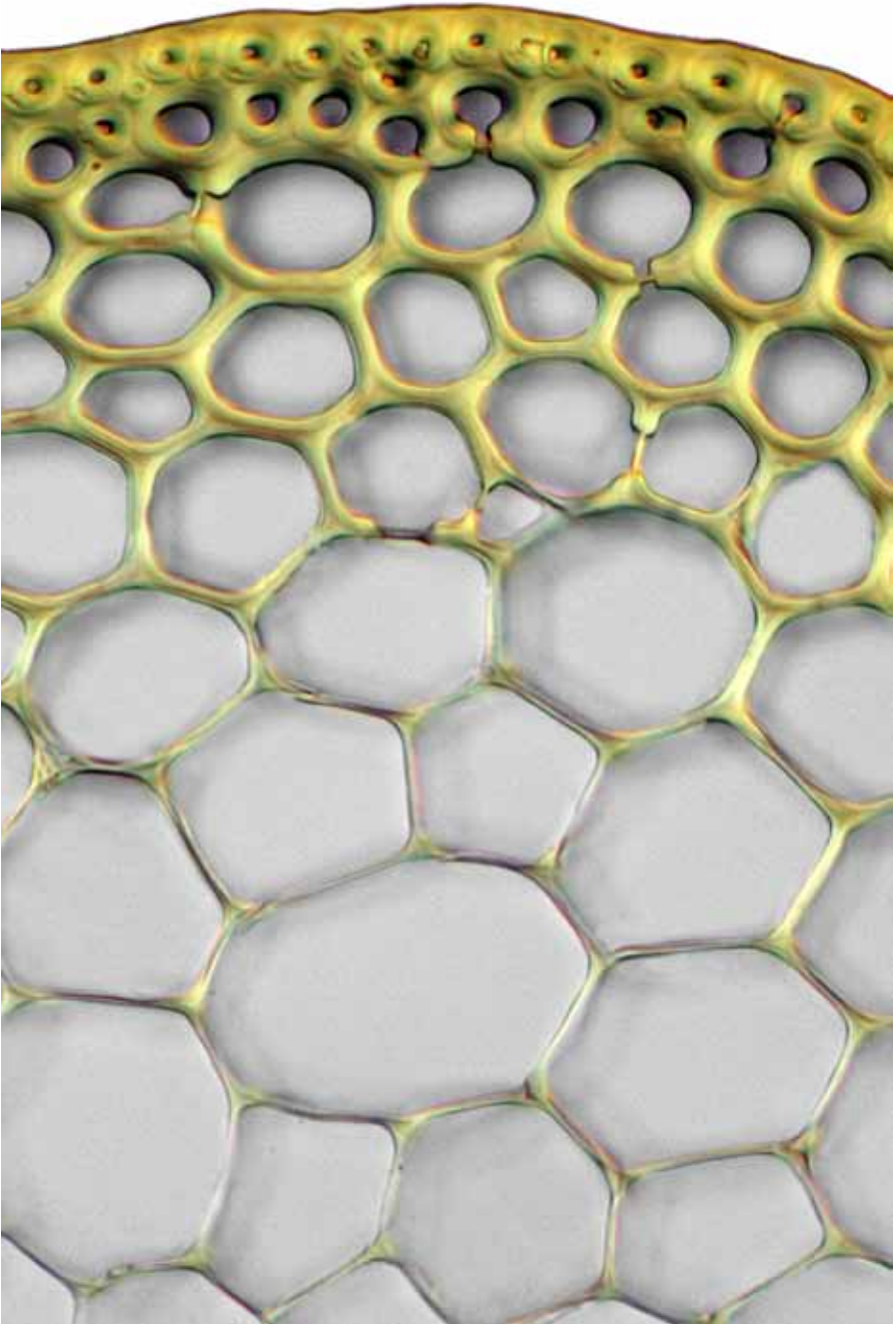




*Acrocladium chlamydophyllum* mature capsule (dry)

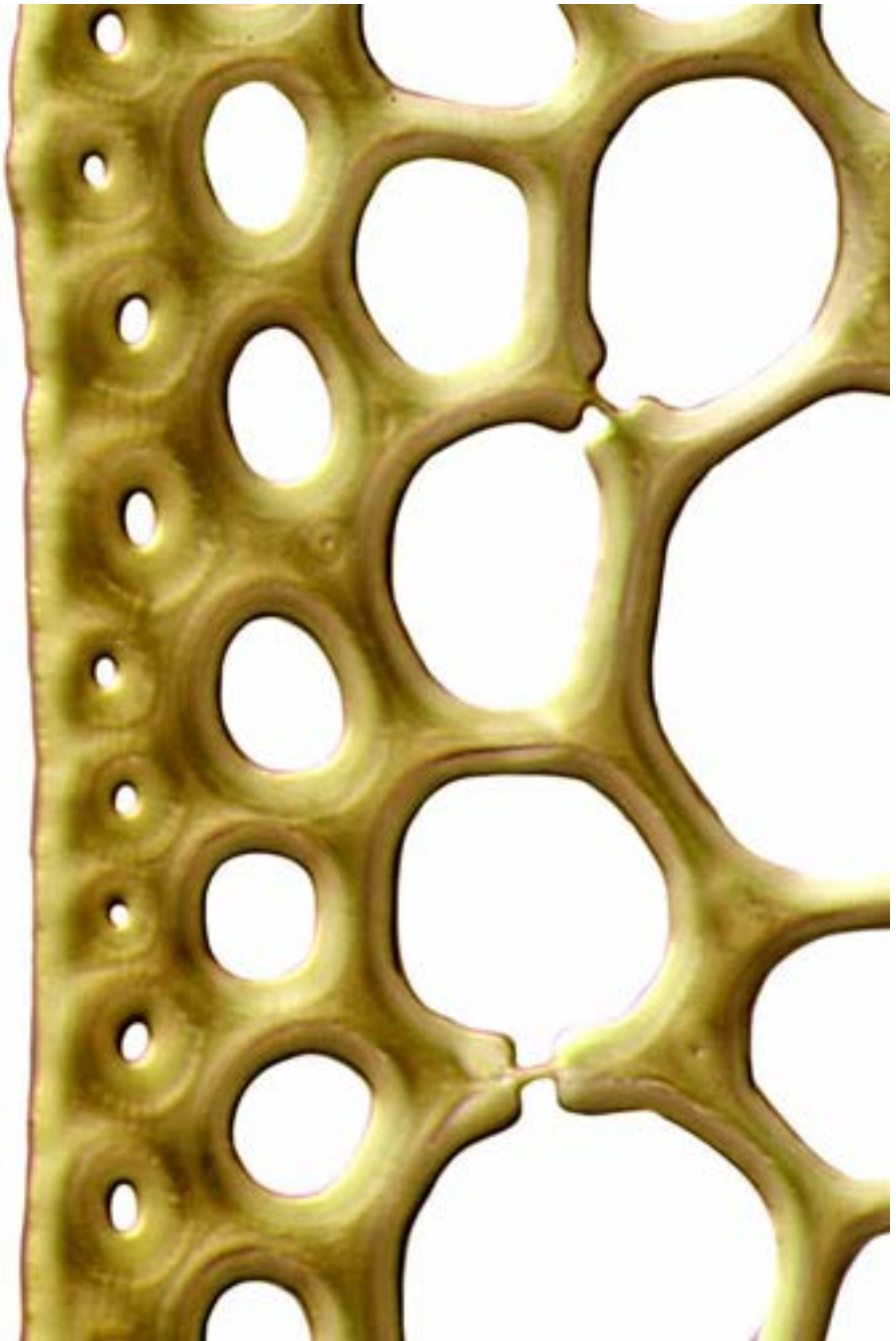
0.5 mm

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*Acrocladium chlamydophyllum* stem cross-section  
10  $\mu\text{m}$

continued next page



*Acrocladium chlamydophyllum* stem cross-section  
10  $\mu\text{m}$

continued next page

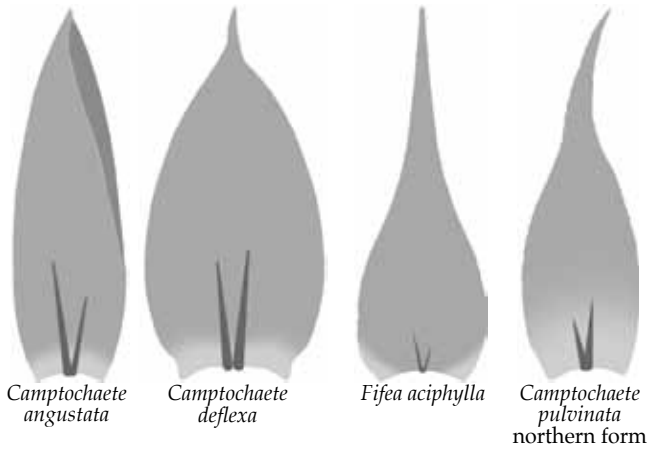
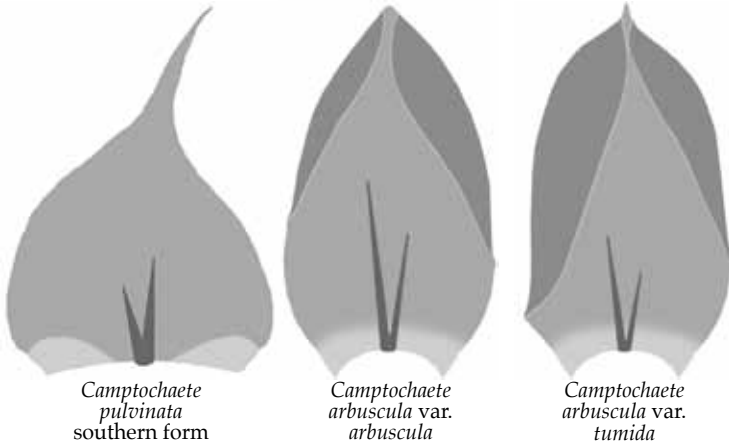


*Acrocladium chlamydophyllum* leaf cross-sections (on left, margin near leaf base)  
5  $\mu$ m

**Key\* to the New Zealand species and varieties of *Camptochaete* (5) and *Fifea* (1)**

- 1 Leaves of branches and the frond axis falcate-secund..... ● ***Camptochaete pulvinata***  
 1: Leaves of branches and the frond axis not falcate-secund.....2
- 2(1:) Apex of leaves of the branches and frond axis ending in a long-aciculate acumen  
 6–10 cells long; terminal cell > 75  $\mu\text{m}$  long ..... ● ***Fifea aciphylla***  
 2: Apex of leaves of the branches and frond axis obtuse, broadly acute, or acuminate,  
 lacking an aciculate acumen, 1–2 cells at the most; terminal cell < 50  $\mu\text{m}$  long.....3
- 3(2:) Branch leaves narrowly ovate-lanceolate, serrulate..... ● ***Camptochaete angustata***  
 3: Branch leaves broadly ovate to oblong, entire or nearly so.....4
- 4(3:) Leaves not markedly altered when dry; cells in apex 4–7. ● ***Camptochaete deflexa***  
 4: Leaves collapsed and wrinkled when dry; cells in apex < 2 .....5
- 5(4:) Branches and frond axes mostly complanate, untidy in appearance, the leaves not  
 in neat spirals; leaves obtuse to acuminate ● ***Camptochaete arbuscula* var. *arbuscula***  
 5: Branches and frond axes inflated and loosely julaceous, the leaves arranged in neat  
 catenulate spirals; leaves abruptly mucronate ● ***Camptochaete arbuscula* var. *tumida***

\* based on Tangney, RS (1997): A generic revision of the genus *Camptochaete* Reichdt.,  
 Lembophyllaceae (Musci). *Journal of the Hattori Botanical Laboratory* **81**, 79.



**Camptochaete angustata** (Mitt.) Reichardt

**form:** primary stem stoloniform; secondary stem branched, dendroid, 30–60 mm long, leaves dark green to brownish or yellowish green

**habitat:** tree bark, rotting logs, exposed roots, and rock in forest, 0–600 m

**leaf:** size: axis leaves  $1.8\text{--}2.2 \times 0.6\text{--}0.9$  mm; branch leaves  $0.9\text{--}1.5 \times 0.2\text{--}0.4$  mm

**shape:** axis leaves narrowly ovate-oblong; branch leaves narrowly elliptic

**tip:** acute

**base:** alar cells  $\pm$  quadrate, in a triangular group

**costa:** long and double, reaching about midleaf, but sometimes absent

**border:** not differentiated

**margin:**  $\pm$  entire below, irregularly denticulate above, plane

**cells:**  $40\text{--}70 \times 5\text{--}8$   $\mu\text{m}$ , linear, firm- to thick-walled, smooth

**capsule:** 1.5–2.0 mm, oblong-cylindric, exserted, inclined to horizontal, reddish brown; seta 6–8 mm, reddish brown; operulum conic or apiculate; exostome teeth striate below, baculate above (covered in rods that are longer than wide), endostome cilia nodose, baculate; spores 15–18  $\mu\text{m}$  in diam.

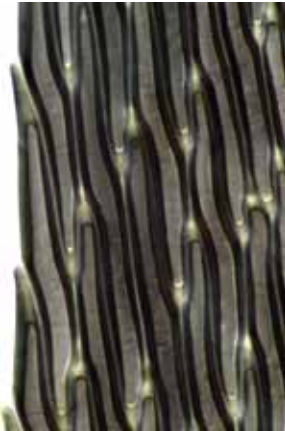


costa can be absent



portion of vegetative frond and shoot (dry), leaf outline, and leaf apex

5 mm, 1 mm, 0.1 mm, 10  $\mu\text{m}$



margin at midleaf, cells at midleaf, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

continued next page

**Camptochaete arbuscula** (Sm.) Reichdt. var. **arbuscula**

**form:** primary stem stoloniform; secondary stem dendroid, branched, 40–60(–110) mm long, leaves pale green to yellow-green, glossy

**habitat:** logs, tree bark, or rarely soil in damp forest

**leaf:** size: stem leaves 1.5–2.5 × 0.8–1.4 mm; branch leaves smaller

*shape:* ovate, concave

*tip:* acute

*base:* basal cells wider and longer than blade cells

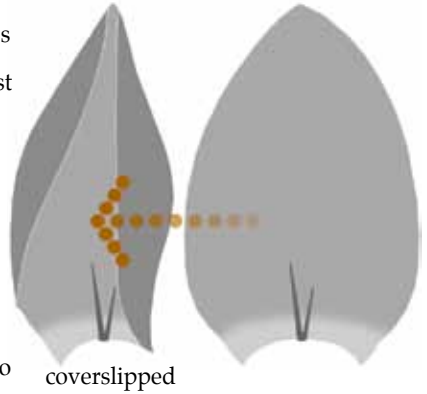
*costa:* faint, short and double

*border:* not differentiated

*margin:* entire below, ± denticulate above, plane

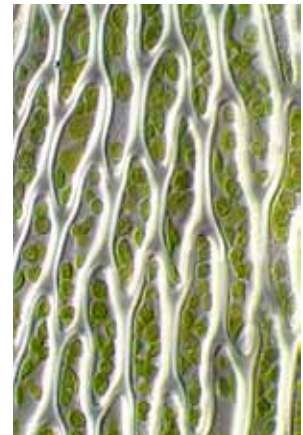
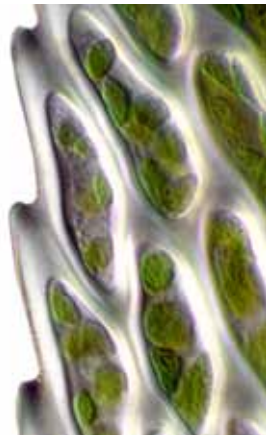
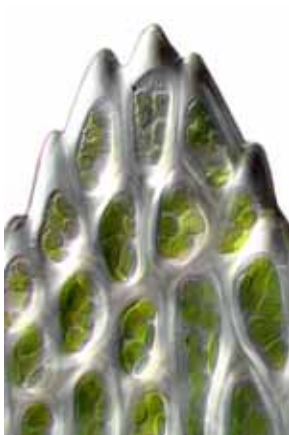
*cells:* 20–25 × 5–7 μm, rhombic, ± sigmoid, firm-walled, smooth

**capsule:** 1.5–2.5 mm, exserted, oval-oblong, erect to cernuous, brown; seta 3–10 mm, lateral



vegetative habit, fertile shoot, leaf outline, and immature capsule

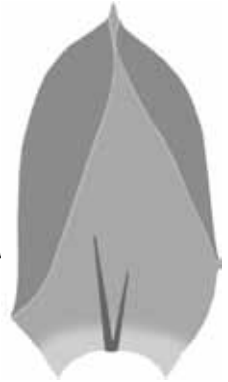
50 mm, 5 mm, 0.5 mm, 0.5 mm



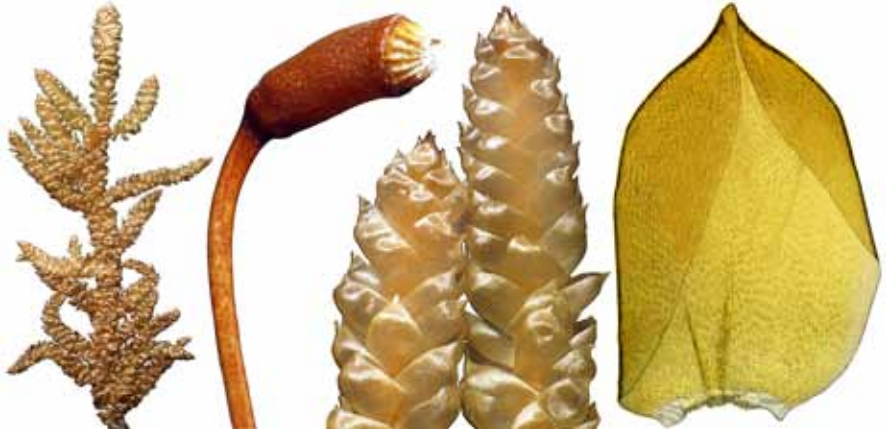
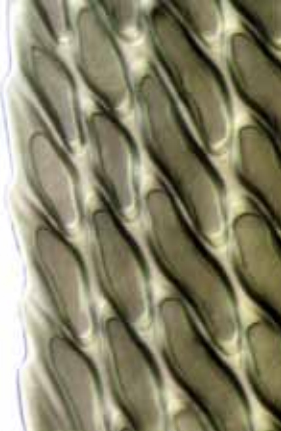
leaf apex, margin at midleaf, and cells midleaf

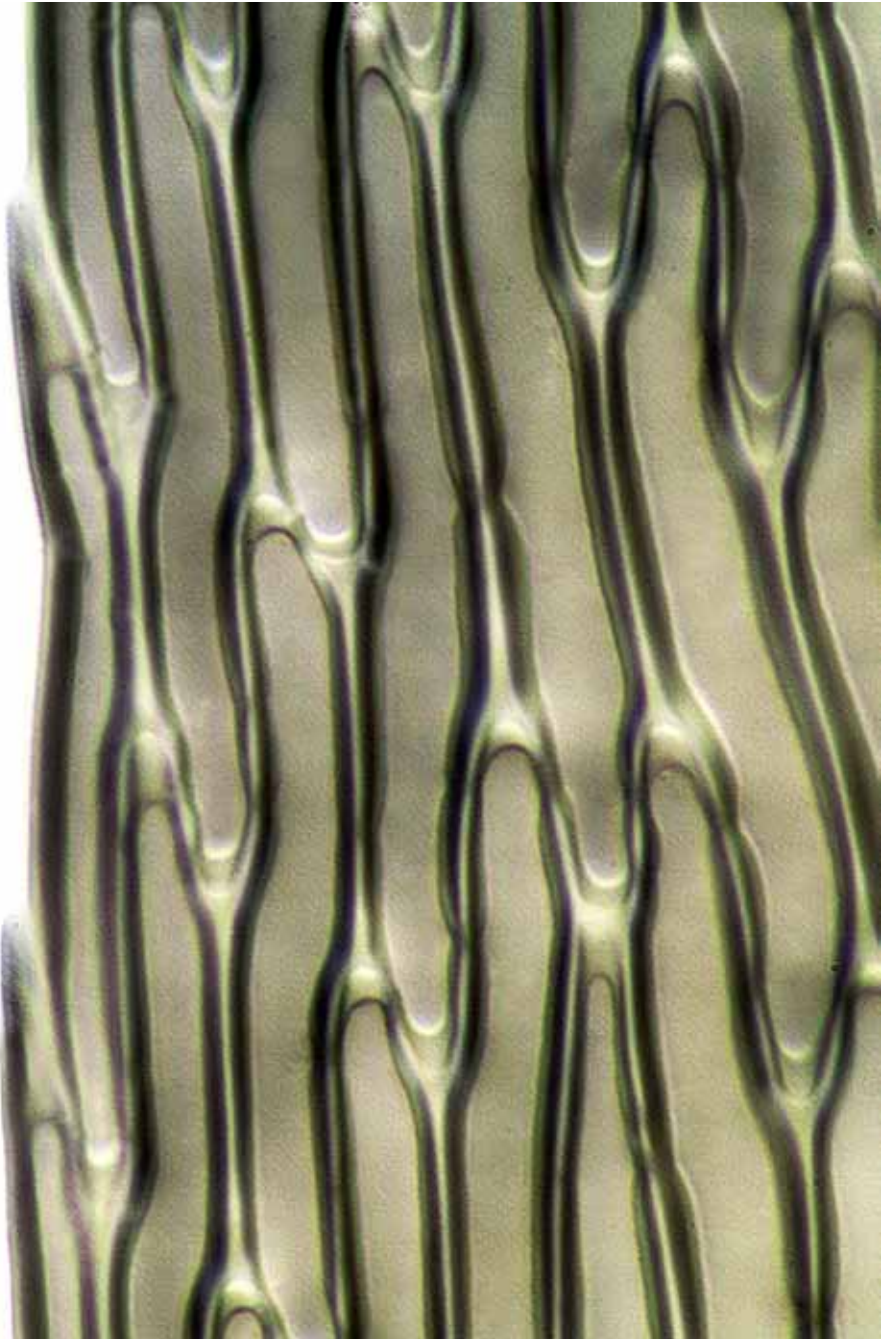
10 μm, 10 μm, 10 μm



**Camptochaete arbuscula** var. **tumida** Tangney**form:** matted, creeping, ± pinnately branched, ± julaceous stems**habitat:** soil or bark of exposed tree roots, in forest to 900 m**leaf:** size: 2.0–1.3 mm*shape:* widely ovate to oblong, deeply concave*tip:* rounded to obtuse, cucullate with a short mucro*base:* alar cells in a distinct group, shorter than other laminal cells*costa:* faint, short and double*border:* not differentiated*margin:* entire below, weakly denticulate above, plane*cells:* 15–50 × 4–9 μm, linear-rhombic, ± sigmoid, firm- to thick-walled, smooth**capsule:** to 2.2 mm, oblong-cylindric, horizontal, exerted, reddish brown; seta 8–13 mm; calyptra cucullate; peristome double

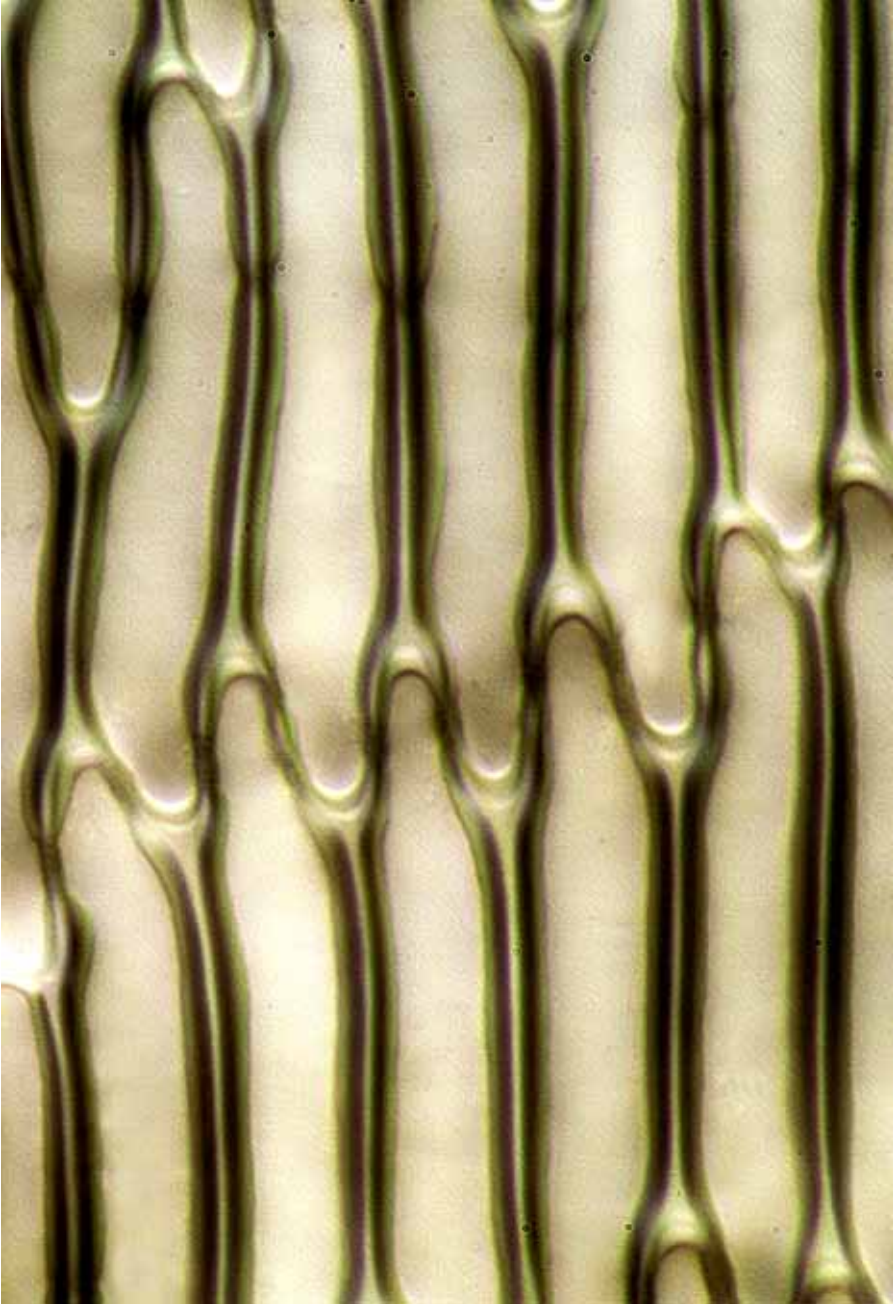
coverslipped

vegetative shoot (dry), capsule (dry), shoot tips (dry), and leaf outline (coverslipped)  
5 mm, 1 mm, 1 mm, 0.5 mmmucronate leaf apex, margin of upper leaf, and leaf basal angle  
50 μm, 10 μm, 50 μm



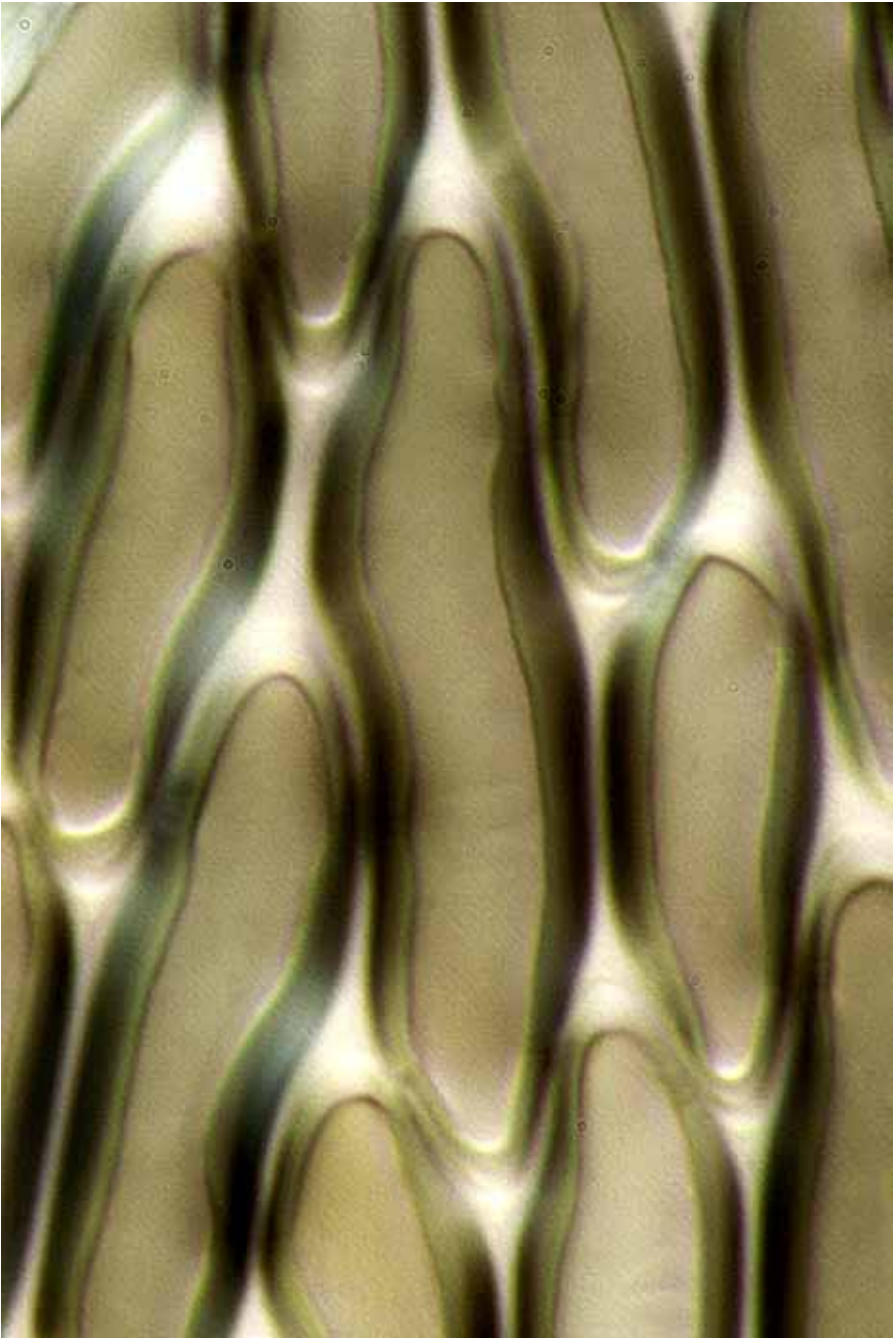
*Camptochaete arbuscula* var. *tumida* margin midleaf  
10  $\mu$ m

continued next page



*Camptochaete arbuscula* var. *tumida* cells of lower leaf  
10  $\mu$ m

continued next page



*Camptochaete arbuscula* var. *tumida* cells of upper leaf  
10  $\mu$ m

continued next page

**Camptochaete deflexa** (Wilson) A.Jaeger

**form:** primary stem stoloniform; secondary stem dendroid, 40–80(–100) mm long, branched, leaves dark green or olive-green

**habitat:** rock and exposed roots in damp lowland forest, sea level to 1100 m

**leaf:** size: 1.5–2.5 × 1.2–1.8 mm

*shape:* widely ovate, concave

*tip:* shortly apiculate

*base:* basal cells thinner-walled than the other blade cells

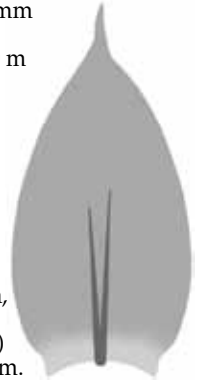
*costa:* long and double

*border:* not differentiated

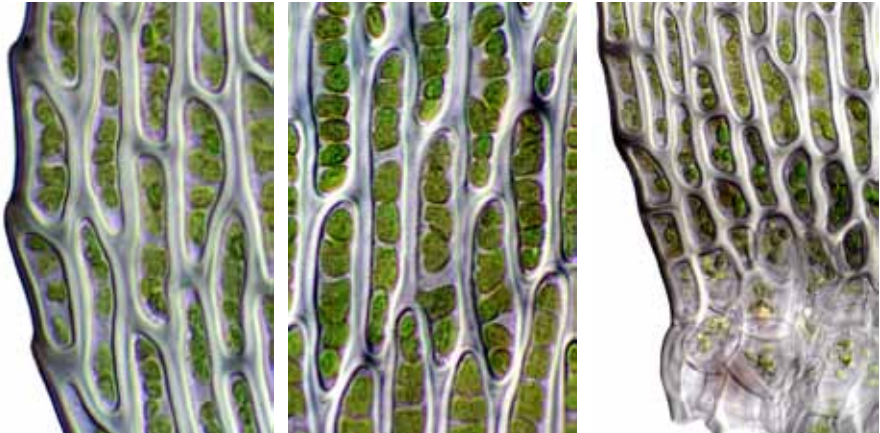
*margin:* entire below, irregularly denticulate above, plane

*cells:* 20–25 × 5–7 μm, linear-rhombic, firm-walled, smooth

**capsule:** 1.5–2.5 mm, oval-oblong, exserted, erect to cernuous, red-brown, seta 3–10 mm, lateral; operculum blunt or apiculate; exostome teeth, cross-striate below, baculate (covered in rods that are longer than wide) above, endostome cilia 2–3, nodulose, baculate; spores 13–15 μm in diam.



dendroid vegetative shoot (moist), branchlet, capsule, leaf outline, and leaf apex  
 10 mm, 1 mm, 1 mm, 0.5 mm, 10 μm



margin of lower leaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

continued next page



*Camptochaete deflexa* leaf apex  
10  $\mu$ m

continued next page



*Camptochaete deflexa* midleaf cells  
10  $\mu\text{m}$

**Camptochaete pulvinata** (Hook.f. & Wilson) A.Jaeger

**form:** primary stem creeping; secondary stem complanate, pinnately branched, dendroid; leaves pale green to olive-green

**habitat:** soil, bark of tree bases, or rock in forest, sea level to 930 m

**leaf:** size: 1.0–1.7 × 0.6–1.5 mm

**shape:** lanceolate to widely ovate, strongly concave, falcate-secund tip: abruptly narrowed to an acute apex

**base:** basal cells ± rectangular, ± porose; alar region 7–12 × 7–11 μm

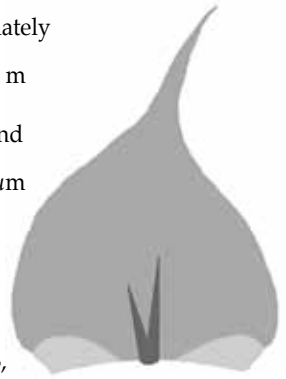
**costa:** absent or weak, short and double

**border:** not differentiated

**margin:** entire to denticulate, plane to incurved

**cells:** 40–80 × 5 μm, ± rhombic, thick-walled, smooth

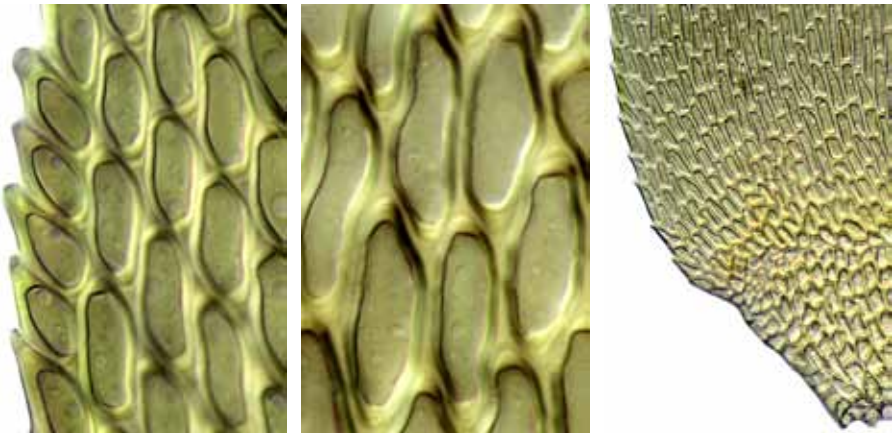
**capsule:** 1–2 mm, cylindric, lateral, exserted, inclined to horizontal; seta 8–10 mm, reddish brown to purple; brown; operculum ± apiculate; peristome double, endostome cilia 2–3, finely bullate; spores 10–12 μm in diam.



southern form



vegetative shoot (dry), leaf outlines (northern and southern forms), and leaf apex  
 1 mm, 0.5 mm (2), 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 50 μm



**Fifea aciphylla** (Dixon & Sainsbury) H.A.Crum

**form:** primary stem creeping, secondary stem pinnately branched, the branches curved, flexuose, to 10 mm long, leaves green to golden

**habitat:** soil in damp shady forest

**leaf:** size: 0.8–1.0 mm

*shape:* ovate-lanceolate base contracting to a long acumen, concave

*tip:* long-acuminate, the terminal cell 50–75  $\mu\text{m}$  long

*base:* basal cells shorter than the other lamina cells

*costa:* none or short and double

*border:* not differentiated

*margin:* entire to faintly serrulate, plane

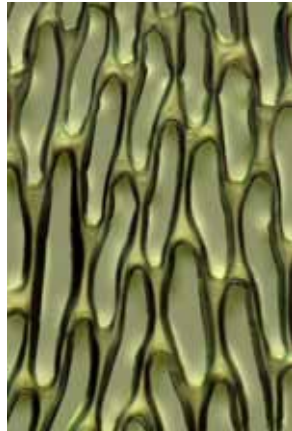
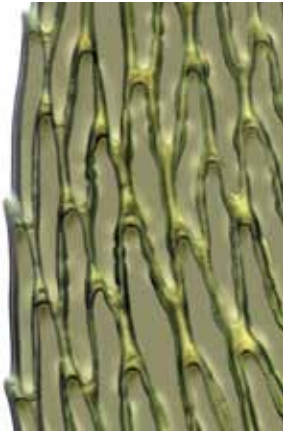
*cells:* 25–40  $\times$  8–10  $\mu\text{m}$ , rounded-rhombic, firm-walled, smooth

**capsule:** 1.5 mm, ovoid, asymmetric, exserted, erect to cernuous, brown to castaneous; seta 10 mm, red, slender; annulate; operculum high-conic, bluntly apiculate; exostome teeth joined basally, cross-striolate, endostome cilia nodulose; spores 12–16  $\mu\text{m}$  in diam., smooth



vegetative frond and shoot (dry) (2), leaf outline, and leaf apex (2)

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 50  $\mu\text{m}$ , ■ 50  $\mu\text{m}$



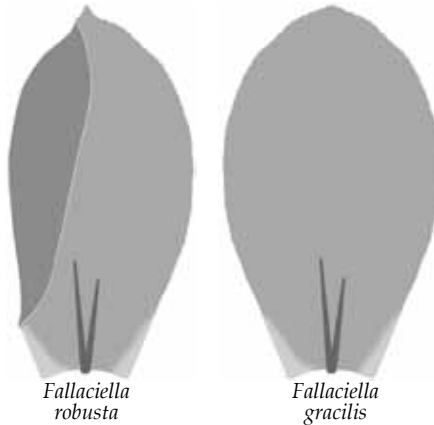
margin at midleaf, cells at midleaf, and leaf basal angle

■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$ , ■ 10  $\mu\text{m}$

**Key\* to the New Zealand species of *Fallaciella* (2)**

- 1 Plant glossy; leaves collapsed-wrinkled when dry; upper margin concave when moist; apex sharply apiculate and recurved; distal cell prorae not papillose..... ● ***Fallaciella robusta***
- 1: Plant dull; leaves little altered when dry; upper margin plane when moist; apex broadly acute, not apiculate, not recurved; distal cell prorae typically papillose..... ● ***Fallaciella gracilis***

\* based on Tangney, RS; Fife, AJ (2003): A review of the genus *Fallaciella* (Bryopsida: Lembophyllaceae), including a new species from South Island, New Zealand. *Journal of Bryology* 25, 121–128.



**Fallaciella gracilis** (Hook.f. & Wilson) H.A.Crum

**form:** primary stem creeping, filiform, radiculose, secondary stem 15–40 mm long, procumbent, irregularly branched, leaves dull, yellow-green

**habitat:** damp or wet rock near streams, rarely on bark

**leaf:** size: 0.6–1.0 × 0.4–0.6 mm

*shape:* obovate-oblong to ovate-oblong

*tip:* obtuse to rounded

*base:* basal cells quadrate, forming a distinct region

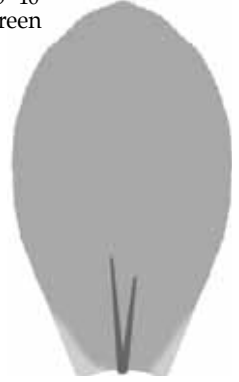
*costa:* absent or faint and double

*border:* not differentiated

*margin:* serrulate toward the apex, plane

*cells:* 20–40 × 5–7 μm, rhombic, ± sigmoid, incrassate, smooth

**capsule:** 1.3–2 mm, ovoid-oblong, asymmetric, exserted, inclined to cernuous, red-brown; seta 15–20 mm, arcuate at the tip; annulate; operculum short conico-rostrate; exostome teeth cross-striolate, endostome cilia 2–3, baculate; spores 15–18 μm in diam.



vegetative shoots (moist) (2), mature capsule, leaf outline, and leaf apex

1 mm, 1 mm, 1 mm, 0.1 mm, 10 μm



margin of upper leaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm

**Fallaciella robusta** Tangney & Fife

**form:** primary stem creeping, matted, secondary stems ± bipinnately branched, ± stipitate, leaves yellow-green to brownish, glossy

**habitat:** rock in damp shaded forest

**leaf:** size: stem leaves  $1.5 \times 1$  mm; branch leaves smaller

*shape:* broadly ovate, deeply concave, collapsed-wrinkled when dry

*tip:* stem leaves acute to broadly acute; branch leaves apiculate

*base:* alar cells quadrate, thick-walled, extending up the margin

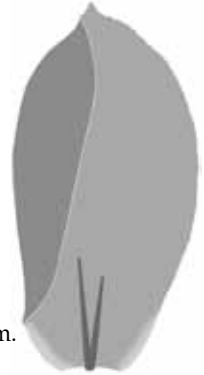
*costa:* short and double

*border:* not differentiated

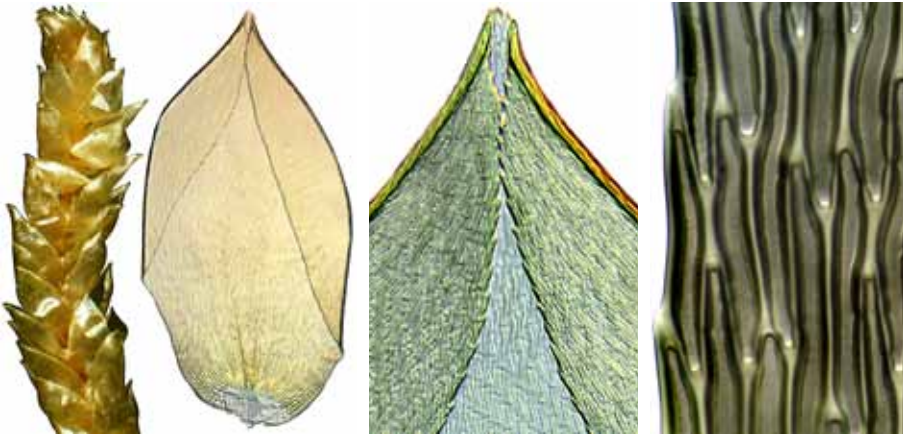
*margin:* bluntly serrulate, plane below, cucullate at the tip

*cells:*  $25\text{--}34 \times 5\text{--}7$   $\mu\text{m}$ , rhombic to linear, firm-walled, smooth

**capsule:** 1.6 mm, ovoid-oblong, exserted, cernuous, red-brown; seta 15 mm, weakly sinistrorse; peristome hypnoid; spores  $12\text{--}15$   $\mu\text{m}$  in diam.

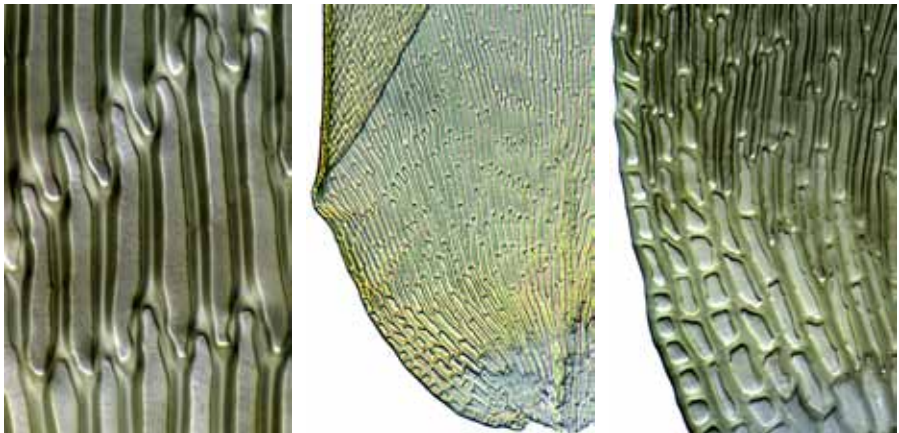


coverslipped



vegetative branch (dry), leaf outline (coverslipped), leaf apex, and margin lower leaf

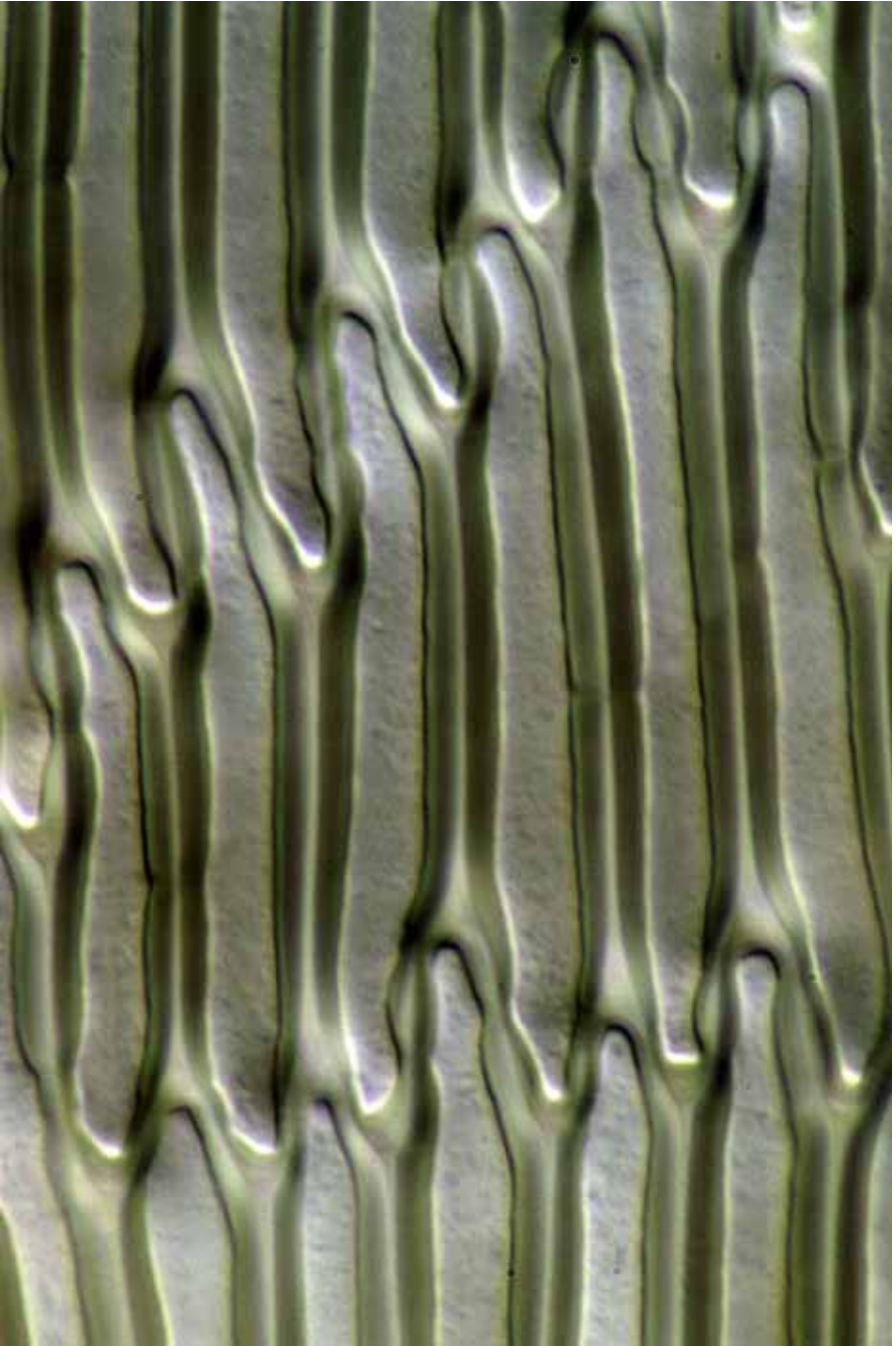
1 mm, 0.1 mm, 50  $\mu\text{m}$ , 10  $\mu\text{m}$



cells at midleaf, and leaf basal angle (2)

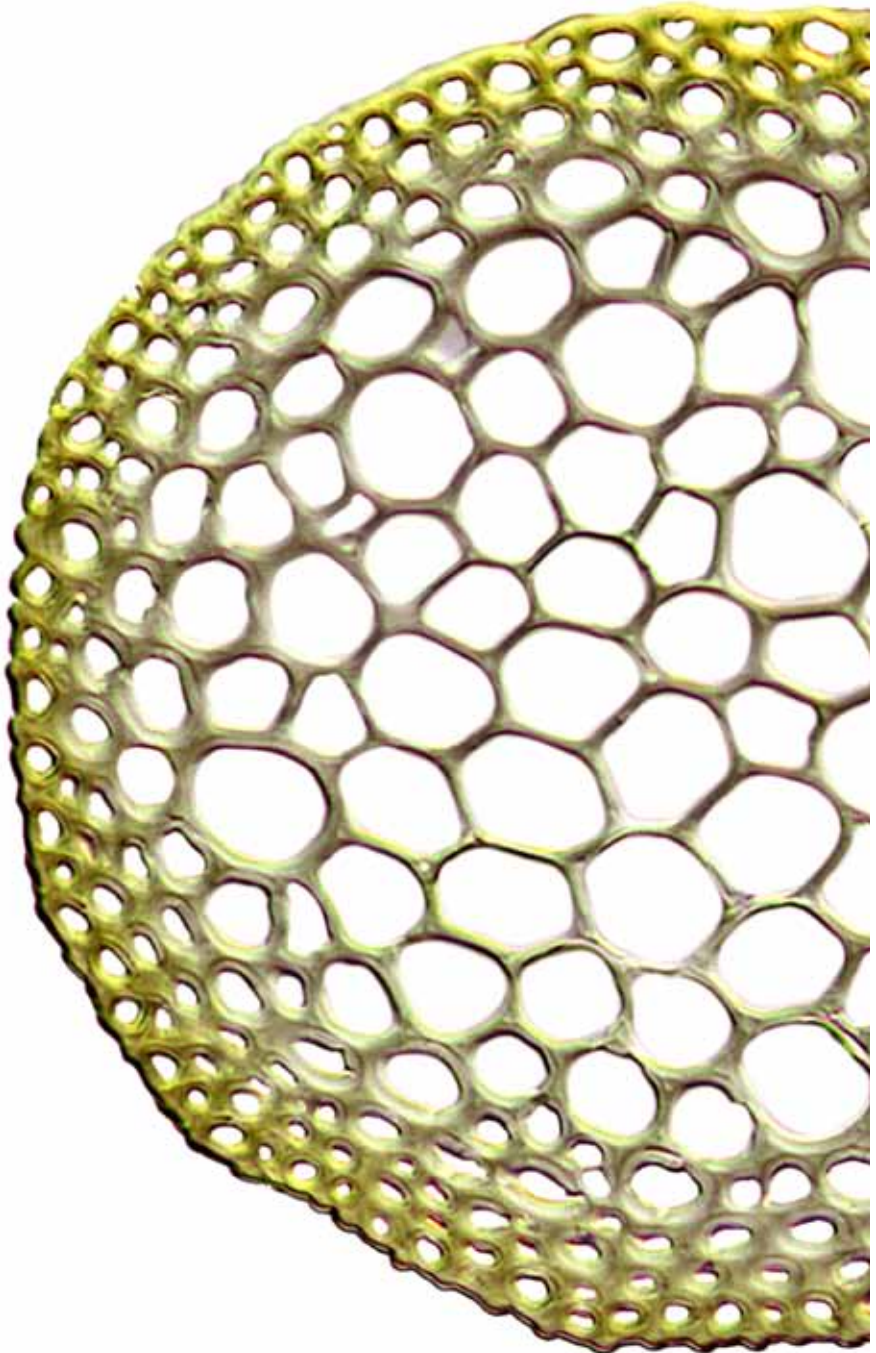
10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 50  $\mu\text{m}$

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*Fallaciella robusta* cells midleaf  
10  $\mu\text{m}$

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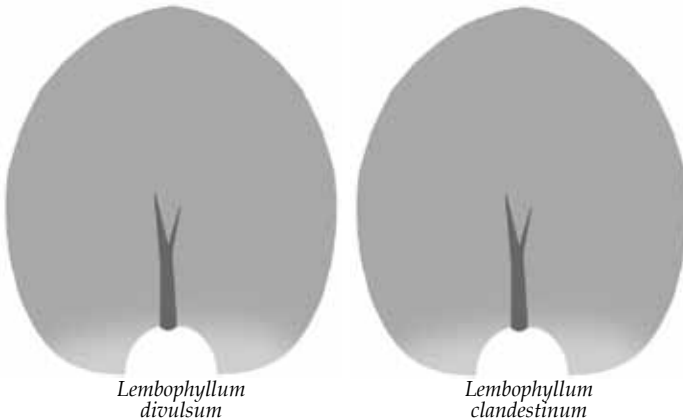


*Fallaciella robusta* stem cross-section showing lack of a distinct central strand  
10  $\mu\text{m}$

**Key\* to the New Zealand species of *Lembophyllum* (2)**

- 1 Upper leaf cells 9–16  $\mu\text{m}$  long, subrhombic or hexagonal, firm-walled ..... ● ***Lembophyllum divulgum***  
 1: Upper leaf cells 13–25  $\mu\text{m}$  long, narrowly elliptic, incrassate ..... ● ***Lembophyllum clandestinum***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 383–384.



**Lembophyllum clandestinum** (Hook.f. & Wilson) Lindb.

**form:** primary stem creeping, radiculose; secondary stem flexuose, procumbent, ± pinnately branched, to 100 mm long, strongly julaceous, leaves yellow-green to yellow-brown, glossy

**habitat:** bark, soil, or rock

**leaf:** size: 0.8–1.3 × 0.7–1.2 mm

*shape:* suborbicular, cochleariform, unaltered when dry

*tip:* rounded to obtuse

*base:* angle cells small, incrassate, often forming auricles

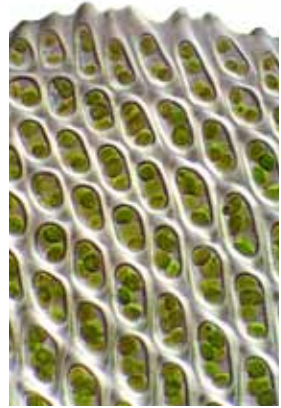
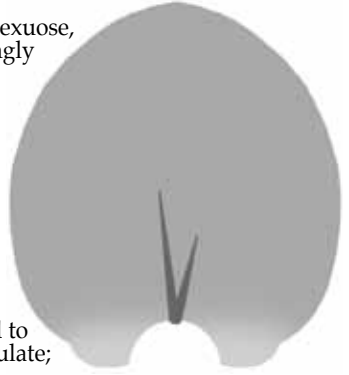
*costa:* absent, single and faint, or short and double

*border:* not differentiated

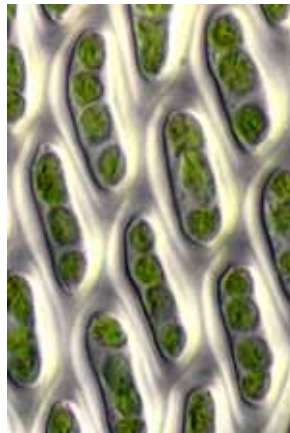
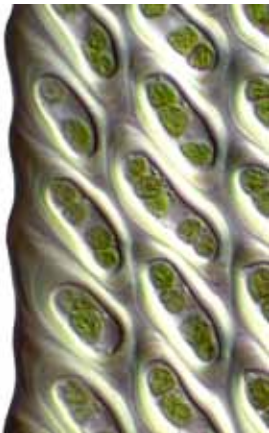
*margin:* entire below, minutely crenulate above, plane

*cells:* upper 13–25 μm long, oval-elliptic, incrassate, smooth

**capsule:** 1.5–2 mm; oblong-ovoid, lateral, exserted, inclined to horizontal; seta 13–25 mm, red, flexuose; operculum apiculate; peristome hypnoid; spores 12–16 μm in diam.



vegetative habit, fertile shoot, mature capsule, leaf outline (partial), and leaf apex  
 5 mm, 1 mm, 1 mm, 0.5 mm, 10 μm



margin at midleaf, cells at midleaf, and leaf basal angle  
 10 μm, 10 μm, 10 μm

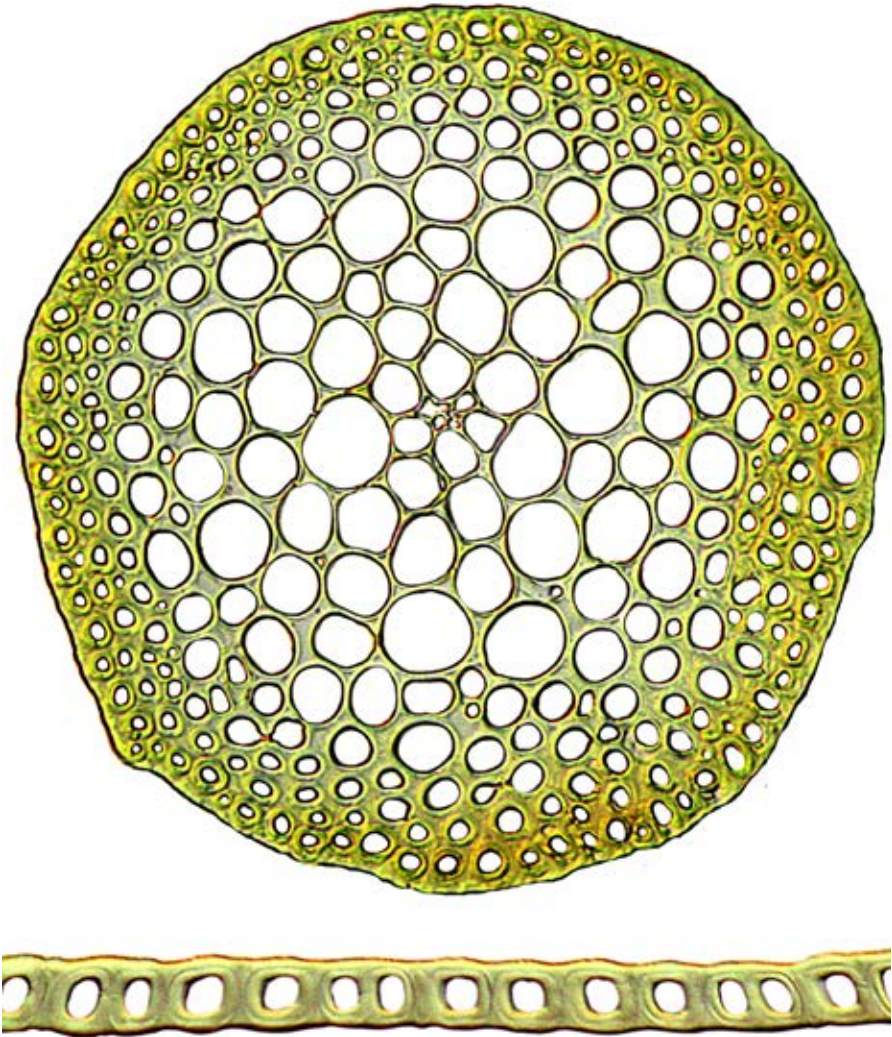
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*Lembohyllum clandestinum* habit  
5 mm

continued next page



*Lembophyllum clandestinum* stem and leaf cross-sections  
10  $\mu\text{m}$  (above), 10  $\mu\text{m}$  (below)

continued next page

**Lembophyllum divulgum** (Hook.f. & Wilson) Lindb.

**form:** primary stem creeping, radiculose; secondary stem to 40 mm long, erect, julaceous, subpinnately branched, leaves pale green

**habitat:** bark or rock in damp forest, lowland to montane

**leaf:** size: 0.8–1.3 × 0.7–1.2 mm

*shape:* suborbicular, cochleariform, little altered when dry

*tip:* rounded to obtuse

*base:* angle cells small, ± subquadrate, often coloured

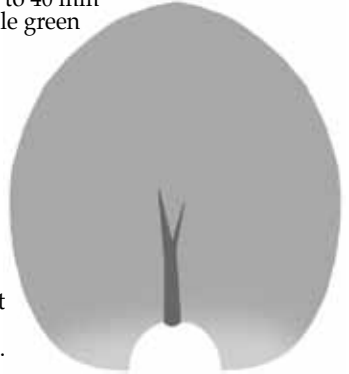
*costa:* absent, single and faint, or rarely double

*border:* not differentiated

*margin:* entire below, ± serrulate toward the apex, plane

*cells:* upper cells 9–16 μm long, rhombic, firm-walled, smooth; lower cells elongate, porose

**capsule:** 1.5–2.0 mm; oblong-ovoid, lateral, exserted, erect to horizontal; seta 12–25 mm, red, flexuose; operculum apiculate; peristome hypnoid; spores 12–16 μm in diam.



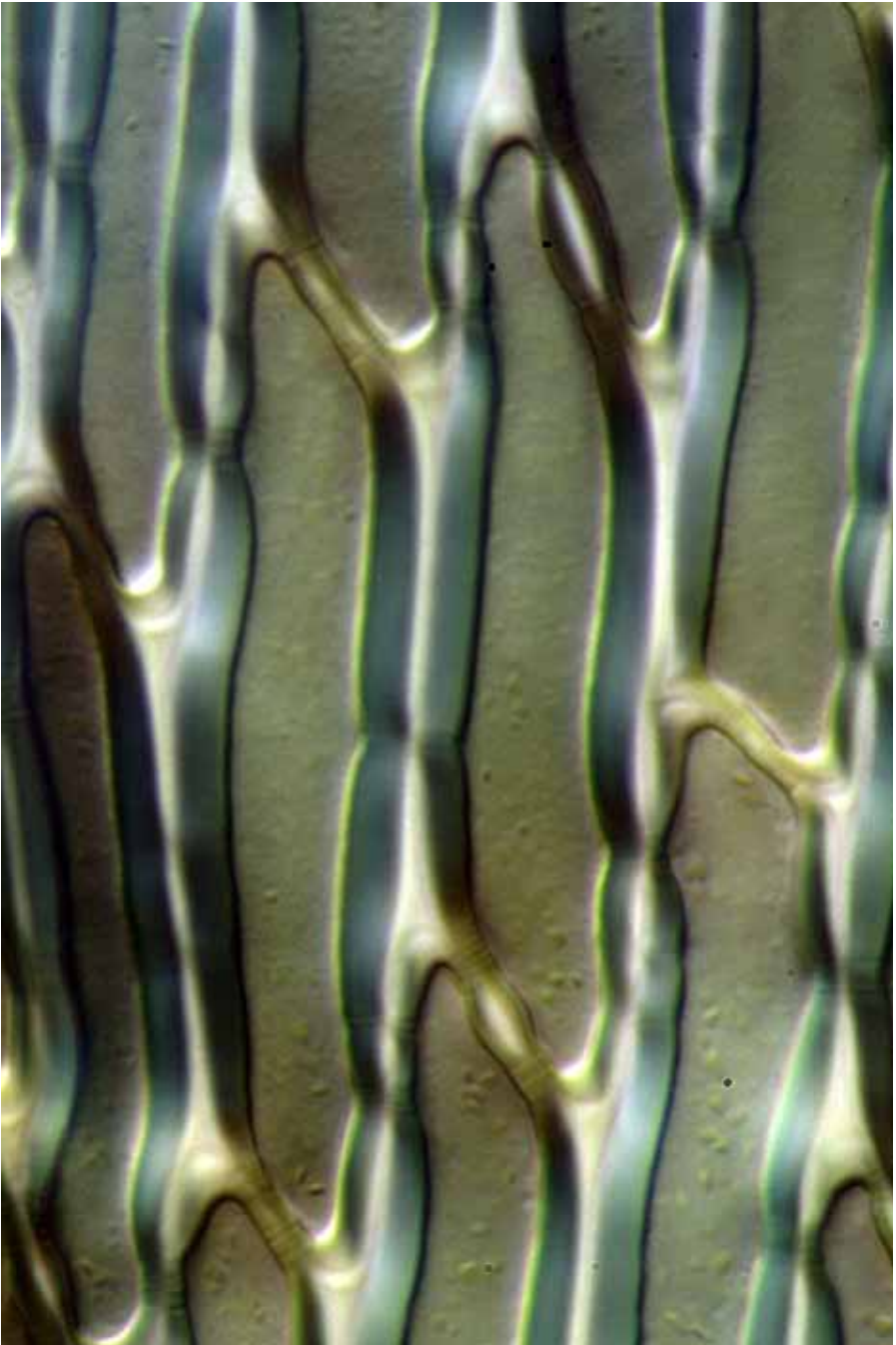
vegetative shoots (dry) (2), leaf outline (partial), and leaf apex

■ 1 mm, ■ 1 mm, ■ 0.1 mm, ■ 10 μm



margin at midleaf, cells near leaf base, and leaf basal angle

■ 10 μm, ■ 10 μm, ■ 10 μm



*Lembophyllum divulgum* cells near leaf base  
10  $\mu\text{m}$

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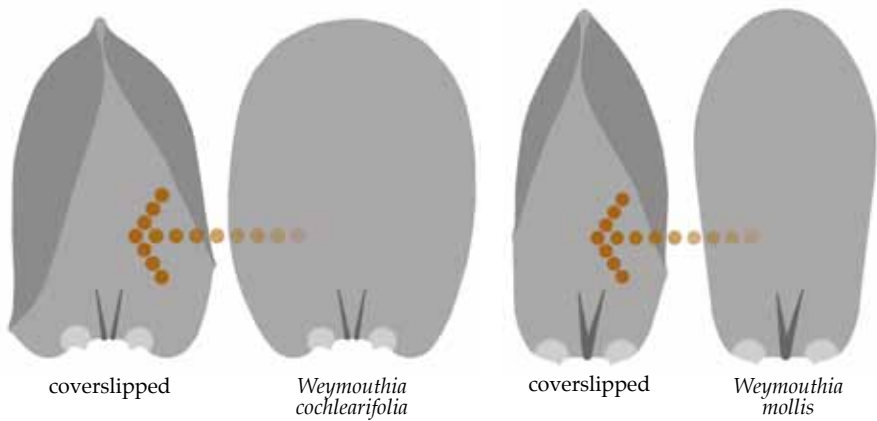


*Lembophyllum divulgum* mature capsule and peristome  
1 mm

**Key\* to the New Zealand species of *Weymouthia* (2)**

- 1 Leaves 2–3 mm long, suborbicular; lamina cell walls porose..... ● ***Weymouthia cochlearifolia***  
 1: Leaves 1–2 mm long, oblong-spathulate; lamina cell walls not porose..... ● ***Weymouthia mollis***

\* based on Sainsbury, GOK (1955): *A Handbook of the New Zealand Mosses*, RSNZ Bull. 5, 352.



**Weymouthia cochlearifolia** (Schwägr.) Dixon

**form:** primary stem pendent; secondary flexuose, yellowish, glossy, branched

**habitat:** branch bark, damp, shady forest

**leaf:** size: 2–3 × 1.5–2.4 mm

*shape:* suborbicular, deeply concave

*tip:* rounded, cucullate

*base:* angle cells incrassate, in auricles

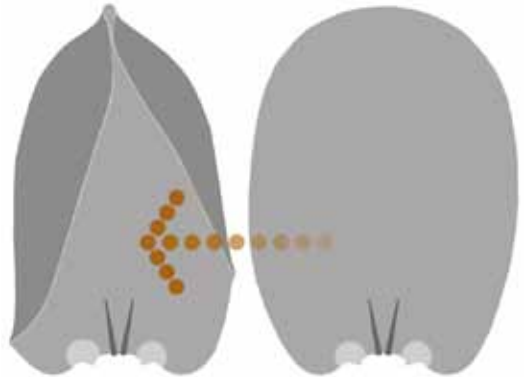
*costa:* absent or short and double

*border:* not differentiated

*margin:* entire, plane

*cells:* 40–70 × 6–7 μm, linear to fusiform, thick-walled, porose, smooth

**capsule:** 1.5–2.5 mm, oval, asymmetric, long-exserted, suberect, red-brown; seta 5–20 mm; calyptra ± hairy; operculum conic; peristome hypnoid

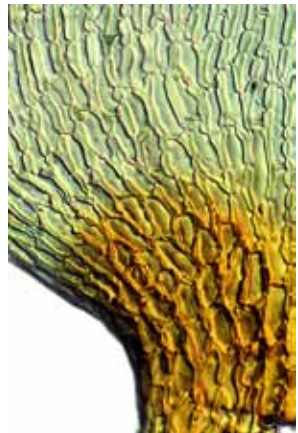


coverslipped



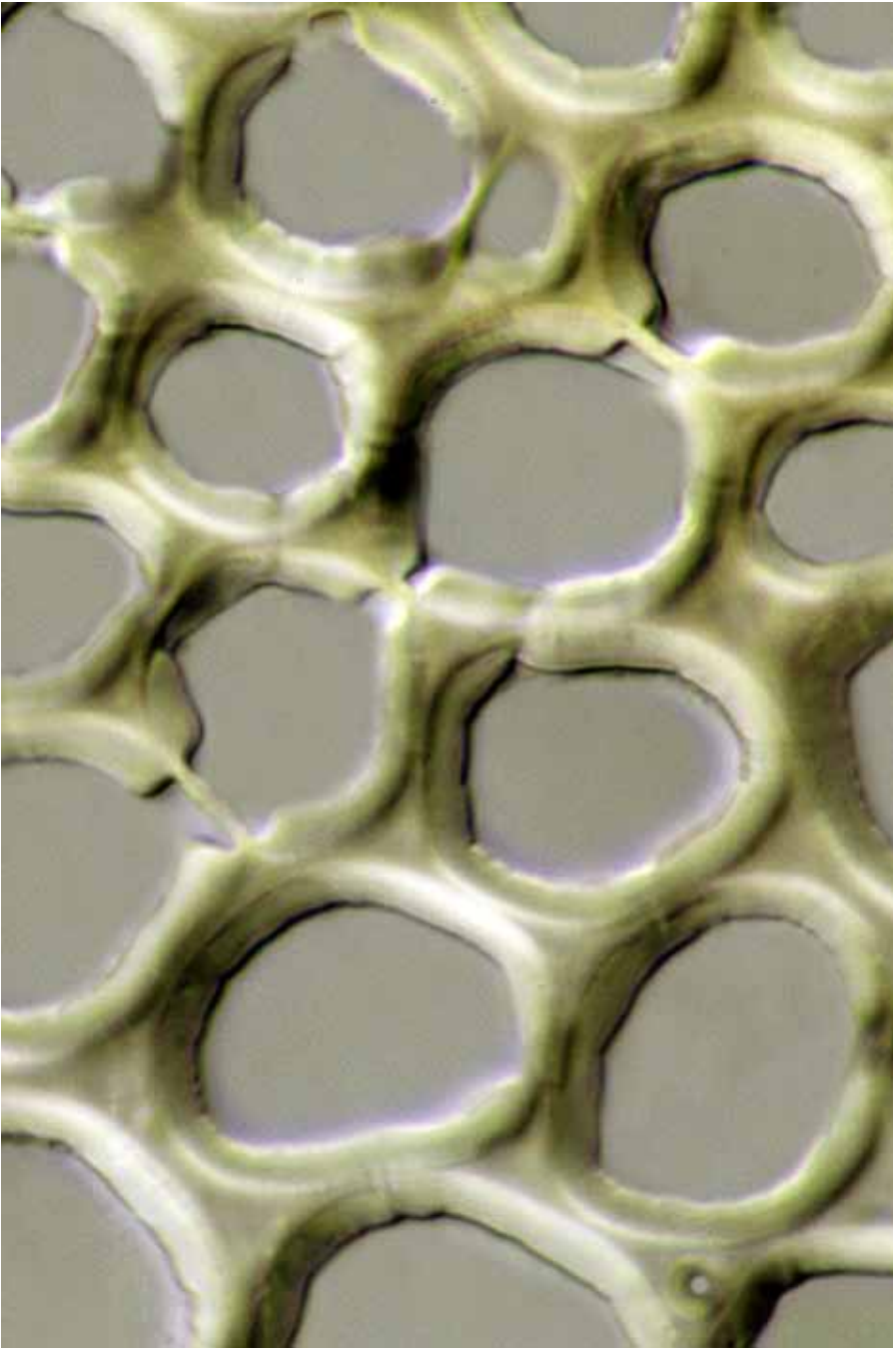
vegetative habit, fertile shoot, capsule with peristome, and leaf outline (coverslipped)

5 mm, 5 mm, 1 mm, 1 mm



margin at midleaf, cells at midleaf, and leaf basal angle

10 μm, 10 μm, 10 μm



*Weymouthia cochlearifolia* stem cross-section  
10  $\mu$ m



*Weymouthia mollis* (Hedw.) Broth.

**form:** primary stem pendent; secondary stem flexuose, branched, to 250 mm long, leaves pale green, glossy  
**habitat:** bark of twigs in damp forest and rainforest

**leaf:** size: 1–2 × 0.5–1.0 mm

*shape:* oblong-spathulate

*tip:* obtuse to rounded, ± cucullate

*base:* angle cells incrassate, dark, short, in auricles

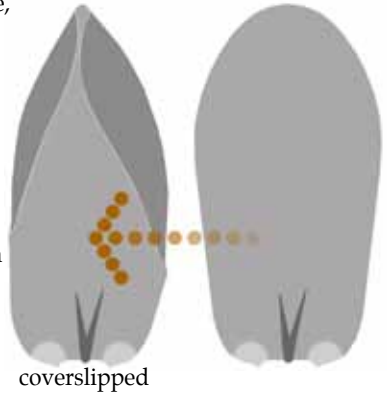
*costa:* absent or short and double

*border:* not differentiated

*margin:* entire, plane but folds when coverslipped

*cells:* 40–70 × 4–5 μm, vermicular, firm-walled, smooth

**capsule:** 1–1.5 mm, ovoid, lateral, exerted, erect on the seta, brown; seta 4–5 mm, arcuate at the tip; calyptra hairy; operculum curved conico-rostrate; peristome hypnoid, cilia none



vegetative shoot (2), young capsule with calyptra, leaf outline, and leaf apex  
 ■ 1 mm, ■ 1 mm, ■ 1 mm, ■ 0.5 mm, ■ 10 μm



margin at midleaf, leaf basal angle, and mature capsule with peristome  
 ■ 10 μm, ■ 50 μm, ■ 1 mm

**Haplohymenium pseudotriste** (Müll.Hal.) Broth.

**form:** matted, creeping stems, thin, wiry, ± radiculose, olive- to yellow-green, ± pinnately branched, the branches julaceous and obtuse at their tips

**habitat:** smooth bark or rarely shady limestone, to 300 m

**leaf:** size: stem leaves to 0.5 mm; branch leaves 0.4–0.6 mm long

**shape:** stem leaves ovate-lanceolate; branch leaves lingulate, ovate below

**tip:** stem leaves acute; branch leaves rounded to acute to ± apiculate

**base:** alar cells not differentiated

**costa:** reaching 2/3 up the blade, rarely short and double

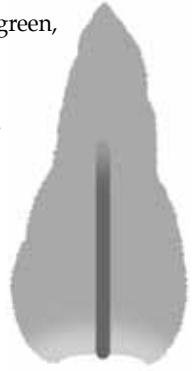
**border:** not differentiated

**margin:** crenulate, plane

**cells:** 6–8  $\mu\text{m}$ , isodiametric, firm-walled, bulging, pluripapillose

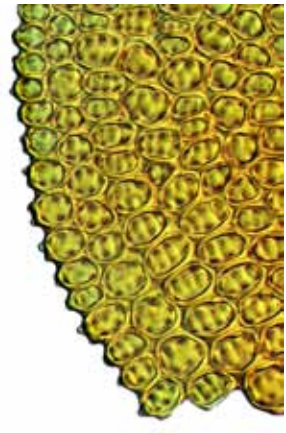
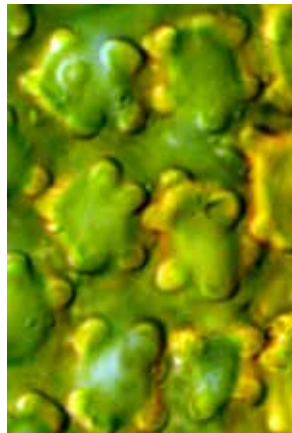
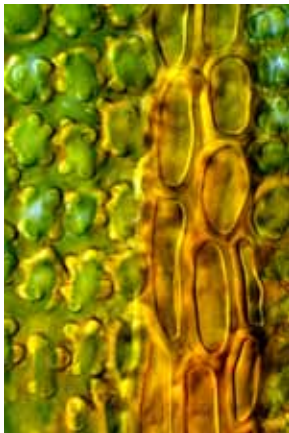
**capsule:** capsules not known in New Zealand

**notes:** *Eropodium glaucum* has no costa; *Lindbergia maritima* has axillary brood bodies; *Pseudoleskea imbricata* grows mostly on rock; species of *Thuidium* and *Thuidiopsis* have papillose paraphyllia.



vegetative shoots (dry) (2), leaf outline, and leaf apex

1 mm, 1 mm, 0.1 mm, 10  $\mu\text{m}$



costa at midleaf, leaf surface papillae, and leaf basal angle

10  $\mu\text{m}$ , 10  $\mu\text{m}$ , 10  $\mu\text{m}$

**Glossary** (for illustrations, see Malcolm, B; Malcolm, N (2006): *Mosses and Other Bryophytes, an Illustrated Glossary*, second edition. Micro-Optics Press, Nelson)

**abaxial** — facing away from a stem or axis, hence a leaf's "underside", "outer", "back", or "lower" surface (*the opposite of adaxial*, facing toward a stem or axis, hence a leaf's "upperside" or "inner" surface).

**abrupt** — changing suddenly over a short distance.

**acrocarpous** (noun **acrocarpy**) — producing sporophytes at the tips of main stems (*compare with pleurocarpous*, producing sporophytes laterally, and **cladocarpous**, producing sporophytes at the tips of branches). Most acrocarpous mosses are erect, tufted, and sparingly branched, whereas most pleurocarpous mosses are prostrate, matted, and highly branched.

**acumen** (plural **acumina**, adjective **acuminate**) — a long, narrow, tapering point with slightly concave margins.

**acute** — tapering with nearly straight margins to a point with an angle less than 90° (*compare with obtuse*, blunt, with the sides making an angle of more than 90°).

**adaxial** — facing toward a stem or axis, hence a leaf's "upperside" or "inner" surface (*the opposite of abaxial*, facing away from a stem or axis, hence a leaf's "underside", "outer", "back", or "lower" surface).

**alar cells** — specialized cells at both basal corners of a moss leaf that differ from the other leaf cells in their size, shape, colour, or wall thickness and ornamentation.

**angle cells** (or **angular cells**) — ± specialized cells in the basal angles of a leaf.

**annulus** (plural **annuli**, adjective **annular**) — a band of specialized cells at the junction of the lid (operculum) and the mouth of a moss capsule. During dehiscence (opening) of the capsule, the annulus peels off or breaks up, allowing the lid to fall off and the spores to escape.

**apex** (plural **apices**, adjective **apical**) — the tip or unattached end of a stem, leaf, or other structure.

**apiculate** — ending in a short, abrupt point (an apiculus) that's longer than a mucro but shorter and less stout than a cusp.

**apiculus** (plural **apiculi**, adjective **apiculate**) — a short abrupt point at a tip or apex.

**apophysis** (plural **apophyses**) — a distinctly swollen and often stomatous sterile base of a capsule where it joins the seta (*synonym hypophysis*).

**aquatic** — growing or living in water.

**archegonium** (plural **archegonia**) — a moss' female reproductive organ. It's like a flask with a long neck and a swollen base (venter), and contains an egg (ovum).

**arcuate** — curved or bent like an archery bow or the arc of a circle.

**arista** (plural **aristae**, adjective **aristate**) — a hard, straight awn or bristle at the tip of a leaf, usually a projection of the costa beyond the tip of the blade.

**aristate** — ending in a bristle-point or awn (arista).

**asexual reproduction** — reproduction without the fusion of sex cells (gametes, eggs and sperm).

**asymmetric** (or **asymmetrical**) — lacking symmetry of form, but more precisely, said of anything that can't be cut into two mirror halves along *any* plane through its axis.

**attenuate** — tapering to a point.

**auricle** — an ear-like lobe of specialized cells near the margin of a leaf base.

**autoicous** — producing both male and female sex organs (antheridia and archegonia) on the same plant but in separate inflorescences (*compare with dioicous*, producing male and female sex organs (antheridia and archegonia) on separate plants).

**awn** — a bristle at the tip of a leaf, usually hyaline and formed by a **costa** projecting beyond the end of the leaf blade.

**axil** — the angle between a stem and the upper (facing) surface of a leaf, branch, or some other structure growing out of that stem.

**axillary hyaline nodule** — in *Fissidens*, a protuberant cluster of enlarged cells in a leaf axil, best seen after the leaf has been removed.

**baculate** — covered with rods (bacula) that are longer than wide.

**basal angles** — the groups of cells in the two outermost corners of a leaf base.

**basal membrane** — a delicate cylindrical or tubular membrane at the base of the inner peristome (endostome) of the capsule of many mosses. It gives rise to segments that often alternate with cilia.

- bi-** — a prefix meaning *two*, as in *bistratose* (made up of two layers of cells) (*compare with uni-*, a prefix meaning *one*, **tri-**, a prefix meaning *three*, **pluri-**, a prefix meaning *several or a few*, and **multi-**, a prefix meaning *many*).
- bifurcated** — forked into roughly equal halves.
- bistratose** — two cell layers thick.
- blade** — the thin and usually flat main portion of a leaf.
- border** — cells along a leaf margin that differ from the other leaf cells in their shape, size, colour, or wall thickening.
- brood bodies** — structures that function as vegetative propagules, such as gemmae, bulbils, underground tubers, or reduced branches (surculi) and leaves.
- calyptra** (plural **calyptrae**) — a membranous or hairy cap that forms from the wall of the archegonium (the female reproductive organ) and protects the embryonic sporophyte (the spore-producing generation of a moss life cycle). It's formed from tissues around the base of the archegonium (after the fertilization of the egg), and is ripped off as the seta elongates.
- campanulate** — bell-shaped, like an upside-down cup with a flaring mouth.
- canaliculate** — grooved or channelled lengthwise like a canal, gutter, or channel (*synonym channelled*).
- cancellinae** (singular **cancellina**, adjective **cancellinate**) — the large, sharply defined, empty, porose, and usually transparent cells in the leaf base of mosses mostly in the family Calymperaceae (*Calymperes* and *Syrrophodon*).
- carinate** — shaped like the keel of a boat.
- cauline** — part of, resembling, shaped like, or belonging to the stem.
- central strand** — a thin column or cylinder of elongate cells at the centre of the stem of some mosses.
- cernuous** — nodding or drooping at about 45°.
- channelled** — with a longitudinal groove formed by upturned margins or a sunken **costa** (*synonym canaliculate*).
- chlorocysts** — (1) in a *Sphagnum* leaf, long and narrow cells containing chlorophyll and forming a network surrounding much larger hyaline cells (hyalocysts), (2) in the leaves of the Leucobryaceae mosses (*Leucobryum*, for example), small green cells enclosed by layers of hyaline cells or intermixed with them.
- chlorophyllous** — containing chlorophyll and therefore appearing green.
- ciliate** — having fine hairs (cilia) along a margin or on a surface.
- cilium** (plural **cilia**, adjective **ciliate**) — a delicate hair-like structure.
- circinate** — coiled into a near-circle, with the tip or apex innermost.
- cladocarpous** (noun **cladocarp**) — producing sporophytes at the tips of branches (*compare with acrocarpous*, producing sporophytes at the tips of main stems, and **pleurocarpous**, producing sporophytes laterally).
- clavate** — club-shaped, lengthened and thickened toward the tip.
- cleared** — said of cells that have been stripped of their contents for better viewing under a microscope, usually by being soaked for several hours in either lactic acid or potassium hydroxide (KOH).
- cleistocarpous** — (of capsules) lacking a lid (operculum) or valves, and thus opening not along a line of built-in weakness but instead by the decay or rupture of the wall (*compare with stegocarpous*, opening with a lid or valves).
- cochleariform** — shaped like a spoon, hence deeply concave (*compare with spatulate*, shaped like a spatula, flat rather than concave).
- collenchymatous** — having cell walls that are thicker at the corners than the sides.
- coma** (plural **comae**, adjective **comal** or **comate**) — a cluster of branches at the tip of a *Sphagnum* moss, or in other mosses a tuft of crowded leaves at the stem apex.
- commissural pores** — in species of *Sphagnum* mosses, pores arranged along the margins of the hyaline leaf cells (hyalocysts).
- commissure** — in *Sphagnum* leaves, the margins of hyaline cells (hyalocysts) where they adjoin green cells (chlorocysts).
- complanate** — flattened into one plane.
- concave** — curving inwards or dished like a shallow soup bowl (*compare with convex*, curving outwards).
- concolorous** (with) — coloured the same as...

- conduplicate**— folded lengthwise so sharply that the two sides are nearly parallel.
- conic** (or **conico-**) — shaped like a cone.
- contorted** — (1) irregularly bent, twisted, or curved, (2) overlapping like shingles.
- convex** — curving or bulging outwards (*compare with* **concave**, curving inwards).
- cordate** — heart-shaped and attached by the notch rather than the tip.
- costa** (plural **costae**, adjective **costate**) — the thickened midrib or nerve of a leaf.
- crenate** — scalloped along the edge with coarse rounded teeth (*compare with* **crenulate**, scalloped along the edge with tiny rounded teeth, usually bulging cells).
- crenulate** — scalloped along the edge with tiny rounded teeth, usually bulging cells (*compare with* **crenate**, scalloped along the edge with coarse rounded teeth).
- crested** — a mane-like growth of cilia or other projections on a seta or costa.
- crisped** (or **crispate**) — strongly curled, twisted, or wavy like crisp bacon.
- C-shaped** — appearing crescent-shaped when viewed from above with an ordinary light microscope.
- cucullate** — resembling or shaped like a hood (for example, a cucullate leaf is concave at its tip, with the two sides of the leaf curving inwards).
- cuspl** — a stout and rigid tooth-like point.
- cuspidate** — ending abruptly in a stout and rigid tooth-like cusp or point.
- cuticle** (adjective **cuticular**) — a coating on the outermost wall of cells that are in direct contact with the environment, secreted onto the surface of the epidermis.
- cygneous** — curved downwards at the top like the neck of a swan.
- cymbiform** — shaped like a shallow boat.
- deciduous** — falling off, not persistent, or lost at maturity.
- decurrency** (adjective **decurent**) — any part of a structure that extends below the insertion or point of origin of that structure on a stem or costa.
- dehiscent** — rupturing or splitting open.
- dendroid** — resembling a tree in form.
- dentate** — having coarse or multicellular teeth along the margin (*compare with* **denticulate**, having fine teeth along the margin).
- denticulate** — having fine teeth along the margin (*compare with* **dentate**, having coarse or multicellular teeth along the margin).
- differentiated** — (1) specialized in morphology and physiology, (2) differing from nearby cells in size, shape, and/or colour.
- dimorphic** — having two distinctly different forms.
- dioicous** — producing male and female sex organs on separate plants (*compare with* **autoicous**, producing male and female sex organs on the same plant but in different inflorescences).
- distant** — widely spaced, as in leaves along a stem or teeth along a margin.
- distichous** — arranged in two rows or ranks on the opposite sides of a stem.
- dorsal** — the upper surface of a prostrate stem or the outer surface of a peristome tooth (*compare with* **ventral**, the lower surface of a prostrate stem or the inner surface of a peristome tooth).
- dorsal leaves** — one or more rows of leaves on the upperside of a prostrate stem (*compare with* **ventral leaves**, one or more rows of modified leaves on the underside of a prostrate stem).
- ecostate** — lacking a costa.
- elliptic** — shaped like an ellipse, with a wide middle and rounded ends.
- elongate** — markedly lengthened.
- emarginate** — notched or indented at the apex.
- emergent** — partly exposed, as in a capsule protruding only partly beyond the tips of the surrounding leaves and bracts.
- endostome** — in many mosses, the inner peristome, usually arising from the basal membrane and consisting of segments alternating with one or more cilia (*compare with* **exostome**, the outer peristome, the outer ring of teeth of a double peristome).
- entire** — said of a margin that's smooth, lacking any teeth, cilia, or indentations.
- ephemeral** — completing the entire life cycle within only a few months (*compare with* **perennial**, (1) living indefinitely, (2) taking at least three years to mature).
- epiphyte** (adjective **epiphytic**) — growing on a plant (or bark).
- equitant** — sheathing a stem tightly.

- erect** — said of anything that's pointing in the same direction as what it's attached to, for example a seta and its capsule or a leaf and its stem.
- excurrent** — (of costae) extending beyond the apex (*compare with* **failing**, not reaching the apex, **percurrent**, extending to the apex but not beyond, and **subpercurrent**, not quite reaching the apex).
- exostome** — the outer row or rows of the peristome, consisting of teeth that often are forked toward the top (*compare with* **endostome**, the inner peristome, consisting of segments and cilia).
- exothecium** (plural **exothecia**, adjective **exothecial**) — the outermost layer of cells in a capsule.
- exserted** — fully exposed (*compare with* **immersed**, fully hidden, and **emergent**, partly exposed).
- failing** — not reaching the apex (*compare with* **excurrent**, extending beyond the apex, **percurrent**, extending to the apex but not beyond, and **subpercurrent**, not quite reaching the apex).
- faint** — indistinct, poorly or weakly developed.
- falcate** — resembling a sickle blade, with edges curved and parallel.
- falcate-secund** — having leaves both curved and turned toward one side of the stem.
- fascicle** — a bundle or cluster of branches, leaves, propagules, or other structures.
- fibrillose** (*the opposite of* **efibrillose**) — ornamented with fine spiral or annular fibre-like wall thickenings.
- filament** (adjective **filamentous**) — a row of cells attached end-to-end, long and sometimes branched.
- filiform** — filamentous, thread-like, long and slender.
- firm-walled** — said of walls taking up between a tenth and a quarter of the cell width (*compare with* **thin-walled**, the walls taking up less than a tenth of the cell width, and **thick-walled**, the walls taking up a quarter or more of the cell width).
- flaccid** — soft, flabby, or limp (*compare with* **turgid**, plump, swollen, or inflated).
- flexuose** — zig-zag, wavy, bent, or twisted.
- foliate** — leafy.
- frond** (adjective **frondose**) — a highly branched shoot system that's flattened and resembles a fan, umbrella, or fern leaf.
- furrowed** — grooved lengthwise.
- fusiform** — narrow and tapered at both ends like a weaver's shuttle.
- gametophyte** — the multicellular gamete- (sex cell) producing generation of a moss or other embryophyte (*compare with* **sporophyte**, the spore-producing generation of a moss or other embryophyte).
- gemma** (plural **gemmae**, adjective **gemmae**) — a propagule produced asexually and usually consisting of a few to many cells. Gemmae can be formed on stems, rhizoids, leaves, leaf axils, or on specialized gemmiferous (gemmae-bearing) structures.
- gibbous** — bulging or swollen on one side toward the top.
- glaucous** — having a whitish or greyish bloom like the surface of a ripe plum.
- globose** — spherical or nearly so.
- gregarious** — growing close together but not densely, as in mats or tufts.
- guide cells** — a layer of large, thin-walled cells stretching across a moss leaf costa.
- gymnostomous** — lacking a capsule lid (peristome).
- hair-point** — a hair-like and often hyaline leaf tip, formed either by a costa projecting well beyond the end of the leaf blade, or by a gradual tapering of the blade tip.
- hexagonal** — having six nearly equal sides.
- homomallous** — all pointing in one direction.
- hyaline** — transparent or nearly so, lacking chlorophyll or other pigments.
- hyalocyst** — in the leaves of *Sphagnum* species, a colourless water-storage cell.
- hyalodermis** (or **hyaloderm**) — in the stems of many mosses, but especially species of *Sphagnum*, an outer layer composed of large, empty, colourless cells.
- hydrated** — wetted.
- hydric** — very wet (*compare with* **mesic**, intermediate between very wet and very dry, and **xeric**, very dry).
- hypophysis** (plural **hypophyses**) — a distinctly swollen and often stomatous sterile base of a capsule where it joins the seta (*synonym* **apophysis**).

- imbricate** — overlapping like shingles.
- immersed** — (of capsules) overtopped by surrounding leaves or bracts.
- inclined** — angled 20°–60° from the vertical (or from the seta in the case of a capsule, and then described as “inclined on the seta”).
- incurved** — curved upwards and inwards.
- inflated** — swollen like a full bladder.
- inflorescence** — a cluster of sex organs plus any leaves or bracts surrounding them.
- innovation** (adjective **innovative**) — (1) any new branch, (2) a lateral branch that forms at the base of a terminal inflorescence.
- inrolled** — rolled inwards.
- insertion** — the line or point of attachment of a leaf or branch to a stem.
- interrupted** — said of any disturbance to an arrangement that’s usually continuous or symmetric.
- intramarginal border** — a leaf border of one or more rows of specialized cells lying a short distance in from the leaf edge.
- involute** — rolled inwards at the edges (*the opposite of revolute*, rolled downwards and under at the edges).
- irregular** — not regular, as in the shape of leaf cells or the spacing of marginal teeth.
- isodiametric** — about as wide as long.
- julaceous** — resembling a catkin, with crowded leaves appressed against the stem and overlapping each other.
- juxtacostal** — located near or next to the costa.
- keeled** — sharply folded in the middle like the keel of a boat.
- lamellae** (singular **lamella**) — ribs or flaps running lengthwise down the leaves of some mosses (notably *Polytrichum* and the other hair-caps).
- lamina** (plural **laminae**, adjective **laminal**) — the flat blade of a leaf (usually one cell thick), not including the costa (midrib or nerve) if present.
- lanceolate** — lance-shaped, 3–6 times longer than wide, widest below the middle, and with slightly convex sides tapering gradually toward the apex.
- lateral** — at the side or at 90° to the stem (*compare with terminal*, at the tip or unattached end of a leaf, stem, or other structure).
- lateral leaves** — in mosses that have two kinds of leaves arranged in rows, the *larger* leaves (usually in two opposing rows along the sides of the stem).
- ligulate** — strap-shaped (*compare with lingulate*, tongue-shaped and therefore wider).
- linear** — long and narrow with nearly parallel edges.
- lingulate** — tongue-shaped (*compare with ligulate*, strap-shaped and therefore somewhat narrower).
- littoral** — of the sea.
- lumen** (plural **lumina**) — the cavity of a cell inside the cell walls.
- mammillose** — bluntly bulging in the middle (*compare with papillose*, ornamented with one or more solid protuberances).
- margin** (adjective **marginal**) — the edge of a structure such as a leaf.
- mesic** — moist, intermediate between very wet and very dry (*compare with hydric*, very wet, and *xeric*, very dry).
- midleaf** — the part of a leaf that’s roughly halfway between the base and the tip.
- midrib** — a vein in the centre of a leaf (*synonyms costa* and *nerve*).
- mitrate** (or **mitriform**) — shaped like a bishop’s cap (mitre), conic with an entire or regularly lobed base (*compare with cucullate*, conic and split down one side).
- muco** (plural **mucrones**, adjective **mucronate**) — a short and abrupt point.
- mucronate** — ending abruptly in a short point (muco) (*compare with apiculate*, ending in a point somewhat longer than a muco, and **cuspidate**, ending in an even longer point that’s also stouter).
- multi-** — a prefix meaning *many*, as in *multipapillose*, having many papillae per cell) or *multistratose* (made up of many cell layers) (*compare with uni-*, a prefix meaning *one*, **bi-**, a prefix meaning *two*, and **tri-**, a prefix meaning *three*).
- multicellular** — made up of many cells.
- naked** — smooth, lacking hairs, cilia, rhizoids, or other projections.
- neck** (adjective **necked**) — the sterile portion of a capsule (the portion that doesn’t produce spores) between the base of the spore chamber (urn) and the top of the seta.

- nerve** — the midrib of a leaf (*synonym costa*).
- ob-** — a prefix meaning *upside down or the reverse of*.
- obconic** — shaped like an upside-down cone.
- oblique** — slanted.
- oblong** — nearly rectangular in outline.
- obovate** — shaped like an egg but upside down.
- obtuse** — blunt, with the sides making an angle of more than 90° (*compare with acute*, tapering with nearly straight margins to a point with an angle less than 90°).
- operculum** (plural **opercula**, adjective **operculate**) — the lid of a moss capsule.
- orbicular** — circular in outline or nearly so.
- oval** — in outline shaped like a short ellipse.
- ovate** — egg-shaped in outline.
- ovoid** — (adjective) egg-shaped (three-dimensional); (noun) an egg-shaped solid.
- palmate** — arranged like fingers on the palm of a hand.
- panduriform** — violin-shaped.
- papilla** (plural **papillae**) — a minute solid protuberance on a cell surface, variously wart-like, spinose, forked, branched, or C-shaped.
- papillose** — roughened or ornamented with one or more papillae per cell (*compare with mamillose*, bluntly bulging in the middle).
- paraphyllia** (singular **paraphyllum**) — tiny filaments, scales, or leaf-like structures scattered on the stems of some mosses (*compare with pseudoparaphyllia*, which are clustered around the bases of branches or branch buds).
- paraphyses** (singular **paraphysis**) — sterile, septate, usually uniseriate hairs, some club-shaped or coloured, intermixed with the sex organs in most mosses.
- pellucid** — transparent or translucent.
- pendent** — drooping or hanging down.
- pentastichous** — arranged in five vertical rows evenly spaced around a stem.
- percurrent** — extending to the apex but not beyond (*compare with subpercurrent*, not quite reaching the apex, **excurrent**, extending beyond the apex, and **failing**, not reaching the apex).
- perennial** — (1) living for an indefinite number of years, (2) taking at least three years to mature (*compare with ephemeral*, completing the entire life cycle within only a few months).
- perichaetium** (plural **perichaetia**, adjective **perichaetial**) — the female sex organs plus the cluster of modified leaves surrounding them (*compare with perigonium*, the male sex organs plus the cluster of modified leaves surrounding them).
- perigonium** (plural **perigonia**, adjective **perigonial**) — the male sex organs plus the cluster of modified leaves surrounding them (*compare with perichaetium*, the female sex organs plus the cluster of modified leaves surrounding them).
- peristome** (adjective **peristomate**) — a single or double circle of teeth at the mouth of a capsule. A single peristome consists of only teeth, whereas in a double peristome, the outer peristome (the exostome) consists of teeth, and the inner peristome (the endostome) consists of segments, sometimes alternating with cilia and often arising from a basal membrane.
- persistent** — remaining attached or active.
- piliferous** — having hair-points.
- piliform** — hair-like.
- pinnate** — arranged like the barbs on a feather.
- pit** (adjective **pitted**) — a recessed or thinned area in a plant cell wall, usually opposite a similar pit in the wall of an adjacent cell.
- plane** — flat, lying in one plane, two-dimensional.
- pleurocarpous** (noun **pleurocarpy**) — producing sporophytes laterally (*compare with acrocarpous*, producing sporophytes at the tips of main stems, and **cladocarpous**, producing sporophytes at the tips of branches). Most pleurocarpous mosses are prostrate, matted, and highly branched, whereas most acrocarpous mosses are erect, tufted, and sparingly branched.
- plica** (plural **plicae**) — a lengthwise pleat or ridge.
- plicate** — pleated, folded, or furrowed lengthwise (*compare with undulate*, somewhat wavy in one direction, **rugose**, strongly wavy, folded, or wrinkled crosswise, **sul-**



- cate**, strongly grooved, furrowed, or folded lengthwise, and **striate**, marked with lines or ridges lengthwise).
- pluristratose** — several-layered.
- porose** — having cell wall pits, usually opposite similar pits in adjacent cell walls.
- propagulum** (or **propagule**) (plural **propagula** or **propagules**) — a reduced branch, bud, leaf, or other structure that reproduces a plant vegetatively.
- prorate** (or **prorose**) — (of a surface) coarsely roughened by the protruding tips of cells that strongly overlap at their ends.
- prorulate** (or **prorulose**) — (of a surface) minutely roughened by the protruding tips of cells that slightly overlap at their ends.
- prosenchymatous** — composed of tissue made up of long tapering parallel cells overlapping at their tips rather than butt-joined end-to-end.
- prostrate** — lying flat.
- protonema** (plural **protonemata**, adjective **protonemal**) — the first stage of growth (usually filamentous) of a germinating spore or other propagule.
- pseudoparaphyllia** (singular **pseudoparaphyllum**) — tiny filaments, scales, or leaf-like structures clustered around the bases of branches or branch buds (*compare with* **paraphyllia**, tiny filaments, scales, or leaf-like structures scattered on the stems of some mosses).
- pseudopodium** (plural **pseudopodia**) — in species of the moss genera *Andreaea* and *Sphagnum*, a tall, leafless stalk topped by a capsule (it looks like a seta, but isn't a true seta because it grows from the leafy egg-and-sperm-shedding plant in the moss life cycle rather than the spore-shedding plant that the capsule grows from).
- pyriform** — pear-shaped.
- quadrate** — square-sided or nearly so.
- radial** — arranged symmetrically in three or more rows around a stem.
- rank** — a row of similar structures such as leaves on a stem or teeth in a peristome.
- recurved** — curved backwards, downwards, or under.
- reflexed** — bent or curved abruptly downwards and inwards.
- resorption** (adjective **resorbed**) — the lysing, digestion, or erosion of parts of the cell walls in *Sphagnum* leaves, leaving irregular gaps in the surfaces of the hyaline cells (hyalocysts) or on the margins of the leaves.
- revoluble** — rolling away or falling off as a ring.
- revolute** — rolled backwards or downwards and under at the edges (*the opposite of* **involute**, rolled inwards at the edges).
- rhizoid** — a slender filament on stems and sometimes leaves.
- rhizome** (adjective **rhizomate**) — a slender, horizontal, underground stem.
- rhombic** — having an outline resembling a diamond or rhombus.
- rostrate** — long-beaked.
- rounded** — shaped like part of a circle.
- rudimentary** — poorly developed or vestigial.
- rugose** — strongly wavy, folded, or wrinkled crosswise (*compare with* **plicate**, pleated, folded, or furrowed lengthwise, **undulate**, somewhat wavy in one direction, **sulcate**, strongly grooved, furrowed, or folded lengthwise, and **striate**, marked with lines or ridges lengthwise).
- rugulose** — minutely or somewhat rugose.
- sainsburia-type peristome** — the peristome teeth are deeply split in most *Fissidens* species, but they're not in New Zealand's *Fissidens taylorii* var. *sainsburyanus*. That variant is so unusual that it's been named the *sainsburia*-type peristome.
- secund** — strongly turned or bent toward one side.
- segment** — a single, tooth-like division of the inner peristome (endostome).
- serrate** — regularly toothed like a saw blade, with the teeth pointing toward the tip.
- serrulate** — minutely regularly toothed, with each tooth part of a single cell.
- seta** (plural **setae**) — the stalk of a capsule.
- setaceous** — bristle-like.
- sheathing** — surrounding or closely clasping a stem or seta.
- side-nerve** — a branchlet of a costa.
- sigmoid** — S-shaped.
- simple** — not forked or branched.

- sinuose** — having a wavy or uneven wall or margin.
- sinus** — in *Andreaea* leaves, a U-shaped indentation along the leaf margin.
- smooth** — lacking any surface irregularities such as papillae, spines, or striae.
- spathulate** — in the shape of a spatula, narrow below and broad and flat above (*compare with cochleariform*, shaped like a spoon and therefore deeply concave).
- spherical** — shaped like a sphere or nearly so.
- spinose** — having sharp teeth or spines.
- sporophyte** — the spore-producing generation of a moss or other embryophyte (*compare with gametophyte*, the multicellular gamete- (sex cell) producing generation of a moss or other embryophyte).
- spreading** — making an angle of more than 45° with the stem.
- squarrose** — making an angle of 90° with the stem.
- stegocarpous** — (of capsules) opening with a lid (operculum) or valves (*compare with cleistocarpous*, lacking a lid or valves and thus opening not along a line of built-in weakness but instead by the decay or rupture of the wall).
- stellate** — star-shaped.
- stereids** — stiffener cells that support the leaves and stems of some mosses. They're long, slender, and thick-walled (fibre-like), are alive at maturity in some species, and occur in bundles in the costa and borders of leaves or in the central strand and toward the outside of stems.
- stipe** (adjective **stipitate**) — the erect, unbranched trunk-like stem of mosses that look like miniature fern fronds.
- stoma** (plural **stomata**, adjective **stomatous**) — a tiny pore for gas exchange, usually surrounded by two guard cells that control its opening, and in mosses usually found in only the neck of capsules.
- stria** (plural **striae**, adjective **striate**) — a line or ridge running lengthwise.
- striola** (plural **striolae**, adjective **striolate**) — a delicate or fine line or ridge running lengthwise.
- strumose** — swollen goiter-like on one side.
- sub-** — a prefix meaning *nearly, almost, below, or somewhat*.
- subapex** — the portion of a leaf just below the apex.
- subpercurrent** — not quite reaching the tip (*compare with excurrent*, extending beyond the apex, **failing**, not reaching the apex, and **percurrent**, extending to the apex but not beyond).
- subquadrate** — not quite square-sided.
- substratum** (plural **substrata**) — whatever surface an organism is growing on, such as soil, plant debris, bark, living leaves, or rock.
- subula** (plural **subulae**, adjective **subulate**) — a long and slender needle- or awl-like point.
- subulate** — shaped like an awl, tapering to a fine point from a broad base.
- sulcate** — strongly grooved, furrowed, or folded lengthwise (*compare with plicate*, pleated, folded, or furrowed lengthwise, **rugose**, strongly wavy, folded, or wrinkled crosswise, **undulate**, somewhat wavy in one direction, and **striate**, marked with lines or ridges lengthwise).
- superficial** — on the surface.
- super-** — a prefix meaning *placed above or higher than or of higher quality or size*.
- supra-** — a prefix meaning *just above, beyond, or greater than*.
- surculus** (plural **surculi**) — a reduced branch or leaf that functions as a vegetative propagule.
- symmetric** (or **symmetrical**) — said of anything that can be cut into two mirror halves along an unlimited number of planes.
- systylious** — said of a capsule that opens without shedding its lid (which remains attached to the tip of the columella, a core of sterile tissue at the capsule's centre).
- teniola** (plural **teniolae**) — an intramarginal border of hyaline (colourless) cells.
- terete** — circular or nearly so in cross-section.
- terminal** — located at the tip or unattached end of a structure (*compare with lateral*, at the side or at 90° to the stem).
- terrestrial** — growing on soil.
- thick-walled** — said of walls taking up a quarter or more of the cell width (*compare*

- with **thin-walled**, the walls taking up less than a tenth of the cell width, and **firm-walled**, the walls taking up between a tenth and a quarter of the cell width).
- thin-walled** — said of walls taking up less than a tenth of the cell width (*compare with firm-walled*, the walls taking up between a tenth and a quarter of the cell width, and **thick-walled**, the walls taking up a quarter or more of the cell width).
- tomentum** (plural **tomenta**, adjective **tomentose**) — a felted and woolly covering of rhizoids.
- toothed** — armed with teeth or other sharp projections.
- tri-** — a prefix meaning *three* (*compare with uni-*, a prefix meaning *one*, **bi-**, a prefix meaning *two*, **pluri-**, a prefix meaning *several or a few*, and **multi-**, a prefix meaning *many*).
- triangular** — shaped like a triangle.
- trigonous** — said of a cell having triangle- or heart-shaped wall thickenings in the corners where it abuts two adjacent cells.
- truncate** — cut off closely and squarely at the apex.
- tuber** — a gemma-like but non-green brood body (asexual propagule) that's borne on rhizoids, usually underground.
- turbinate** — shaped like a child's top, an upside-down pear, or an inverted cone.
- turf** (plural **turves** or **turfs**) — a growth form of large patches of short or tall, erect and crowded shoots.
- turgid** — plump, swollen, or inflated (*compare with flaccid*, soft, flabby, or limp).
- umbellate** — arranged in a cluster of branches all arising from one point on a stem.
- underleaves** — leaves (usually arranged in a row) that are smaller than the other leaves on the stem, and usually shaped differently as well.
- undifferentiated** — said of cells that are *not* distinctly different in size, shape, and/or colour from nearby cells, for example in the alar region of a leaf base (*the opposite of differentiated*).
- undulate** — somewhat wavy in one direction (*compare with plicate* — pleated, folded, or furrowed lengthwise, **rugose**, strongly wavy, folded, or wrinkled crosswise, **sulcate**, strongly grooved, furrowed, or folded lengthwise, and **striate**, marked with lines or ridges lengthwise).
- uni-** — a prefix meaning *one*, as in *unipapillose* (having only a single papilla per cell) or *unistratose* (made up of a single layer of cells) (*compare with bi-*, a prefix meaning *two*, **tri-**, a prefix meaning *three*, **pluri-**, a prefix meaning *several or a few*, and **multi-**, a prefix meaning *many*).
- urceolate** — urn-shaped, narrowed somewhat below the mouth and again strongly at the base.
- urn** — the spore-bearing part of a capsule.
- vaginant lamina** — the slotted portion of the forward edge of a *Fissidens* leaf.
- valves** (adjective **valvate**) — in *Andreaea*, the segments that the opening capsule wall splits into along built-in lines of weakness.
- ventral** — the lower surface of a prostrate stem or the inner surface of a peristome tooth (*compare with dorsal*, the upper surface of a prostrate stem or the outer surface of a peristome tooth).
- ventral leaves** — one or more rows of modified leaves on the underside of a prostrate stem (*compare with dorsal leaves*, one or more rows of leaves on the upperside of a prostrate stem).
- vermicular** — long, narrow, and wavy like a worm.
- verrucose** — coarsely warty or roughened on the surface, as in the ornamentation of a spore (*compare with verruculose*, delicately or irregularly roughened or warty on the surface).
- verruculose** — delicately or irregularly roughened or warty on the surface (*compare with verrucose*, coarsely warty or roughened on the surface).
- vestigial** — reduced to only a non-functioning trace or remnant.
- wide-spreading** — making an angle of almost 90° with the stem.
- xeric** — very dry (*compare with hydric*, very wet, and **mesic**, intermediate between very wet and very dry).

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## Index of genera

<i>Acaulon</i> .....	471–472	<i>Cyclodictyon</i> .....	1068
<i>Achrophyllum</i> .....	1032–1037	<i>Cyrtodon</i> .....	1254–1255
<i>Acrocladium</i> .....	1295–1300	<i>Cyrtopus</i> .....	954
<i>Alleniella</i> .....	1267–1268	<i>Daltonia</i> .....	1056
<i>Aloina</i> .....	473–478	<i>Dawsonia</i> .....	90
<i>Amblystegium</i> .....	1077–1081	<i>Dendrocryphaea</i> .....	1256–1257
<i>Amphidium</i> .....	386–390	<i>Dendrohypopterygium</i> .....	1014
<i>Andreaea</i> .....	61–84	<i>Dendroligotrichum</i> .....	91–94
<i>Anoectangium</i> .....	479	<i>Dichelodontium</i> .....	984
<i>Archidium</i> .....	245–248	<i>Dicnemon</i> .....	402–408
<i>Ardeuma</i> .....	480	<i>Dicranella</i> .....	409–416
<i>Atrichum</i> .....	85–89	<i>Dicranoloma</i> .....	417–436
<i>Aulacomnium</i> .....	935–939	<i>Dicranoweisia</i> .....	391–395
<i>Austrohondaella</i> .....	1216–1218	<i>Dicranum</i> .....	437
<i>Barbula</i> .....	481–495	<i>Didymodon</i> .....	513–531
<i>Bartramia</i> .....	779–788	<i>Distichium</i> .....	351–352
<i>Beeveria</i> .....	1038	<i>Distichophyllum</i> .....	1057–1066
<i>Blindia</i> .....	224–240	<i>Ditrichum</i> .....	353–368
<i>Brachytheciastrum</i> .....	1123–1128	<i>Drepanocladus</i> .....	1090–1093
<i>Brachythecium</i> .....	1123–1138	<i>Eccremidium</i> .....	369–371
<i>Braithwaitea</i> .....	944	<i>Echinodium</i> .....	1286–1292
<i>Braunia</i> .....	904–907	<i>Ectropothecium</i> .....	1188
<i>Breutelia</i> .....	787–797	<i>Encalypta</i> .....	139–144
<i>Bryobeckettia</i> .....	145	<i>Entodon</i> .....	1215
<i>Bryoerythrophyllum</i> .....	496–498	<i>Entosthodon</i> .....	146–154
<i>Bryum</i> .....	673–684	<i>Ephemeropsis</i> .....	1067
<i>Buxbaumia</i> .....	131–133	<i>Ephemerum</i> .....	532–534
<i>Calliergon</i> .....	1100	<i>Epipterygium</i> .....	740
<i>Calliergonella</i> .....	1184–1186	<i>Eriodon</i> .....	1139
<i>Calomnion</i> .....	912–916	<i>Erpodium</i> .....	385
<i>Calymperes</i> .....	464–469	<i>Eurhynchium</i> .....	1140–1148
<i>Calyptopogon</i> .....	499–500	<i>Fabronia</i> .....	1178–1183
<i>Calypstrochaeta</i> .....	1039–1050	<i>Fallaciella</i> .....	1314–1318
<i>Camptochaete</i> .....	1301–1312	<i>Fifea</i> .....	1301–1302
<i>Campyladelphus</i> .....	1082–1085	<i>Fissidens</i> .....	250–340
<i>Campylopodium</i> .....	398–401	<i>Funaria</i> .....	155–157
<i>Campylopus</i> .....	449–460	<i>Gemmabryum</i> .....	685–712
<i>Canalohypopterygium</i> .....	1003–1005	<i>Gigaspermum</i> .....	135–138
<i>Catagonium</i> .....	1206–1207	<i>Glyphothecium</i> .....	985–987
<i>Catharomnion</i> .....	1006–1009	<i>Goniobryum</i> .....	919
<i>Ceratodon</i> .....	341–345	<i>Goniomitrium</i> .....	158
<i>Chenia</i> .....	501–507	<i>Grimmia</i> .....	197–216
<i>Chrysoblastella</i> .....	346–350	<i>Gymnostomum</i> .....	535–537
<i>Cladomnion</i> .....	981–983	<i>Hampeella</i> .....	988–992
<i>Climacium</i> .....	1074–1076	<i>Haplohymenium</i> .....	1330
<i>Codonoblepharon</i> .....	817–822	<i>Hedwigia</i> .....	904–908
<i>Conostomum</i> .....	798–804	<i>Hennediella</i> .....	538–550
<i>Coscinodon</i> .....	196	<i>Holodontium</i> .....	396
<i>Cratoneuron</i> .....	1086	<i>Holomitrium</i> .....	438–442
<i>Cratoneuroopsis</i> .....	1087–1089	<i>Hylocomium</i> .....	1208–1209
<i>Crosbya</i> .....	1051–1055	<i>Hymenodon</i> .....	940–941
<i>Crossidium</i> .....	508–512	<i>Hyophila</i> .....	551–555
<i>Cryphaea</i> .....	1243–1253	<i>Hypnobartlettia</i> .....	1094–1095
<i>Cryptogonium</i> .....	1258–1259	<i>Hypnodendron</i> .....	955–964
<i>Cryptopodium</i> .....	917–918	<i>Hypnum</i> .....	1189–1195
<i>Ctenidium</i> .....	1187	<i>Hypopterygium</i> .....	1015–1027
<i>Cyathophorum</i> .....	1010–1013	<i>Ischyrodon</i> .....	1181–1183

continued next page

<i>Isopterygiopsis</i> .....	1196	<i>Ptychomnion</i> .....	993–1000
<i>Isopterygium</i> .....	1216, 1219	<i>Ptychostomum</i> .....	714–719
<i>Kiaeria</i> .....	397	<i>Pulchrinodus</i> .....	670–671
<i>Lembophyllum</i> .....	1319–1325	<i>Pyrrhobryum</i> .....	920–928
<i>Leptobryum</i> .....	666	<i>Racomitrium</i> .....	169–195
<i>Leptodictyum</i> .....	1096–1097	<i>Racopilum</i> .....	945–953
<i>Leptodon</i> .....	1293–1294	<i>Rhacocarpus</i> .....	909–911
<i>Leptodontium</i> .....	556–557	<i>Rhaphidorrhynchium</i> .....	1225–1226
<i>Leptostomum</i> .....	771–778	<i>Rhizogonium</i> .....	929–934
<i>Leptotheca</i> .....	942	<i>Rhynchostegium</i> .....	1155–1160
<i>Lepyrodon</i> .....	1262–1266	<i>Rhytidiadelphus</i> .....	1208–1211
<i>Leratia</i> .....	822	<i>Rosulabryum</i> .....	720–739
<i>Leucobryum</i> .....	461–463	<i>Saelania</i> .....	379
<i>Lindbergia</i> .....	1107	<i>Sanionia</i> .....	1098
<i>Lopidium</i> .....	1028–1029	<i>Sauloma</i> .....	1030–1031
<i>Macrocoma</i> .....	823–826	<i>Schistidium</i> .....	217–222
<i>Macromitrium</i> .....	827–855	<i>Schizymenium</i> .....	770
<i>Meesia</i> .....	667–669	<i>Schlotheimia</i> .....	877–881
<i>Mesotus</i> .....	443–445	<i>Sciadocladus</i> .....	973–980
<i>Meteoriopsis</i> .....	1164–1165	<i>Sclerodontium</i> .....	447–448
<i>Microbryum</i> .....	558–560	<i>Scleropodium</i> .....	1161
<i>Micromitrium</i> .....	561–562	<i>Scorpidium</i> .....	1099
<i>Mittenia</i> .....	660	<i>Scorpiurium</i> .....	1162–1163
<i>Mniodendron</i> .....	955–956, 965–972	<i>Seligeria</i> .....	241–244
<i>Neckera</i> .....	1267–1270	<i>Sematophyllum</i> .....	1227–1240
<i>Neckeropsis</i> .....	1271–1272	<i>Sphagnum</i> .....	39–59
<i>Notoligotrichum</i> .....	95–104	<i>Straminergon</i> .....	1101
<i>Ochiobryum</i> .....	741–743	<i>Symphysodontella</i> .....	1260
<i>Oligotrichum</i> .....	105–106	<i>Syntrichia</i> .....	572–600
<i>Orthodontium</i> .....	943	<i>Syrhropodon</i> .....	470
<i>Orthorrhynchium</i> .....	1261	<i>Tayloria</i> .....	661–665
<i>Orthothecium</i> .....	1197	<i>Tetracoscinodon</i> .....	601
<i>Orthotrichum</i> .....	856–876	<i>Tetraphidopsis</i> .....	1001–1002
<i>Palamocladium</i> .....	1149	<i>Tetrodontium</i> .....	130
<i>Papillaria</i> .....	1166–1177	<i>Thamnobryum</i> .....	1281–1285
<i>Pendulothecium</i> .....	1273–1280	<i>Thuidiopsis</i> .....	1111–1116
<i>Philonotis</i> .....	805–814	<i>Thuidium</i> .....	1117–1122
<i>Physcomitrella</i> .....	159	<i>Timmia</i> .....	134
<i>Physcomitrium</i> .....	160–168	<i>Tortella</i> .....	602–613
<i>Plagiobryum</i> .....	713	<i>Tortula</i> .....	614–631
<i>Plagiomnium</i> .....	744–748	<i>Trachyloma</i> .....	1069–1073
<i>Plagiopus</i> .....	815	<i>Trematodon</i> .....	381–384
<i>Plagiothecium</i> .....	1212–1214	<i>Trichodon</i> .....	380
<i>Platyhypnidium</i> .....	1150	<i>Trichostomum</i> .....	632–640
<i>Pleuridium</i> .....	372–378	<i>Tridontium</i> .....	641–643
<i>Pleurophascum</i> .....	658–659	<i>Triquetrella</i> .....	644–648
<i>Pogonatum</i> .....	107–108	<i>Ulota</i> .....	882–894
<i>Pohlia</i> .....	749–769	<i>Vesicularia</i> .....	1203–1205
<i>Polytrichadelphus</i> .....	109–112	<i>Warburgiella</i> .....	1241–1242
<i>Polytrichastrum</i> .....	113–122	<i>Warnstorfia</i> .....	1102–1106
<i>Polytrichum</i> .....	123–129	<i>Weissia</i> .....	649–656
<i>Pseudephemerum</i> .....	446	<i>Weymouthia</i> .....	1326–1329
<i>Pseudocrossidium</i> .....	563–569	<i>Wijkia</i> .....	1220–1224
<i>Pseudoleskea</i> .....	1108	<i>Willia</i> .....	657
<i>Pseudoscleropodium</i> .....	1151–1154	<i>Zygodon</i> .....	895–903
<i>Pseudotaxiphyllum</i> .....	1198–1202		
<i>Pterygoneurum</i> .....	570–571		
<i>Ptychomitrium</i> .....	223		

**Index of epithets**

abruptinervis — *Tortula*  
 acaulon — *Tortula*  
 aciculare — *Ptychomnion*  
 aciphylla — *Fifea*  
 acuminata — *Cryphaea*  
 acuminatum — *Goniomitrium*  
 acutifolia subsp. *acuminata* — *Andreaea*  
 acutifolia subsp. *acutifolia* — *Andreaea*  
 adianthoides — *Fissidens*  
 aduncus — *Drepanocladus*  
 aestivum — *Anoetangium*  
 affinis — *Breutelia*  
 alaris — *Bartramia*  
 alaris — *Hampeella*  
 albicans — *Brachythecium*  
 algovicum var. *rutheanum* — *Bryum*  
 allisonii — *Brachythecium*  
 alpina — *Andreaea*  
 alpinum — *Polytrichastrum*  
 amblyodon — *Bryum*  
 amoenum — *Rhaphidorrhynchium*  
 anderssonii — *Syntrichia*  
 androgynum — *Atrichum*  
 angulatum — *Macromitrium*  
 angustata — *Camptochaete*  
 angustifolium — *Orthotrichum*  
 anisophyllus — *Fissidens*  
 annotina — *Pohlia*  
 anodon — *Grimmia*  
 antarctica — *Dicranoweisia*  
 antarctica — *Syntrichia*  
 aphylla — *Buxbaumia*  
 apiculata — *Calyptrochaeta*  
 apocarpum — *Schistidium*  
 apophysatus — *Entosthodon*  
 arbuscula var. *arbuscula* — *Camptochaete*  
 arbuscula var. *tumida* — *Camptochaete*  
 arcuatum — *Hypnodendron*  
 arenae subsp. *arenae* — *Hennediella*  
 arenae subsp. *petriei* — *Hennediella*  
 areolata — *Tortula*  
 argenteum — *Bryum*  
 armatus — *Syrhopodon*  
 arnoldii — *Pleuridium*  
 asperipes — *Eurhynchium*  
 asplenioides — *Fissidens*  
 assimile — *Orthotrichum*  
 atrovirens — *Tortula*  
 aucklandicum — *Orthotrichum*  
 auriculatum — *Pendulothecium*  
 australasiae — *Didymodon*  
 australe — *Gemmabryum*  
 australe — *Notoligotrichum*  
 australe — *Ptychomitrium*  
 australe — *Sphagnum*  
 australis — *Andreaea*  
 australis — *Fabronia*  
 australis — *Grimmia*

australis — Lepyrodon  
 australis — Pohlia  
 austrinum — Platyhypnidium  
 austrocrispa — Weissia  
 austrofunalis — Grimmia  
 bartlettii — Bryobeckettia  
 bartramioides — Cryptopodium  
 bellii — Notoligotrichum  
 berteroi — Fissidens  
 bicolor var. bicolor — Campylopus  
 bifarium — Pyrrhobryum  
 bifrons — Aloina  
 billardierei — Rosulabryum  
 billardieri — Dicranoloma  
 blandum — Ochiobryum  
 blechnoides — Fissidens  
 blumeanum — Cyclodictyon  
 brachiatus — Drepanocladus  
 brachydontium — Trichostomum  
 brevicaule — Macromitrium  
 brevirostre — Ditrichum  
 brevisetacea — Syntrichia  
 brotherusii — Ditrichum  
 brownianum — Tetrodontium  
 brownii — Calypstrochaeta  
 brownseyi — Calomnion  
 bryoides — Fissidens  
 bryoides — Schizymerium  
 buchananii — Ditrichum  
 bulbosum — Cyathophorum  
 caespiticium — Gemmabryum  
 calcareum — Gymnostomum  
 callophylla — Tayloria  
 calobolax — Willia  
 calvum — Orthotrichum  
 calycina — Barbula  
 calycinum — Dicnemon  
 calyptratus — Coscinodon  
 campbelliana — Schlotheimia  
 campestre — Brachythecium  
 camptotrachela — Pohlia  
 campylothecium — Rosulabryum  
 capillaceum — Distichium  
 capillare — Rosulabryum  
 capitatus — Fissidens  
 cardotii — Dicranella  
 cardotii — Seligeria  
 celatus — Mesotus  
 ceratodonteus — Didymodon  
 chilensis — Chrysoblastella  
 chlamydophyllum — Acrocladium  
 chlorophyllosa — Cryphaea  
 chrysogaster — Hypnum  
 chrysoneuron — Gemmabryum  
 ciliata — Hedwigia  
 ciliatum — Catharomnion  
 cirrhata — Tortella  
 clandestinum — Lembophyllum  
 clavatum — Gemmabryum



clavatus — *Campylopus*  
 cochlearifolia — *Weymouthia*  
 colensoi — *Mniodendron*  
 comatum — *Mniodendron*  
 commune — *Polytrichum*  
 comosum var. comosum — *Mniodendron*  
 comosum var. sieberi — *Mniodendron*  
 compactum — *Sphagnum*  
 complanatum — *Calomnion*  
 concinnum — *Lopidium*  
 contacta — *Blindia*  
 controversa var. controversa — *Weissia*  
 controversa var. gymnostoma — *Weissia*  
 convoluta — *Barbula*  
 coronatum — *Gemmabryum*  
 cossonii — *Scorpidium*  
 crassifolium subsp. crassifolium — *Orthotrichum*  
 crassinerve — *Rosulabryum*  
 crassinervia — *Bartramia*  
 crassum — *Gemmabryum*  
 creberrimum — *Ptychostomum*  
 crinitum — *Pseudocrossidium*  
 crispulum var. adnatum — *Distichophyllum*  
 crispulum var. crispulum — *Distichophyllum*  
 crispulum — *Notoligotrichum*  
 crispulum — *Racomitrium*  
 crispulum var. robinsonii — *Fissidens*  
 cristata — *Calyptrochaeta*  
 cristatum — *Sphagnum*  
 crocea — *Papillaria*  
 cruda — *Pohlia*  
 crumianum — *Racomitrium*  
 cucullatum — *Scorpiurium*  
 cupressiforme var. cupressiforme — *Hypnum*  
 cupressiforme var. filiforme — *Hypnum*  
 cupressiforme var. lacunosum — *Hypnum*  
 cupulatum — *Orthotrichum*  
 curiosissimum — *Racomitrium*  
 curvatus var. curvatus — *Fissidens*  
 curvatus var. inclinabilis — *Fissidens*  
 curvirostrum — *Conostomum*  
 cuspidata — *Calliergonella*  
 cuspidigerum var. convolutaceum — *Racopilum*  
 cyathiforme — *Orthotrichum*  
 cylindracea — *Symphysodontella*  
 cylindricarpum — *Ditrichum*  
 cylindricus — *Trichodon*  
 cylindritheca — *Eriodon*  
 cymbifolium — *Thuidium*  
 davallianum — *Microbryum*  
 davidai — *Crossidium*  
 dealbatus — *Fissidens*  
 deflexa — *Camptochaete*  
 dendroides — *Climacium*  
 densifolium — *Ptychomnion*  
 dentatum — *Achrophyllum*  
 dicarpum — *Dicranoloma*  
 dichotomum — *Gemmabryum*  
 didictyon — *Hypopterygium*

didymum — *Racomitrium*  
 dietrichiae — *Dicranella*  
 dietrichiae — *Fissidens*  
 difficile — *Ditrichum*  
 dilatatus — *Cyrtodon*  
 diminuta — *Seligeria*  
 distichaceum — *Pseudotaxiphyllum*  
 distichophylloides — *Beeveria*  
 distichum — *Rhizogonium*  
 diversinerve — *Trachyloma*  
 divulsum — *Lembophyllum*  
 dixonianum — *Dicnemon*  
 dubius — *Fissidens*  
 elatum — *Archidium*  
 elegans — *Orthorrhynchium*  
 elongata — *Breutelia*  
 elongata — *Pohlia*  
 elongatum — *Racomitrium*  
 ericoides — *Cladomnion*  
 exilis — *Fissidens*  
 extenuata var. caudata — *Wijkia*  
 extenuata var. extenuata — *Wijkia*  
 falciculatum — *Sphagnum*  
 falcifolium — *Pseudotaxiphyllum*  
 fasciatum — *Dicranoloma*  
 filicinum — *Cratoneuron*  
 filiculiforme — *Dendrohypopterygium*  
 fiordensis — *Sematophyllum*  
 flavolimbata — *Papillaria*  
 flavovirens — *Tortella*  
 flexicaule — *Ditrichum*  
 flexicaulis — *Papillaria*  
 flexicollis — *Calypstrochaeta*  
 flexipes — *Trematodon*  
 fluitans — *Warnstorfia*  
 fontana — *Hypnobartlettia*  
 fontanum — *Brachythecium*  
 fontinaliopsis — *Warnstorfia*  
 formosum — *Polytrichastrum*  
 fragilis — *Tortella*  
 funkii — *Ptychostomum*  
 furfurosa — *Thuidiopsis*  
 gaudichaudii — *Leptotheca*  
 geheebii — *Crossidium*  
 glaucescens — *Saelania*  
 glaucum — *Erpodium*  
 gracile — *Macromitrium*  
 gracilis — *Fallaciella*  
 gracillima — *Dicranella*  
 gracillimum — *Codonoblepharon*  
 graphiomitrium — *Orthotrichum*  
 grossirete — *Macromitrium*  
 harriotii — *Bryum*  
 heimii — *Hennediella*  
 helmsii — *Macromitrium*  
 heteromalla — *Dicranella*  
 hispidum — *Echinodium*  
 homomallum — *Sematophyllum*  
 hookeri — *Zygodon*

hornschuchianum — Pseudocrossidium  
 hortense — Orthotrichum  
 hygrometrica — Funaria  
 hylogenes — Fissidens  
 hymenodonta — Alleniella  
 hyophilus — Fissidens  
 imberbis — Braunia  
 imbricata — Pseudoleskea  
 immersa — Blindia  
 inclinans — Leptostomum  
 incrasscapsulis — Grimmia  
 inflatus — Pulchrinodus  
 inflectens — Vesicularia  
 integerrimus — Fissidens  
 integrifolium — Acaulon  
 intermedius — Zygodon  
 interruptum — Leptodontium  
 introflexus — Campylopus  
 irroratus — Tetracoscinodon  
 involuta — Hyophila  
 javense — Leucobryum  
 jolliffii — Sematophyllum  
 juniperinum — Polytrichum  
 kerrii — Sciadocladus  
 kirkii — Campylopus  
 kirkii — Sematophyllum  
 knightii — Schlotheimia  
 knightii — Tortella  
 laevigata — Grimmia  
 laevigata — Neckera  
 laevigatum — Gemmabryum  
 laevipila — Syntrichia  
 laeviusculum — Thuidium  
 lagurus — Lepyrodon  
 lamprostachys — Plagiothecium  
 lanuginosum — Racomitrium  
 lapponicum — Amphidium  
 laxatum — Rhynchostegium  
 laxis — Entosthodon  
 leioneuron — Dicranum  
 lepineana — Neckeropsis  
 leptocladus — Fissidens  
 leptophylla — Chenia  
 lepturus — Ischyrodon  
 leskeoides — Palamocladium  
 leucocyta — Warburgiella  
 leuconeura — Papillaria  
 lewinskyae — Blindia  
 ligulaefolium — Macromitrium  
 ligulare — Macromitrium  
 limata — Austrohondaella  
 lineare — Campylopodium  
 lineare — Orthodontium  
 linearis var. angustifolius — Fissidens  
 linearis var. linearis — Fissidens  
 longipes — Macromitrium  
 longirostre — Macromitrium  
 longirostris — Grimmia  
 longisetum — Polytrichastrum

lucidum — Plagiothecium  
 lutea — Ulota  
 mackayi — Trematodon  
 macrocarpum — Leptostomum  
 macrophylla — Henediella  
 magellanica — Blindia  
 magellanicus — Polytrichadelphus  
 marginata — Tortula  
 marginatum — Hypnodendron  
 maritima — Lindbergia  
 maritima — Tortula  
 martinii — Blindia  
 medium — Campylopodium  
 megalotis — Fissidens  
 membranata — Ulota  
 menziesii var. angustifolium — Codonoblepharon  
 menziesii — Dicranoloma  
 menziesii — Sciadocladus  
 microcarpum — Distichophyllum  
 microstomum — Macromitrium  
 microvaginata — Andreaea  
 minutirameum — Isopterygium  
 minutum — Codonoblepharon  
 minutum — Eccremidium  
 mnioides subsp. contortum — Pyrrhobryum  
 mnioides — Calyptopogon  
 mollis — Weymouthia  
 mossmaniana — Bartramia  
 mucronatum — Bryum  
 mucronifolia — Tortula  
 muehlenbergii — Entosthodon  
 muralis — Tortula  
 muriculatum — Rhynchostegium  
 mutabilis — Andreaea  
 nervosa — Crosbya  
 nervosum — Pleuridium  
 nitens subsp. nitens — Catagonium  
 nitens — Papillaria  
 nitida — Andreaea  
 nitidum — Dichelodontium  
 nitidum — Pseudephemerum  
 norvegica — Timmia  
 novae-hollandiae — Rhizogonium  
 novae-seelandiae — Hyophila  
 novae-seelandiae — Plagiobryum  
 novae-zealandiae — Plagiomnium  
 novae-zealandiae — Buxbaumia  
 novae-zealandiae — Didymodon  
 novo-zealandicum — Sphagnum  
 nutans — Pohlia  
 obesifolium — Dicranoloma  
 oblongifolium — Pendulothecium  
 oblongifolius — Fissidens  
 obtusifolia — Leratia  
 ochii — Pohlia  
 octoblepharum — Tayloria  
 oederiana — Plagiopus  
 opararensense — Epipterygium  
 orthophyllum — Macromitrium

ovalifolia — Cryphaea  
 ovalifolium — Pleurophascum  
 ovatum — Pterygoneurum  
 pagorum — Syntrichia  
 pallens — Hampeella  
 pallescens — Ptychostomum  
 pallidum — Sclerodontium  
 pallidus — Campylopus  
 pallidus — Fissidens  
 palustre — Aulacomnium  
 pandum — Thamnobryum  
 papillata — Bartramia  
 papillata — Triquetrella  
 papillosa — Syntrichia  
 paradoxum — Brachytheciastrum  
 paramattense — Pyrrhobryum  
 parvula — Cryphaea  
 patula — Weissia  
 pendula — Breutelia  
 pennatum — Rhizogonium  
 pentastichum — Conostomum  
 perangustus — Fissidens  
 perichaetiale — Holomitrium  
 perichaetiale — Sphagnum  
 perichaetialis — Ulota  
 perlimbatum — Rosulabryum  
 phaea — Syntrichia  
 phyllogonioides — Cryptogonium  
 pilifer — Hymenodon  
 plagiopodia — Grimmia  
 planifolium — Trachyloma  
 platycaulon — Dicranoloma  
 plicatus — Entodon  
 plumosum — Brachythecium  
 plumula — Mittenia  
 plurisetum — Dicranoloma  
 polygamus — Campyliadelphus  
 praelongum — Eurhynchium  
 preissianum — Gemmabryum  
 productus — Entosthodon  
 proropens — Macromitrium  
 pruinoseum — Racomitrium  
 pseudotriquetrum — Ptychostomum  
 pseudotriste — Haplohymenium  
 ptychophyllum — Racomitrium  
 pubescens — Ctenidium  
 pulchella — Isopterygiopsis  
 pulchellum — Distichophyllum  
 pulchellum — Eccremidium  
 pulchellum — Eurhynchium  
 pulvinata var. africana — Grimmia  
 pulvinata — Camptochaete  
 pumila — Kiaeria  
 pumilum — Thamnobryum  
 punctatum — Pendulothecium  
 punctulatum — Ditrichum  
 purpurascens — Rhacocarpus  
 purpurascens — Tayloria  
 purpureocaulis — Campylopus

purpureus — *Ceratodon*  
 purum — *Pseudoscleropodium*  
 pusilla — *Tetraphidopsis*  
 pusillum var. *otagoensis* — *Conostomum*  
 pusillum var. *pusillum* — *Conostomum*  
 pusillum — *Physcomitrium*  
 pygmaea — *Syntrichia*  
 pyriforme — *Leptobryum*  
 pyriforme — *Physcomitrium*  
 pyriformis — *Philonotis*  
 quadrifarium — *Achrophyllum*  
 radians — *Entosthodon*  
 radiculosum — *Gemmabryum*  
 ramsayae — *Macromitrium*  
 readeri — *Physcomitrella*  
 reclinata — *Meteoriopsis*  
 recurvirostrum — *Bryoerythrophyllum*  
 recurvirostrum — *Ardeuma*  
 reflexidens — *Grimmia*  
 relaxa — *Cratoneuropsis*  
 repens — *Gigaspermum*  
 retusum — *Macromitrium*  
 rhaptocarpa — *Encalypta*  
 richardsonii — *Calliergon*  
 rigidulus var. *pseudostrictus* — *Fissidens*  
 rigidulus var. *rigidulus* — *Fissidens*  
 riparium — *Leptodictyum*  
 rivulare var. *rivulare* — *Schistidium*  
 rivulare var. *subflexifolium* — *Schistidium*  
 robusta — *Bartramia*  
 robusta — *Blindia*  
 robusta — *Fallaciella*  
 robusta — *Syntrichia*  
 robustum — *Dicranoloma*  
 robustum — *Racopilum*  
 rotundifolium — *Distichophyllum*  
 rubella — *Syntrichia*  
 rubens — *Gemmabryum*  
 rubra var. *rubra* — *Syntrichia*  
 rubra var. *subantarctica* — *Syntrichia*  
 ruderale — *Gemmabryum*  
 rufescens — *Zygodon*  
 rufo-aureum — *Ditrichum*  
 rupestre var. *papillosum* — *Orthotrichum*  
 rupestre var. *rupestre* — *Orthotrichum*  
 ruralis — *Syntrichia*  
 rutabulum — *Brachythecium*  
 sainsburyi — *Orthotrichum*  
 salebrosum — *Brachythecium*  
 sandwichense — *Ectropothecium*  
 sarmentosa — *Warnstorfia*  
 sauteri — *Gemmabryum*  
 scabrifolia — *Philonotis*  
 schreberiana — *Dicranella*  
 sciophilum — *Trichostomum*  
 sciuroides — *Glyphothecium*  
 semicryptum — *Dicnemon*  
 seppeltii — *Blindia*  
 serpens — *Amblystegium*

serrata — Syntrichia  
 serratum — Ephemerum  
 sessile — Ephemerum  
 setosus — Cyrtopus  
 simplex — Sphagnum  
 smithii — Leptodon  
 sparsa — Thuidiopsis  
 speciosum — Eurhynchium  
 spenceri — Dicranoweisia  
 spininervium subsp. spininervium — Hypnodendron  
 splachnoides — Daltonia  
 splachnoides — Tortula  
 splendens — Hylocomium  
 squarrosus — Sphagnum  
 squarrosus — Rhytidiadelphus  
 starckeanum — Microbryum  
 stellatus — Campyliadelphus  
 straminea — Crosbya  
 stramineum — Straminergon  
 striatipilum — Racomitrium  
 strictum — Ditrichum  
 strictum — Holodontium  
 strictum — Orthothecium  
 strictum — Fissidens  
 strumiferum — Racopilum  
 subbasilare — Goniobryum  
 suberectus — Trematodon  
 subhumile var. contiguum — Sematophyllum  
 subnitens — Sphagnum  
 subnudus var. gracilis — Entosthodon  
 subnudus var. subcuspidatus — Entosthodon  
 subnudus var. subnudus — Entosthodon  
 subpilosum — Brachythecium  
 subtomentosum — Rosulabryum  
 subulata — Andreaea  
 subulatum — Pleuridium  
 subulatum — Pogonatum  
 sulcata — Braithwaitea  
 superba var. superba — Dawsonia  
 tahitense — Calymperes  
 tamarisci — Hypopterygium  
 tamariscinum — Canalohypopterygium  
 tasmanica — Dendrocryphaea  
 tasmanica — Tayloria  
 tasmanica — Triquetrella  
 tasmanicum var. parvithecum — Orthotrichum  
 tasmanicum var. tasmanicum — Orthotrichum  
 tasmanicum — Tridontium  
 taxifolius — Fissidens  
 taylorii var. epiphytus — Fissidens  
 taylorii var. sainsburyanus — Fissidens  
 taylorii var. taylorii — Fissidens  
 tenella — Cryphaea  
 tenella — Sauloma  
 tenellus var. australiensis — Fissidens  
 tenellus var. tenellus — Fissidens  
 tenerum — Calymperes  
 tenerum — Micromitrium  
 tenuidens — Bryum

tenuifolia — Pohlia  
tenuifolium — Rhynchostegium  
tenuirostre — Oligotrichum  
tenuirostre — Trichostomum  
tenuis — Philonotis  
tenuis subsp. tenuis — Macrocoma  
tenuisetum — Gemmabryum  
tongariroense — Dendroligotrichum  
tophaceus — Didymodon  
torquatus — Didymodon  
torquescens — Rosulabryum  
tortuosum — Amphidium  
touretii — Scleropodium  
trentepohlioides — Ephemeropsis  
trichophylla — Grimmia  
trichopodium — Holomitrium  
triquetrus — Rhytidiadelphus  
truncata — Tortula  
uliginosa — Meesia  
umbrosum — Echinodium  
uncinata — Sanionia  
uncinatum — Sematophyllum  
unguiculata — Barbula  
vaginata — Dicranella  
varium — Amblystegium  
velutinum — Brachytheciastrum  
viridipila — Tortula  
viridis — Ulota  
vulgaris — Encalypta  
wahlenbergii — Pohlia  
waiensis — Fissidens  
weymouthii — Didymodon  
wilsonii — Grimmia



## Index of binomials

Species printed in **boldface** are illustrated on the page(s) noted.  
A genus printed in *italics* has more than one species in New Zealand, and those species are treated on the page(s) noted.

<b>Acaulon integrifolium</b> .....	374, 471–472
<i>Achrophyllum</i> .....	1032–1037
<b>Achrophyllum dentatum</b> .....	1032–1034
<b>Achrophyllum quadrifarium</b> .....	1032, 1035–1037
<b>Acrocladium chlamydophyllum</b> .....	1295–1300
<b>Alleniella hymenodonta</b> .....	1267–1268
<i>Aloina</i> .....	473–478
<b>Aloina ambigua</b> .....	473–475
<b>Aloina bifrons</b> .....	473, 476–478
<i>Amblystegium</i> .....	1077–1081
<b>Amblystegium serpens</b> .....	1077–1078
<b>Amblystegium varium</b> .....	1077, 1079–1081
<i>Amphidium</i> .....	386–390
<b>Amphidium cyathicarpum</b> .....	386–387, 479
<b>Amphidium lapponicum</b> .....	386, 388–390
<i>Andreaea</i> .....	61–84
<b>Andreaea acutifolia</b> subsp. <b>acuminata</b> .....	61–63
<b>Andreaea acutifolia</b> subsp. <b>acutifolia</b> .....	61–65
<b>Andreaea alpina</b> .....	61–62, 66–68
<b>Andreaea amblyophylla</b> .....	61–62, 69–70, 77
<b>Andreaea australis</b> .....	61–62, 71
<b>Andreaea flabellata</b> .....	61–62, 72–74
<b>Andreaea flexuosa</b> .....	61–62, 75–76
<b>Andreaea heinemannii</b> .....	61–62
<b>Andreaea huttonii</b> .....	61–62, 77–79
<b>Andreaea microvaginata</b> .....	61–62, 80
<b>Andreaea mutabilis</b> .....	61–62, 81–82
<b>Andreaea nitida</b> .....	61–62, 83
<b>Andreaea subulata</b> .....	61–62, 84
<b>Anoetangium aestivum</b> .....	479
<b>Archidium elatum</b> .....	245–248
<b>Ardeuma recurvirostrum</b> .....	480
<b>Atrichum androgynum</b> .....	85–89
<b>Aulacomnium palustre</b> .....	935–939
<b>Austrohondaella limata</b> .....	1216–1218
<i>Barbula</i> .....	481–495
<b>Barbula calycina</b> .....	481–491
<b>Barbula convoluta</b> .....	481, 492
<b>Barbula unguiculata</b> .....	481, 493–495, 650
<i>Bartramia</i> .....	779–786
<b>Bartramia alaris</b> .....	779
<b>Bartramia crassinervia</b> .....	779–781
<b>Bartramia crossmaniana</b> .....	779, 782–783
<b>Bartramia papillata</b> .....	779, 784–785
<b>Bartramia robusta</b> .....	779, 786
<b>Beeveria distichophylloides</b> .....	1038
<i>Blindia</i> .....	224–240
<b>Blindia contacta</b> .....	224–227
<b>Blindia immersa</b> .....	224, 228–229
<b>Blindia lewinskyae</b> .....	224, 230
<b>Blindia magellanica</b> .....	224, 231–233
<b>Blindia martinii</b> .....	224, 234–235
<b>Blindia robusta</b> .....	224, 236–237
<b>Blindia seppeltii</b> .....	224, 238–240
<i>Brachytheciastrum</i> .....	1123–1128
<b>Brachytheciastrum paradoxum</b> .....	1123–1126

continued next page

<b>Brachytheciastrum velutinum</b> .....	1123–1124, 1127–1128
<i>Brachythecium</i> .....	1123–1138
<b>Brachythecium albicans</b> .....	1123–1124, 1129–1130
<b>Brachythecium allisonii</b> .....	1123–1124
<b>Brachythecium campestre</b> .....	1123–1124, 1131–1132
<b>Brachythecium fontanum</b> .....	1123–1124, 1133
<b>Brachythecium plumosum</b> .....	1123–1124, 1134
<b>Brachythecium rutabulum</b> .....	1123–1124, 1135–1136
<b>Brachythecium salebrosum</b> .....	1123–1124, 1129, 1137–1138
<b>Brachythecium subpilosum</b> .....	1123–1124
<b>Braithwaitea sulcata</b> .....	944
<b>Braunia imberbis</b> .....	904–907
<i>Breutelia</i> .....	787–797
<b>Breutelia affinis</b> .....	787–791
<b>Breutelia elongata</b> .....	787, 792–793
<b>Breutelia pendula</b> .....	787, 792–797
<b>Bryobeckettia bartlettii</b> .....	145
<i>Bryoerythrophyllum</i> .....	496–498
<b>Bryoerythrophyllum dubium</b> .....	496–497
<b>Bryoerythrophyllum recurvirostrum</b> .....	496, 498
<i>Bryum</i> .....	673–684
<b>Bryum algovicum</b> var. <b>rutheanum</b> .....	673–676
<b>Bryum amblyodon</b> .....	673–674, 677–678
<b>Bryum argenteum</b> .....	673–674, 679–681
<b>Bryum harriottii</b> .....	673–674, 681–682
<b>Bryum mucronatum</b> .....	673–674, 683–684
<b>Bryum tenuidens</b> .....	673–674
<i>Buxbaumia</i> .....	131–133
<b>Buxbaumia aphylla</b> .....	131–132
<b>Buxbaumia novae-zelandiae</b> .....	131, 133
<b>Calliergon richardsonii</b> .....	1100
<b>Calliergonella cuspidata</b> .....	1184–1186
<i>Calomnion</i> .....	912–916
<b>Calomnion brownseyi</b> .....	912–915
<b>Calomnion complanatum</b> .....	912–913, 916
<i>Calymperes</i> .....	464–469
<b>Calymperes tahitense</b> .....	464–465
<b>Calymperes tenerum</b> .....	464, 466–469
<b>Calyptopogon mnioides</b> .....	499–500
<i>Calyptrochaeta</i> .....	1039–1050
<b>Calyptrochaeta apiculata</b> .....	1039–1041
<b>Calyptrochaeta brownii</b> .....	1039, 1042–1044
<b>Calyptrochaeta cristata</b> .....	1039, 1045–1047
<b>Calyptrochaeta flexicollis</b> .....	1039, 1048–1050
<i>Camptochaete</i> .....	1301–1312
<b>Camptochaete angustata</b> .....	1301–1303
<b>Camptochaete arbuscula</b> var. <b>arbuscula</b> .....	1301–1302, 1304
<b>Camptochaete arbuscula</b> var. <b>tumida</b> ....	1301–1302, 1305–1308
<b>Camptochaete deflexa</b> .....	1301–1302, 1309–1311
<b>Camptochaete pulvinata</b> .....	1301–1302, 1312
<i>Campyliadelphus</i> .....	1082–1085
<b>Campyliadelphus polygamus</b> .....	1082–1084
<b>Campyliadelphus stellatus</b> .....	1082, 1085
<i>Campylopodium</i> .....	398–401
<b>Campylopodium capillaceum</b> .....	398, 399–400
<b>Campylopodium lineare</b> .....	398, 401
<i>Campylopus</i> .....	449–460
<b>Campylopus bicolor</b> var. <b>bicolor</b> .....	449–451
<b>Campylopus clavatus</b> .....	449, 452
<b>Campylopus introflexus</b> .....	449, 453
<b>Campylopus kirkii</b> .....	449, 454–455

<i>Campylopus pallidus</i> .....	449, 456–457
<i>Campylopus purpureocaulis</i> .....	449, 458–460
<i>Canalohypopterygium tamariscinum</i> .....	1003–1005
<i>Catagonium nitens</i> subsp. <i>nitens</i> .....	1206–1207
<i>Catharomnion ciliatum</i> .....	1006–1009
<i>Ceratodon purpureus</i> .....	341–345
<i>Chenia leptophylla</i> .....	501–507
<i>Chrysoblastella chilensis</i> .....	346–350
<i>Cladomnion ericoides</i> .....	981–983
<i>Climacium dendroides</i> .....	1074–1076
<i>Codonoblepharon</i> .....	817–822
<i>Codonoblepharon gracillimum</i> .....	817–818
<i>Codonoblepharon menziesii</i> .....	817, 819–821
<i>Codonoblepharon minutum</i> .....	817, 822
<i>Conostomum</i> .....	798–804
<i>Conostomum curvirostrum</i> .....	798–799
<i>Conostomum pentastichum</i> .....	798, 800–801
<i>Conostomum pusillum</i> var. <i>otagoensis</i> .....	798, 802–803
<i>Conostomum pusillum</i> var. <i>pusillum</i> .....	798, 804
<i>Coscinodon calyptratus</i> .....	196
<i>Cratoneuron filicinum</i> .....	1086
<i>Cratoneuropsis relaxa</i> .....	1087–1089, 1094
<i>Crosbya</i> .....	1051–1055
<i>Crosbya nervosa</i> .....	1051–1054
<i>Crosbya straminea</i> .....	1051, 1055
<i>Crossidium</i> .....	508–512
<i>Crossidium davidai</i> .....	508–511
<i>Crossidium geheebii</i> .....	508, 512
<i>Cryphaea</i> .....	1243–1253
<i>Cryphaea acuminata</i> .....	1243–1244
<i>Cryphaea chlorophyllosa</i> .....	1243, 1245
<i>Cryphaea ovalifolia</i> .....	1243, 1246–1248
<i>Cryphaea parvula</i> .....	1243, 1249–1251
<i>Cryphaea tenella</i> .....	1243, 1252–1253
<i>Cryptogonium phyllogonioides</i> .....	1258–1259
<i>Cryptopodium bartramioides</i> .....	917–918
<i>Ctenidium pubescens</i> .....	1187
<i>Cyathophorum bulbosum</i> .....	1010–1013
<i>Cyclodictyon blumeianum</i> .....	1068
<i>Cyrtodon dilatatus</i> .....	1254–1255
<i>Cyrtopus setosus</i> .....	954
<i>Daltonia splachnoides</i> .....	1056
<i>Dawsonia superba</i> var. <i>superba</i> .....	90
<i>Dendrocryphaea tasmanica</i> .....	1256–1257
<i>Dendrohypopterygium filiculiforme</i> .....	1014
<i>Dendroligotrichum tongariroense</i> .....	91–94
<i>Dichelodontium nitidum</i> .....	984
<i>Dicnemon</i> .....	402–408
<i>Dicnemon calycinum</i> .....	402–404
<i>Dicnemon dixonianum</i> .....	402–403, 405–406
<i>Dicnemon semicryptum</i> .....	402, 406–408
<i>Dicranella</i> .....	409–416
<i>Dicranella cardotii</i> .....	409–410
<i>Dicranella dietrichiae</i> .....	409, 411
<i>Dicranella gracillima</i> .....	409, 412
<i>Dicranella heteromalla</i> .....	409, 413
<i>Dicranella schreberiana</i> .....	409
<i>Dicranella vaginata</i> .....	409, 414–416
<i>Dicranoloma</i> .....	417–436
<i>Dicranoloma billardieri</i> .....	417–421
<i>Dicranoloma dicarpum</i> .....	417–418, 422–424

<b>Dicranoloma fasciatum</b> .....	417–418, 425–426
<b>Dicranoloma menziesii</b> .....	417–418, 427
<b>Dicranoloma obesifolium</b> .....	417–418, 428–429
<b>Dicranoloma platycaulon</b> .....	417–418, 430
<b>Dicranoloma plurisetum</b> .....	417–418, 431–433
<b>Dicranoloma robustum</b> .....	417–418, 434–436
<i>Dicranoweisia</i> .....	391–395
<b>Dicranoweisia antarctica</b> .....	391–392
<b>Dicranoweisia spenceri</b> .....	391, 393–395
<b>Dicranum leioneuron</b> .....	437
<i>Didymodon</i> .....	513–531
<b>Didymodon australasiae</b> .....	513–517
<b>Didymodon ceratodonteus</b> .....	513, 518–519, 524
<b>Didymodon novae-zelandiae</b> .....	513, 520–523
<b>Didymodon tophaceus</b> .....	513, 524–525
<b>Didymodon torquatus</b> .....	513, 526–528
<b>Didymodon weymouthii</b> .....	513, 529–531
<b>Distichium capillaceum</b> .....	351–352
<i>Distichophyllum</i> .....	1057–1066
<b>Distichophyllum crispulum</b> var. <b>adnatum</b> .....	1057–1058
<b>Distichophyllum crispulum</b> var. <b>crispulum</b> .....	1057, 1059–1060
<b>Distichophyllum microcarpum</b> .....	1057, 1061
<b>Distichophyllum pulchellum</b> .....	1057, 1062–1064
<b>Distichophyllum rotundifolium</b> .....	1057, 1065–1066
<i>Ditrichum</i> .....	353–368
<b>Ditrichum brevirostre</b> .....	353–356
<b>Ditrichum brotherusii</b> .....	353–354, 357
<b>Ditrichum buchananii</b> .....	353–354, 358–360
<b>Ditrichum cylindricarpum</b> .....	353–354, 361
<b>Ditrichum difficile</b> .....	353–354, 362–363
<b>Ditrichum flexicaule</b> .....	353–354, 364
<b>Ditrichum punctulatum</b> .....	353–354, 361, 365–366
<b>Ditrichum rufo-aureum</b> .....	353–354
<b>Ditrichum strictum</b> .....	353–354, 367–368
<i>Drepanocladus</i> .....	1090–1093
<b>Drepanocladus aduncus</b> .....	1090–1091
<b>Drepanocladus brachiatus</b> .....	1090, 1092–1093
<i>Eccremidium</i> .....	369–371
<b>Eccremidium minutum</b> .....	369–370
<b>Eccremidium pulchellum</b> .....	369, 371
<i>Echinodium</i> .....	1286–1292
<b>Echinodium hispidum</b> .....	1286–1290
<b>Echinodium umbrosum</b> .....	1286, 1291–1292
<b>Ectropothecium sandwichense</b> .....	1188
<i>Encalypta</i> .....	139–144
<b>Encalypta rhaptocarpa</b> .....	139–142
<b>Encalypta vulgaris</b> .....	139, 143–144
<b>Entodon plicatus</b> .....	1215
<i>Entosthodon</i> .....	146–154
<b>Entosthodon apophysatus</b> .....	146–149
<b>Entosthodon jamesonii</b> subsp. <b>productus</b> .....	146–147, 150
<b>Entosthodon laxus</b> .....	146–147, 151
<b>Entosthodon muhlenbergii</b> .....	146–147, 152
<b>Entosthodon radians</b> .....	146–147, 153
<b>Entosthodon subnudus</b> var. <b>gracilis</b> .....	146–147, 154
<b>Entosthodon subnudus</b> var. <b>subcuspidatus</b> .....	146–147
<b>Entosthodon subnudus</b> var. <b>subnudus</b> .....	146–147
<b>Ephemeropsis trentepohlioides</b> .....	1067
<i>Ephemerum</i> .....	532–534
<b>Ephemerum serratum</b> .....	532–533
<b>Ephemerum sessile</b> .....	532, 534

<i>Epipterygium</i> <i>opararens</i> .....	740
<i>Eriodon</i> <i>cylindritheca</i> .....	1139
<i>Erpodium</i> <i>glaucum</i> .....	385, 1330
<i>Eurhynchium</i> .....	1140–1148
<i>Eurhynchium</i> <i>asperipes</i> .....	1140–1143
<i>Eurhynchium</i> <i>praelongum</i> .....	1140, 1144–1145
<i>Eurhynchium</i> <i>pulchellum</i> .....	1140, 1146
<i>Eurhynchium</i> <i>speciosum</i> .....	1140, 1147–1148
<i>Fabronia</i> <i>australis</i> .....	1178–1183
<i>Fallaciella</i> .....	1314–1318
<i>Fallaciella</i> <i>gracilis</i> .....	1314–1315
<i>Fallaciella</i> <i>robusta</i> .....	1314, 1316–1318
<i>Fifea</i> <i>aciphylla</i> .....	1301–1302, 1313
<i>Fissidens</i> .....	250–340
<i>Fissidens</i> <i>adanthoides</i> .....	250, 253
<i>Fissidens</i> <i>anisophyllus</i> .....	251, 254
<i>Fissidens</i> <i>asplenioides</i> .....	251, 255–260
<i>Fissidens</i> <i>berteroi</i> .....	250, 261–262
<i>Fissidens</i> <i>blechnoides</i> .....	252, 263–266
<i>Fissidens</i> <i>bryoides</i> .....	251, 267–268
<i>Fissidens</i> <i>capitatus</i> .....	251, 269–270
<i>Fissidens</i> <i>crispulus</i> var. <i>robinsonii</i> .....	250, 271–272
<i>Fissidens</i> <i>curvatus</i> var. <i>curvatus</i> .....	250, 273
<i>Fissidens</i> <i>curvatus</i> var. <i>inclinabilis</i> .....	252, 274–275
<i>Fissidens</i> <i>dealbatus</i> .....	250, 276–278
<i>Fissidens</i> <i>dietrichiae</i> .....	251, 279–281
<i>Fissidens</i> <i>dubius</i> .....	250, 282–283
<i>Fissidens</i> <i>exilis</i> .....	250, 284–285
<i>Fissidens</i> <i>hylogenes</i> .....	250, 276, 286–291
<i>Fissidens</i> <i>hyophilus</i> .....	251, 292–293
<i>Fissidens</i> <i>integerrimus</i> .....	251, 294–295
<i>Fissidens</i> <i>leptocladus</i> .....	251, 296–297, 332
<i>Fissidens</i> <i>linearis</i> var. <i>angustifolius</i> .....	251, 298–299
<i>Fissidens</i> <i>linearis</i> var. <i>linearis</i> .....	251, 300–303
<i>Fissidens</i> <i>megalotis</i> .....	250, 304–307
<i>Fissidens</i> <i>oblongifolius</i> .....	251, 308–309
<i>Fissidens</i> <i>pallidus</i> .....	251, 310–312
<i>Fissidens</i> <i>perangustus</i> .....	250, 313–314
<i>Fissidens</i> <i>rigidulus</i> var. <i>pseudistrictus</i> .....	251, 315–318
<i>Fissidens</i> <i>rigidulus</i> var. <i>rigidulus</i> .....	250, 252, 319–322
<i>Fissidens</i> <i>strictus</i> .....	251, 323–324
<i>Fissidens</i> <i>taxifolius</i> .....	250, 325–327
<i>Fissidens</i> <i>taylorii</i> var. <i>epiphytus</i> .....	252, 328–330
<i>Fissidens</i> <i>taylorii</i> var. <i>sainsburyanus</i> .....	250, 252, 331–332
<i>Fissidens</i> <i>taylorii</i> var. <i>taylorii</i> .....	252, 333–334
<i>Fissidens</i> <i>tenellus</i> var. <i>australiensis</i> .....	251, 335–336
<i>Fissidens</i> <i>tenellus</i> var. <i>tenellus</i> .....	251, 337–338
<i>Fissidens</i> <i>waiensis</i> .....	252, 339–340
<i>Funaria</i> <i>hygrometrica</i> .....	155–157
<i>Gemmabryum</i> .....	687, 685–712
<i>Gemmabryum</i> <i>australe</i> .....	685–686, 688–689
<i>Gemmabryum</i> <i>caespiticium</i> .....	685–686, 690–692
<i>Gemmabryum</i> <i>chrysoeuron</i> .....	685–686, 693–694
<i>Gemmabryum</i> <i>clavatum</i> .....	685–686, 695–696
<i>Gemmabryum</i> <i>coronatum</i> .....	685–686, 697–698
<i>Gemmabryum</i> <i>crassum</i> .....	685–686, 699–700
<i>Gemmabryum</i> <i>dichotomum</i> .....	685–686, 701
<i>Gemmabryum</i> <i>laevigatum</i> .....	685–686, 702–703
<i>Gemmabryum</i> <i>preissianum</i> .....	685–686, 704–705
<i>Gemmabryum</i> <i>radiculosum</i> .....	685–686, 706
<i>Gemmabryum</i> <i>rubens</i> .....	685–686, 707–708

<b>Gemmabryum ruderale</b> .....	685–686, 709–710
<b>Gemmabryum sauteri</b> .....	685–686, 711–712
<b>Gemmabryum tenuisetum</b> .....	685–686
<b>Gigaspermum repens</b> .....	135–138
<b>Glyphothecium sciurioides</b> .....	985–987
<b>Goniobryum subbasilare</b> .....	919
<b>Goniomitrium acuminatum</b> .....	158
<i>Grimmia</i> .....	197–216
<b>Grimmia anodon</b> .....	197–199
<b>Grimmia australis</b> .....	197, 200–201
<b>Grimmia austrofunalis</b> .....	197–198, 202
<b>Grimmia incrassicapsulis</b> .....	197–198, 203–204
<b>Grimmia laevigata</b> .....	197–198, 205
<b>Grimmia longirostris</b> .....	197–198, 206–207
<b>Grimmia plagiopodia</b> .....	197–198, 208
<b>Grimmia pulvinata</b> var. <b>africana</b> .....	197–198, 209–210
<b>Grimmia reflexidens</b> .....	197–198, 211–212
<b>Grimmia trichophylla</b> .....	197–198, 213–214
<b>Grimmia wilsonii</b> .....	197–198, 215–216
<b>Gymnostomum calcareum</b> .....	535–537
<i>Hampeella</i> .....	988–992
<b>Hampeella alaris</b> .....	988–990
<b>Hampeella pallens</b> .....	988–989, 991–992
<b>Haplohymenium pseudotriste</b> .....	1330
<b>Hedwigia ciliata</b> .....	904–905, 907–908
<i>Henediella</i> .....	538–550
<b>Henediella arenae</b> subsp. <b>arenae</b> .....	538–541
<b>Henediella arenae</b> subsp. <b>petriei</b> .....	538, 542–545
<b>Henediella heimii</b> .....	538, 546
<b>Henediella macrophylla</b> .....	538, 547–550
<b>Holodontium strictum</b> .....	396
<i>Holomitrium</i> .....	438–442
<b>Holomitrium perichaetiale</b> .....	438–440
<b>Holomitrium trichopodium</b> .....	438, 441–442
<b>Hylocomium splendens</b> .....	1208–1209
<b>Hymenodon pilifer</b> .....	940–941
<i>Hyophila</i> .....	551–555
<b>Hyophila involuta</b> .....	551–552
<b>Hyophila novae-seelandiae</b> .....	551, 553–555
<b>Hypnobartlettia fontana</b> .....	1094–1095
<i>Hypnodendron</i> .....	955–964
<b>Hypnodendron arcuatum</b> .....	955–959
<b>Hypnodendron marginatum</b> .....	955–956, 960–961
<b>Hypnodendron spininervium</b> subsp. <b>spininervium</b> .....	955–956, 962–964
<i>Hypnum</i> .....	1189–1195
<b>Hypnum chrysogaster</b> .....	1189–1191
<b>Hypnum cupressiforme</b> var. <b>cupressiforme</b> .....	1189, 1192–1193
<b>Hypnum cupressiforme</b> var. <b>filiforme</b> .....	1189, 1194
<b>Hypnum cupressiforme</b> var. <b>lacunosum</b> .....	1189, 1195
<i>Hypopterygium</i> .....	1015–1027
<b>Hypopterygium didictyon</b> .....	1015–1019
<b>Hypopterygium tamarisci</b> .....	1015, 1020–1027
<b>Ischyrodon lepturus</b> .....	1181–1183
<b>Isopterygiopsis pulchella</b> .....	1196
<b>Isopterygium minutirameum</b> .....	1216, 1219
<b>Kiaeria pumila</b> .....	397
<i>Lembophyllum</i> .....	1319–1325
<b>Lembophyllum clandestinum</b> .....	1319–1322
<b>Lembophyllum divulsum</b> .....	1319, 1323–1325
<b>Leptobryum pyriforme</b> .....	666

<i>Leptodictyum riparium</i> .....	1096–1097
<i>Leptodon smithii</i> .....	1293–1294
<i>Leptodontium interruptum</i> .....	556–557
<i>Leptostomum</i> .....	771–778
<i>Leptostomum inclinans</i> .....	771–775
<i>Leptostomum macrocarpum</i> .....	771, 775–778
<i>Leptothea gaudichaudii</i> .....	942
<i>Lepyrodon</i> .....	1262–1266
<i>Lepyrodon australis</i> .....	1262–1265
<i>Lepyrodon lagurus</i> .....	1262, 1266
<i>Leratia obtusifolia</i> .....	822
<i>Leucobryum javense</i> .....	461–463
<i>Lindbergia maritima</i> .....	1107, 1330
<i>Lopidium concinnum</i> .....	1028–1029
<i>Macrocoma tenuis</i> subsp. <i>tenuis</i> .....	823–826
<i>Macromitrium</i> .....	827–855
<i>Macromitrium angulatum</i> .....	827–830
<i>Macromitrium brevicaulis</i> .....	827–829, 831
<i>Macromitrium gracile</i> .....	827–829, 832–833
<i>Macromitrium grossirete</i> .....	827–829, 834–836
<i>Macromitrium helmsii</i> .....	827–829, 837
<i>Macromitrium ligulaefolium</i> .....	827–829, 838
<i>Macromitrium ligulare</i> .....	827–829, 839–840
<i>Macromitrium longipes</i> .....	827–829, 841–843
<i>Macromitrium longirostre</i> .....	827–829, 844–845
<i>Macromitrium microstomum</i> .....	827–829, 846
<i>Macromitrium orthophyllum</i> .....	827–829, 847–848
<i>Macromitrium prorepens</i> .....	827–829, 849–852
<i>Macromitrium ramsayae</i> .....	827–829, 853–854
<i>Macromitrium retusum</i> .....	827–829, 837, 855
<i>Meesia uliginosa</i> .....	667–669
<i>Mesotus celatus</i> .....	443–445
<i>Meteoriopsis reclinata</i> .....	1164–1165
<i>Microbryum</i> .....	558–560
<i>Microbryum davallianum</i> .....	558–559
<i>Microbryum starckeanum</i> .....	558, 560
<i>Micromitrium tenerum</i> .....	561–562
<i>Mittentia plumula</i> .....	660
<i>Mniodendron</i> .....	955–956, 965–972
<i>Mniodendron colensoi</i> .....	955–956, 965–966
<i>Mniodendron comatum</i> .....	955–956, 967
<i>Mniodendron comosum</i> var. <i>comosum</i> .....	955–956, 967–970
<i>Mniodendron comosum</i> var. <i>sieberi</i> .....	955–956, 968, 971–972
<i>Neckera</i> .....	1267–1270
<i>Neckera laevigata</i> .....	1267, 1269–1270
<i>Neckeropsis lepineana</i> .....	1271–1272
<i>Notoligotrichum</i> .....	4, 95–104
<i>Notoligotrichum australe</i> .....	4, 95–98
<i>Notoligotrichum bellii</i> .....	95, 99–100
<i>Notoligotrichum crispulum</i> .....	95, 101–104
<i>Ochiobryum blandum</i> .....	741–743
<i>Oligotrichum tenuirostre</i> .....	105–106
<i>Orthodontium lineare</i> .....	943
<i>Orthorrhynchium elegans</i> .....	1261
<i>Orthothecium strictum</i> .....	1197
<i>Orthotrichum</i> .....	856–876
<i>Orthotrichum angustifolium</i> .....	856–857
<i>Orthotrichum assimile</i> .....	856–859
<i>Orthotrichum aucklandicum</i> .....	856–857
<i>Orthotrichum calvum</i> .....	856–857, 860–863
<i>Orthotrichum crassifolium</i> subsp. <i>crassifolium</i> .....	856–857, 864

<b>Orthotrichum cupulatum</b> .....	856–857, 865
<b>Orthotrichum cyathiforme</b> .....	856–857
<b>Orthotrichum graphiomitrium</b> .....	856–857, 866–867
<b>Orthotrichum hortense</b> .....	856–857, 868–869
<b>Orthotrichum rupestre</b> var. <b>papillosum</b> .....	856–857
<b>Orthotrichum rupestre</b> var. <b>rupestre</b> .....	856–857, 870
<b>Orthotrichum sainsburyi</b> .....	856–857
<b>Orthotrichum tasmanicum</b> var. <b>parvithecum</b> .....	856–857, 871–873
<b>Orthotrichum tasmanicum</b> var. <b>tasmanicum</b> .....	856–857, 874–876
<b>Palamocladium leskeoides</b> .....	1149
<i>Papillaria</i> .....	1166–1177
<b>Papillaria crocea</b> .....	1166–1168
<b>Papillaria flavolimbata</b> .....	1166, 1169–1172
<b>Papillaria flexicaulis</b> .....	1166, 1173–1174
<b>Papillaria leuconeura</b> .....	1166, 1175
<b>Papillaria nitens</b> .....	1166, 1176–1177
<i>Pendulothecium</i> .....	1273–1280
<b>Pendulothecium auriculatum</b> .....	1273–1276
<b>Pendulothecium oblongifolium</b> .....	1273, 1277–1278
<b>Pendulothecium punctatum</b> .....	1273, 1279–1280
<i>Philonotis</i> .....	805–814
<b>Philonotis pyriformis</b> .....	805–809
<b>Philonotis scabrifolia</b> .....	805, 810–811
<b>Philonotis tenuis</b> .....	805, 812–814
<b>Physcomitrella readeri</b> .....	159
<i>Physcomitrium</i> .....	160–168
<b>Physcomitrium pusillum</b> .....	160–162
<b>Physcomitrium pyriforme</b> .....	160, 163–168
<b>Plagiobryum novae-seelandiae</b> .....	713
<b>Plagiomnium novae-zealandiae</b> .....	744–748
<b>Plagiopus oederiana</b> .....	815
<i>Plagiothecium</i> .....	1212–1214
<b>Plagiothecium lamprostachys</b> .....	1212–1213
<b>Plagiothecium lucidum</b> .....	1212, 1214
<b>Platyhypnidium austrinum</b> .....	1150
<i>Pleuridium</i> .....	372–378
<b>Pleuridium arnoldii</b> .....	372–373
<b>Pleuridium nervosum</b> .....	372, 374–375, 471
<b>Pleuridium subulatum</b> .....	372, 376–378
<b>Pleurophascum ovalifolium</b> .....	cover, 658–659
<b>Pogonatum subulatum</b> .....	107–108
<i>Pohlia</i> .....	749–769
<b>Pohlia annotina</b> .....	749–750, 751–752
<b>Pohlia australis</b> .....	749–750, 753
<b>Pohlia camptotrachela</b> .....	749–750, 754
<b>Pohlia cruda</b> .....	749–750, 755–757
<b>Pohlia elongata</b> .....	749–750, 758–759
<b>Pohlia nutans</b> .....	749–750, 760–762
<b>Pohlia ochii</b> .....	749–750, 763–766
<b>Pohlia tenuifolia</b> .....	749–750, 767
<b>Pohlia wahlenbergii</b> .....	749–750, 768–769
<b>Polytrichadelphus magellanicus</b> .....	109–112, 782
<i>Polytrichastrum</i> .....	113–122
<b>Polytrichastrum alpinum</b> .....	113–118
<b>Polytrichastrum formosum</b> .....	113, 119–121
<b>Polytrichastrum longisetum</b> .....	113, 122
<i>Polytrichum</i> .....	123–129
<b>Polytrichum commune</b> .....	123–126
<b>Polytrichum juniperinum</b> .....	34, 123, 127–129, 180
<b>Pseudephemerum nitidum</b> .....	446



<i>Pseudocrossidium</i> .....	563–569
<b>Pseudocrossidium crinitum</b> .....	563–568
<b>Pseudocrossidium hornschurchianum</b> .....	563, 569
<b>Pseudoleskea imbricata</b> .....	1108, 1330
<b>Pseudoscleropodium purum</b> .....	1151–1154, 1161
<i>Pseudotaxiphyllum</i> .....	1198–1202
<b>Pseudotaxiphyllum distichaceum</b> .....	1198–1200
<b>Pseudotaxiphyllum falcifolium</b> .....	1198, 1201–1202
<b>Pterygoneurum ovatum</b> .....	570–571
<b>Ptychomitrium australe</b> .....	223
<i>Ptychomnion</i> .....	3, 993–1000
<b>Ptychomnion aciculare</b> .....	3, 993–996
<b>Ptychomnion densifolium</b> .....	993, 997–1000
<i>Ptychostomum</i> .....	714–719
<b>Ptychostomum creberrimum</b> .....	714–715
<b>Ptychostomum funkii</b> .....	714, 716
<b>Ptychostomum pallescens</b> .....	714, 717–718
<b>Ptychostomum pseudotriquetrum</b> .....	714, 719
<b>Pulchrinodus inflatus</b> .....	670–671
<i>Pyrrhobryum</i> .....	920–928
<b>Pyrrhobryum bifarium</b> .....	920–923
<b>Pyrrhobryum mnioides</b> subsp. <b>contortum</b> .....	920, 924–927
<b>Pyrrhobryum paramattense</b> .....	920, 928
<i>Racomitrium</i> .....	169–195
<b>Racomitrium crispulum</b> .....	169–173, 191
<b>Racomitrium crumianum</b> .....	169–170, 174–175
<b>Racomitrium curiosissimum</b> .....	169–170, 176–179
<b>Racomitrium didymum</b> .....	169–170, 180
<b>Racomitrium elongatum</b> .....	169–170, 181–183
<b>Racomitrium lanuginosum</b> .....	169–170, 184–187
<b>Racomitrium pruinoseum</b> .....	169–170, 188–190
<b>Racomitrium typhophyllum</b> .....	169–170, 180, 191
<b>Racomitrium striatipilum</b> .....	169–170, 192–195
<i>Racopilum</i> .....	945–953
<b>Racopilum cuspidigerum</b> var. <b>convolutaceum</b> ..	945–949, 952
<b>Racopilum robustum</b> .....	945, 950
<b>Racopilum strumiferum</b> .....	945, 951–953
<b>Rhacocarpus purpurascens</b> .....	909–911
<b>Rhaphidorrhynchium amoenum</b> .....	1225–1226
<i>Rhizogonium</i> .....	929–934
<b>Rhizogonium distichum</b> .....	929–933
<b>Rhizogonium novae-hollandiae</b> .....	929, 933
<b>Rhizogonium pennatum</b> .....	929, 934
<i>Rhynchostegium</i> .....	1155–1160
<b>Rhynchostegium laxatum</b> .....	1155–1157
<b>Rhynchostegium muriculatum</b> .....	1155, 1157–1159
<b>Rhynchostegium tenuifolium</b> .....	1155, 1160
<i>Rhytidiadelphus</i> .....	1208–1211
<b>Rhytidiadelphus squarrosus</b> .....	1208, 1210
<b>Rhytidiadelphus triquetrus</b> .....	1208, 1211
<i>Rosulabryum</i> .....	720–739
<b>Rosulabryum billardierei</b> .....	720–723, 733
<b>Rosulabryum campylotheceum</b> .....	720, 724
<b>Rosulabryum capillare</b> .....	720, 725–726
<b>Rosulabryum crassinerve</b> .....	720, 727–732
<b>Rosulabryum perlimbatum</b> .....	720, 733–734
<b>Rosulabryum subtomentosum</b> .....	720, 735–738
<b>Rosulabryum torquescens</b> .....	720, 739
<b>Saelania glaucescens</b> .....	379
<b>Sanionia uncinata</b> .....	1098
<b>Sauloma tenella</b> .....	1030–1031

<i>Schistidium</i> .....	217–222
<b>Schistidium apocarpum</b> .....	217–218
<b>Schistidium rivulare</b> var. <i>rivulare</i> .....	217, 219–221
<b>Schistidium rivulare</b> var. <i>subflexifolium</i> .....	217, 222
<b>Schizymerium bryoides</b> .....	770
<i>Schlotheimia</i> .....	877–881
<b>Schlotheimia campbelliana</b> .....	877–879
<b>Schlotheimia knightii</b> .....	877, 880–881
<i>Sciadocladus</i> .....	973–980
<b>Sciadocladus kerrii</b> .....	973–976
<b>Sciadocladus menziesii</b> .....	973, 977–980
<b>Sclerodontium pallidum</b> .....	447–448
<b>Scleropodium touretii</b> .....	1161
<b>Scorpidium cossonii</b> .....	1099
<b>Scorpiurium cucullatum</b> .....	1162–1163
<i>Seligeria</i> .....	241–244
<b>Seligeria cardotii</b> .....	241–242
<b>Seligeria diminuta</b> .....	241, 243–244
<i>Sematophyllum</i> .....	1227–1240
<b>Sematophyllum fiordensis</b> .....	1227–1231
<b>Sematophyllum homomallum</b> .....	1227–1228, 1232–1233
<b>Sematophyllum jolliffii</b> .....	1227–1228, 1234–1235
<b>Sematophyllum kirkii</b> .....	1227–1228, 1236
<b>Sematophyllum subhumile</b> var. <i>contiguum</i> .....	1227–1228, 1237–1238
<b>Sematophyllum uncinatum</b> .....	1227–1228, 1239–1240
<i>Sphagnum</i> .....	39–59
<b>Sphagnum australe</b> .....	39–41
<b>Sphagnum compactum</b> .....	39–40, 42–43
<b>Sphagnum cristatum</b> .....	39–40, 44–46
<b>Sphagnum falcatum</b> .....	39–40, 47
<b>Sphagnum novo-zelandicum</b> .....	39–40, 48–52
<b>Sphagnum perichaetiale</b> .....	39–40
<b>Sphagnum simplex</b> .....	39–40, 53–54
<b>Sphagnum squarrosum</b> .....	39–40, 55–57
<b>Sphagnum subnitens</b> .....	39–40, 58–59
<b>Straminergon stramineum</b> .....	1101
<b>Symphysodontella cylindracea</b> .....	1260
<i>Syntrichia</i> .....	572–600
<b>Syntrichia anderssonii</b> .....	572–577
<b>Syntrichia antarctica</b> .....	572–573, 578–581
<b>Syntrichia brevisetacea</b> .....	572–573
<b>Syntrichia laevipila</b> .....	572–573, 582–583
<b>Syntrichia pagorum</b> .....	572–573, 584
<b>Syntrichia papillosa</b> .....	572–573, 585–587
<b>Syntrichia phaea</b> .....	572–573, 588–591
<b>Syntrichia pygmaea</b> .....	572–573
<b>Syntrichia robusta</b> .....	572–573
<b>Syntrichia rubella</b> .....	572–573
<b>Syntrichia rubra</b> var. <i>rubra</i> .....	572–573, 592–593
<b>Syntrichia rubra</b> var. <i>subantarctica</i> .....	572–573, 594–596
<b>Syntrichia ruralis</b> .....	572–573, 597
<b>Syntrichia serrata</b> .....	572–573, 598–600
<b>Syrhophodon armatus</b> .....	470
<i>Tayloria</i> .....	661–665
<b>Tayloria callophylla</b> .....	661–662
<b>Tayloria octoblepharum</b> .....	661, 663
<b>Tayloria purpurascens</b> .....	661, 664
<b>Tayloria tasmanica</b> .....	661, 665
<b>Tetracoscinodon irroratus</b> .....	601
<b>Tetraphidopsis pusilla</b> .....	1001–1002

<b>Tetrodontium brownianum</b> .....	130
<i>Thamnobryum</i> .....	1281–1285
<b>Thamnobryum pandum</b> .....	1281–1282
<b>Thamnobryum pumilum</b> .....	1281, 1283–1285
<i>Thuidiopsis</i> .....	1111–1116, 1330
<b>Thuidiopsis furfurosa</b> .....	1111–1115
<b>Thuidiopsis sparsa</b> .....	1111, 1116
<i>Thuidium</i> .....	1111, 1117–1122, 1330
<b>Thuidium cymbifolium</b> .....	1111, 1117–1119
<b>Thuidium laeviusculum</b> .....	1111, 1120–1122
<b>Timmia norvegica</b> .....	134
<i>Tortella</i> .....	482, 602–613
<b>Tortella cirrhata</b> .....	602–603
<b>Tortella flavovirens</b> .....	602, 604–605
<b>Tortella fragilis</b> var. <i>fragilis</i> .....	602, 606–611
<b>Tortella knightii</b> .....	602, 612–613
<i>Tortula</i> .....	614–631
<b>Tortula abruptinervis</b> .....	614–617
<b>Tortula acaulon</b> .....	614–615, 618–619
<b>Tortula areolata</b> .....	614–615, 620–621
<b>Tortula atrovirens</b> .....	614–615, 622–623
<b>Tortula marginata</b> .....	614–615, 624
<b>Tortula maritima</b> .....	614–615, 625
<b>Tortula mucronifolia</b> .....	614–615, 626–627
<b>Tortula muralis</b> .....	614–615, 628
<b>Tortula splachnoides</b> .....	614–615, 629–630
<b>Tortula truncata</b> .....	614–615, 631
<i>Tortula viridipila</i> .....	614–615
<i>Trachyloma</i> .....	1069–1073
<b>Trachyloma diversinerve</b> .....	1069–1071
<b>Trachyloma planifolium</b> .....	1069, 1072–1073
<i>Trematodon</i> .....	381–384
<b>Trematodon flexipes</b> .....	381–383
<b>Trematodon mackayi</b> .....	381–383
<b>Trematodon suberectus</b> .....	381, 383–384
<b>Trichodon cylindricus</b> .....	380
<i>Trichostomum</i> .....	632–640
<b>Trichostomum brachydontium</b> .....	632–633
<b>Trichostomum sciophilum</b> .....	632, 634–636
<b>Trichostomum tenuirostre</b> .....	632, 637–640
<b>Tridontium tasmanicum</b> .....	641–643
<i>Triquetrella</i> .....	644–648
<b>Triquetrella papillata</b> .....	644–647
<b>Triquetrella tasmanica</b> .....	644, 648
<i>Uloa</i> .....	882–894
<b>Uloa lutea</b> .....	882–887
<b>Uloa membranata</b> .....	882, 887–890
<b>Uloa perichaetialis</b> .....	882, 891
<b>Uloa viridis</b> .....	882, 892–894
<b>Vesicularia inflectens</b> .....	1203–1205
<b>Warburgiella leucocyta</b> .....	1228, 1241–1242
<i>Warnstorfia</i> .....	1102–1106
<b>Warnstorfia fluitans</b> .....	1102–1103
<b>Warnstorfia fontinaliopsis</b> .....	1102, 1104
<b>Warnstorfia sarmentosa</b> .....	1102, 1105–1106
<i>Weissia</i> .....	649–656
<b>Weissia austrocrispa</b> .....	649–651
<b>Weissia controversa</b> var. <i>controversa</i> .....	649, 652–653
<b>Weissia controversa</b> var. <i>gymnostoma</i> .....	649, 654–655
<b>Weissia patula</b> .....	649, 656
<i>Weymouthia</i> .....	1326–1329

<b>Weymouthia cochlearifolia</b> .....	1326–1328
<b>Weymouthia mollis</b> .....	1326, 1329
<i>Wijkia</i> .....	1220–1224
<b>Wijkia extenuata</b> var. <b>caudata</b> .....	1220–1222
<b>Wijkia extenuata</b> var. <b>extenuata</b> .....	1220, 1223–1224
<b>Willia calobolax</b> .....	657
<i>Zygodon</i> .....	387, 895–903
<b>Zygodon hookeri</b> .....	895–899
<b>Zygodon intermedius</b> .....	895, 900–901
<b>Zygodon rufescens</b> .....	895, 902–903