NEW ZEALAND'S FOLIOSE LICHENS

AN ILLUSTRATED KEY

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New Zealand's Foliose Lichens—an Illustrated Key is an electronic key in the form of a .pdf file with internal hyperlinks to its illustrations and text. It's free, and you're welcome to copy it. It will launch on a PC or Macintosh computer using Adobe's Acrobat® Reader (version 7.0 or later), which you can download free of charge from the Adobe web-site at <www.adobe.com>

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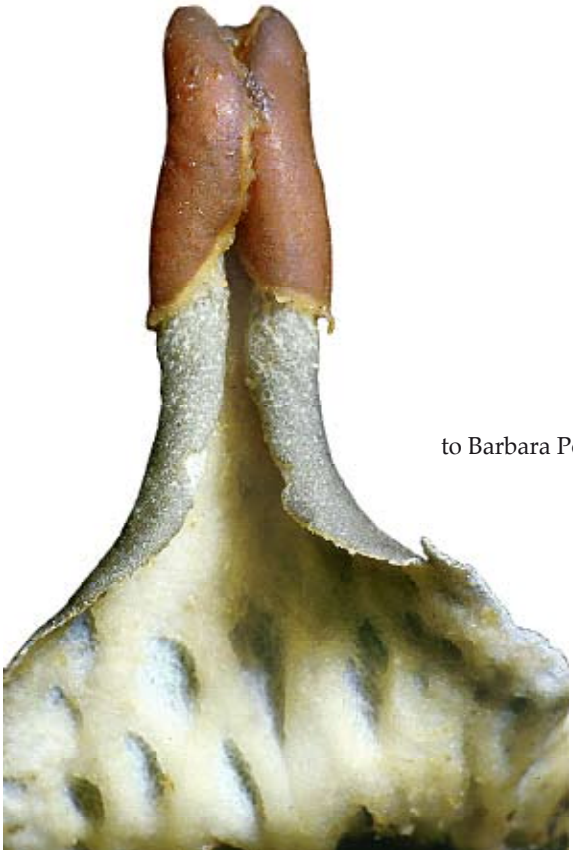

to Barbara Polly

acknowledgments

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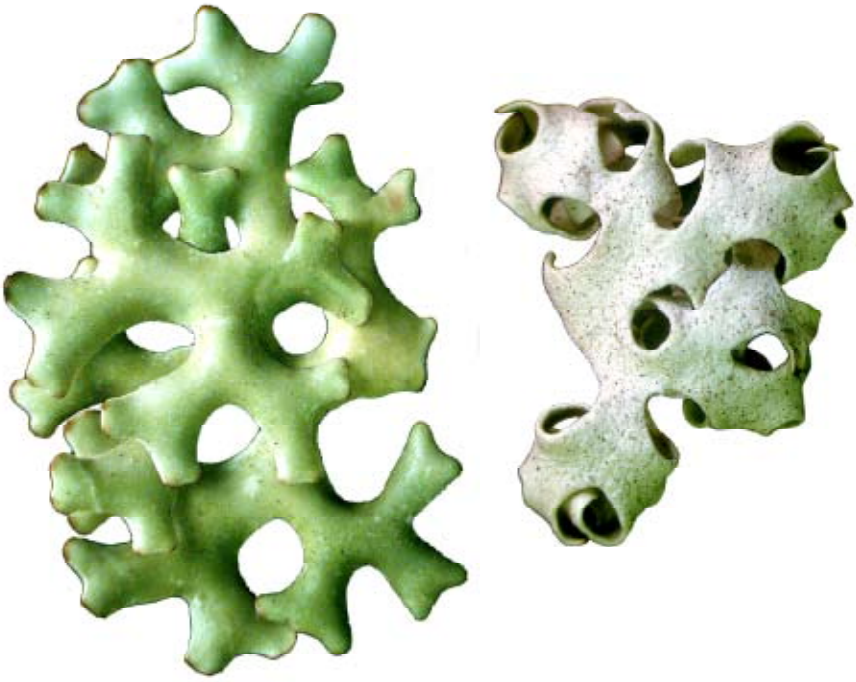
scope of the key

This key is a tool for identifying New Zealand's foliose lichens down to genus. Foliose means "leaf-like", and it's one of three *growth forms* that lichens have been lumped into by long tradition. The other two are **crustose** (crust-like) and **fruticose** (shrub-like). Trouble is, not all lichens fit neatly into one of those three categories. For example, some crustose lichens have leaf-like lobes on their edges, and some fruticose lichens are so flattened top to bottom that they look distinctly leaf-like.

Over the years, lichenologists have tried to lessen such confusing overlaps either by adding more categories or by defining the original three in more detail. As an example of the first strategy, a new category **placodioid** means crustose with leaf-like lobes around the edges. As an example of the second, for a lichen to be called fruticose, it should be three-dimensional, *and* all of its surfaces should have a cortex (a tough covering of fused fungal hyphae), *and* the cortex should be largely free of rhizines or other specialized structures for anchoring the lichen (that vital job is done at the very base of the lichen, just as roots do for a shrub). Conversely, for any lichen to be considered foliose, it should be only two-dimensional and its underside should be clearly specialized for anchoring. Lastly, for a lichen to be called crustose, its underside should not only anchor the lichen, but also lack a cortex.

Even with those tweaks, overlaps are still a problem with a vexing few lichens, and arguably New Zealand has more than its fair share of them. For example, the *Xanthoparmelia semiviridis* pictured below and on the cover straddles the two growth form categories of foliose and fruticose. Unlike most lichens, it never attaches itself to anything, and when it dries out it curls up into a tiny tumbleweed and blows away in the wind. Within minutes of being wetted up again by rain or dew, it uncurls and switches on its light-capturing photosynthetic machinery. Such footloose lichens have been dubbed *vagrant* lichens because they're "of no fixed abode" and "always on the move".



The vagrant lichen *Xanthoparmelia semiviridis* moist (left) and dry and curled up (right)
1 mm

When it's dried out and curled up as a tumbleweed look-alike, *Xanthoparmelia semiviridis* is strongly three-dimensional, so it looks convincingly fruticose. When it's moist and fully spread out in its light-capturing mode, it's only two-dimensional, so it's just as convincingly foliose. Similarly, not having rhizines or other specialized bits to anchor it down puts it into the fruticose category, but having an upperside and an underside puts it firmly into the foliose category. In our view, the sensible way to cope with those contradictions is to place it in *both* categories.

Xanthoparmelia semiviridis is by no means the only lichen straddling two growth-form categories. Several of our foliose lichens, for example, have no cortex on their underside, blurring the usual distinction between crustose and foliose. Similarly, several of our fruticose lichens are flattened into only two dimensions and their underside is dotted with anchoring rhizines, thus blurring the usual distinction between fruticose and foliose.

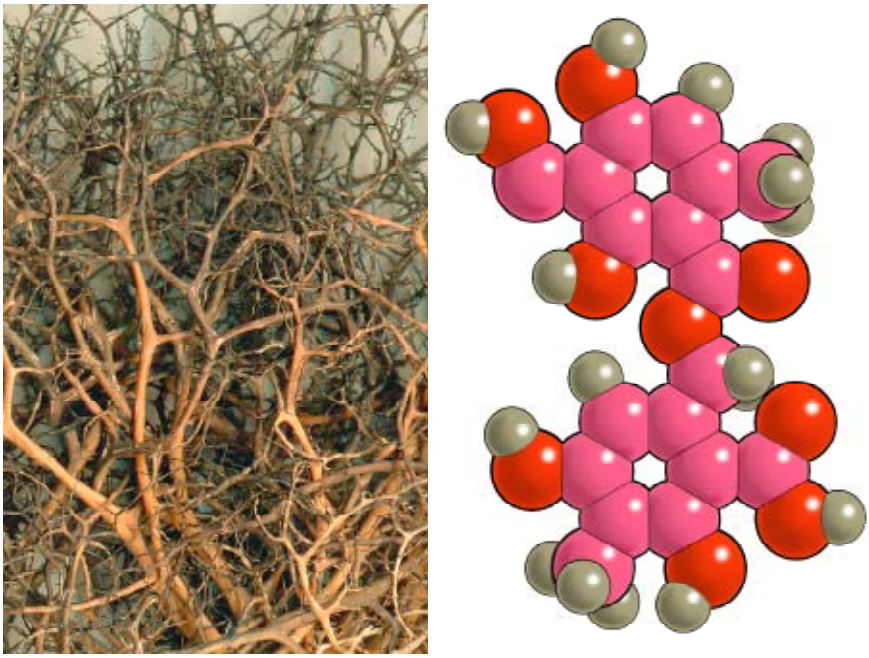
Such overlaps complicate the task of constructing a key to New Zealand's lichen genera. The 40% of our 350-odd genera with only a single species are of course no problem at all, but the remaining 60% surely are. The more species those genera contain (and 15 of the genera of foliose species have over a dozen), the more likely that they'll be untidy mixes of growth forms. Writers of generic keys have coped with that problem in two ways. Some have just shoehorned each genus into a single category, dismissing any oddball species as messy background noise that can safely be ignored. That's been the fate of *Teloschistes*, *Bunodophoron*, *Siphula*, and *Parasiphula*, usually keyed out as containing *only* fruticose species even though some clearly are more accurately described as foliose. Other authors have resigned themselves to building the untidy genera into more than one key. We've opted for that strategy, and accordingly have added those four genera to this key.

Physcia adscendens

spot-tests for secondary metabolites

Lichens synthesize a wide variety of organic compounds that are lumped into two groups called primary and secondary metabolites. Primary metabolites are the lipids, carbohydrates, proteins, and other compounds vital to the lichens' structure and day-to-day metabolism. Some of them are synthesized by the lichen's fungal partner—its mycobiont—and others by the lichen's algal and/or cyanobacterial partner(s)—its photobiont(s). In contrast, secondary metabolites are synthesized by the fungus alone and secreted onto the surface of its hyphae in either an amorphous form or as crystals. In some lichens they accumulate to 5–10% of the lichen's dry weight.

If they're found in *only* lichens, they're called lichen substances. More than 600 such compounds have now been isolated, and the molecular structures of many are known. A few are named for lichen genera, among them alectorialic acid for *Alectoria* (below), usnic acid for *Usnea*, and lecanoric acid for *Lecanora*. More than 5000 lichen species have been searched for them, roughly a third of all known species.

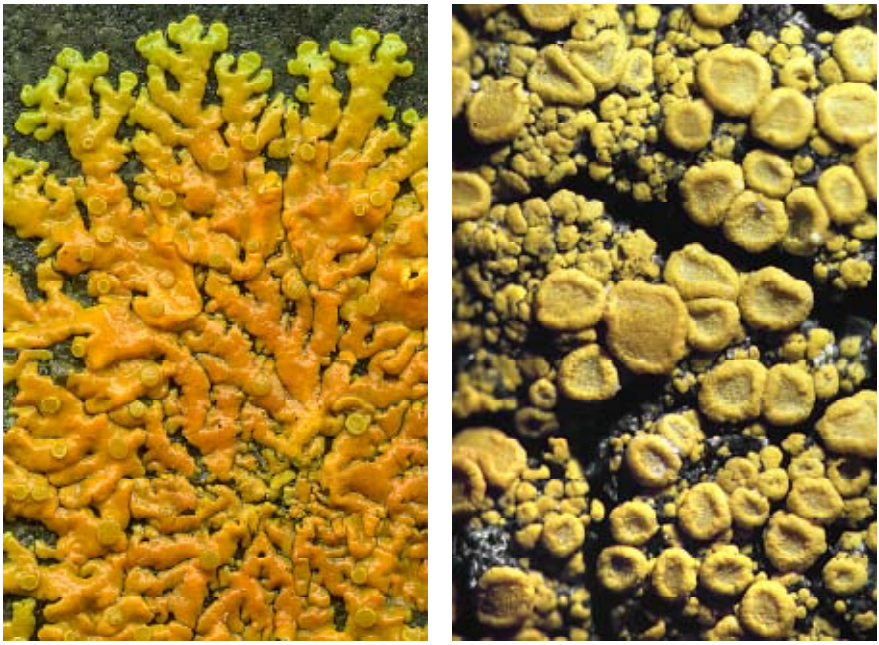


Alectoria nigricans (left) and a space-filling model of alectorialic acid (right)
5 mm (left), colour key—red = oxygen, grey = hydrogen, magenta = carbon

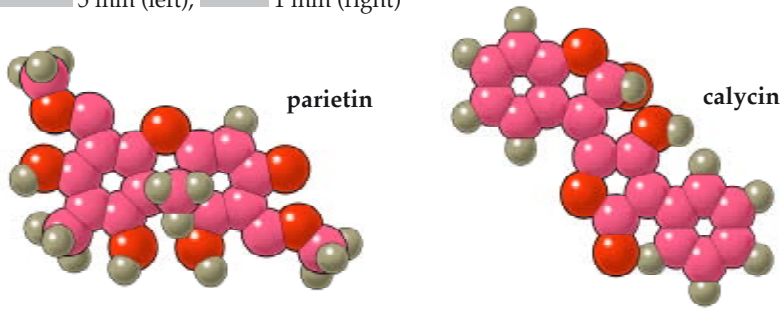
Some lichen substances are phenol derivatives that nobble moulds and rot-bacteria, keeping the lichens free of infections and allowing them to live for hundreds of years. The substances also fend off insects, slugs, and other animals that graze lichens. Other lichen substances waterproof the air-filled interior (medulla) of lichens, thus preventing any waterlogging, which could kill the lichen.

Still other lichen substances are sunscreens. The vibrant yellow-orange pigment of a *Xanthoria* lichen reduces by 90% the sunlight reaching the lichen's algal partner. You might think that would interfere with photosynthesis, but in fact it protects the alga against *too much* sunlight. Lichen algae are damaged if they're exposed to full sunlight, possibly because they're no longer shielded from short-wavelength ultraviolet (UV) radiation. Hence, it's not surprising that a lichen growing out in the open in full sun is both thicker and more heavily pigmented than the same lichen growing in the shade. The lichen has automatic machinery that boosts pigment production and thickens the thallus if the lichen is persistently exposed to more sunlight.

Some lichen substances are pigments, so they're easily detected by their colour. For example, species of *Usnea* and *Xanthoparmelia* get their distinctive yellow-green colour from usnic acid, *Xanthoria* species their gaudy orange or red from parietin (below left) (a pigment that can't be called a true lichen substance because it's made by several vascular plants as well), *Candelariella* species their egg-yolk yellow from calycin (below right), the brown species of *Xanthoparmelia* their dark chestnut hues from melanin, and some *Cladonia* species their blood-red scarlets from rhodocladonic acid.

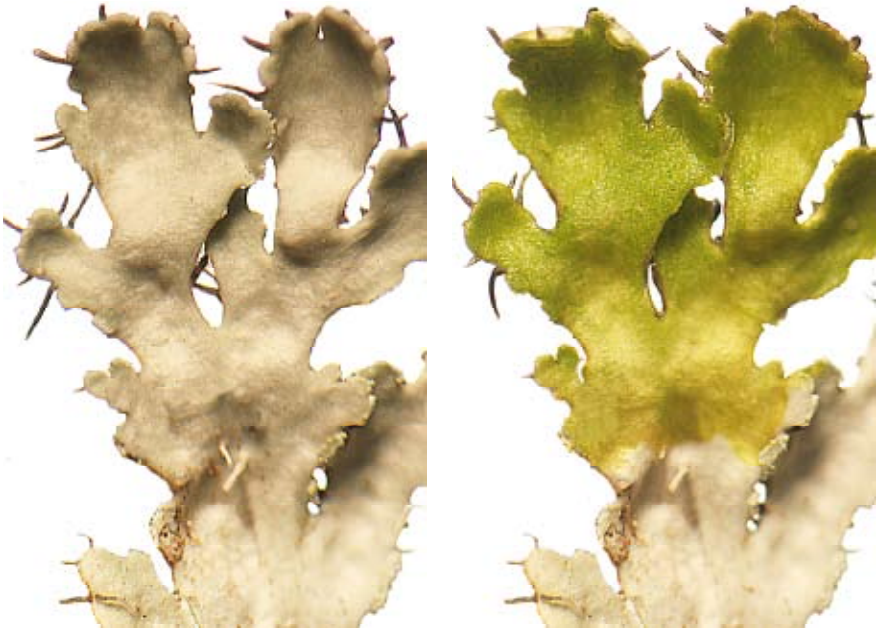


Xanthoria ligulata (left) and *Candelariella vitellina* (right)
5 mm (left), 1 mm (right)



Most lichen substances, though, can't be seen because they're colourless. As a result, they can be detected and identified only with modern high-tech wizardry such as thin-layer chromatography, spectroscopy, and X-ray crystallography. Such techniques are expensive, and they also demand skill and experience. However, you can cheaply and quickly identify at least a few lichen substances using spot-tests, so named because you spot-wet the lichen with chemical reagents while watching closely for colour reactions. Alternatively, you can crystallize the lichen substances on a microscope slide and then identify them by comparing them with published photographs of crystals of purified standards. To do that, you must first extract the lichen substances by crushing up your specimen in acetone or some other organic solvent.

Spot-tests typically use only three reagents, and two of them are cheap and easy to get—a 10% water solution of potassium hydroxide (called the K test), a solution of commercial bleach (called the C test), and a saturated alcohol solution (95% ethanol) of *p*-phenylenediamine (1,4-diaminobenzene) (called the P or Pd test). The three reagents are applied in separate spots, but in a fourth spot the K and C are applied together (that's called the KC test when the K is applied first, and CK when the C is first).



Before and after photographs of *Heterodermia speciosa* showing a K+ yellow spot-test for the presence of atranorin, the lichen substance that's responsible for the grey colour of many species in the lichen families Parmeliaceae and Physciaceae 1 mm

Some lichenologists use various concentrations of iodine as a fourth reagent, and nitric acid as a fifth. In addition to those, you can use sulphuric acid to detect oxalic acid, which is common in lichens as crystalline inclusions but isn't a lichen substance because it's found in many groups of plants as well. The reaction yields starbursts of distinctive gypsum crystals (they're best seen under a compound microscope).

Treat all spot-reagents with caution, avoiding contact with your skin, eyes, lungs, or clothing. The *p*-phenylenediamine is especially hazardous whether it's a dry powder or in solution. Of the three common reagents, the K solution is the most stable, lasting half a year if it's tightly stoppered (use a cork or plastic stopper, not glass). Replace the C solution when it no longer smells strongly of chlorine, and keep it in a refrigerator when you're not using it. The *p*-phenylenediamine is by far the least stable, lasting only three or four hours.

Apply the solutions to the lichen's cortex or medulla (or both) using a small pointed brush (size 0), a finely drawn-out pipette, or a blunted hypodermic needle. To avoid contamination, keep a separate brush, pipette, or needle for each reagent. Some of the colour reactions fade quickly, so run the tests while watching with a dissection microscope. Wait at least half a minute before concluding that the test is negative.

Armed with the results of the four most common spot-tests (K, C, KC, and Pd), you can use the key on the next page to identify 24 secondary metabolites. Be warned that compounds that are chemically related and therefore give similar colour reactions will key out together. To identify them further, you must use some additional technique such as thin-layer chromatography.

KEY TO SOME COMMON SECONDARY METABOLITES USING SPOT-TESTS

NOTE: If necessary, you can retrace your path through the key by using the numbers in parentheses that follow the number of the first lead of each couplet.

1 K–.....2
1: K+ 9

2(1) C+ red or rose.....3
2: C–.....4

3(2) C+ rose .....**olivetoric acid**
3: C+ red .....**lecanoric** or **gyrophoric acid**

4(2:) KC+.....5
4: KC–.....8

5(4) KC+ yellow or yellow-orange 6
5: KC+ red or rose 7

6(5) KC+ yellow..... **usnic acid**
6: KC+ yellow-orange..... **barbatic acid**

7(5:) KC+ rose ..... **norlobaridone**
7: KC+ red..... **alpha-collatolic, glomelliferic,** or **lobaric acid**

8(4:) Pd+ red..... **alectoronic acid**
8: Pd+ sulphur-yellow ..... **psoromic acid**

9(1:) K+ violet..... **hypothamnolic acid, euplectin, parietin,** or **skyrin**
9: K+ red, orange, yellow, or brown 10

10(9:) K+ yellow-brown.....
..... **fumarprotocetraric, protocetraric**, or **succinprotocetraric acid**
10: K+ not yellow-brown.....11

11(10:) K+ yellow or orange.....12
11: K+ yellow then red.....14

12(11) Pd+ yellow.....**atranorin**
12: Pd+ not yellow 13

13(12:) Pd+ brick-red ..... **physodalic acid**
13: P+ orange ..... **stictic** or **thamnolic acid**

14(11:) Pd+ pale yellow ..... **hypostictic acid**
14: Pd+ orange.....**norstictic** or **salazinic acid**

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Elix, JA (1996): Biochemistry and secondary metabolites. In *Lichen Biology*, Nash, TH III (ed.), Cambridge University Press, Cambridge.
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using the key

Keys are handy tools for identifying things. They were adopted by biologists more than three centuries ago, 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*. The two halves of each couplet are called *leads* (both those leads are labelled with the same number, but the number of the second lead is followed by an extra symbol of some sort, in this key a colon). The first three couplets of a key might look as depicted just below (the number in parentheses following a generic name is the number of species of that genus that are known to occur in New Zealand).

1 Green when moist (the lichen's main photosynthetic partner is a green alga)... 2
1. Brown or grey when moist (the lichen's main partner is a cyanobacterium) ... 20

2(1) Spores produced on the lichen's underside..... **Nephroma** (**7**)
2. Spores produced on the lichen's upperside, or the lichen sterile 3

3(2.) Underside dotted with cyphellae..... **Sticta** (**14**)
3. Underside not dotted with cyphellae..... 4

You work your way through the key by choosing the lead in each couplet that better describes the specimen that you're trying to identify. With each decision 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 what a term in the key means, you can look it up in the glossary that begins on page 167. Terms printed in brown in that glossary are illustrated—by single-clicking on a term, you can jump to its illustration. As well, you can call up illustrations of the lichens themselves by clicking on the **boldface** Latin generic names in the key. Return to the key by clicking as many times as necessary on the back-tracking (left-pointing) arrow in the navigation menu of the Reader® (if backtracking isn't listed as a menu option, find it by trolling down through the toolbar menus and switch it on by clicking in its on/off box).

Bunodophoron scrobiculatum

KEY TO THE GENERA OF NEW ZEALAND'S FOLIOSE LICHENS (57 genera)

NOTE: (1) The number in parentheses following the number of the first lead of each couplet is for retracing your path through the key, (2) the **boldface** number in parentheses following a generic name is the number of species of that genus that are known to occur in New Zealand, (3) the italic phrases "*1 of 2*", "*2 of 3*", and so on following a generic name tell you how many times that genus appears in the key.

1 Thallus (lichen body) peltate (attached by a central holdfast) 2
1: Thallus not peltate..... 6

2(1) Photosynthetic partner (photobiont) a cyanobacterium..... 3
2: Photosynthetic partner a green alga..... 4

3(2) Spores simple, many per ascus; underside plane, brownish .. **Peltula euploca**
3: Spores trans-septate, 8 per ascus; underside faveolate, white ..**Peltularia crassa**

4(2:) Spore-bodies (ascomata) perithecia 5
4: Spore-bodies apothecia, or thallus sterile..... **Umbilicaria** (**17**)

5(4) On coastal rock; photosynthetic partner dispersed..... **Mastodia tessellata**
5: On alpine rock; photosynthetic partner in a layer .....
..... **Dermatocarpon miniatum** var. **complicatum**

6(1:) Underside with cyphellae (tiny, smooth cup-like depressions) ..... **Sticta** (**14**)
6. Underside without cyphellae 7

7(6:) Underside with pseudocyphellae (tiny, rough, white or yellow pores, that can be few or tiny and hard to see) or large naked white patches..... 8
7: Underside without either pseudocyphellae or naked white patches..... 9

8(7) Underside with naked patches (mostly > 1 mm in diameter and always white); photosynthetic partner (photobiont) cyanobacterial; upperside usually sorediate, both laminal and marginal..... **Lobarina scrobiculata**
8: Underside with true pseudocyphellae (mostly < 1 mm in diameter and white or yellow); photosynthetic partner green and/or cyanobacterial; upperside sorediate or not ..... **Pseudocyphellaria** (**48**)

9(7:) Upperside or margins with pseudocyphellae 10
9: Upperside or margins without pseudocyphellae..... 16

10(9) Pseudocyphellae punctate (point-like), ± randomly scattered 11
10: Pseudocyphellae linear or effigurate (forming complex patterns), or on warts or isidia 13

11(10) Underside rhizinate (covered with tiny root-like anchors) 12
11: Underside naked or only sparsely rhizinate ..... **Cetrelia braunsiana**

12(11) Thallus lobes < 1 mm wide; lichexanthone (UV+ yellow) in the cortex or the medulla..... **Pyxine** (**2**)
12: Thallus lobes > 2 mm wide; lichexanthone absent..... **Punctelia** (**6**)

13(10:) Lobe margins with scattered cilia ..... **Tuckermanopsis chlorophylla**
13. Lobe margins without cilia 14

14(13:) Upperside greyish; pseudocyphellae laminal or marginal 15
14: Upperside brownish; pseudocyphellae on warts or the tips of isidia.....
..... **Melanohalea** (**2**)

15(14) Underside naked or only sparsely rhizinate ..**Dirinaria** (**3**) (*1 of 2*) **aegialita**
15: Underside uniformly rhizinate to margin ..... **Parmelia** (**15**)

16(9:) Spore-bodies (ascomata) on underside 17
16: Spore-bodies on upperside or margins, or thallus sterile 18

17(16) Spores released into a mazaedium; spores simple .....**Bunodophoron** (**16**)
17: Spores released from flat apothecia; spores 1–3-septate ..... **Nephroma** (**7**)

18(16:) Underside with a dark hypothallus (pad of dense, woolly hyphae)..... 19
18: Underside without a hypothallus, with or without felted tomentum 20

19(18) Hypothallus hyphae moniliform (bead-like); thallus on bark; asci 8-spored
.....**Pannoparmelia** (**2**)
19: Hypothallus hyphae not moniliform; thallus on rock; asci many-spored.....
.....**Anzia** (**2**)

20(18:) Cephalodia (nodules of cyanobacteria) external 21
20: Cephalodia internal or absent 22

21(20) Apothecia with only a proper exciple (margin lacking photobiont); spores brown, 4/ascus ..... **Solorina** (**2**) (*1 of 2*) **spongiosa**
21: Apothecia with a thalline exciple (margin containing photobiont) obscuring the proper exciple; spores colourless, 8/ascus..... **Pannaria** (20)

22(20:) Thallus underside (but not the upperside) bright orange.....
..... **Solorina** (**2**) (*1 of 2*) **crocea**
22: Thallus underside not bright orange..... 23

23(22:) Photosynthetic partner dispersed, cyanobacterial 24
23: Photosynthetic partner in a layer, green or cyanobacterial..... 26

24(23) Thallus cartilaginous wet or dry; spores simple..... **Physma** (**2**)
24: Thallus cartilaginous when dry but soft when wet; spores trans-septate or muriform 25

25(24:) Cortex (outermost layer) one cell thick on both surfaces ....**Leptogium** (**20**)
25: Cortex lacking altogether..... **Collema** (**17**)

26(23:) Thallus red or orange (can be greyish in shade), K+ purple..... 27
26: Thallus yellow, green, grey, or brown, not K+ purple 29

27(26) Lobe margins ciliate .....**Teloschistes** (**7**)
27: Lobe margins not ciliate 28

28(27:) Apothecial underside rhizinate ..... **Xanthomendoza novozelandica**
28: Apothecial underside not rhizinate .....**Xanthoria** (**6**)

29(26:) Thallus upperside bright yellow .....**Candelaria concolor**
29: Thallus upperside green, yellow-green, grey, or brown..... 30

30(29:) Underside veined *and* the photosynthetic partner cyanobacterial..... 31
30: Underside not veined or if veined then the partner not cyanobacterial..... 32

31(30) Upper surface glabrous (naked)..... **Peltigera** (**16**)
31: Upper surface tomentose (matted with hairs) . **Erioderma** (**2**) (*1 of 2*) **leylandii**

32(30:) Spores released into a mazaedium..... **Calycidium** (**2**)
32: Spores released from an apothecium, or thallus sterile..... 33

33(32:) Apothecia pale pink and low-stalked..... **Icmadophila** (**2**) **splachnirima**
33: Apothecia not pale pink and low-stalked, or thallus sterile 34

34(33:) Thallus inflated 35
34: Thallus not inflated 36

35(34) Upperside perforate, or if not perforate then isidiate ..... **Menegazzia** (**20**)
35: Upperside not perforate ..... **Hypogymnia** (**8**)

36(34:) Underside ecorticate *and* the photosynthetic partner green *and* the spores simple ..... **Heterodea muelleri**
36: Without the above combination of traits 37

37(36:) Upperside pubescent (sparsely hairy) or tomentose (matted with hair) . 38
37: Upperside not hairy 39

38(37) Upperside Pd+ orange (pannarin)..... **Erioderma** (**2**) (*2 of 2*) **sorediatum**
38: Upperside Pd– (no colour reaction) ..... **Leioderma** (4)

39(37:) Marginal cilia branched ..... **Everniastrum sorocheilum**
39: Marginal cilia simple or absent 40

40(39:) Photosynthetic partner cyanobacterial 41
40: Photosynthetic partner green 47

41(40) Underside corticate 42
41: Underside ecorticate ..... **Steinera** (**4**)

42(41) Photosynthetic partner *Scytonema* 43
42: Photosynthetic partner *Nostoc* 45

43(42) Lobe margins curled downward; thallus concentrically ridged .... **Coccocarpia** (**3**)
43: Lobe margins not curled downward; thallus not concentrically ridged 44

44(43:) Underside rhizohyphate, not tomentose ..... **Degelia** (5)
44: Underside tomentose, not rhizohyphate ..... **Lobaria** (**4**) (*1 of 3*)

45(42:) Lobes broad, the widest > 5 mm, usually much more .... **Lobaria** (**4**) (*2 of 3*)
45: Lobes narrow, the widest < 5 mm 46

46(45:) Silky hairs underneath the apothecia (if not, then the thallus squamulose) ..... **Parmeliella** (**14**) **subgranulata**
46: Apothecia without silky hairs underneath..... **Fuscoderma** (**4**)

47(40:) Thallus with internal cephalodia (visible as swellings on the underside)... ..... **Lobaria** (**4**) (*3 of 3*)
47: Thallus without internal cephalodia 48

48(47:) Upperside greenish brown, dark brown, or nearly black when moist..... 49
48: Upperside whitish, light grey, grey-green, grey-blue, grey-brown, yellow-green, yellowish and/or tinged with red when moist 50

49(48) Upperside with a microscopically pored epicortex; upper cortex reacting HNO3+ blue or blue-green ..... **Xanthoparmelia** (**81**) (*1 of 4*)
49: Upperside with a non-pored epicortex; upper cortex reacting HNO3– or HNO3+ reddish ..... **Melanelia** (**3**)

50(48:) Upperside yellow-green or yellowish when moist (usnic acid present, KC+ yellow-orange) 51
50: Upperside whitish, light grey, grey-green, grey-blue, grey-brown, and/or tinged with red when moist (usnic acid absent, KC–) 53

51(50) Lobe apices incised ..... **Xanthoparmelia** (**81**) (*2 of 4*)
51: Lobe apices rounded 52

52(51:) Rhizines dense, branched at 90°, extending beyond the margins in a dense mat ..... **Hypotrachyna** (**15**) (*1 of 3*) **sinuosa**
52: Rhizines sparse, simple, not extending as a mat ..... **Flavoparmelia** (**3**)

53(50:) Upper cortex reacting K+ yellow (containing atranorin) 54
53: Upper cortex not reacting K+ yellow (not containing atranorin) 69

54(53) Medulla reacting Pd+ orange or K+ yellow then red (salazinic or norstictic acid) 55
54: Medulla not reacting Pd+ orange or K+ yellow then red 59

55(54) Lobe margins ciliate (sometimes only sparsely) 56
55: Lobe margins not ciliate 57

56(55) Lobes broad, the widest > 5 mm ..... **Parmotrema** (**17**) (*1 of 4*)
56: Lobes narrow, the widest < 5 mm ..... **Parmelinopsis** (**8**) **swinscowii** (*1 of 2*)

57(55:) Upperside of periclinally arranged hyphae, hence appearing fibrous when viewed under a microscope; underside usually ecorticate ..... **Heterodermia** (**11**) (*1 of 2*)
57: Upperside of anticlinally arranged hyphae, hence appearing cellular when viewed under a microscope; underside usually corticate 58

58(57:) Conidia bifusiform or bacillar ..... **Xanthoparmelia** (**81**) (*3 of 4*)
58: Conidia filiform, cylindrical, or shoe-shaped ..... **Parmotrema** (**17**) (*2 of 4*)

59(54:) Underside pale, or if dark then ecorticate 60
59: Underside dark 61

60(59) Upperside of anticlinally arranged hyphae, hence appearing cellular when viewed under a microscope; underside usually corticate ... **Physcia** (**14**) (*1 of 2*)
60: Upperside of periclinally arranged hyphae, hence appearing fibrous when viewed under a microscope; underside usually ecorticate ..... **Heterodermia** (**11**) (*2 of 2*)

61(59:) Lobes without marginal cilia 62
61: Lobes with marginal cilia (sometimes only a few) 67

62(61) Underside naked throughout or at least at the margin 63
62: Underside usually rhizinate to the margin 66

63(62) Lobes broad, the widest > 7 mm ..... **Parmotrema** (**17**) (*3 of 4*)
63: Lobes narrow, the widest < 7 mm 64

64(63:) Underside naked or nearly so ..... **Dirinaria** (**3**) (*2 of 2*)
64: Underside rhizinate, with only the margin naked 65

65(64:) Rhizines simple ..... **Canoparmelia** (**4**)
65: Rhizines branched or tufted at the tip ..... **Physcia** (**14**) **erumpens, Physcia** (**14**) (*2 of 2*) **integrata**

66(62:) Rhizines simple.....**Xanthoparmelia** (**81**) (*4 of 4*)
66: Rhizines branched.....**Hypotrachyna** (**15**) (*2 of 3*)

67(61:) Lobes broad, the widest > 5 mm .....**Parmotrema** (**17**) (*4 of 4*)
67: Lobes narrow, the widest < 5 mm..... 68

68(67:) Lobe apices truncate; marginal cilia evenly dispersed .....
.....**Parmelinopsis** (**8**) (*2 of 2*)
68: Lobe apices rounded; marginal cilia mostly in the lobe sinuses..**Parmelina** (**4**)

69(53:) Thallus erect, attached by only its base; always sterile; on soil..... 70
69: Thallus prostrate, attached by its underside; usually fertile; rarely on soil ... 71

70(69) Containing dibenzofuranes (porphyrilic acid and/or methyl porphyrilate) or depsidones (lobaric acid) or lacking all secondary compounds.....
.....**Parasiphula** (**6**)
70: Containing depsides (thamnolic, hypothamnolic, baeomycesic, or squamatic acid) or chromones..... **Siphula** (**6**)

71(69:) Rhizines branched..... **Hypotrachyna** (**15**) **osseoalba** (*3 of 3*)
71: Rhizines simple, short or long..... 72

72(71:) Thallus closely attached, rhizines short .....**Hyperphyscia** (**2**)
72: Thallus loosely attached, rhizines long..... **Phaeophyscia** (**5**)

Anzia Stizenb.

Anzia jamesii habit
1 mm

species: 2 in NZ, 30 worldwide
thallus: foliose
substratum: rock
margin: eciliate, lobed
hypothallus: spongy, continuous
colour: whitish grey, green, or blue
texture: smooth to warty
cortex: present, epicortex non-pored
photobiont: chlorococcoid
medulla: heteromerous, white
ascomata: apothecia, absent in NZ species
propagules: isidia, soredia
asexual: pycnidia, absent in NZ species
cephalodia: none
pores: none
chemistry: *cortex*: K+ yellow; *medulla*: K–, C–, KC–, Pd–; atranorin, chloroatranorin, and various acids; cell walls containing *Cetraria*-type lichenan

Anzia jamesii upperside (left), underside with continuous hypothallus (right)
1 mm

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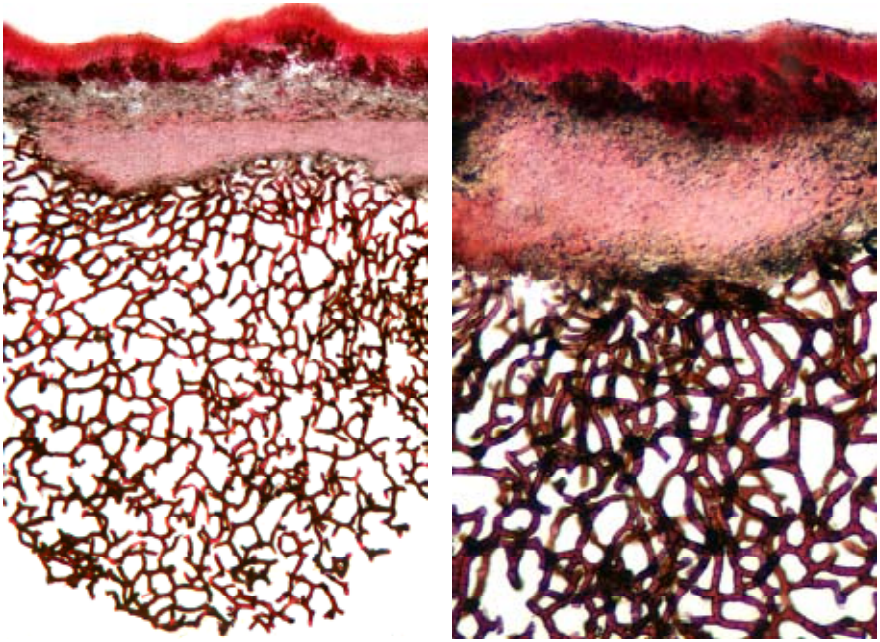
Anzia (cont'd)

Anzia jamesii continuous spongy hypothallus
1 mm



Anzia jamesii thallus xs, stained red, with spongy hypothallus below
100 μm (left), 100 μm (right)

Bunodophoron A.Massal.

Bunodophoron macrocarpum habit
5 mm

continued next page

Bunodophoron (cont'd)

Bunodophoron insigne underside showing mazaedium (dark woolly mass at top)
1 mm

continued next page

Bunodophoron (cont'd)

Bunodophoron insigne upperside
1 mm

species: 16 in NZ, 30 worldwide
thallus: foliose to fruticose
substratum: bark, bryophytes, soil, rock
margin: entire to isidiate
prothallus: none
colour: green, blue-green, yellow-green
texture: smooth to scabrid
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: terminal on underside
apothecial disc: black
exciple: thalline, ± disappearing with age
propagules: none
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ± globose
spore colour: grey to reddish brown
chemistry: *medulla*: K– or + yellow, Pd– or + orange-red; *cortex*: isousnic acid; *medulla*: sphaerophorin in most species, constictic, stictic, cryptostictic, pseudoplacodiolic, placodiolic, protocetraric, isopatagonic, patagonic, salazinic, norascomatic, and ascomatic acids

Bunodophoron insigne fertile lobe, upperside (left), underside with mazaedia (right)
5 mm

continued next page

Bunodophoron (cont'd)

Bunodophoron microsporum fertile lobe, upperside (left), underside, mazaedia (right)
5 mm (left), 1 mm (right)

Bunodophoron ramuliferum fertile lobe, upperside (left), underside, mazaedium (right)
5 mm (left), 1 mm (right)

continued next page

Bunodophoron (cont'd)

Bunodophoron scrobiculatum lobe, upperside (left), underside (right)
1 mm

Bunodophoron scrobiculatum mazaedium, upperside (left), underside (right)
1 mm

Calycidium Stirt.

species: 2 in NZ, 2 worldwide
thallus: foliose
substratum: bark or mossy rock
margin: eciliate, lobed
prothallus: none
colour: green to grey-green
texture: smooth
cortex: present above and below
photobiont: chlorococcoid
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: brown to black
exciple: thalline, surrounding mazaedium
propagules: none
asexual: none
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: brown
chemistry: K–, C–, KC–, Pd–, UV– or + orange; xanthones

Calycidium cuneatum fertile lobe upperside
1 mm

Calycidium cuneatum fertile lobes (undersides)
1 mm (left), 1 mm (right)

Candelaria A.Massal.

Candelaria concolor habit
1 mm

species: 1 in NZ, 10 worldwide
thallus: squamulose or foliose to fruticose
substratum: bark, rarely rock
margin: eciliate, entire, ± isidiate/sorediate
prothallus: none
colour: chrome yellow to yellow-green
texture: smooth
cortex: present above and below
photobiont: chlorococcoid
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: yellow
exciple: thalline; proper rudimentary only
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 20–50
spore septation: 0–1
spore shape: ellipsoid
spore colour: hyaline
chemistry: Pd–, K–, KC–, C–, UV– or + orange; calycin and pulvinic dilactone

Candelaria concolor lobes (left), white rhizines (right)
1 mm (left), 1 mm (right)

Canoparmelia Elix & Hale

Canoparmelia pustulescens habit
0.5 mm

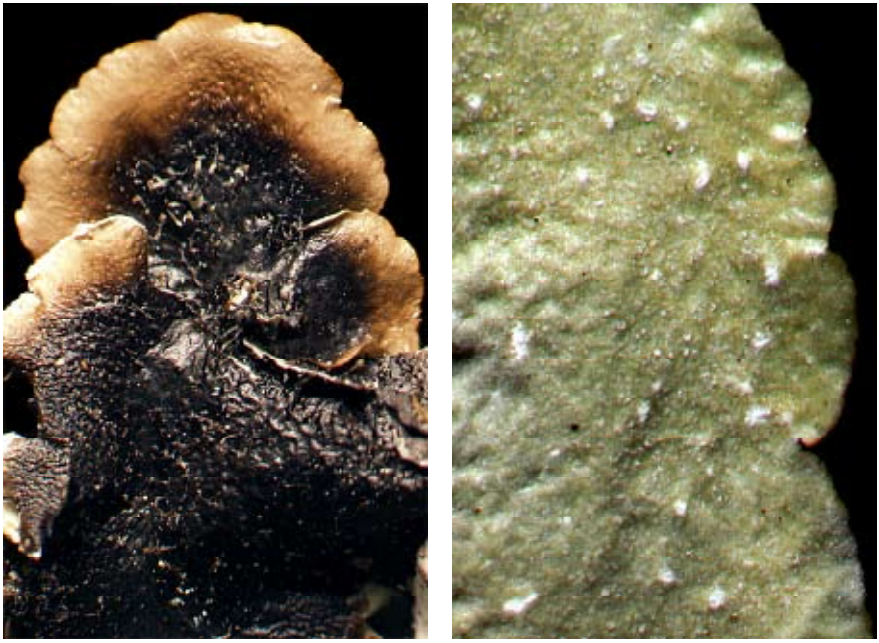
species: 4 in NZ, 45 worldwide
thallus: foliose
substratum: bark, acidic rock
margin: eciliate, entire
prothallus: none
colour: ashy white to grey or grey-green
texture: smooth
cortex: present, with pored epicortex
photobiont: chlorococcoid
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile or ± stalked
apothecial disc: red-brown to dark brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: hyaline
chemistry: atranorin, chloroatranorin, and the acids lecanoric, sekikaic, caperatic, divaricatic, and stenosporic; the cell walls contain isolichenan

Canoparmelia pustulescens apothecia (left), underside with dark rhizines (right)
1 mm (left), 0.5 mm (right)

Cetrelia W.L.Culb. & C.F.Culb.

Cetrelia braunsiana habit
5 mm

species: 1 in NZ, 17 worldwide
thallus: foliose
substratum: bark, rock
margin: eciliate, rounded
prothallus: none
colour: ash-white to tan
texture: smooth
cortex: present above and below
photobiont: *Trebouxia*
medulla: heteromerous, white
ascomata: apothecia, not seen in NZ
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: laminal pseudocyphellae
chemistry: *cortex*: K+ yellow; *medulla*: K–, C–, KC+ pink, Pd–; *cortex*: atranorin; *medulla*: orcinol depsides, depsidones (alectoronic and α-collatolic acids)



Cetrelia braunsiana lobe underside (left), white pseudocyphellae (right)
1 mm (left), 1 mm (right)

Coccocarpia Pers.

Coccocarpia erythroxyli fertile habit
1 mm

species: 3 in NZ, 21 worldwide
thallus: foliose
substratum: bark or rock
margin: eciliate, rounded
prothallus: none
colour: bluish or brownish grey
texture: smooth
cortex: present above and below
photobiont: cyanobacterial, *Scytonema*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: adnate
apothecial disc: red-brown
exciple: proper
propagules: isidia, phyllidia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: hyaline
chemistry: none

Coccocarpia erythroxyli apothecia
1 mm

Coccocarpia palmicola habit
1 mm

Collema F.H.Wigg.

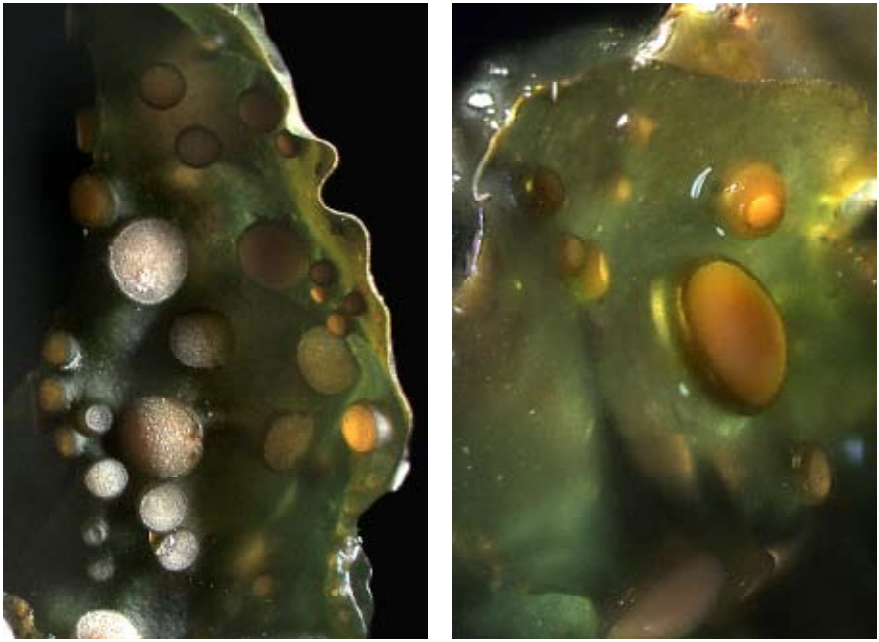
Collema fasciculare apothecia
0.5 mm

continued next page

Collema (cont'd)

Collema fasciculare apothecia
1 mm

species: 17 in NZ, 82 worldwide
thallus: foliose
substratum: soil, bark, rock
margin: eciliate, lobate
prothallus: none
colour: brown to dark grey
texture: smooth
cortex: none
photobiont: cyanobacterial, *Nostoc*
medulla: homoiomerous
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: white, red, brown, or black
exciple: proper, thalline
propagules: isidia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 2–16
spore septation: 1–many
spore shape: acicular to ellipsoid, ± apiculate
spore colour: trans-septate to muriform
chemistry: none



Collema leucocarpum apothecia
1 mm (left), 1 mm (right)

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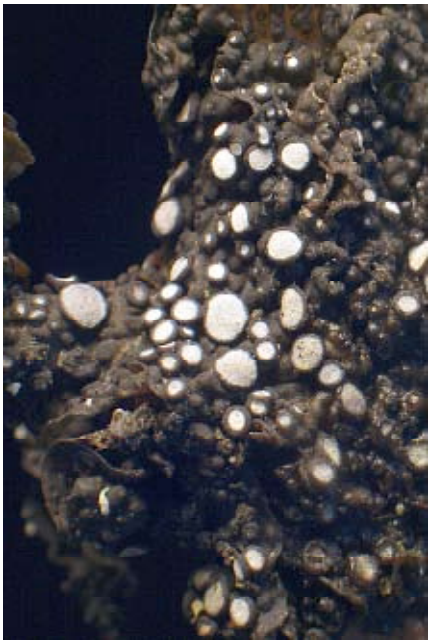
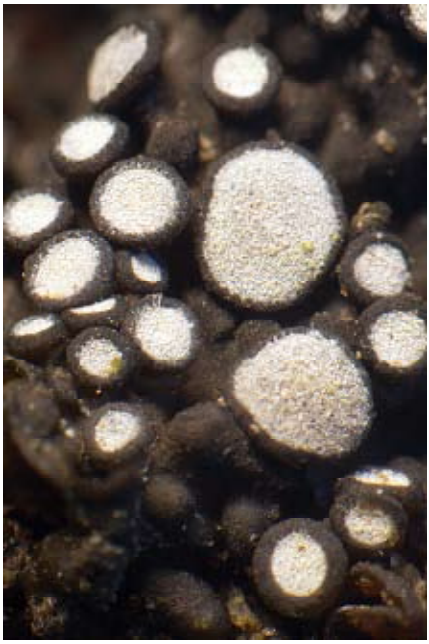
Collema (cont'd)





Collema glaucophthalmum apothecia (white-pruinose)
1 mm (left), 1 mm (right)

Collema subconveniens fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

continued next page

Collema (cont'd)

Collema novozelandicum fertile habit
1 mm (left), 1 mm (right)

Collema laeve apothecia
1 mm (left), 1 mm (right)

Degelia Arv. & D.J.Galloway

Degelia duplomarginata
1 mm

species: 5 in NZ, 16 worldwide
thallus: foliose to placodioid
substratum: soil, bark, acidic rock
margin: eciliate, smooth
prothallus: none
colour: grey to bluish grey
texture: smooth to minutely scabrid
cortex: present on both surfaces
photobiont: cyanobacterial, *Scytonema*
medulla: heteromerous, white
underside: pale to dark, rhizohyphae
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: red-brown
exciple: proper, with or without thalline
propagules: isidia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: none

Degelia duplomarginata apothecia (left), rhizines (right)
1 mm (left), 1 mm (right)

continued next page

Degelia (cont'd)

Degelia durietzii fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

Degelia gayana apothecia (left), rhizines (right)
1 mm (left), 1 mm (right)

Dermatocarpon Eschw.

species: 1 in NZ, 35 worldwide
thallus: peltate-foliose
substratum: rock
margin: eciliate, entire
prothallus: none
colour: bright green to greenish brown
texture: scabrid, ± pruinose
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
underside: smooth, erhizinate
ascomata: perithecia
perithecial elevation: immersed
exciple: proper
propagules: none
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid to ovoid
spore colour: clear
chemistry: none

Dermatocarpon miniatum lobe (dry)
0.1 mm

Dermatocarpon miniatum upperside (left) and underside (right)
0.1 mm

Dirinaria (Tuck.) Clem.

Dirinaria applanata thallus margin (dry)
1 mm

species: 3 in NZ, 35 worldwide
thallus: foliose
substratum: bark, rock
margin: eciliate, entire
prothallus: none
colour: pale to dark grey, ± pruinose
texture: smooth to pustular
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white to yellow
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: black, ± pruinose
exciple: thalline
propagules: soredia, finger-like projections
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1, thick-walled
spore shape: ellipsoid
spore colour: brown
chemistry: *cortex*: K+ yellow; *medulla*: K–, C–, KC–, Pd–; *cortex*: atranorin; *medulla*: K+ purple pigment, triterpenoids, divaricatic acid

Dirinaria applanata soralia and apothecia (dry)
1 mm (left), 1 mm (right)

continued next page

Dirinaria (cont'd)

Dirinaria picta thallus margin (moist on left, dry on right))
1 mm (left), 1 mm (right)

Dirinaria picta apothecia and soredia (dry on left, moist on right)
1 mm (left), 1 mm (right)

Erioderma Fée

species: 2 in NZ, 31 worldwide
thallus: foliose
substratum: bark, including twigs
margin: eciliate
prothallus: none
colour: grey- or blue-green
texture: hairy or tomentose
cortex: upperside only
photobiont: cyanobacterial, *Scytonema*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: ± stalked, marginal
apothecial disc: red-brown to black
exciple: proper only
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ± globose
spore colour: clear
chemistry: Pd+ yellow-orange; pannarin or eriodermin

Erioderma leylandii subsp. *leylandii* fertile habit
1 mm

Erioderma leylandii subsp. *leylandii* apothecia, laminal tomentum
1 mm (left), 1 mm (right)

Everniastrum Hale ex Sipman

species: 1 in NZ, 31 worldwide
thallus: foliose
substratum: bark, rarely rock
margin: ciliate, the cilia branched
prothallus: none
colour: grey or blue-grey
texture: smooth
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: absent in NZ species
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
chemistry: *cortex*: K+ yellow; *medulla*: K+ yellow → red, C–, KC+ red, Pd+ orange; atranorin, chloroatranorin, salazinic, consalazinic, and protolichesterinic acids

Everniastrum sorocheilum upperside
1 mm

Everniastrum sorocheilum undersides, fertile (left) and sterile (right)
1 mm (left), 1 mm (right)

Flavoparmelia Hale

Flavoparmelia haysomii upperside
1 mm

species: 3 in NZ, 17 worldwide
thallus: foliose
substratum: rock, bark, lignum, timber
margin: eciliate
prothallus: none
colour: green to yellow-green or yellow
texture: smooth, wrinkled, or pustulate
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white to ± yellow
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: red-brown to dark brown
exciple: thalline
propagules: soredia, finger-like projections
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K–, UV–; *medulla*: K– or K+ purple or yellow → red, C–, KC–, Pd+ brick red; atranorin, skyrin in pigmented part of medulla, acids salazinic, caperatic, gyrophoric, protocetraric, and usnic

Flavoparmelia haysomii laminal pustules (left), underside (right)
1 mm (left), 1 mm (right)

Fuscoderma (D.J.Galloway & P.M.Jørg) P.M.Jørg. & D.J.Galloway

species: 4 in NZ, 5 worldwide
thallus: foliose
substratum: bryophytes, bark
margin: eciliate
prothallus: none
colour: olive-green to grey
texture: smooth to papillate or scabrid
cortex: present on both surfaces
photobiont: cyanobacterial, *Nostoc*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: orange to red-brown
exciple: proper only
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *medulla*: Pd+ yellow-orange; vicanicin, norvicanicin

Fuscoderma applanatum fertile habit
1 mm

Fuscoderma amphibolum fertile habit, apothecia
1 mm (left), 1 mm (right)

Heterodea Nyl.

Heterodea muelleri fertile habit (dry)
1 mm

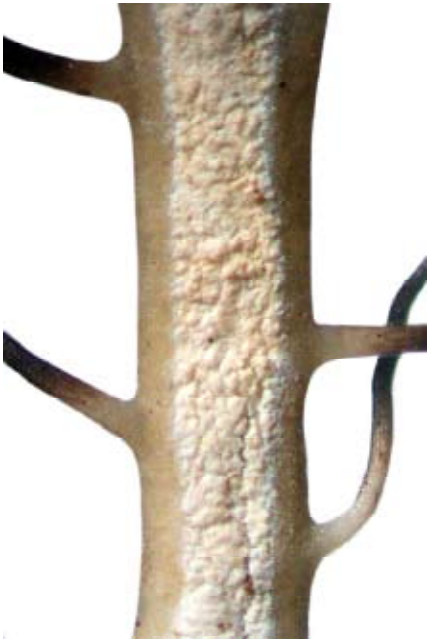
species: 1 in NZ, 2 worldwide
thallus: foliose
substratum: soil
margin: eciliate, entire
prothallus: none
colour: yellow-green to yellow-brown
texture: smooth
cortex: upperside only
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile on margins
apothecial disc: red-brown to dark brown
exciple: eventually excluded
propagules: none
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: KC+ yellow; *medulla*: K–, C–, KC–, Pd–; *cortex*: usnic acid; *medulla*: diffractaic acid

Heterodermia muelleri upperside (left) and underside (right)
1 mm

Heterodermia Trevis.

Heterodermia leucomela habit (dry)
1 mm

species: 11 in NZ, c. 90 worldwide
thallus: foliose, ± loosely attached
substratum: soil, rock, or bark
margin: entire to ciliate, ± ribbon-like
prothallus: none
colour: greenish, white, or grey
texture: smooth to pruinose
cortex: present above, not always below
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: brown to black
exciple: thalline
propagules: isidia, soredia, phyllidia
asexual: none
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1, thick-walled
spore shape: ellipsoid
spore colour: brown
chemistry: *cortex*: K+ yellow; *medulla*: K+ yellow → red, KC+ red, Pd+ orange; atranorin, zeorin, acids norstictic and salazinic, pigments



Heterodermia leucomela underside
1 mm (left), 1 mm (right)

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Heterodermia (cont'd)

Heterodermia speciosa habit (left), underside (right)
1 mm (left), 1 mm (right)

Heterodermia japonica habit
1 mm

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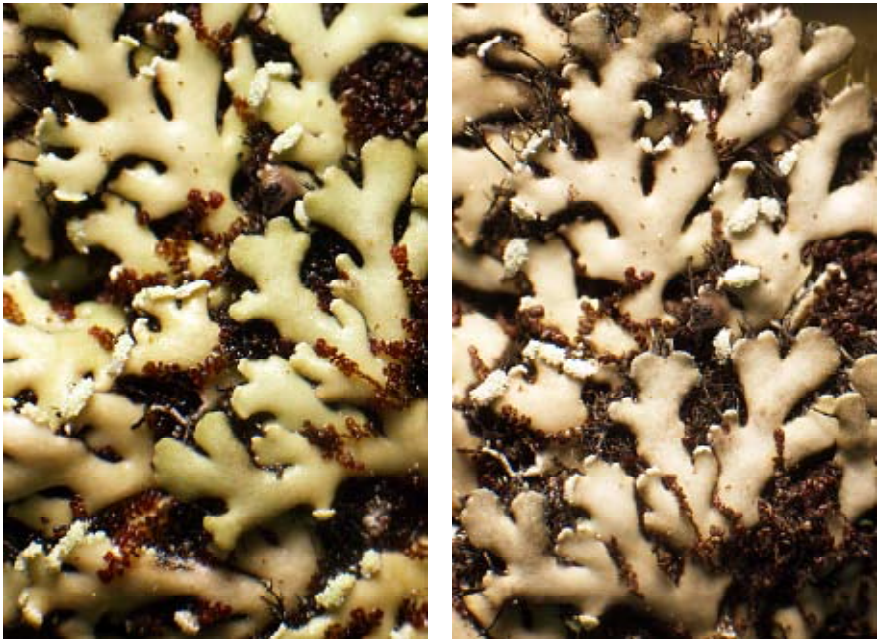
Heterodermia (cont'd)

Heterodermia obscurata lobes (moist) (underside on right)
1 mm



Heterodermia lutescens habit (moist on left)
1 mm

Hyperphyscia Müll.Arg.

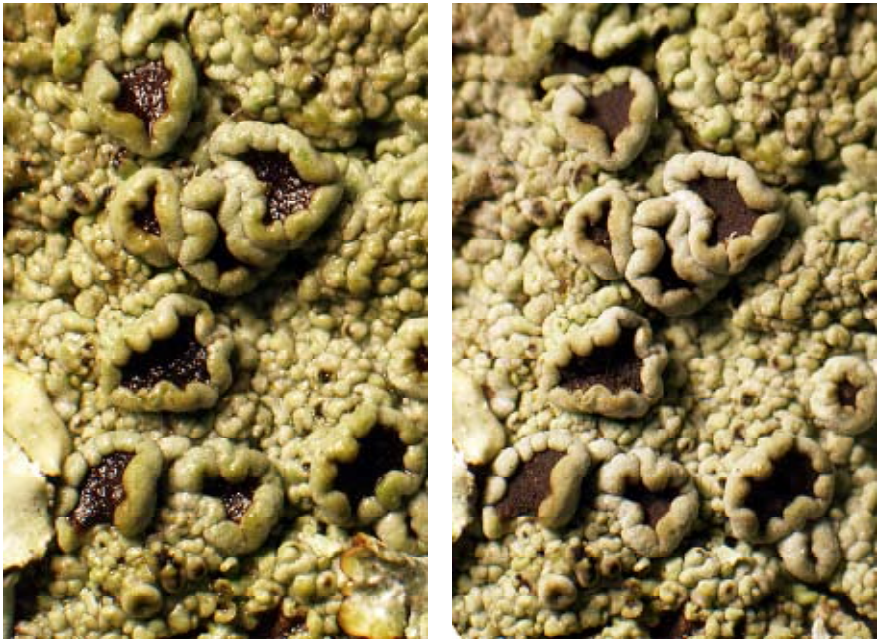
Hyperphyscia plinthiza fertile habit
1 mm

continued next page

Hyperphyscia (cont'd)

Hyperphyscia plinthiza apothecia
1 mm

species: 2 in NZ, 12 worldwide
thallus: foliose
substratum: bark or rarely rock
margin: eciliate
prothallus: none
colour: brown to grey-brown
texture: smooth to tuberculate
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: brown or black
exciple: thalline
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1–3 to submuriform
spore shape: ellipsoid to oblong
spore colour: brown
chemistry: none



Hyperphyscia plinthiza apothecia wet (left) and dry (right)
1 mm

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Hyperphyscia (cont'd)

Hyperphyscia adglutinata habit (dry)
1 mm (left), 1 mm (right)

Hyperphyscia adglutinata apothecia (dry)
1 mm (left), 1 mm (right)

Hypogymnia (Nyl.) Nyl.

Hypogymnia turgidula fertile habit
1 mm

continued next page

Hypogymnia (cont'd)

Hypogymnia turgidula apothecia
1 mm

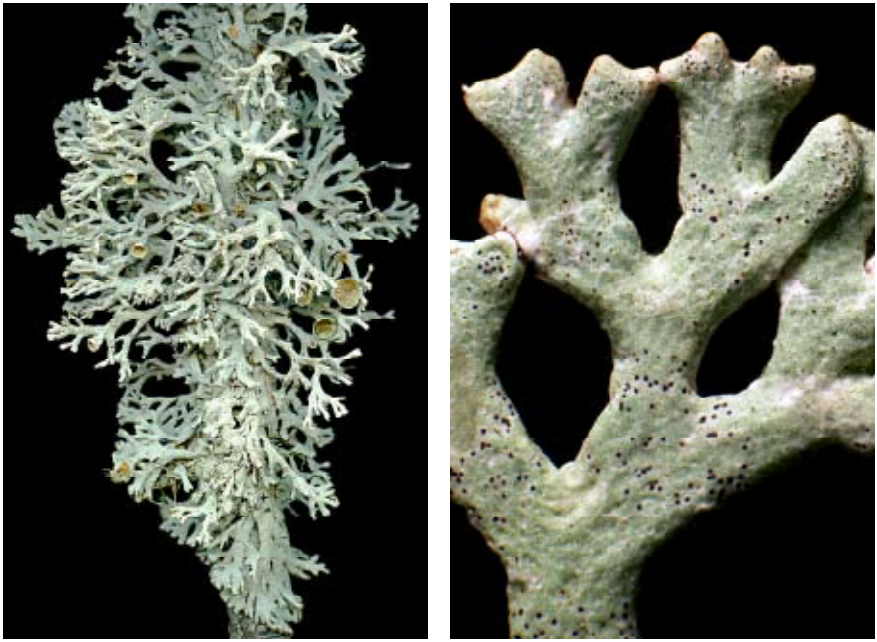
species: 8 in NZ, 86 worldwide
thallus: foliose, inflated, solid or hollow
substratum: bark
margin: eciliate
prothallus: none
colour: whitish, grey, or grey-green
texture: smooth
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: ± stalked
apothecial disc: pale to red-brown
exciple: thalline
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K+ yellow; *medulla*: KC+ red, Pd– or + reddish; atranorin, chloroatranorin, acids protocetraric, physodic, oxyphysodic, alectoronic, physodalic, vittatolic

Hypogymnia turgidula apothecia and soredia
1 mm (left), 1 mm (right)

continued next page

Hypogymnia (cont'd)

Hypogymnia lugubris var. *compactior* upperside (left), underside (right)
1 mm



Hypogymnia mundata fertile habit (left), terminal lobes (right)
5 mm (left), 1 mm (right)

continued next page

Hypogymnia (cont'd)

Hypogymnia subphysodes var. *subphysodes* sorediate margin lobes (left), apothecia (right)
1 mm (left), 1 mm (right)

Hypogymnia subphysodes var. *austrodioides* margin lobes (left), apothecia, soredia (right)
1 mm (left), 1 mm (right)

Hypotrachyna (Vain.) Hale

Hypotrachyna sinuosa habit
1 mm

species: 15 in NZ, 165 worldwide
thallus: foliose
substratum: bark, lignum, acidic rock
margin: eciliate, entire
prothallus: none
colour: white, grey, or yellow-green
texture: smooth
cortex: present, with pored epicortex
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K+ yellow, UV–; *medulla*: K–, C– or + orange, KC– or + pink, Pd–; atranorin, chloroatranorin, α-collatolic, alectoronic, physodic, barbatic, obtusatic, squamatic, diffractaic, and other acids

Hypotrachyna sinuosa sorediate lobe tips (left), rhizinate underside (right)
1 mm (left), 1 mm (right)

Icmadophila Trevis.

Icmadophila splachnirima fertile habit
1 mm

continued next page

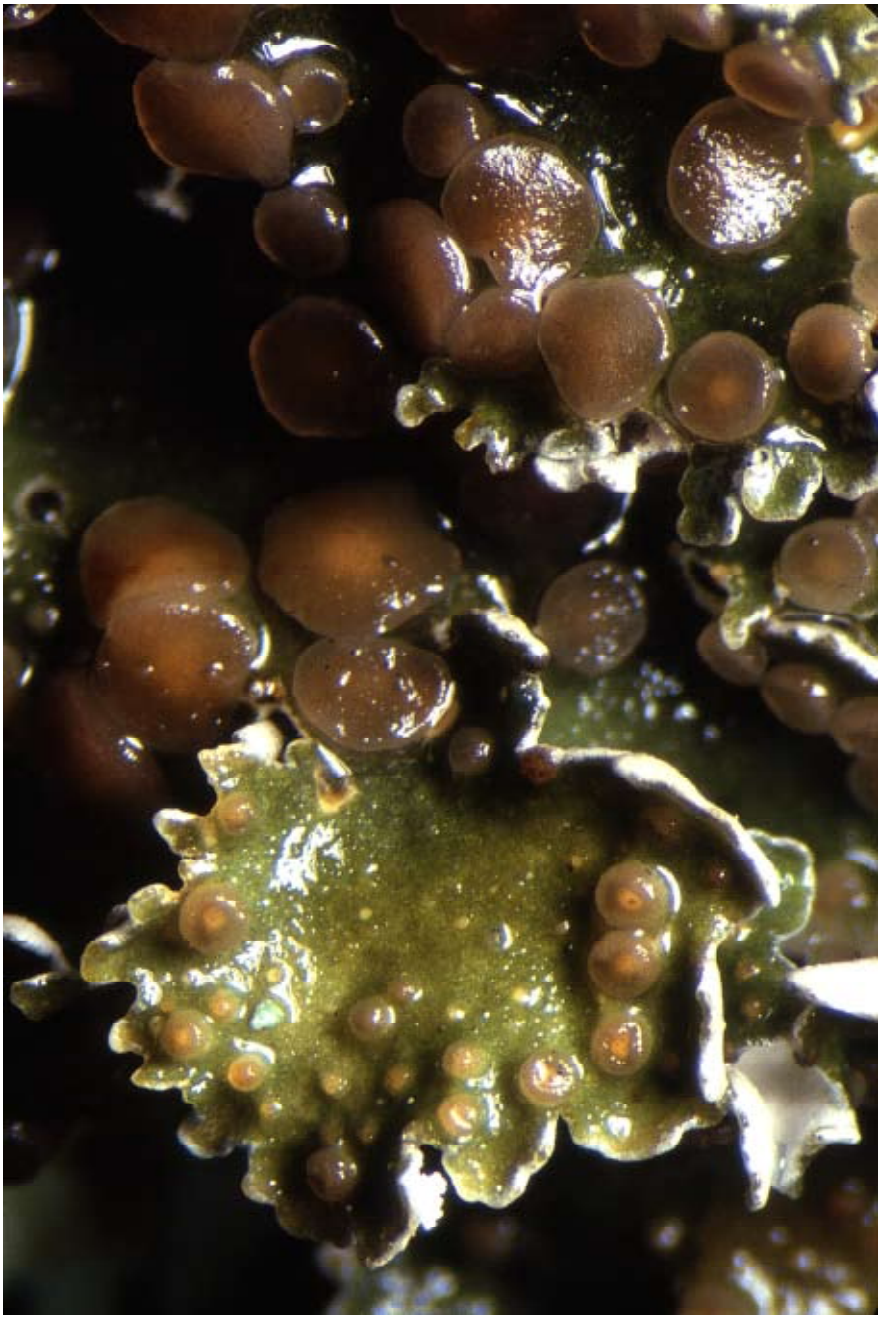
Icmadophila (cont'd)

Icmadophila splachnirima fertile habit
1 mm

species: 2 in NZ, 4 worldwide
thallus: crustose, squamulose, or foliose
substratum: soil, rotting wood, bryophytes
margin: eciliate, entire
prothallus: none
colour: green to grey
texture: smooth to scabrid
cortex: underside ecorticate
photobiont: *Coccomyxa*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: pink
exciple: proper, thalline soon excluded
propagules: none
asexual: none
cephalodia: none
pores: none
spores/ascus: (6–)8
spore septation: 1–3
spore shape: ellipsoid to fusiform
spore colour: clear
chemistry: K+ pale yellow or orange, C–, KC– or + orange, Pd+ orange; thamnolic, squamatic, and perlatolic acids

Icmadophila splachnirima apothecia (dry on right)
1 mm (left), 1 mm (right)

Leioderma Nyl.



Leioderma pycnophorum apothecia
1 mm

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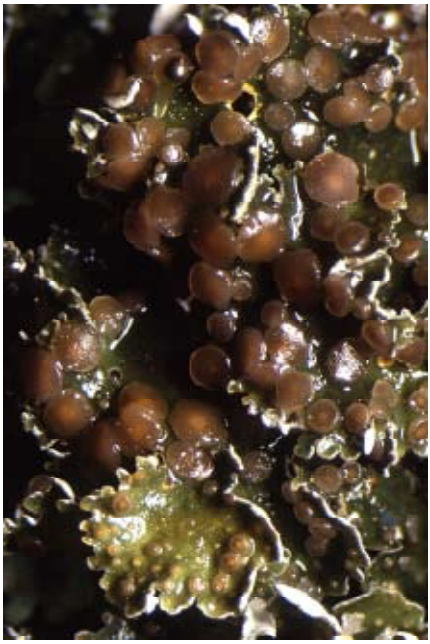
Leioderma (cont'd)



species: 4 in NZ, 7 worldwide
thallus: foliose
substratum: soil, bryophytes, bark, rock
margin: eciliate, entire
prothallus: none
colour: grey-blue to olive-brown
texture: smooth to tomentose
cortex: present on both surfaces
photobiont: cyanobacterial, *Scytonema*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: pale to dark red-brown
exciple: proper only
propagules: soredia, phyllidia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: none

Leioderma pycnophorum fertile habit
1 mm

Leioderma pycnophorum apothecia (left), rhizines (dry) (right)
1 mm (left), 1 mm (right)

Leptogium (Ach.) Gray

Leptogium coralloideum habit (moist)
1 mm

species: 20 in NZ, 180 worldwide
thallus: crustose, foliose, or subfruticose
substratum: bark, rock
margin: eciliate, ± entire
prothallus: none
colour: grey or brown
texture: smooth, wrinkled, or ridged
cortex: present on both surfaces
photobiont: cyanobacterial, *Nostoc*
medulla: homoiomerous
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: whitish, brown, or black
exciple: proper, thalline later ± excluded
propagules: isidia, phyllidia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: (4–)8
spore septation: submuriform
spore shape: ellipsoid to fusiform, ± apiculate
spore colour: clear
chemistry: none

Leptogium coralloideum isidia (left) and ridged-plicate non-isidiate surface (right)
1 mm (left), 1 mm (right)

continued next page

Leptogium (Ach.) Gray

Leptogium cyanescens habit (moist) (left) and marginal lobes (right)
1 mm (left), 1 mm (right)

Leptogium cyanescens marginal lobe (left) and phyllidia (right)
1 mm (left), 0.1 mm (right)

Lobaria (Schreb.) Hoffm.

Lobaria adscripta fertile habit
1 mm

species: 4 in NZ, 60 worldwide
thallus: foliose
substratum: bark or rarely rock
margin: eciliate, entire
prothallus: none
colour: green or bluish grey
texture: smooth to wrinkled
cortex: present on both surfaces
photobiont: green or cyanobacterial
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: reddish brown
exciple: thalline
propagules: isidia, soredia, or phyllidia
asexual: pycnidia
cephalodia: internal in green species
pores: none
spores/ascus: 8
spore septation: 1–7
spore shape: fusiform to acicular
spore colour: clear or brown
chemistry: *cortex*: K–; *medulla*: K–, C– or + red, KC– or + red, Pd–; acids gyrophoric and retigeranic

Lobaria adscripta lobes (left), underside (right)
1 mm (left), 1 mm (right)

Lobarina (Vain.) Nyl. ex Cromb.

Lobarina scrobiculata upperside
1 mm

species: 1 in NZ, 1 worldwide
thallus: foliose
substratum: bark, soil, or rock
margin: eciliate, entire
prothallus: none
colour: bluish or greenish grey
texture: smooth to scrobiculate
cortex: present; naked patches on lower
photobiont: cyanobacterial, *Nostoc*
medulla: heteromerous, white
ascomata: apothecia, absent in NZ species
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
chemistry: *cortex*: K–; *medulla*: K+ orange-red, C– or + rose, Pd+ orange; constictic, norstictic, stictic, and usnic acids plus meta- and para-scrobiculins

Lobarina scrobiculata underside, naked patches
1 mm (left), 1 mm (right)

Mastodia Hook.f & Harv.

species: 1 in NZ, 7 worldwide
thallus: foliose
substratum: rock, intertidal to high tide
margin: eciliate, entire
prothallus: none
colour: greenish brown
texture: warty
cortex: none
photobiont: *Prasiola* marine algae
medulla: homoiomerous
ascomata: perithecia
perithecial elevation: ± immersed
propagules: none
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid to fusiform
spore colour: clear
chemistry: none

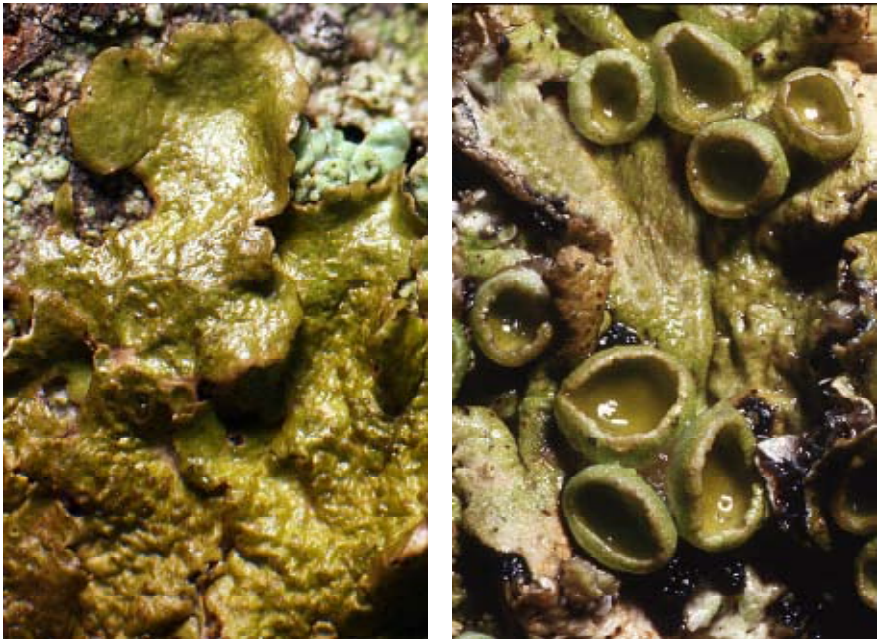
Mastodia tesselata ascocarps, pycnidia
1 mm

Mastodia tesselata perithecia (large), pycnidia (small)
0.1 mm

Melanelia Essl.

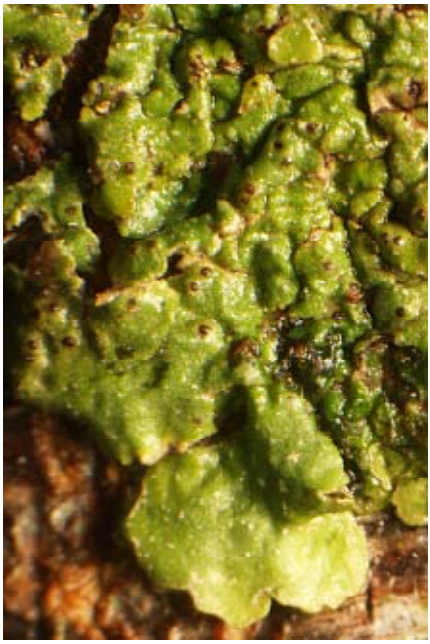
Melanelia glabratuloides fertile habit
1 mm

species: 3 in NZ, 42 worldwide
thallus: foliose
substratum: bark, bryophytes, rock
margin: eciliate
prothallus: none
colour: greenish brown to dark brown
texture: smooth to warty
cortex: present, non-pored epicortex above
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: greenish to red-brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K–; *medulla*: K– or + violet or yellow, C+ rose, KC+ rose, Pd–; gyrophoric and methylhiascic acids; cell walls containing isolichenan



Melanelia calva marginal lobes (left), apothecia (right)
1 mm (left), 1 mm (right)

Melanohalea O.Blanco, A.Crespo, Divakar, Essl., D.Hawksw. & Lumbsch



species: 2 in NZ, 19 worldwide
thallus: foliose
substratum: bark
margin: eciliate
prothallus: none
colour: olive-green to dark brown
texture: smooth to wrinkled
cortex: present, non-pored epicortex above
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: brown
exciple: thalline
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: pseudocyphellae on upperside
spores/ascus: 8(–32)
spore septation: 0
spore shape: ellipsoid to cylindric
spore colour: clear
chemistry: none; cell walls containing isolichenan

Melanohalea zopheroa habit
1 mm

Melanohalea zopheroa marginal lobe (left), pale laminal pseudocyphellae (right)
1 mm (left), 1 mm (right)

Menegazzia A.Massal.

Menegazzia foraminulosa apothecia and thallus perforations
1 mm

continued next page

Menegazzia (cont'd)

Menegazzia foraminulosa fertile habit
1 mm

species: 20 in NZ, 70 worldwide
thallus: foliose, inflated, ± perforate
substratum: bark, rock
margin: eciliate, entire, ± pigmented
prothallus: none
colour: whitish to green
texture: smooth
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white or pigmented
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: red-brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 2 or 8
spore septation: 0, thick-walled
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K+ yellow; *medulla*: K– or + orange, C– or + red, KC– or + orange or red, Pd– or + orange; *cortex*: atranorin, usnic acid; *medulla*: lecanoric, norstictic, menegazziaic, psoromic, conpsoromic, stictic, and echinocarpic acids

Menegazzia foraminulosa perforate marginal lobes (left), apothecia (right)
1 mm (left), 1 mm (right)

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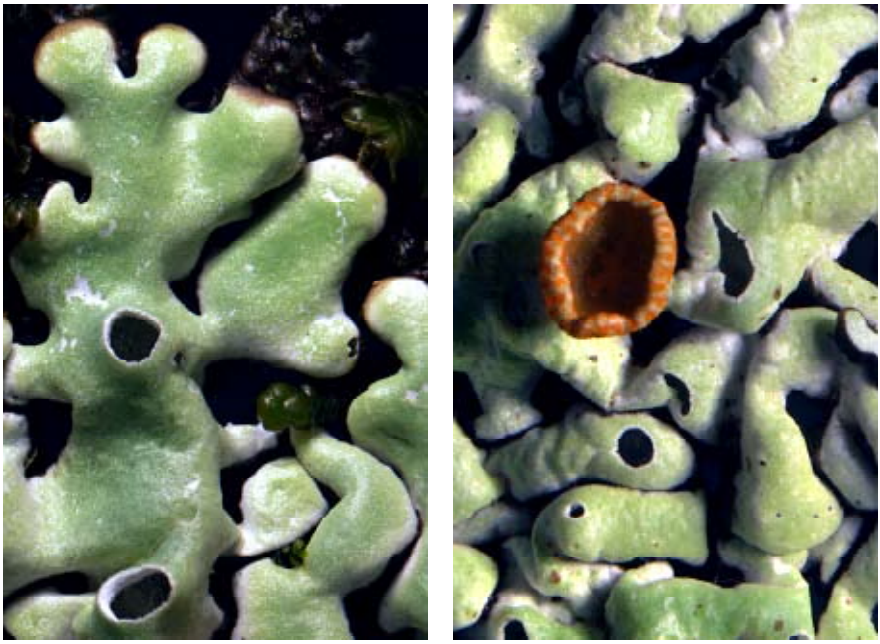
Menegazzia (cont'd)



Menegazzia pulchra marginal lobes and perforations (left), apothecium (right)
1 mm (left), 1 mm (right)

Menegazzia inflata habit
1 mm (left), 1 mm (right)

continued next page

Menegazzia (cont'd)

Menegazzia aeneofusca habit
1 mm (left), 1 mm (right)

Menegazzia caliginosa habit (left), soredia and perforations (right)
1 mm (left), 1 mm (right)

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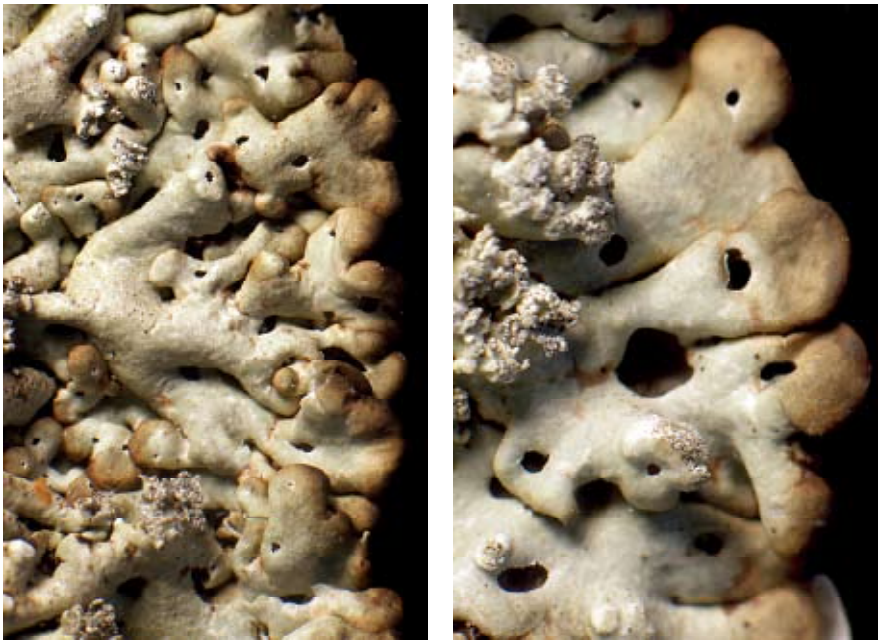
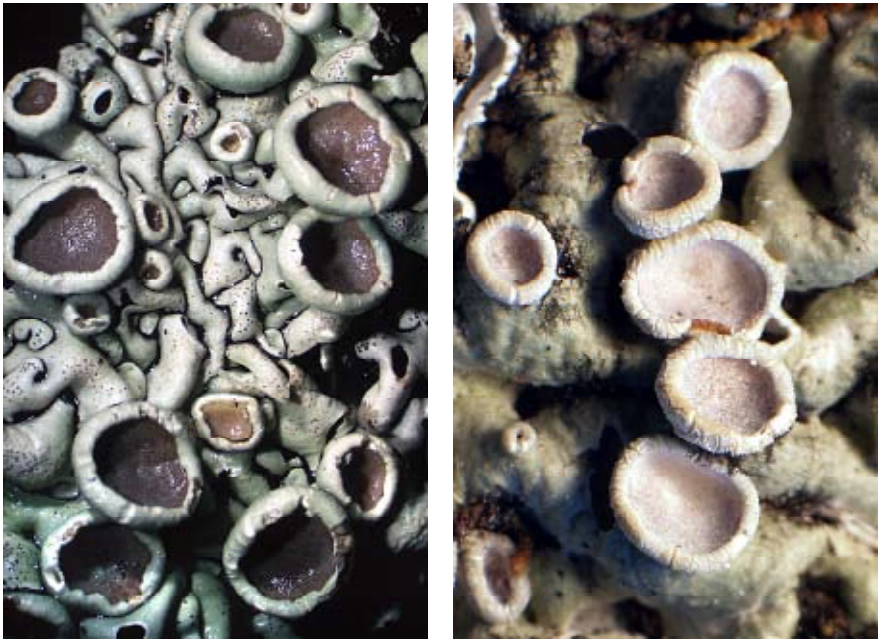
Menegazzia (cont'd)



Menegazzia castanea habit (left), soredia and perforations (right)
1 mm (left), 1 mm (right)



Menegazzia dielsii fertile habit (moist on left, dry and white-pruinose on right))
1 mm (left), 1 mm (right)

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Menegazzia (cont'd)

Menegazzia eperforata habit
1 mm (left), 1 mm (right)

Menegazzia globulifera pigmented lobe margins (left), helmet-shaped soralia (right)
1 mm (left), 0.1 mm (right)

continued next page

Menegazzia (cont'd)

Menegazzia subpertusa habit (left), laminal soredia and perforations (right)
1 mm (left), 1 mm (right)

Menegazzia neozelandica habit (left), sorediate perforations (right)
1 mm (left), 1 mm (right)

continued next page

Menegazzia (cont'd)

Menegazzia nothofagi habit
1 mm (left), 1 mm (right)

Menegazzia pertransita fertile habit, apothecia
1 mm (left), 1 mm (right)

continued next page

Menegazzia (cont'd)

Menegazzia testacea fertile habit, apothecia ▬ 1 mm (left), ▬ 1 mm (right)

Nephroma Ach.

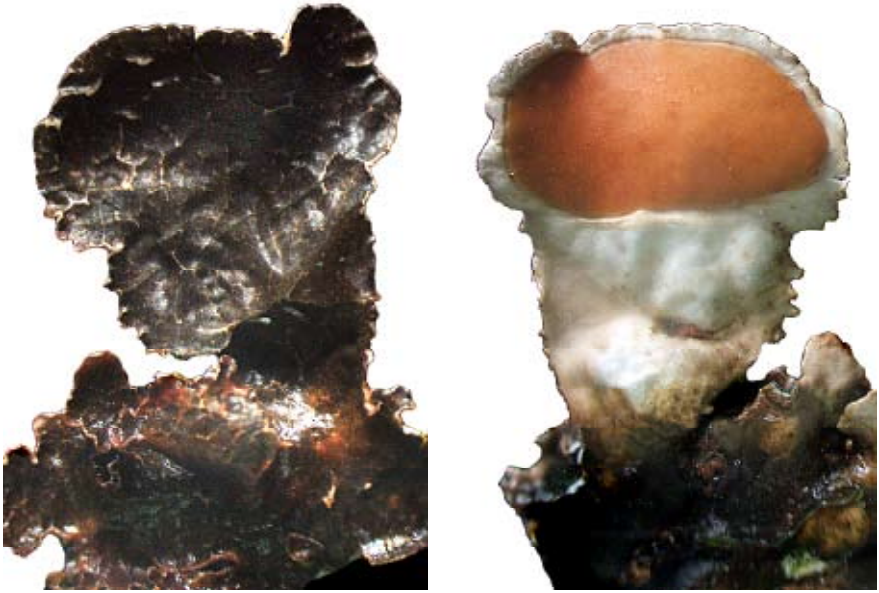
Nephroma australe underside of fertile lobe with apothecia
1 mm

continued next page

Nephroma (cont'd)

Nephroma australe fertile habit
1 mm

species: 7 in NZ, 35 worldwide
thallus: foliose
substratum: bark, rock
margin: eciliate, entire
prothallus: none
colour: green or grey-brown, ± maculate
texture: smooth, wrinkled, or faveolate
cortex: present on both surfaces
photobiont: green or cyanobacterial
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: pale brown to red-brown
exciple: thalline
propagules: phyllidia
asexual: pycnidia
cephalodia: internal in green species
pores: none
spores/ascus: 8
spore septation: 1–3
spore shape: fusiform
spore colour: pale brown
chemistry: (none in some species) zeorin, usnic, perlatolic, and ursolic acids



Nephroma cellulosum upperside (left), underside of fertile lobe with apothecium (right)
1 mm

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Nephroma (cont'd)

Nephroma plumbeum var. *isidiatum* upperside (left), underside, apothecia (right)
1 mm

Nephroma plumbeum var. *isidiatum* underside, apothecia (left), marginal isidia (right)
1 mm (left) 0.5 mm (right)

Pannaria Delise ex Bory

Pannaria immixta fertile habit
1 mm

species: 20 in NZ, 60 worldwide
thallus: squamulose to foliose
substratum: rock, bark
margin: ± lobed
prothallus: brown or blue-black if present
colour: green, bluish grey, or brown
texture: smooth, wrinkled, or tomentose
cortex: present
photobiont: green or cyanobacterial
medulla: white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: red, tan, brown, or black
exciple: proper
propagules: isidia, soredia
asexual: pycnidia
cephalodia: in green species
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid, ± apiculate
spore colour: clear
chemistry: pannarin, argopsin, and terpenoids in some species

Pannaria immixta gyrose apothecia
0.5 mm (left), 0.5 mm (right)

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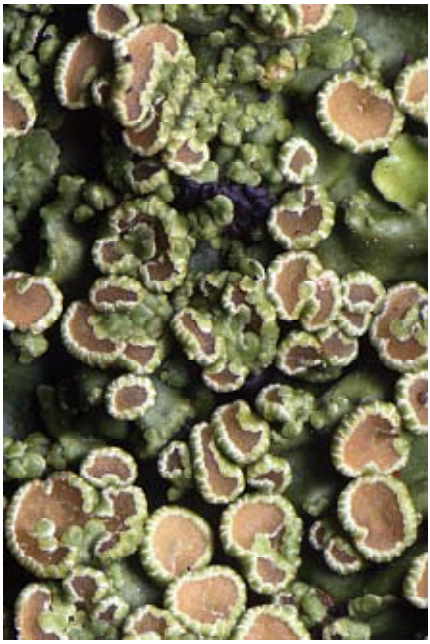
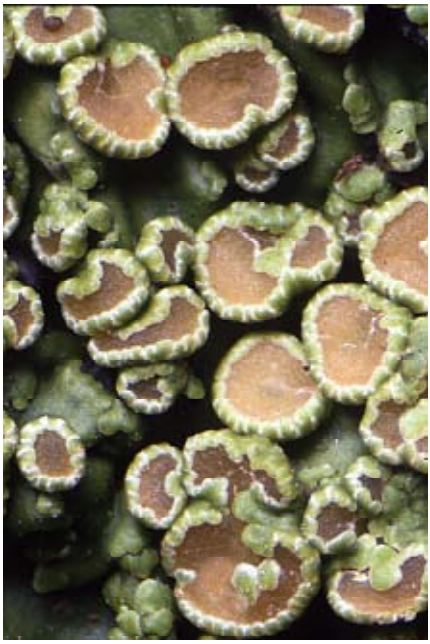
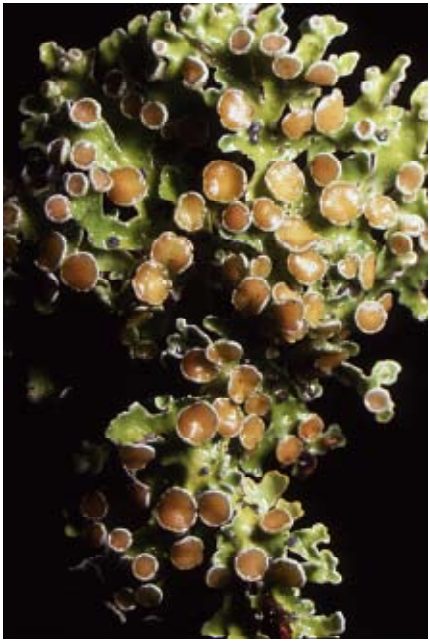
Pannaria (cont'd)





Pannaria allorhiza fertile habit (moist)
1 mm (left), 1 mm (right)



Pannaria euphylla fertile habit (moist)
1 mm (left), 1 mm (right)

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Pannaria (cont'd)

Pannaria elixii habit (moist)
1 mm (left), 1 mm (right)

Pannaria elixii marginal lobes and isidia (moist)
1 mm (left), 1 mm (right)

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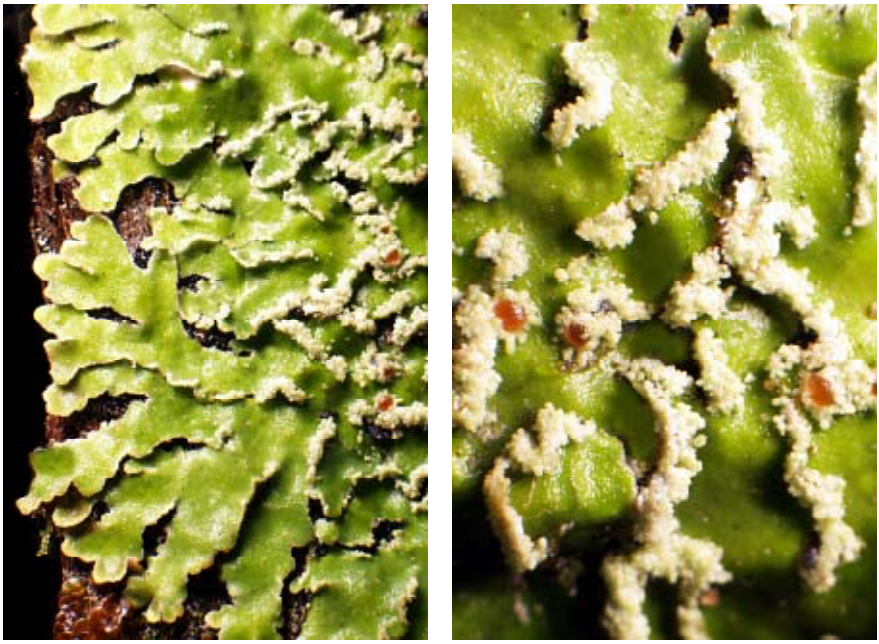
Pannaria (cont'd)



Pannaria leproloma habit (left), marginal soredia (right)
5 mm (left), 1 mm (right)

Pannaria xanthomelana habit and cephalodia (left), apothecia (right)
1 mm (left), 1 mm (right)

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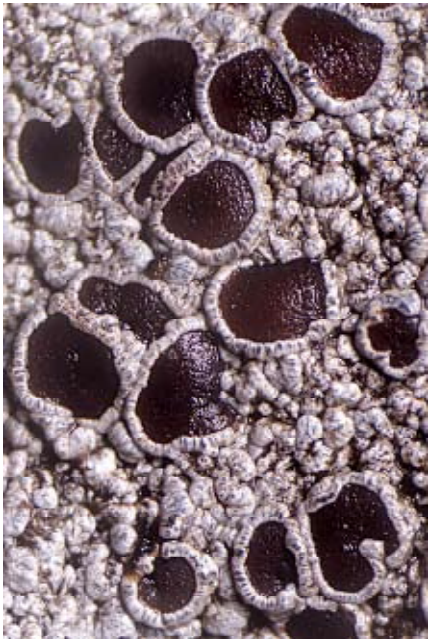
Pannaria (cont'd)

Pannaria durietzii habit (left), elongate marginal lobes, sorediate cephalodia (right)
1 mm (left), 1 mm (right)



Pannaria hookeri margin (left), apothecia (right)
1 mm (left), 1 mm (right)

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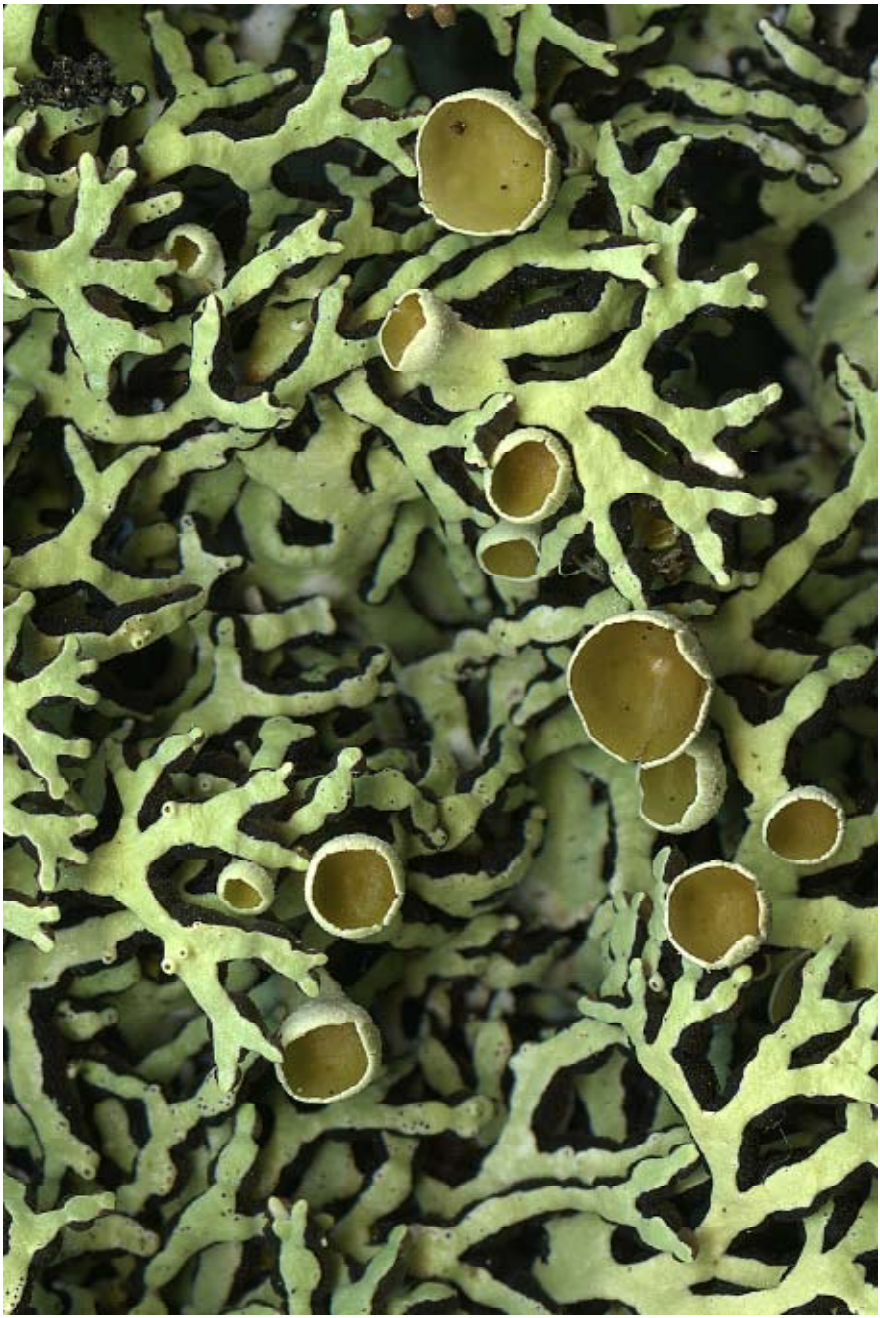
Pannaria (cont'd)

Pannaria microphyllizans marginal lobes (left), phyllidia (right)
1 mm (left), 1 mm (right)

Pannaria subcrustacea squamulose fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

Pannoparmelia (Müll.Arg.) Darb.



Pannoparmelia angustata fertile habit
1 mm

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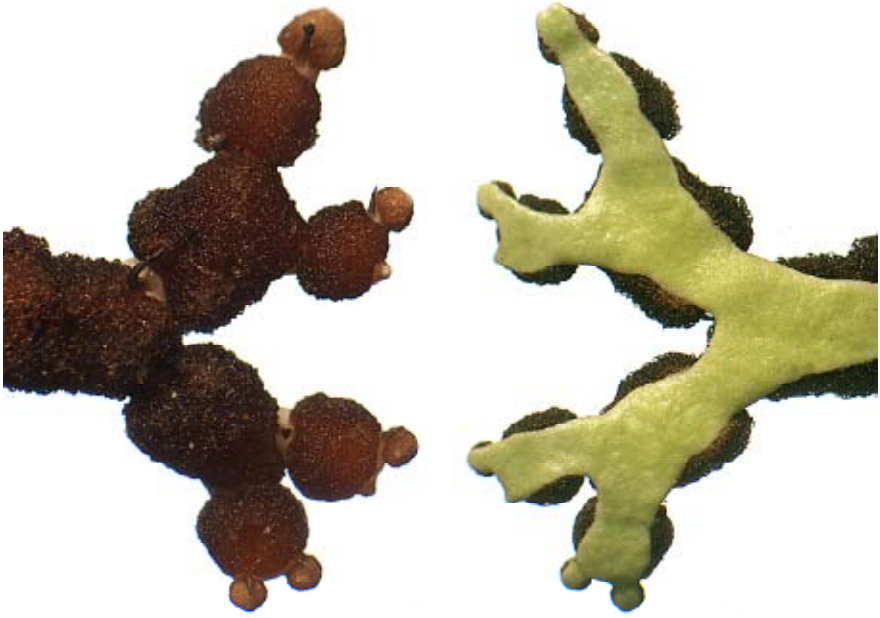
Pannoparmelia (cont'd)

Pannoparmelia angustata fertile habit
5 mm

species: 2 in NZ, 2 worldwide
thallus: foliose
substratum: bark
margin: eciliate, lobed
hypothallus: spongy, beaded
colour: grey to yellow-green
texture: smooth
cortex: present, pored epicortex above
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to stalked
apothecial disc: brown
exciple: thalline
propagules: isidia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: KC+ yellow; *medulla*: K–, C–, KC–, Pd–; *cortex*: usnic acid; *medulla*: divaricatic acid



Pannoparmelia angustata beaded hypothallus (moist), underside (left), upperside (right)
1 mm

Parasiphula Kantvilas & Grube

Parasiphula fragilis
1 mm

continued next page

Parasiphula (cont'd)

Parasiphula fragilis
5 mm

species: 6 in NZ, 7 worldwide
thallus: foliose to fruticose
substratum: soil, bryophytes
margin: eciliate, entire
prothallus: none
colour: white, grey or olive, ± red-tinged
texture: smooth to scabrid
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: none
propagules: none
asexual: none
cephalodia: none
pores: none
chemistry: none in some species; *cortex*: K+ yellow, C–, KC– or + red, Pd–; *medulla*: K+ yellow, C+ green, KC–, Pd–; lobaric, conlobaric, and porphyrilic acids

Parasiphula fragilis lobe (left), lobe cross-sections (right)
1 mm (left), 100 μm (middle), 50 μm (right)

Parmelia Ach.

Parmelia sulcata upperside
1 mm

species: 15 in NZ, 57 worldwide
thallus: foliose
substratum: soil, bark, rock
margin: eciliate, entire
prothallus: none
colour: grey, grey-green, brownish grey
texture: smooth, plane to faveolate
cortex: present, non-pored epicortex above
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to stalked
apothecial disc: pale to dark brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: upperside pseudocyphellate
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid to ± globose
spore colour: clear
chemistry: *cortex*: K+ yellow; *medulla*: K– or + yellow or yellow → red, C–, Pd+ red-orange; atranorin, chloroatranorin, lobaric, salazinic, consalazinic, norstictic, protocetraric, fumarprotocetraric, echinocarpic, and conechinocarpic acids

Parmelia sulcata underside (left), pseudocyphellae on upperside (right)
1 mm (left), 1 mm (right)

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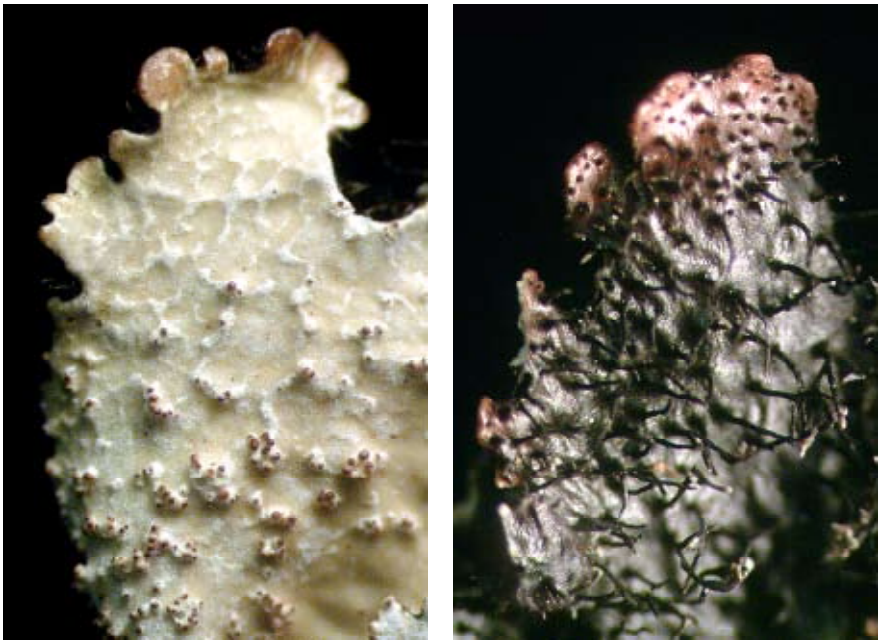
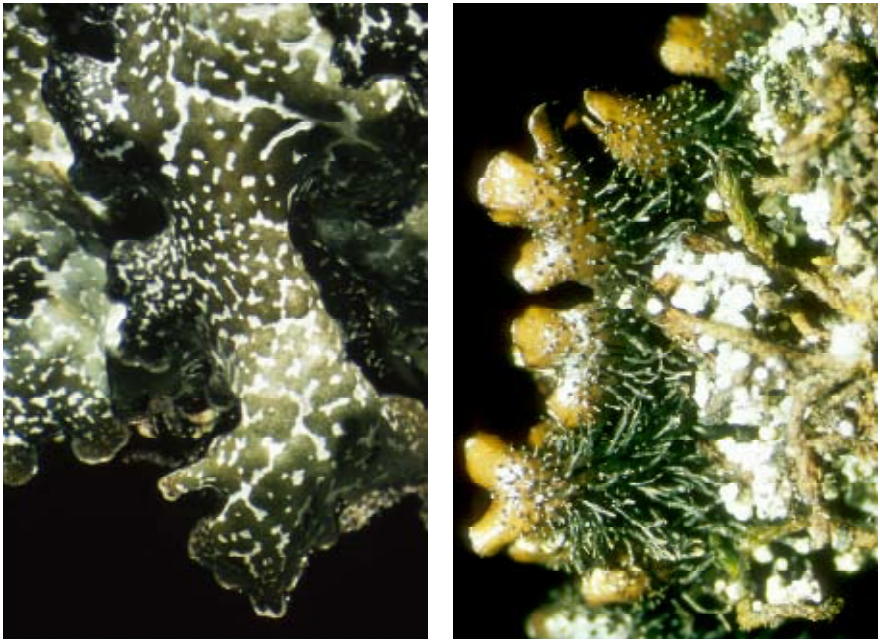
Parmelia (cont'd)



Parmelia saxatilis upperside (left), underside (right)
1 mm (left), 1 mm (right)



Parmelia signifera upperside, white laminal maculae (left), underside, rhizines (right)
1 mm (left), 1 mm (right)

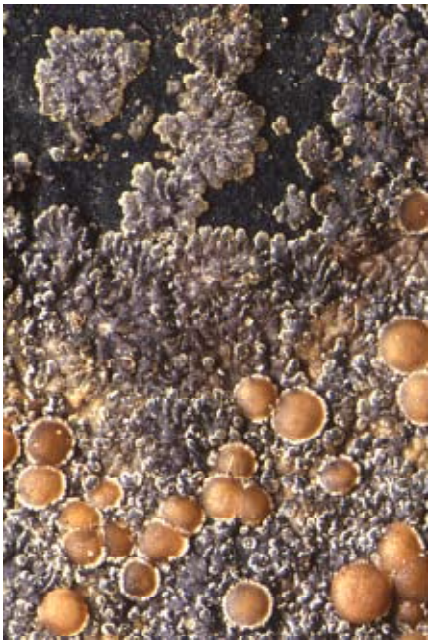
continued next page

Parmelia (cont'd)

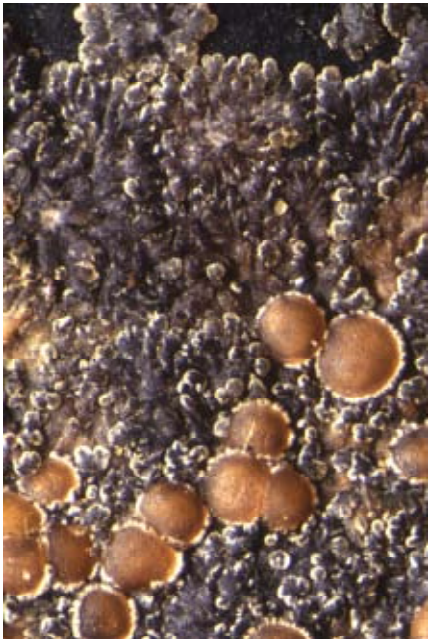
Parmelia erumpens laminal soralia, pseudocyphellae (cracks), maculae (white patches)
1 mm (left), 1 mm (right)

Parmelia cunninghamii upperside (left), underside, rhizines (right)
1 mm

Parmeliella Müll.Arg.



Parmeliella nigrocincta fertile habit
1 mm



Parmeliella nigrocincta apothecia
1 mm

species: 14 in NZ, 64 worldwide
thallus: squamulose to foliose
substratum: soil, bryophytes, bark, rock
margin: eciliate
prothallus: byssoid, blue-black
colour: bluish or brownish grey to ± black
texture: smooth to wrinkled or plicate
cortex: present on both surfaces
photobiont: cyanobacterial, *Nostoc*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: pale to dark brown
exciple: proper only in NZ species
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: none

Parmelina Hale

Parmelina labrosa habit
1 mm

species: 4 in NZ, 10 worldwide
thallus: foliose
substratum: bark, lignum, acidic rock
margin: ± evenly ciliate in the lobe sinuses
prothallus: none
colour: grey to grey-green
texture: smooth
cortex: present, with a pored epicortex
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: pale to dark brown
exciple: thalline, smooth
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K+ yellow; *medulla*: K–, C+ red, KC+ red, Pd–; atranorin, chloroatranorin, and lecanoric acid

Parmelina labrosa marginal lobes and soredia (left), cilia and soredia (right)
1 mm (left), 1 mm (right)

Parmelinopsis Elix & Hale

Parmelinopsis afrorevoluta habit
1 mm

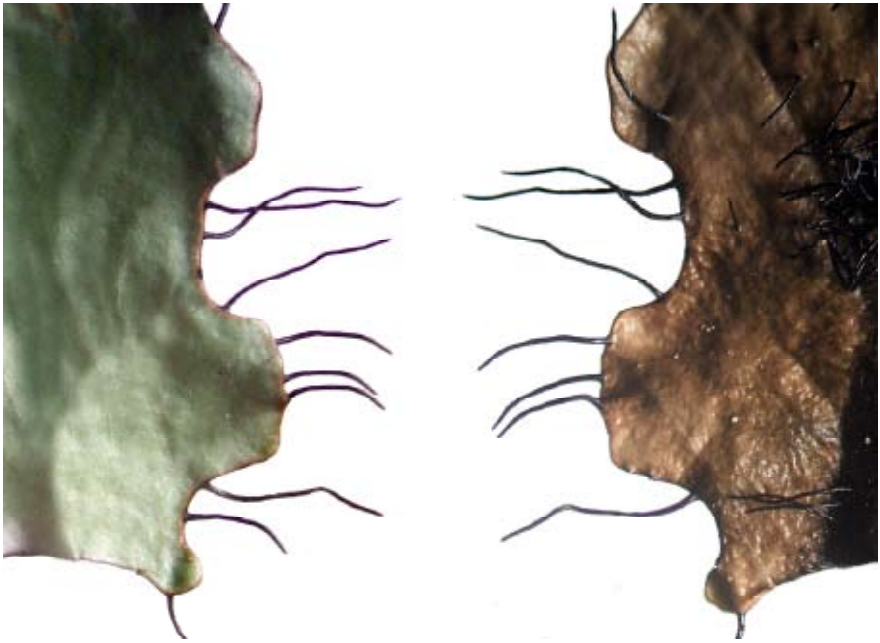
Parmelinopsis afrorevoluta lobes
1 mm

species: 8 in NZ, 25 worldwide
thallus: foliose
substratum: bark, rock
margin: ciliate, the cilia evenly distributed
prothallus: none
colour: whitish to greenish-grey
texture: smooth
cortex: present, pored epicortex above
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: pale to dark brown
exciple: thalline
propagules: isidia (± ciliate), soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0, thick-walled
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K+ yellow; *medulla*: K–, C+ rose, KC+ red, Pd–; *cortex*: atranorin, chloroatranorin; *medulla*: gyrophoric, methylhiascic, umbilicaric, protocetraric, and malonprotocetraric acids

Parmotrema A.Massal.

Parmotrema perlatum habit
1 mm

species: 17 in NZ, 300 worldwide
thallus: foliose
substratum: bark, acidic rock
margin: ciliate or eciliate, entire
prothallus: none
colour: grey, grey-green or yellowish
texture: smooth to rugose or faveolate
cortex: present, pored epicortex above
photobiont: green
medulla: heteromerous, white, ± pigmented
ascomata: apothecia
apothecial elevation: stalked
apothecial disc: red-brown to brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0, thick-walled
spore shape: ellipsoid to reniform
spore colour: clear
chemistry: *cortex*: K+ yellow; *medulla*: K– or + yellow → red, C–, KC+ pink, Pd–; *cortex*: chloroatranorin, atranorin; *medulla*: stictic, constictic, cryptostictic, α-collatolic, menegazziaic, salazinic, consalazinic, norstictic, and protocetraric acids; isolichenan in cell walls



Parmotrema perlatum ciliate margin, upperside (left), underside (right)
1 mm

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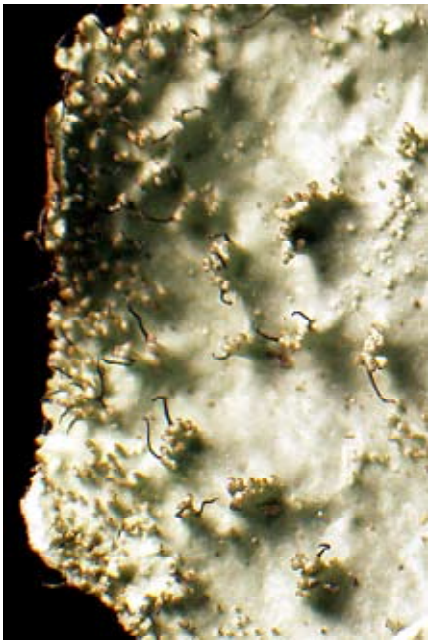
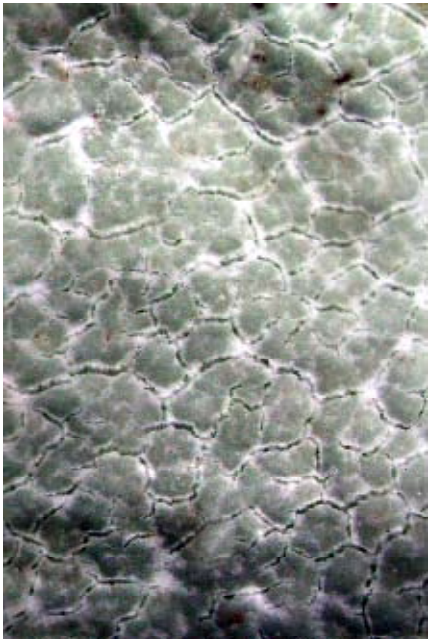
Parmotrema (cont'd)



Parmotrema crinitum upperside (left), ciliate isidia (right)
1 mm (left), 0.5 mm (right)



immature *Parmotrema reticulatum* ciliate margin, crack network (not pseudocyphellae)
1 mm (left), 0.5 mm (right)

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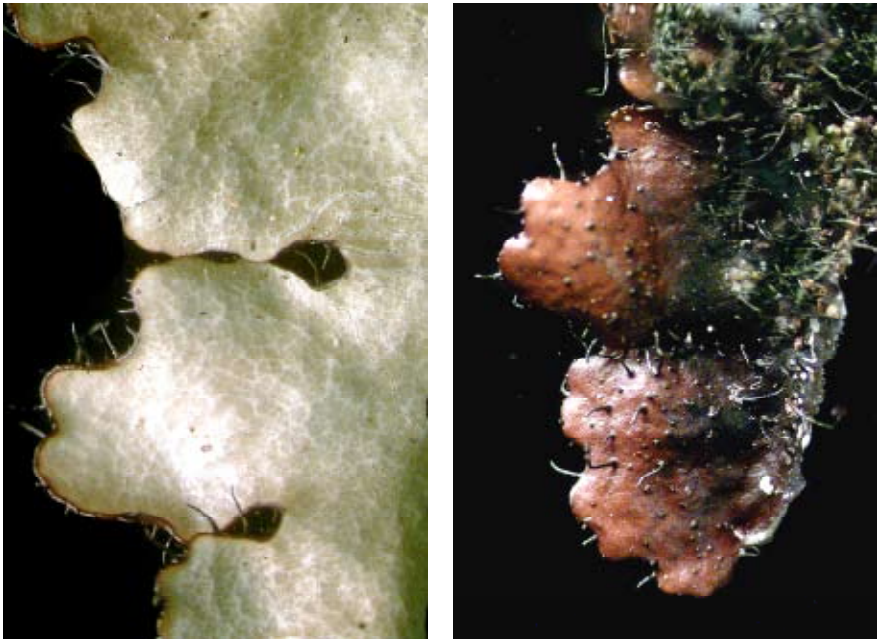
Parmotrema (cont'd)

Parmotrema reparatum reticulate, ciliate upperside and rhizinate, ciliate underside
1 mm



Parmotrema tinctorum upperside (left), underside (right)
1 mm (left), 0.5 mm (right)

Peltigera Willd.

Peltigera dolichorhiza veined underside, apothecium
0.5 mm

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Peltigera (cont'd)

species: 16 in NZ, 70 worldwide
thallus: foliose
substratum: soil, bryophytes, rotting wood
margin: eciliate, entire to tomentose
prothallus: none
colour: bluish grey or grey-brown
texture: smooth to tomentose
cortex: upperside only, ± veined below
photobiont: cyanobacterial in NZ species
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile
apothecial disc: brown to nearly black
exciple: thalline or lacking
propagules: isidia, soredia, phyllidia
asexual: pycnidia
cephalodia: none in NZ species
pores: none
spores/ascus: 8
spore septation: 3–7-septate
spore shape: fusiform to acicular
spore colour: clear to pale brown
chemistry: none in some species; zeorin, peltidactylin, dolichorrhizin, tenuiorin, and gyrophoric acid

Peltigera dilacerata apothecium on lobe tip, upperside
1 mm

Peltigera dilacerata upperside (left), underside, veins and rhizines (right)
1 mm (left), 1 mm (right)

continued next page

Peltigera (cont'd)

Peltigera ulcerata sorediate tip, upperside (left), underside, rhizines (right)
1 mm (left), 1 mm (right)

Peltigera hymenina upperside (left), underside (right)
1 mm

continued next page

Peltigera (cont'd)

Peltigera nana ridged upperside (left), underside (right)
1 mm

Peltigera nana veins and rhizines on underside
1 mm (left), 1 mm (right)

Peltula Nyl.

species: 1 in NZ, 25 worldwide
thallus: peltate-foliose
substratum: soil, rock
margin: eciliate, entire
prothallus: none
colour: olive-green to brown
texture: smooth to undulate
cortex: present on both surfaces
photobiont: cyanobacterial, *Anacystis*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: immersed
apothecial disc: brown
exciple: proper only
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: > 100
spore septation: 0
spore shape: ellipsoid to fusiform
spore colour: clear
chemistry: none

Peltula euploca fertile habit (dry)
0.5 mm

Peltula euploca apothecia (dry)
0.5 mm (left), 0.5 mm (right)

Peltularia R.Sant.

species: 1 in NZ, 4 worldwide
thallus: peltate-foliose
substratum: rock
margin: eciliate, entire to incised
prothallus: none
colour: grey-brown
texture: scabrid
cortex: present on both surfaces
photobiont: cyanobacterial, *Nostoc*
medulla: heteromerous, white
ascomata: apothecia (rare)
apothecial elevation: erupting from cortex
apothecial disc: brown
exciple: thalline
propagules: soredia
asexual: none
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 2–3
spore shape: ellipsoid
spore colour: clear
chemistry: none

Peltularia crassa habit (moist, with *Racomitrium* moss)
1 mm

Peltularia crassa habit (dry on right)
1 mm (left), 1 mm (right)

Phaeophyscia Moberg

Phaeophyscia hispidula habit
1 mm

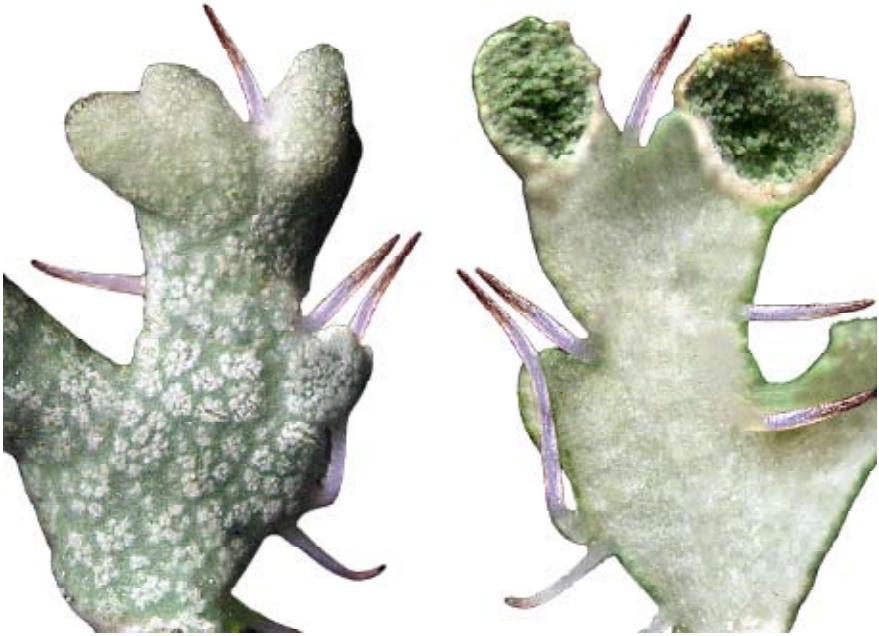
Phaeophyscia hispidula marginal lobes
1 mm

species: 5 in NZ, 28 worldwide
thallus: foliose to ± fruticose
substratum: soil, bark, rock
margin: eciliate, entire
prothallus: none
colour: greenish grey to grey-brown
texture: smooth
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile, ± rhizinate
apothecial disc: brown to black
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1, thick-walled
spore shape: ellipsoid
spore colour: brown
chemistry: none in some species; K+ purple; zeorin, skyrin

Physcia (Schreb.) Michx.

Physcia adscendens habit (on *Xanthoria* sp.)
1 mm

species: 14 in NZ, 70 worldwide
thallus: foliose to fruticose
substratum: bark, lignum, rock
margin: ciliate or eciliate, entire
prothallus: none
colour: light to dark or greenish grey
texture: smooth, ± pruinose
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: brown to black, ± pruinose
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1, thick-walled
spore shape: ellipsoid
spore colour: brown
chemistry: *cortex*: K+ yellow; *medulla*: K– or + yellow; *cortex*: atranorin; *medulla*: zeorin, atranorin, and leucotylin



Physcia adscendens helmet-shaped soralia, maculate upperside (left), underside (right)
1 mm

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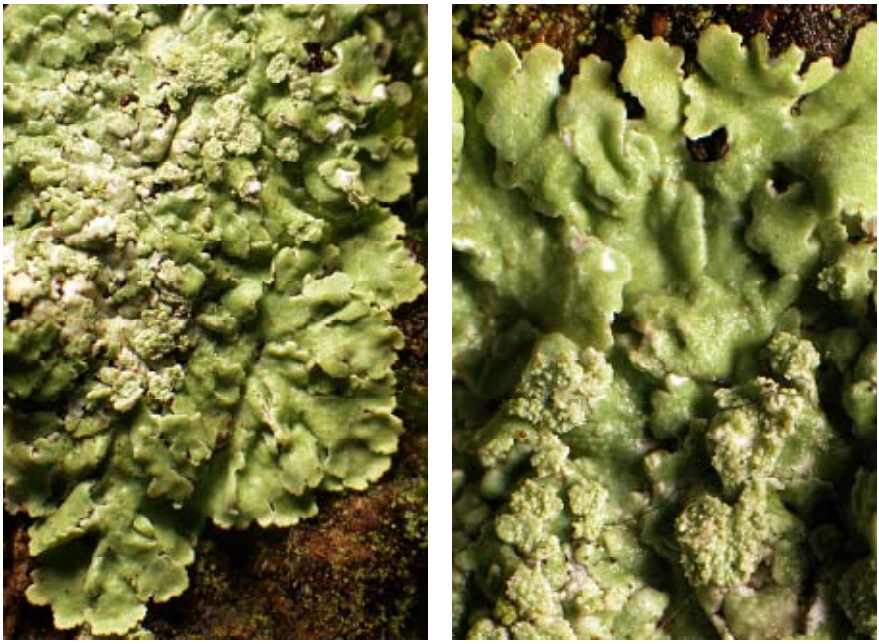
Physcia (cont'd)



Physcia poncinsii habit (left), marginal lobes (right)
1 mm (left), 1 mm (right)

Physcia tribacia upperside (left), underside (right)
0.1 mm

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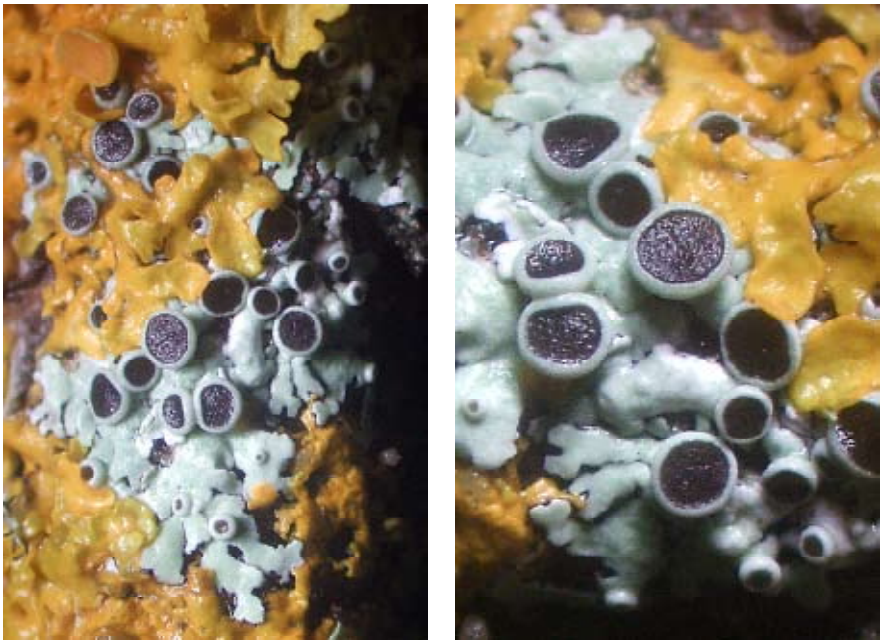
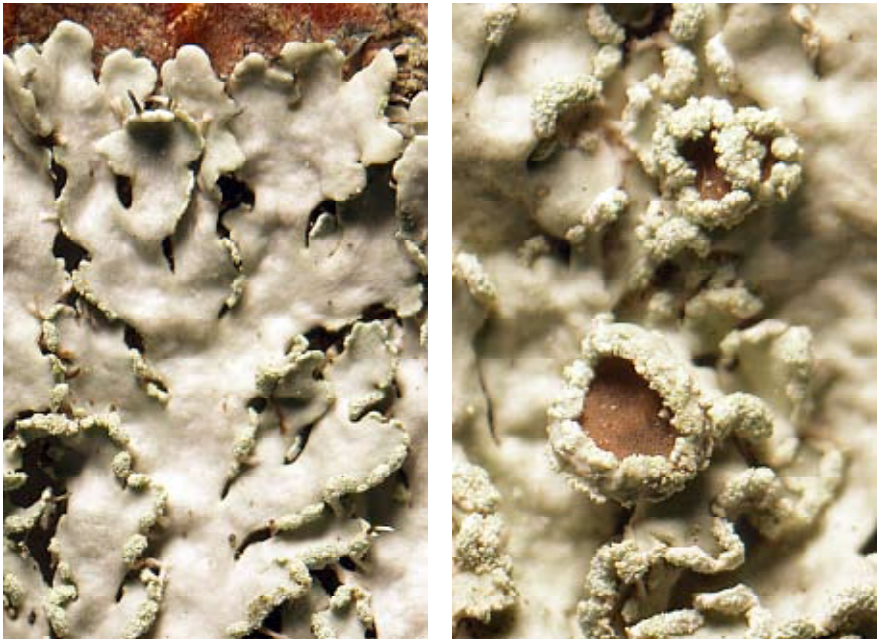
Physcia (cont'd)



Physcia jackii fertile habit (growing on orange *Xanthoria* sp.) (left), apothecia (right)
1 mm (left), 1 mm (right)

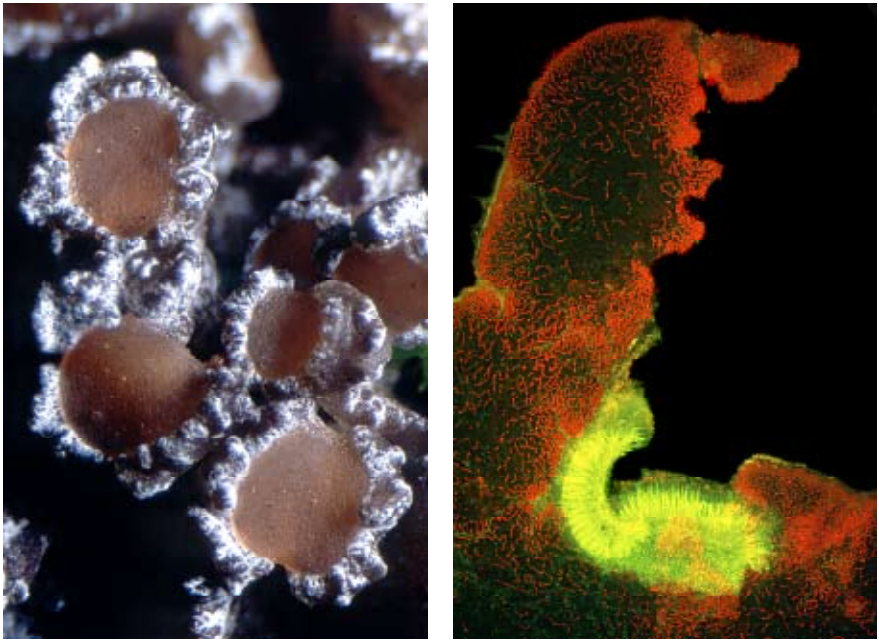


Physcia undulata habit showing sorediate margins (left), apothecia (right)
1 mm (left), 1 mm (right)

Physma A.Massal.

Physma chilense fertile habit
1 mm

species: 2 in NZ, 13 worldwide
thallus: foliose
substratum: bark, especially twigs
margin: eciliate
prothallus: none
colour: green-, brown-, or blue-grey
texture: smooth
cortex: present on both surfaces
photobiont: cyanobacterial, *Nostoc*
medulla: homoiomerous, gelatinous
ascomata: apothecia
apothecial elevation: immersed to sessile
apothecial disc: brown
exciple: thalline, maculate
propagules: none
asexual: none
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0, thick-walled
spore shape: ellipsoid to fusiform
spore colour: clear
chemistry: none



Physma chilense apothecia (left), xs (microscope UV-epifluorescent image) (right)
1 mm (left), 100 μm (right)

Pseudocyphellaria Vain.

Pseudocyphellaria homoeophylla fertile habit
1 mm

continued next page

Pseudocyphellaria (cont'd)

Pseudocyphellaria homoeophylla fertile habit
10 mm

species: 48 in NZ, 115 worldwide
thallus: foliose, loosely attached
substratum: soil, rock, bark, leaves
margin: eciliate, lobed to incised
colour: green above, pale or brown below
texture: smooth, honeycombed, or hairy above, ± tomentose below
cortex: present
photobiont: green, cyanobacterial, or both
medulla: heteromerous, white or yellow
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: brownish to reddish
exciple: thalline
propagules: isidia, soredia, or phyllidia
asexual: pycnidia
cephalodia: only in green species
pores: pseudocyphellae below in all species and above in a few
spores/ascus: 8
spore septation: 1–3
spore shape: ellipsoid
spore colour: brown
chemistry: depsides, depsidones, pulvinic acid derivatives, quinones, triterpenoids

Pseudocyphellaria homoeophylla apothecia
1 mm

Pseudocyphellaria homoeophylla
pseudocyphellae 0.5 mm (left)
cephalodium xs (dark) 100 μm (right)

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Pseudocyphellaria (cont'd)

Pseudocyphellaria crocata apothecia, yellow soredia
1 mm

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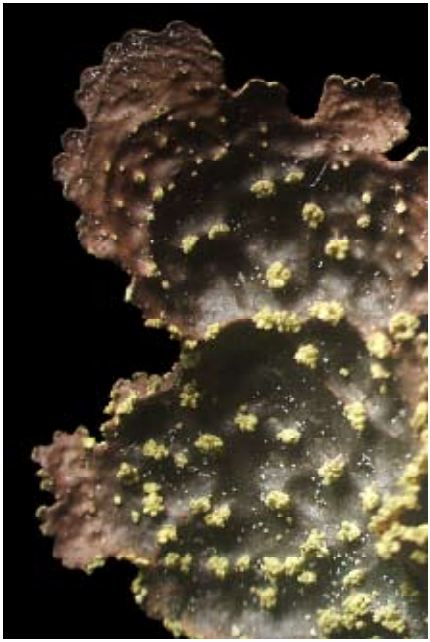
Pseudocyphellaria (cont'd)



Pseudocyphellaria crocata marginal lobes (left), soredia (right)
1 mm (left), 1 mm (right)

Pseudocyphellaria dissimilis habit (left), underside, phyllidiate margins (right)
1 mm (left), 1 mm (right)

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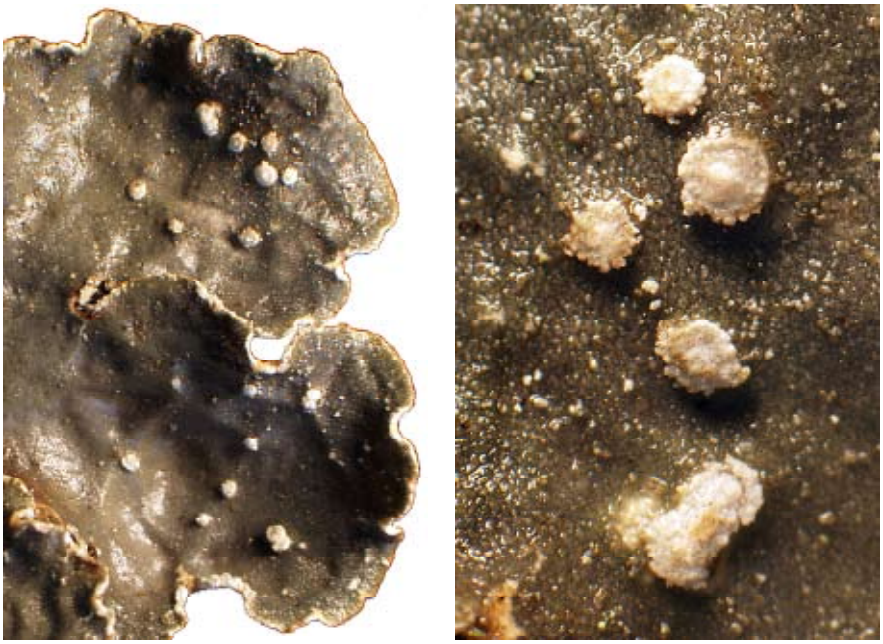
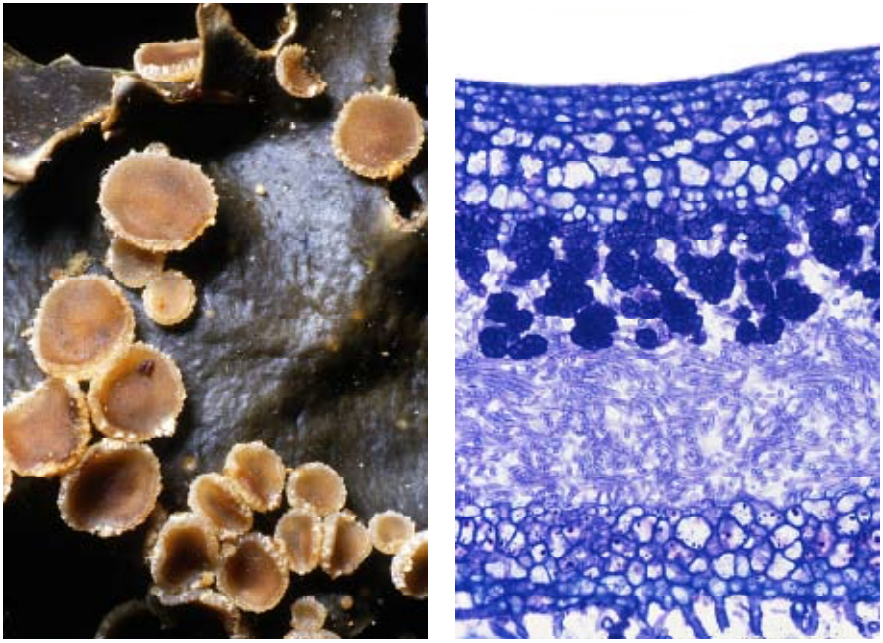
Pseudocyphellaria (cont'd)



Pseudocyphellaria intricata marginal lobe (left), soredia (right)
1 mm (left), 1 mm (right)



Pseudocyphellaria cinnamomea fertile habit (left), vertical section through thallus (right)
1 mm (left), 50 μm

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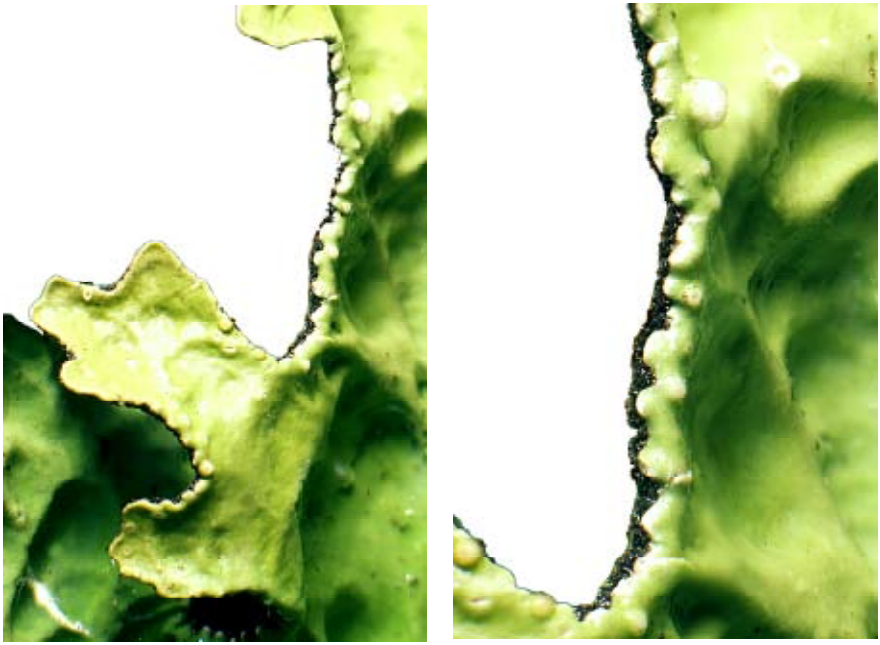
Pseudocyphellaria (cont'd)

Pseudocyphellaria faveolata fertile habit, upperside (left) and underside (right)
1 mm



Pseudocyphellaria faveolata marginal pseudocyphellae
1 mm (left), 1 mm (right)

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Pseudocyphellaria (cont'd)

Pseudocyphellaria degelii faveolate thallus, apothecia
1 mm

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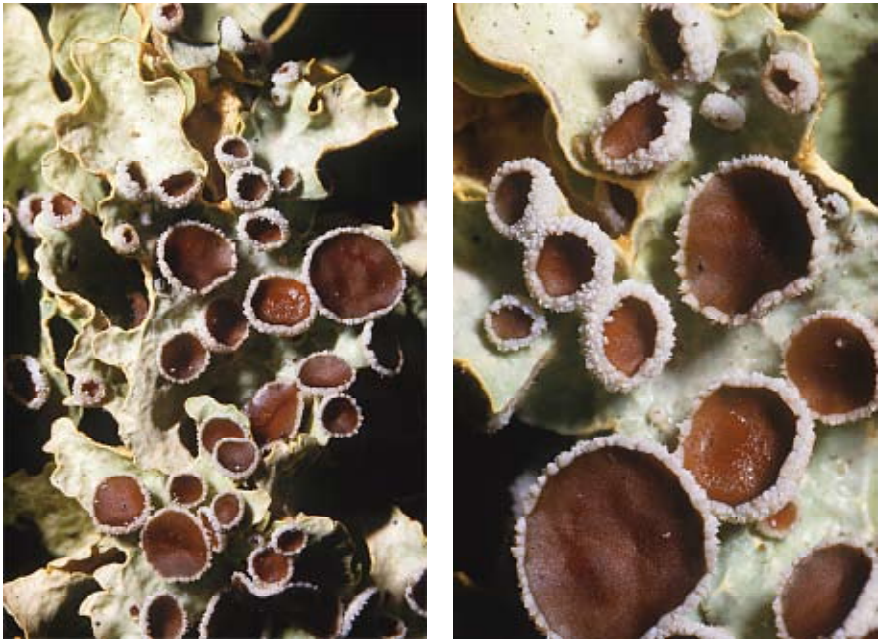
Pseudocyphellaria (cont'd)



Pseudocyphellaria degelii fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

Pseudocyphellaria episticta upperside habit, pseudocyphellae, and underside, phyllidia
1 mm (left), 1 mm (right)

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Pseudocyphellaria (cont'd)

Pseudocyphellaria rubella laminal soredia and white, pubescent hairs
0.1 mm

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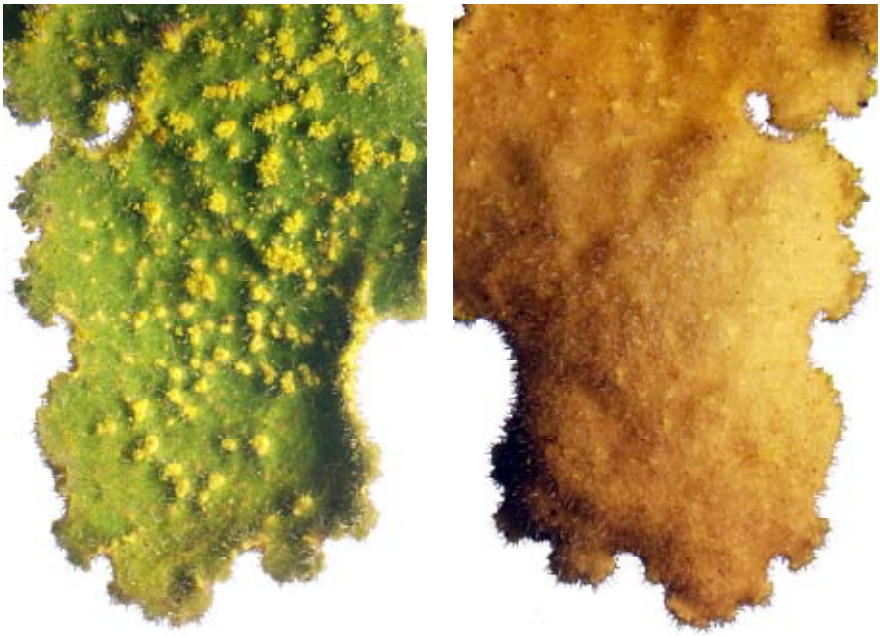
Pseudocyphellaria (cont'd)



Pseudocyphellaria rubella lobe, upperside (left) and underside (right)
1 mm

Pseudocyphellaria gretae sterile habit (left), tomentose marginal isidia (right)
1 mm (left), 1 mm (right)

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Pseudocyphellaria (cont'd)

Pseudocyphellaria rufovirescens fertile lobe
1 mm

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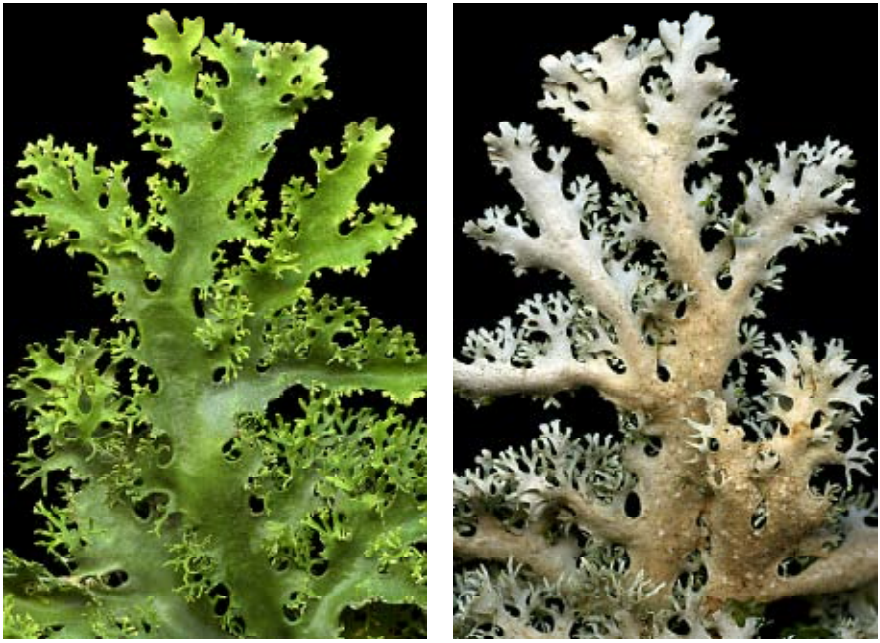
Pseudocyphellaria (cont'd)

Pseudocyphellaria rufovirescens apothecia (left), apothecia, pseudocyphellae (right)
1 mm (left), 1 mm (right)



Pseudocyphellaria multifida vegetative frond, upperside (left) and underside (right)
1 mm

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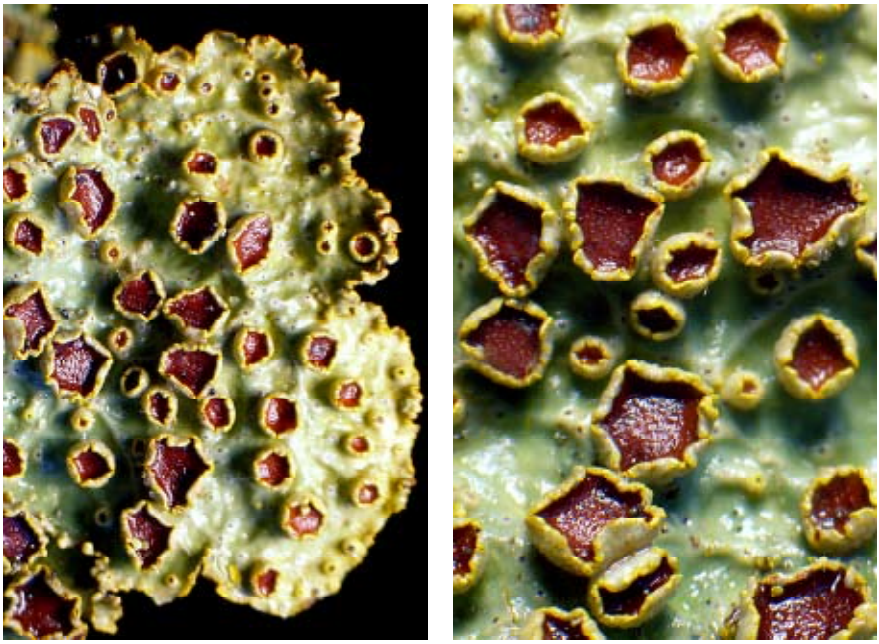
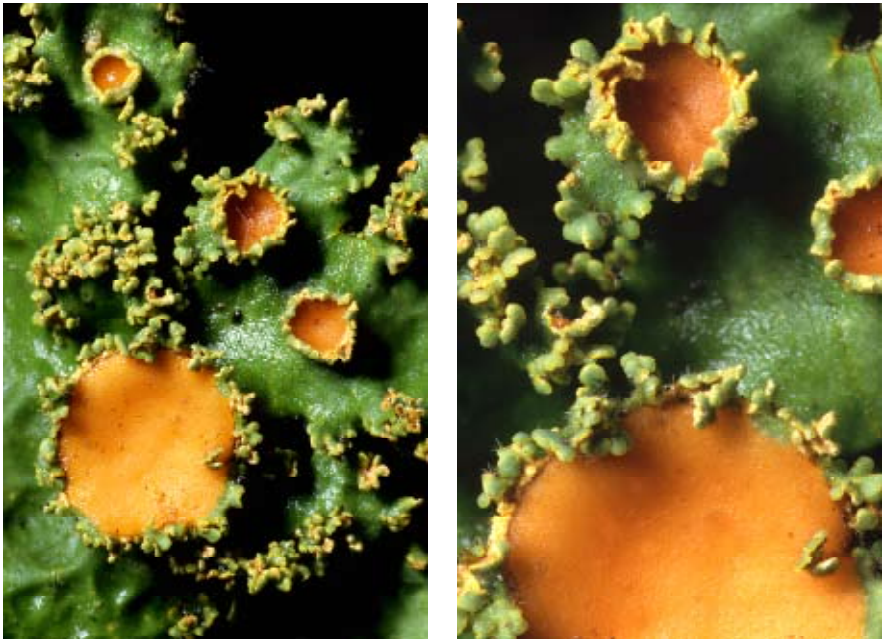
Pseudocyphellaria (cont'd)



Pseudocyphellaria coronata fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)



Pseudocyphellaria colensoi fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

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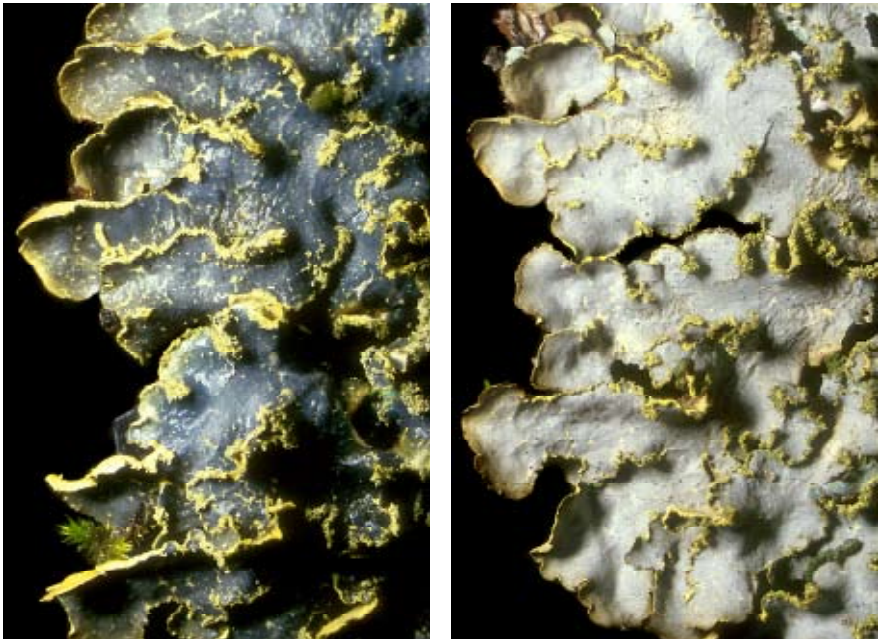
Pseudocyphellaria (cont'd)

Pseudocyphellaria maculata upperside (left), underside (right)
1 mm (left), 1 mm (right)



Pseudocyphellaria ardesiaca yellow soredia, moist (left) and dry (right)
1 mm

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Pseudocyphellaria (cont'd)

Pseudocyphellaria montagnei fertile habit
1 mm

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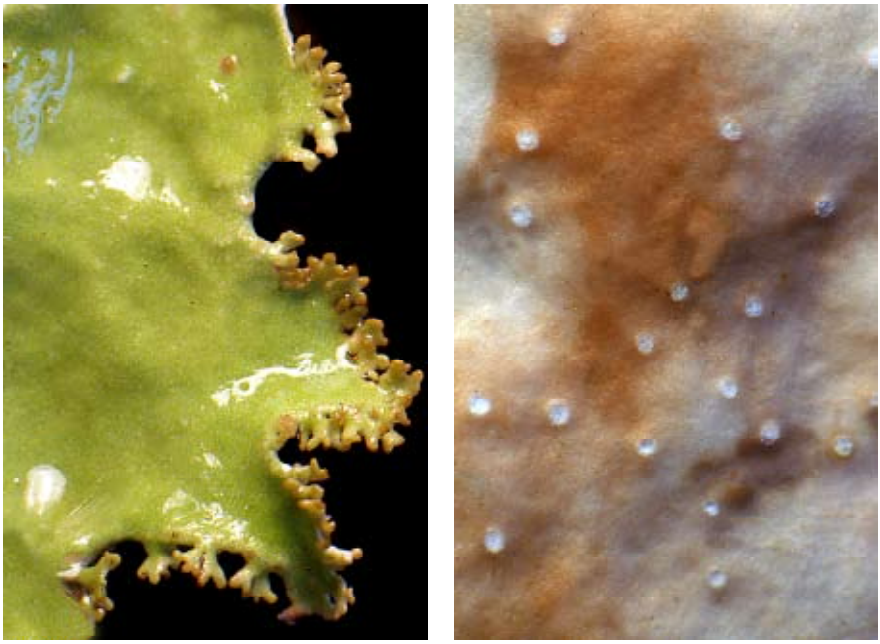
Pseudocyphellaria (cont'd)



Pseudocyphellaria montagnei phyllidiate margin (left), pseudocyphellae (right)
1 mm (left), 0.5 mm (right)

Pseudocyphellaria billardierei fertile lobe (left), underside (right)
1 mm (left), 1 mm (right)

continued next page

Pseudocyphellaria (cont'd)

Pseudocyphellaria glabra marginal lobes, isidia (left), apothecia (right)
1 mm (left), 1 mm (right)

Pseudocyphellaria pickeringii habit (left), massed phyllidia (right)
1 mm (left), 1 mm (right)

continued next page

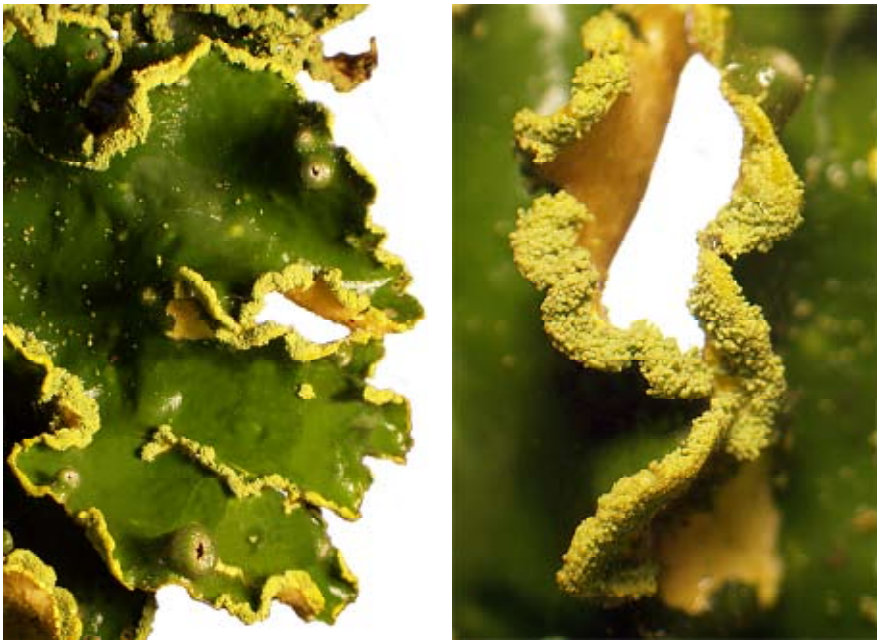
Pseudocyphellaria (cont'd)

Pseudocyphellaria fimbriata apothecia, pubescent phyllidia (left), underside (right)
1 mm (left), 1 mm (right)

Pseudocyphellaria wilkinsii pseudocyphellate upperside and isidiate-phyllidiate margin
1 mm (left), 1 mm (right)

continued next page

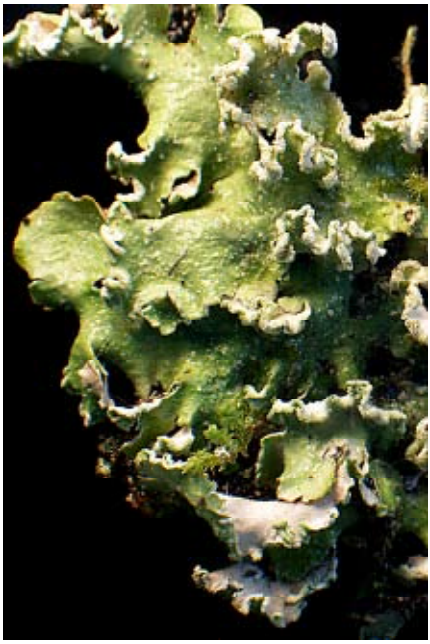
Pseudocyphellaria (cont'd)



Pseudocyphellaria poculifera marginal lobes and minutely coralloid marginal isidia
1 mm (left), 1 mm (right)

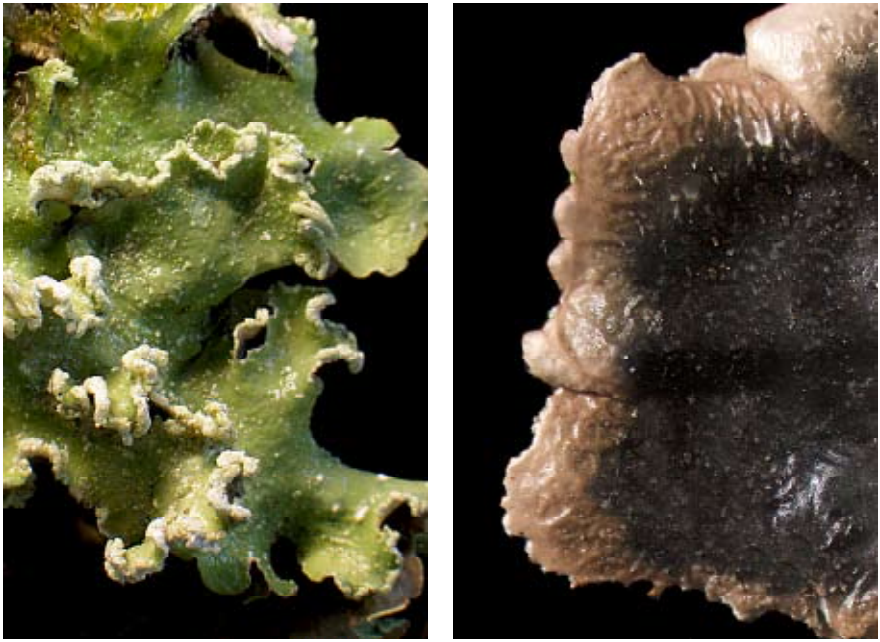
Pseudocyphellaria poculifera underside (left), pseudocyphellae and tomentum (right)
1 mm (left), 1 mm (right)

Punctelia Krog



Punctelia borreri habit
1 mm

species: 6 in NZ, 30 worldwide
thallus: foliose
substratum: bark, rock
margin: eciliate
prothallus: none
colour: grey to grey-green
texture: smooth
cortex: present, with non-pored epicortex
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: stalked
apothecial disc: pale to dark brown
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: pseudocyphellae above
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid to ± globose
spore colour: clear
chemistry: *cortex*: K– or + yellow; *medulla*: K–, C+ rose, KC+ red, Pd–; *cortex*: chloroatranorin; atranorin; *medulla*: gyrophoric, lecanoric, and orsellinic acids; cell walls containing isolichenan



Punctelia borreri soredia, punctate white pseudocyphellae (left), underside (right)
1 mm (left), 1 mm (right)

continued next page

Punctelia (cont'd)

Punctelia subrudecta young rosette (left), soredia (right)
1 mm (left), 1 mm (right)

Punctelia subrudecta marginal lobes and soredia wet (left), dry (right)
1 mm (left), 1 mm (right)

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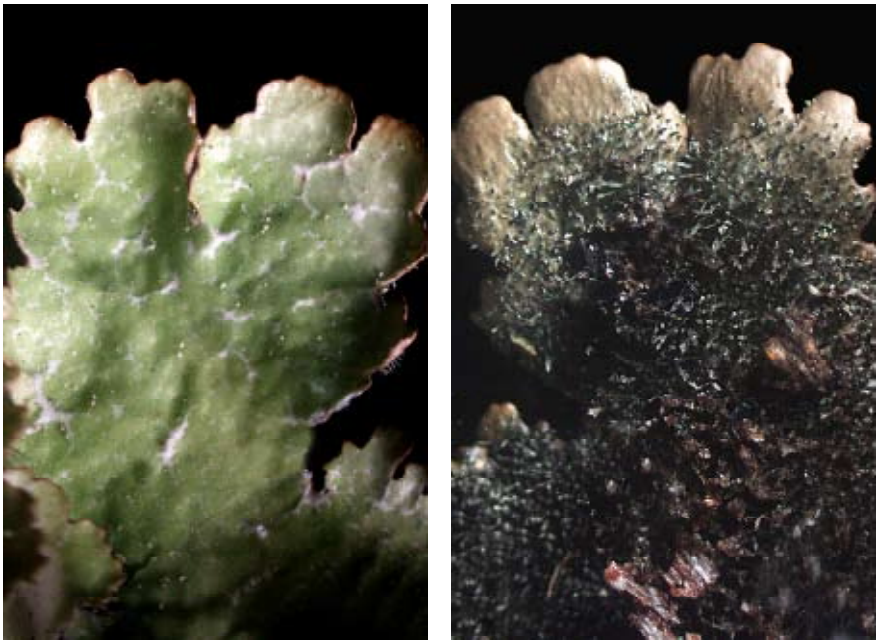
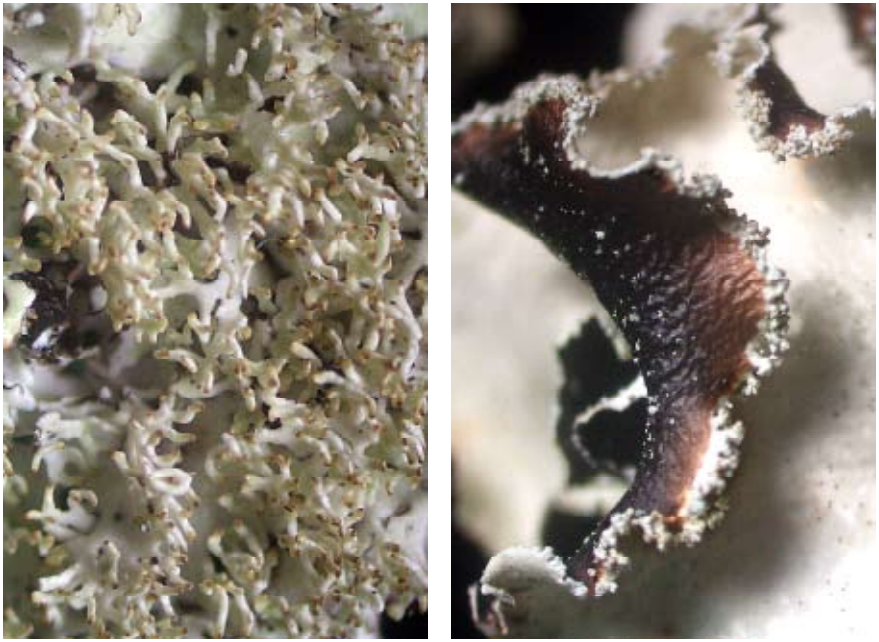
Punctelia (cont'd)



Punctelia novozelandica pale maculae, upperside (left), rhizines, underside (right)
1 mm



Punctelia novozelandica dense laminal coralloid isidia (left), marginal isidia (right)
1 mm (left), 1 mm (right)

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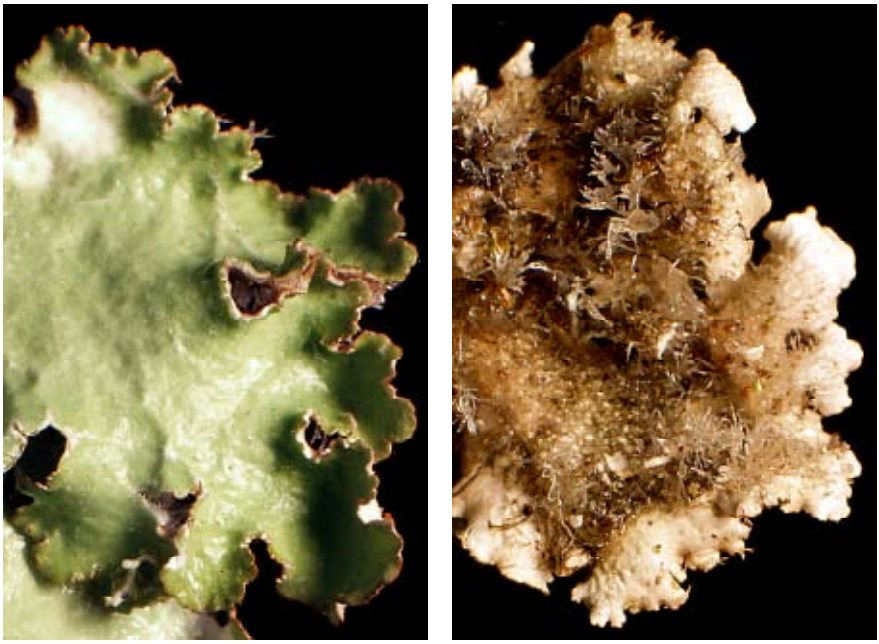
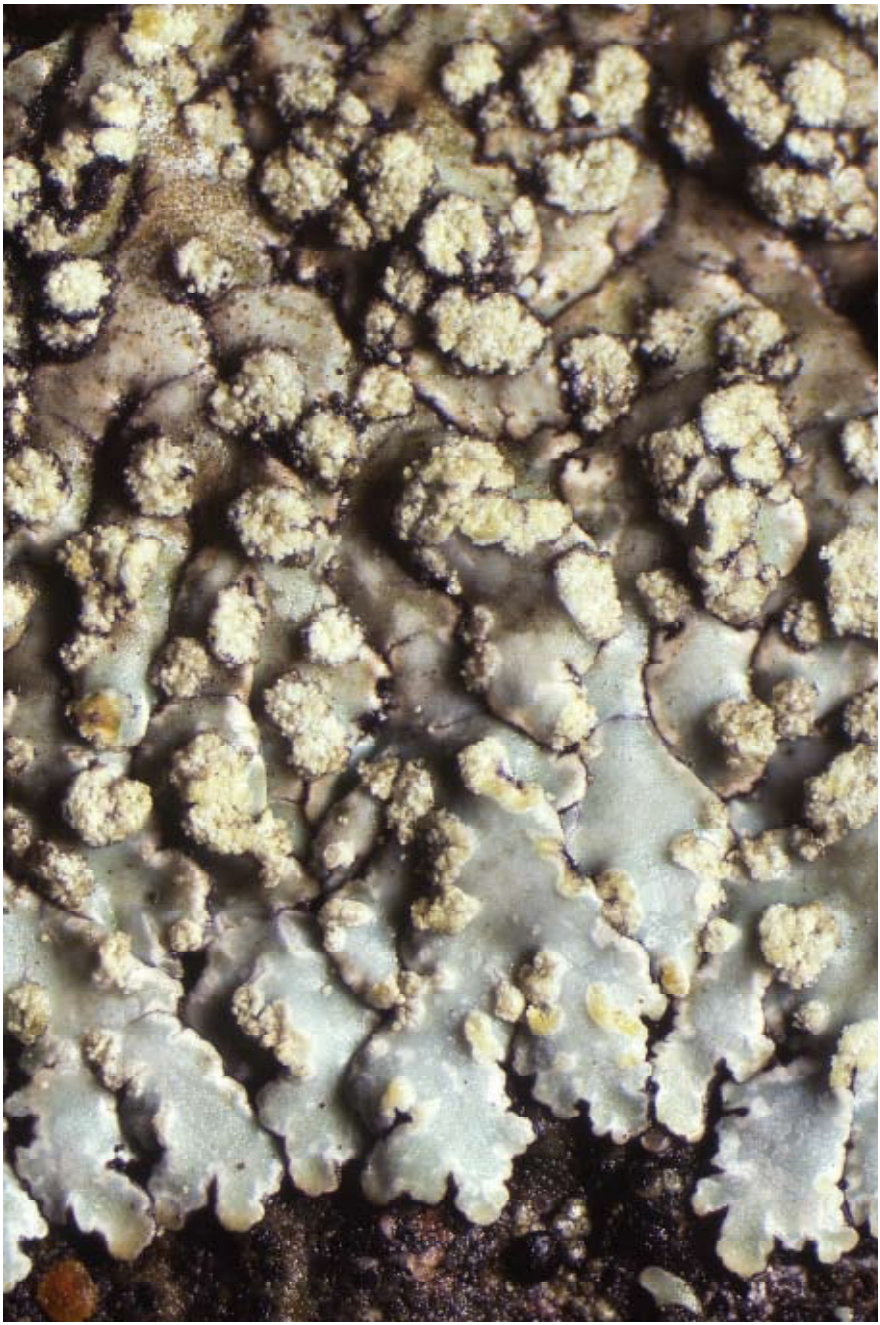
Punctelia (cont'd)



Punctelia subflava upperside (left), underside (right)
1 mm

Punctelia subflava dense dorsiventrally flattened isidia (left), rhizines (right)
1 mm (left), 1 mm (right)

Pyxine Fr.



Pyxine subcinerea habit
1 mm

continued next page

Pyxine (cont'd)

Pyxine subcinerea soredia
1 mm

Pyxine subcinerea marginal lobes
1 mm

species: 2 in NZ, 60 worldwide
thallus: foliose
substratum: bark, rock
margin: eciliate, ± pseudocyphellate
prothallus: none
colour: whitish to green- or brown-grey
texture: smooth, ± pruinose
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white or yellow
ascomata: apothecia, absent in NZ species
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: marginal pseudocyphellae
chemistry: *cortex*: UV+ yellow; *medulla*: K–, C–, KC–, Pd–; *cortex*: lichexanthone

Siphula Fr.

Siphula decumbens
1 mm

continued next page

Siphula (cont'd)

Siphula decumbens
1 mm

species: 6 in NZ, 25 worldwide
thallus: foliose to fruticose
substratum: soil, bryophytes
margin: eciliate, entire
prothallus: none
colour: whitish to green- or blue-grey
texture: scabrid
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: none
propagules: none
asexual: none
cephalodia: none
pores: none
chemistry: *cortex*: K– or + yellow or purple, C–, KC–, Pd– or + yellow-orange; *medulla*: K– or + purple, C–, KC–, Pd–; thamnolic, hypothamnolic, baeomycesic, squamatic, and barbatic acids

Siphula decumbens upperside (left), underside (right)
1 mm

continued next page

Siphula (cont'd)

Siphula dissoluta
1 mm

continued next page

Siphula (cont'd)

Siphula dissoluta habit
1 mm (left), 1 mm (right)

Siphula dissoluta underside (above), upperside (below), underground rhizomorphs (left)
1 mm

continued next page

Siphula (cont'd)

Siphula dissoluta habit (variant in humid, shaded sites)
1 mm

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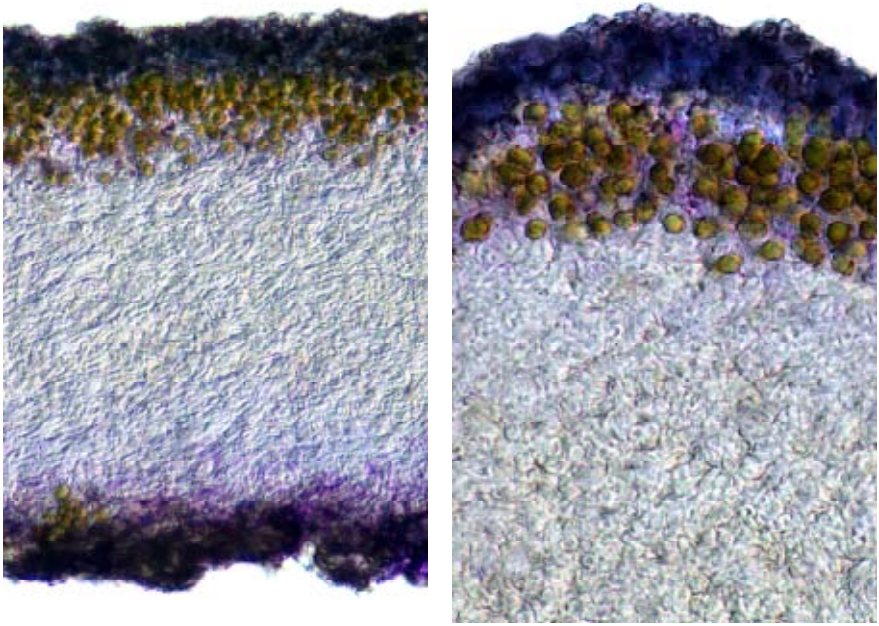
Siphula (cont'd)

Siphula dissoluta upperside (left), underside (right)
1 mm



Siphula dissoluta lobe cross-sections
50 μm (left), 50 μm (right)

Solorina Ach.

Solorina crocea habit
1 mm

Solorina crocea habit
1 mm

species: 2 in NZ, 10 worldwide
thallus: foliose
substratum: soil
margin: eciliate, entire
prothallus: none
colour: green to grey-green
texture: smooth to scabrid
cortex: present on both surfaces
photobiont: green and cyanobacterial, *Nostoc*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: ± immersed
apothecial disc: red-brown
exciple: proper only
propagules: none
asexual: none
cephalodia: external or internal
pores: none
spores/ascus: 4 or 8
spore septation: 1
spore shape: ellipsoid to fusiform
spore colour: brown
chemistry: K+ purple; gyrophoric, solorinic, and norsolorinic acids

Steinera Zahlbr.

Steinera sorediata habit overrunning moss
1 mm

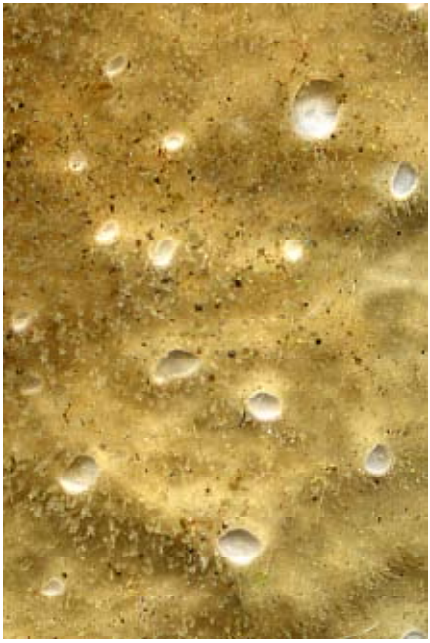
Steinera sorediata marginal lobes
1 mm

species: 4 in NZ, 4 worldwide
thallus: placodioid to foliose
substratum: soil, bryophytes, rock
margin: eciliate, lobate
prothallus: none
colour: grey to olive-brown
texture: scabrid
cortex: upperside only
photobiont: cyanobacterial, *Nostoc*
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: immersed to sessile
apothecial disc: brown to red-brown
exciple: proper only
propagules: soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 3–7
spore shape: subglobose to fusiform
spore colour: clear
chemistry: none

Sticta (Schreb.) Ach.

Sticta fuliginosa upperside
1 mm

species: 14 in NZ, 105 worldwide
thallus: foliose, ± stalked
substratum: bark, rock
margin: eciliate, lobate to rounded
prothallus: none
colour: green to dark brown
texture: smooth to wrinkled
cortex: present above and below
photobiont: chlorococcoid or cyanobacterial
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: pale, reddish, or brown
exciple: thalline
propagules: isidia, soredia, phyllidia
asexual: pycnidia
cephalodia: internal in the green species
pores: cyphellae below
spores/ascus: 8
spore septation: 1–3(–7)
spore shape: fusiform to ellipsoid
spore colour: hyaline to pale brown
chemistry: none



Sticta fuliginosa underside (left), cyphellae (right)
1 mm (left), 1 mm (right)

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Sticta (cont'd)

Sticta filix upperside (left), underside (right)
1 mm (left), 1 mm (right)

Sticta filix young apothecia (left), phyllidiate apothecial rims (right)
1 mm (left), 1 mm (right)

continued next page

Sticta (cont'd)

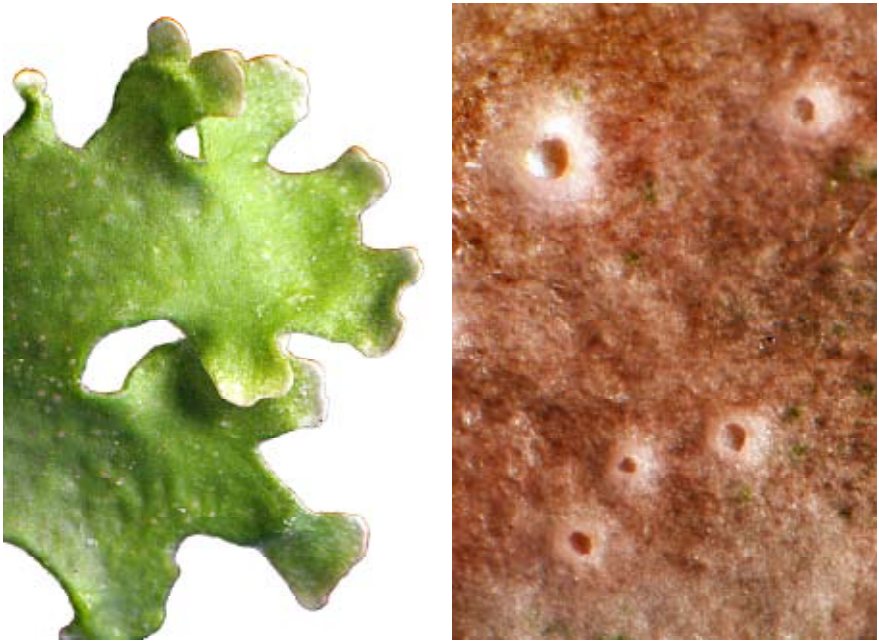
Sticta latifrons habit with stalk and holdfast (left), cyphellae (right)
10 mm (left), 1 mm (right)

Sticta latifrons apothecia
1 mm (left), 1 mm (right)

continued next page

Sticta (cont'd)

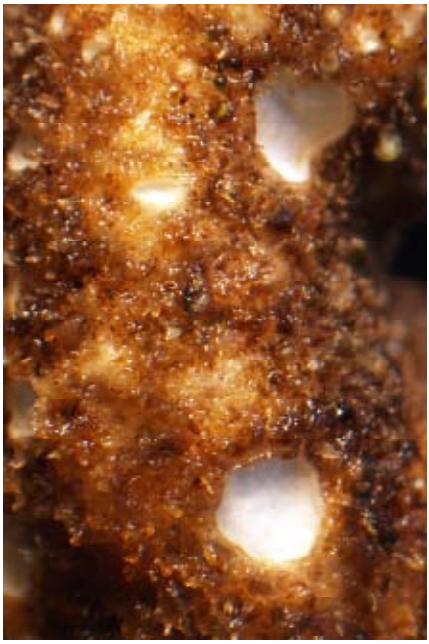
Sticta martinii upperside (left), lobulate phyllidiate margins, underside (right)
1 mm (left), 1 mm (right)



Sticta martinii lobes (left), cyphellae in felted tomentum (right)
0.5 mm (left), 1 mm (right)

continued next page

Sticta (cont'd)

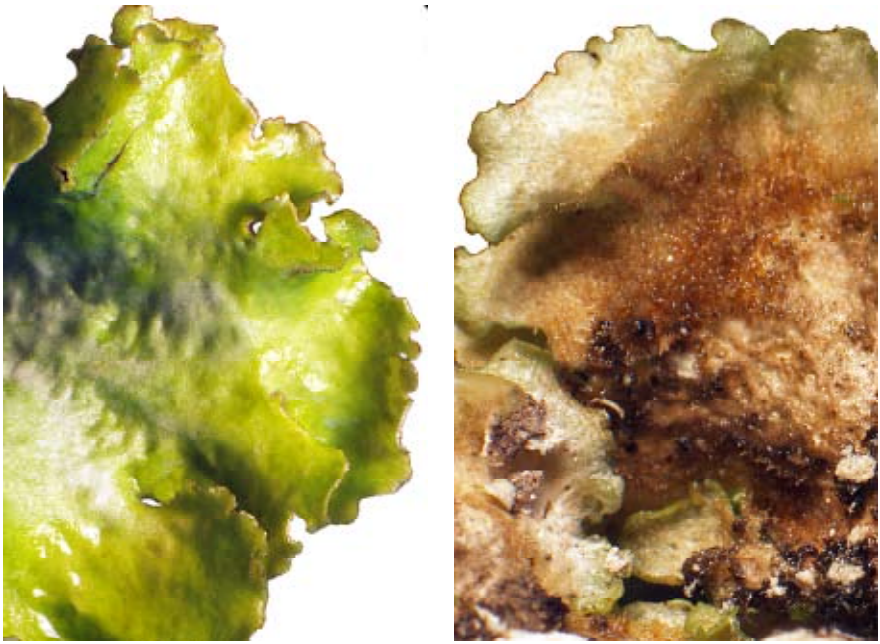


Sticta cinereoglauca apothecia (left), cyphellae (right)
1 mm (left), 1 mm (right)

Sticta lacera ultimate lobes (left), cyphellae in smooth underside (right)
1 mm (left), 0.1 mm (right)

continued next page

Sticta (cont'd)



Sticta squamata upperside (left), underside (right)
1 mm

Sticta colinii upperside (left), cyphellae (right)
1 mm (left), 0.1 mm (right)

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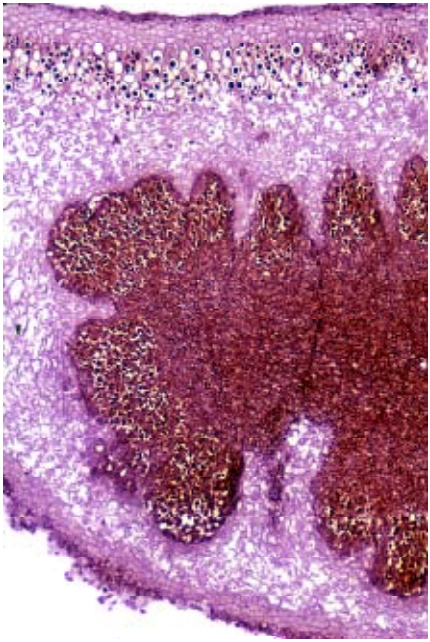
Sticta (cont'd)

Sticta subcaperata apothecia (left), underside (right)
1 mm (left), 1 mm (right)



Sticta subcaperata cyphella xs (left), internal cephalodium xs (right)
100 μm (left), 100 μm (right)

continued next page

Sticta (cont'd)

Sticta babingtonii lobes with marginal phyllidia
1 mm (left), 1 mm (right)

Sticta babingtonii marginal phyllidia, underside and cyphellae
1 mm (left), 1 mm (right)

Teloschistes Norman

Teloschistes chrysophthalmus fertile habit
1 mm

continued next page

Teloschistes (cont'd)

Teloschistes chrysophthalmus fertile habit
1 mm

species: 7 in NZ, 22 worldwide
thallus: foliose to fruticose
substratum: bark, rock
margin: ciliate or eciliate
prothallus: none
colour: yellow to orange
texture: smooth
cortex: present above and below
photobiont: trebouxioid
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: yellow to deep orange
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1 (polarilocular)
spore shape: ellipsoid
spore colour: hyaline
chemistry: K+ purple; parietin

Teloschistes chrysophthalmus apothecia
1 mm (left), 1 mm (right)

continued next page

Teloschistes (cont'd)

Teloschistes sieberianus fertile habit
1 mm (left), 1 mm (right)

Teloschistes velifer habit on twigs
1 mm (left), 1 mm (right)

Tuckermanopsis Gyeln.

species: 1 in NZ, 10 worldwide
thallus: foliose
substratum: bark
margin: ciliate, wavy to incised
prothallus: none
colour: olive-green
texture: smooth to wrinkled
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia, absent in NZ species
propagules: soredia (marginal)
asexual: pycnidia
cephalodia: none
pores: none
chemistry: *medulla*: K–, C–, KC–, Pd–; protolichesterinic acid

no illustrations

Umbilicaria Hoffm.

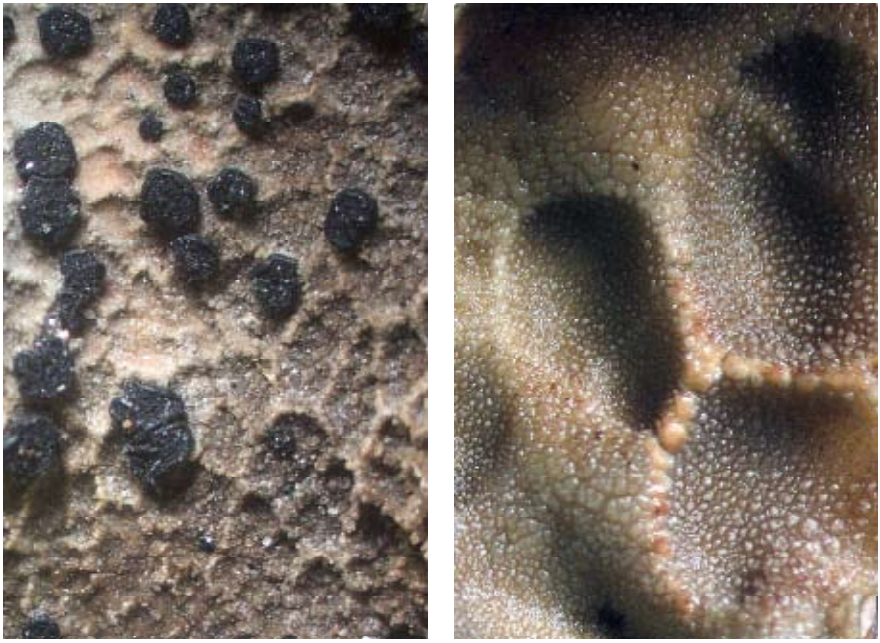
Umbilicaria cylindrica gyrose (concentrically ridged) apothecia
1 mm

continued next page

Umbilicaria (cont'd)

Umbilicaria cylindrica rhizines
1 mm

species: 17 in NZ, 70 worldwide
thallus: peltate-foliose
substratum: rock
margin: ciliate or eciliate
prothallus: none
colour: grey to brown
texture: smooth to reticulate
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to stalked
apothecial disc: black, ± gyrose
exciple: proper only
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: none in some species; K– or + yellow → red, C– or + red, KC–, Pd–; gyrophoric, lecanoric, ovoic, umbilicaric, and norstictic acids

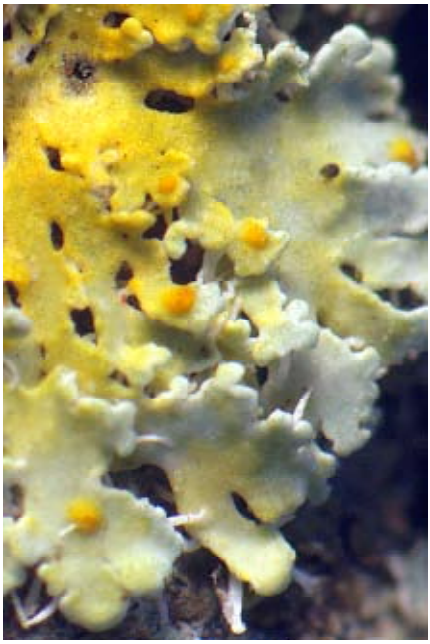


Umbilicaria krascheninnikovii upperside, dry (left), faveolate upper surface, moist (right)
1 mm (left), 1 mm (right)

Xanthomendoza Kondratyuk & Kärnefelt

species: 1 in NZ, 20 worldwide
thallus: foliose
substratum: bark
margin: eciliate
prothallus: none
colour: yellow, yellow-green, or grey-green
texture: smooth
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: stalked
apothecial disc: orange
exciple: thalline
propagules: none
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1 (polarilocular)
spore shape: ellipsoid
spore colour: clear
chemistry: *cortex*: K+ purple; parietin, teloschistin, fallacinal, parietinic acid

Xanthomendoza novozelandica habit
1 mm

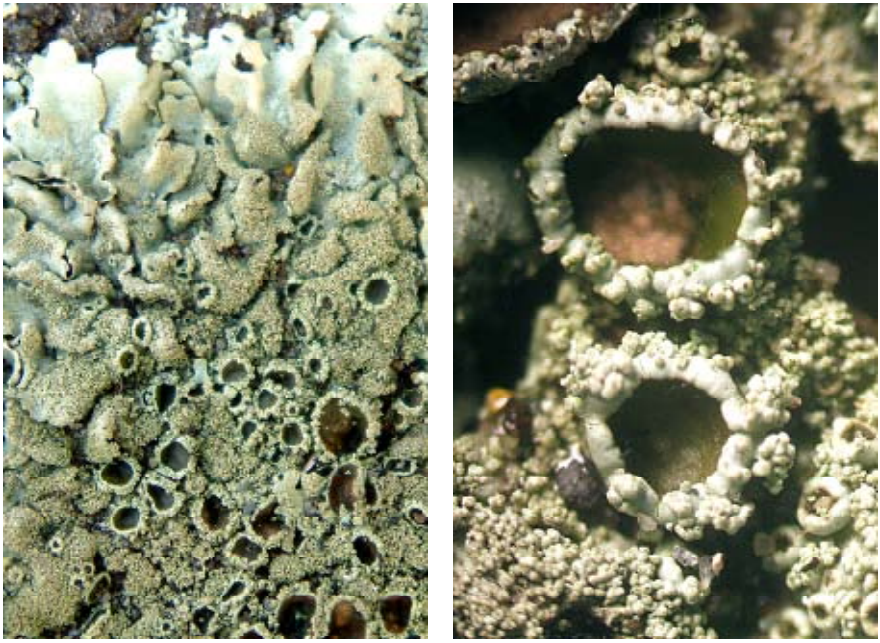


Xanthomendoza novozelandica apothecium (left), lobes, rhizines (right)
1 mm (left), 1 mm (right)

Xanthoparmelia (Vain.) Hale

Xanthoparmelia scabrosa on carpark bitumen
10 mm

species: 81 in NZ, > 400 worldwide
thallus: subcrustose, foliose, subfruticose
substratum: rock, bark, man-made
margin: eciliate, lobed to incised
prothallus: none
colour: yellow-green, grey-green, brown
texture: smooth to wrinkled or cracked
cortex: present, with pored epicortex
photobiont: green
medulla: heteromerous, white or variously pigmented
ascomata: apothecia
apothecial elevation: sessile or ± stalked
apothecial disc: red, brown, or black
exciple: thalline
propagules: isidia, soredia
asexual: pycnidia
cephalodia: none
pores: pseudocyphellae beneath
spores/ascus: 8
spore septation: 0
spore shape: ellipsoid
spore colour: clear
chemistry: usnic or isousnic acid in cortex, *Xanthoparmelia*-type lichenan in walls, ± diverse medullary chemistry



Xanthoparmelia scabrosa apothecia, isidia (left), isidiate thalline exciple (right)
10 mm (left), 1 mm (right)

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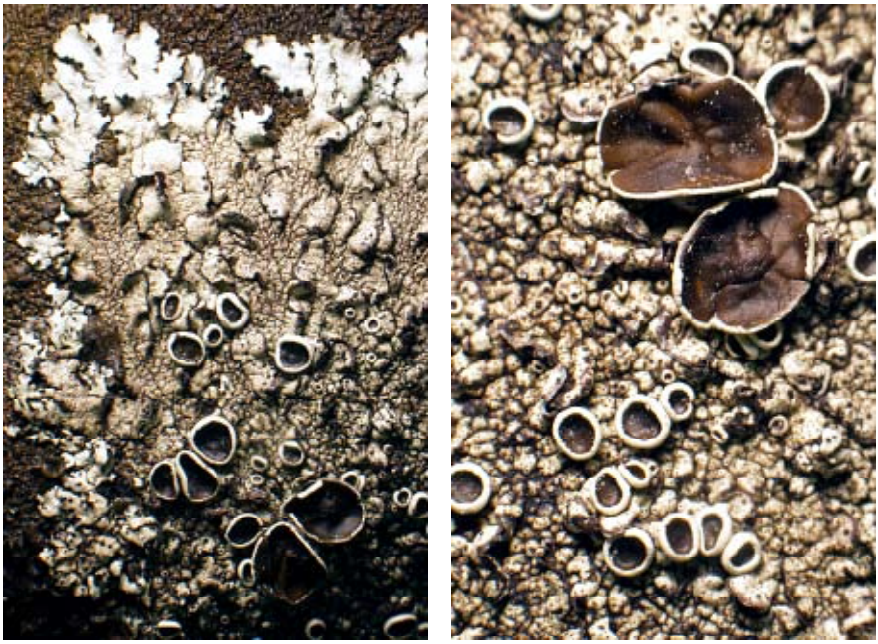
Xanthoparmelia (cont'd)



Xanthoparmelia oleosa fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

Xanthoparmelia semiviridis habit moist (left) and dry (right)
1 mm

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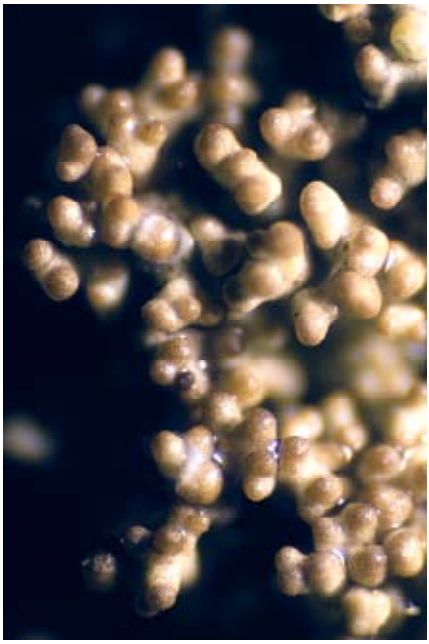
Xanthoparmelia (cont'd)

Xanthoparmelia pulla habit (left), marginal lobes (right)
1 mm (left), 1 mm (right)

Xanthoparmelia amplexula marginal lobes (left), apothecia (right)
5 mm (left), 1 mm (right)

continued next page

Xanthoparmelia (cont'd)



Xanthoparmelia australasica apothecia (left), massed isidia (right)
1 mm (left), 0.1 mm (right)

Xanthoparmelia mougeotina moist (left), dry (right)
1 mm

continued next page

Xanthoparmelia (cont'd)

Xanthoparmelia molliuscula massed lobules of central thallus
1 mm (left), 1 mm (right)

Xanthoparmelia digitiformis lobe (left), apothecia (right)
1 mm (left), 1 mm (right)

continued next page

Xanthoparmelia (cont'd)

Xanthoparmelia substrigosa marginal lobe (left), apothecia (right)
1 mm (left), 5 mm (right)

Xanthoparmelia sorediata habit (moist fragment), upperside (left), underside (right)
1 mm

continued next page

Xanthoparmelia (cont'd)

Xanthoparmelia luteonotata fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

Xanthoparmelia adpicta fertile habit (left), apothecia (right)
1 mm (left), 1 mm (right)

continued next page

Xanthoparmelia (cont'd)

Xanthoparmelia flavescentireagens habit (moist)
1 mm (left), 1 mm (right)

Xanthoparmelia isidiigera habit (left), isidia (right)
1 mm (left), 0.1 mm (right)

continued next page

Xanthoparmelia (cont'd)

Xanthoparmelia furcata habit
1 mm (left), 1 mm (right)

Xanthoparmelia furcata terminal lobes, upperside (left), underside (right)
1 mm

Xanthoria (Fr.) Th.Fr.

Xanthoria ligulata habit
1 mm

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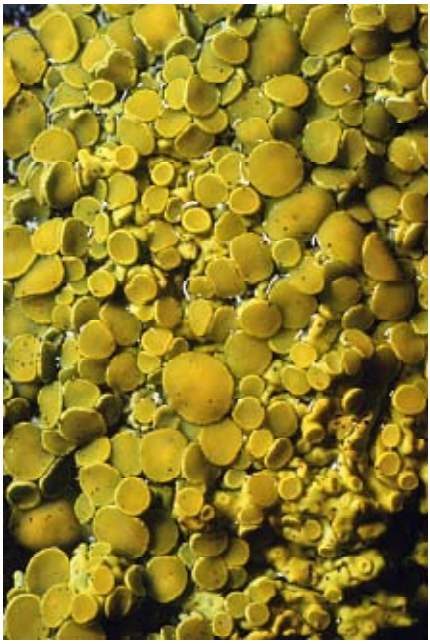
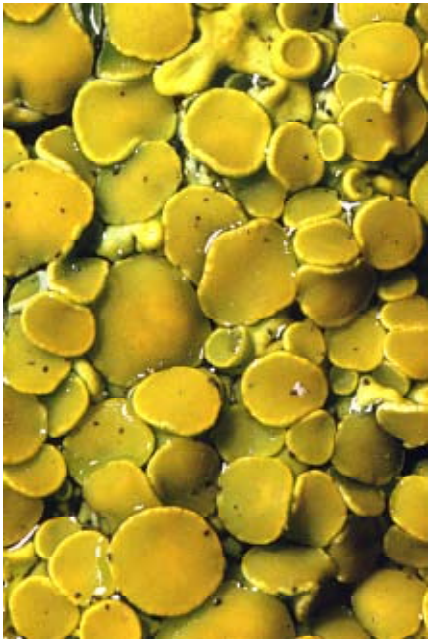
Xanthoria (cont'd)



Xanthoria ligulata habit, shade form
1 mm



Xanthoria ligulata apothecia
1 mm

species: 6 in NZ, 30 worldwide
thallus: foliose to subfruticose
substratum: rock, bark, man-made
margin: ± branched
prothallus: none
colour: yellow to red, ± grey in shade
texture: smooth to wrinkled
cortex: present on both surfaces
photobiont: green
medulla: heteromerous, white
ascomata: apothecia
apothecial elevation: sessile to ± stalked
apothecial disc: yellow, orange, or red
exciple: thalline
propagules: soredia, isidia in some species
asexual: pycnidia
cephalodia: none
pores: none
spores/ascus: 8
spore septation: 1, polarilocular
spore shape: ellipsoid
spore colour: clear
chemistry: K+ red-purple; anthroquinones

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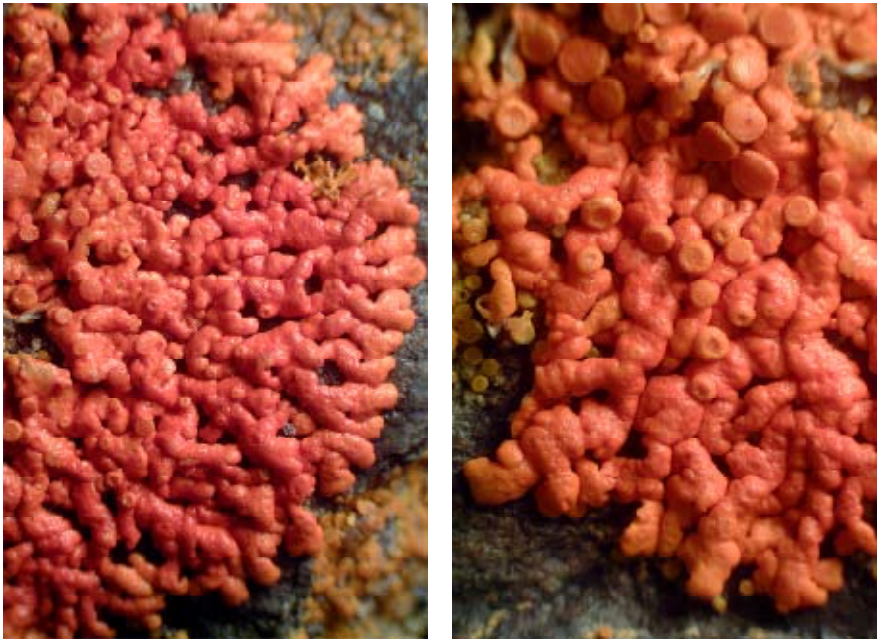
Xanthoria (cont'd)

Xanthoria parietina habit (left), apothecia (right)
5 mm (left), 1 mm (right)



Xanthoria elegans habit (left), apothecia (right)
1 mm (left), 1 mm (right)

continued next page

Xanthoria (cont'd)

Xanthoria polycarpa habit (left), apothecia, marginal lobes (right)
1 mm (left), 1 mm (right)

glossary

anticlinal — oriented perpendicular to the surface (*compare with* **periclinal**, oriented parallel to the surface). The look-alike genera *Physcia* and *Heterodermia* can be separated by the different orientation of hyphae on their uppersides—anticlinal in *Physcia* (hence appearing cellular when viewed under a microscope) and periclinal in *Heterodermia* (hence appearing fibrous under a microscope).

apex (plural **apices**) — the tip or unattached end of a structure.

apiculate — ending abruptly in a short point.

apothecium (plural **apothecia**) — a type of spore-producing body of an Ascomycota fungus. It can be sessile or stalked and variously shaped, for example round in *Lecanora* or elongate in *Graphis*. The fertile portion (called a hymenium) is exposed when the spores are mature (*compare with* **perithecium**, a type of spore-producing body of an Ascomycota fungus that's flask-shaped and closed at the top except for a tiny pore).

ascomata — a spore-producing structure of the Ascomycota fungi.

ascospore — a spore produced inside an ascus.

ascus (plural **asci**) — in the Ascomycota fungi, a sac-like cell that produces ascospores sexually.

atranorin — a secondary metabolite of lichen-forming fungi, responsible for the greyish colour of many species in the families Parmeliaceae (the genera *Canoparmelia, Cetrelia, Everniastrum, Hypotrachyna, Menegazzia, Parmelia, Parmelina, Parmelinopsis, Parmotrema,* and *Punctelia*) and Physciaceae (*Dirinaria, Heterodermia,* and *Physcia*).

bacillar (or **bacilliform**) — shaped like a rod with rounded ends.

bifusiform — narrowed at both ends *and* in the middle (*compare with* **fusiform**, spindle-like, narrowed at both ends).

cartilaginous — firm and tough.

cephalodium (plural **cephalodia**) — in a lichen with a green algal photobiont, a part of the thallus containing a cyanobacterium. It can be on the surface of the thallus (usually the upperside) or inside, and variously shaped, but in section it often resembles a vertebrate brain.

cilium (plural **cilia**, adjective **ciliate**) — a long, tapering, hair-like cluster of parallel and fused hyphae on a lichen's upperside or margin, usually pigmented but sometimes colourless (hyaline) (*compare with* **rhizine**, a root-like cluster of hyphae on a lichen's underside and adapted for attaching the thallus to its substratum, and **rhizohypha**, a single hypha adapted for attaching the thallus to its substratum).

conidium (plural **conidia**) — a type of asexual fungal spore, in lichens typically produced inside flask-shaped pycnidia.

cortex (plural **cortices**, adjective **corticate**) — in lichens, a dense outermost layer that usually covers the exposed surface(s) of a thallus. Fruticose lichens, even if they're flattened top to bottom, typically have a continuous cortex covering their surface. Most foliose lichens do, too, but species of *Collema* have no cortex at all, and species of a notable few other genera lack a cortex on their lower surface, among them *Peltigera, Icmadophila*, most species of *Heterodermia,* and some species of *Leioderma, Pannaria, Physcia,* and *Physma.* Very few crustose lichens have a cortex on their lower surface.

crustose — crust-like, one of the three main growth forms of lichens (*compare with* **foliose**, leaf-like, and **fruticose**, shrub-like).

cyanobacteria (singular **cyanobacterium**, adjective **cyanobacterial**) — a group of photosynthetic bacteria formerly called blue-green algae. Species of cyanobacteria that live as photobionts in lichens are called **cyanobionts**. Most belong to the genera *Nostoc, Scytonema, Spilonema,* and *Gloeocapsa*. They usually colour the lichen surface bluish grey, dark brown, or black, and typically can fix nitrogen.

cyphella (plural **cyphellae**) — a cup-like depression in the underside of a thallus (as in all *Sticta* species). It exposes the medullary hyphae, but they don't protrude because the depression is lined with dense hyphae (*compare with* **pseudocyphella**, a break in the upper or lower cortex of a thallus. It exposes the medullary hyphae, which protrude because the break is not lined with dense hyphae).

ecorticate — lacking a cortex (*the opposite of* **corticate**, having a cortex).
effigurate — forming a complex, irregular pattern.
epicortex — a thin homogeneous layer overlying the cellular cortex and made up of polysaccharides, sometimes minutely pored and then called a pored epicortex.
exciple — the rim of sterile tissue surrounding the spore-producing hymenium and hypothecium of a spore body (*see* **proper exciple** and **thalline exciple**).
faveolate — honeycombed, with depressions separated by a network of ridges.
fertile — reproducing sexually (*the opposite of* **sterile**, not reproducing sexually).
filiform — thread-like.
foliose — leaf-like, one of the three main growth forms of lichens (*compare with* **crustose**, crust-like, and **fruticose**, shrub-like).
fruticose — shrub-like, one of the three main growth forms of lichens (*compare with* **crustose**, crust-like, and **foliose**, leaf-like).
fusiform — spindle-like, narrowed at both ends (*compare with* **bifusiform**, narrowed at both ends *and* in the middle).
glabrous — smooth, without hairs.
gyrose — concentrically ridged or folded.
heteromerous — a thallus anatomy in which the photobiont and mycobiont are arranged in distinct layers (*compare with* **homoiomerous**, a thallus anatomy in which the photobiont and mycobiont are intermixed).
holdfast — a stalk-like structure that anchors a thallus at a single point.
homoiomerous — a thallus anatomy in which the photobiont and mycobiont are intermixed (*compare with* **heteromerous**, a thallus anatomy in which the photobiont and mycobiont are arranged in distinct layers).
hypha (plural **hyphae**, adjective **hyphal**) — a single fungal filament.
hypothallus (plural **hypothalli**) — a layer of woolly and often dark hyphae beneath or at the margin of a thallus. It typically lacks photobiont cells.
immersed — embedded in the thallus or substratum.
incised — cut or torn, usually at the margin.
iodine colour reaction — a colour change (usually blue, purple, or red) caused by iodine reacting with amyloid portions of an ascus, best seen after pretreatment with KOH.
isidium (plural **isidia**, adjective **isidiate**) — a lichen propagule containing both fungal hyphae and photobiont cells, and covered with a cortex. It grows out of the parent lichen's cortex and can be variously shaped (simple or branched, warty, scaly, cylindrical, club-shaped, or coral-like) (*compare with* **soredium**, a lichen propagule that contains both fungal hyphae and photobiont cells but is not covered by a cortex, and **phyllidium**, a small, lobe- or leaf-like propagule formed on the upper surface or margin of a thallus that contains photobiont cells, has a distinct upper and lower cortex, is flattened, often constricted at the base, and readily drops off).
laminal — on the upper surface.
lichexanthone — a secondary metabolite synthesized by some lichens.
lignum — wood that has lost its bark in the first stage of rotting.
linear — long and narrow, with ± parallel margins.
lobe — a rounded projection on the edge or surface of a larger structure.
lobule — a small lobe.
marginal — along the edge of a structure, for example a lobe or thallus.
mazaedium (plural **mazaedia**) — a dry, loose, powdery, and often dark mass of spores and sterile hyphae that forms on the fruiting bodies of some lichens, notably species of the Caliciales.
medulla — in a heteromerous thallus, a layer of loose hyphae below the upper cortex and photobiont layers.
moniliform — resembling a string of beads (see *Pannoparmelia*).
muriform — (of a spore) having both transverse and longitudinal or oblique septa (cross-walls).
norstictic acid — a β-orcinol depsidone synthesized by many lichens, among them foliose species of the genera *Heterodermia, Hypotrachyna, Menegazzia, Pseudocyphellaria, Umbilicaria,* and *Xanthoparmelia*. It reacts yellow → red in a KOH spot-test, as does the chemically similar compound salazinic acid.

Nostoc — a genus of cyanobacteria. Species of *Nostoc* are found throughout the world and are the photosynthetic symbiont in many lichens.

parietin — a lichen pigment, one of the few found in fungi that do or don't lichenize, and in vascular plants as well. It reacts purple-red in KOH.

pedicellate — stalked.

peltate — shaped like a plate or shield and supported by a central stalk.

perforate — pierced by one or more holes.

periclinal — oriented parallel to the surface (*compare with* **anticlinal**, oriented perpendicular to the surface).

perithecium (plural **perithecia**) — a type of spore-producing body of an Ascomycota fungus. It's flask-shaped in cross-section and closed at the top except for a narrow pore that the spores escape through. Perithecia often look much the same from the outside, but inside they're highly variable—they can have four kinds of sterile hairs amongst the spore-sacs (asci) and lining the walls or surrounding the pore at the top. As well, the walls can have several layers, be pigmented or not, and contain photobiont cells or not (*compare with* **apothecium**, a spore-producing body that's open at maturity rather than closed).

photobiont — a photosynthetic symbiont in a lichen. It can be either a green alga or a cyanobacterium, and some lichens have both.

phyllidium (plural **phyllidia**, adjective **phyllidiate**) — a small, lobe- or leaf-like propagule formed on the upper surface or margin of a thallus. It contains photobiont cells, has a distinct upper and lower cortex, is flattened, often constricted at the base, and readily drops off (*compare with* **isidium**, a lichen propagule containing both fungal hyphae and photobiont cells, and covered by a cortex, and **soredium**, a lichen propagule containing both fungal hyphae and photobiont cells, but not covered by a cortex).

placodioid — (of a thallus) crustose at the centre but foliose at the margins, often with overlapping lobes and pleats.

polarilocular — (of a spore) two-celled, with the two locules separated by a thick septum that has a narrow canal running through its centre.

pored — pierced by small holes.

proper exciple — a jacket of sterile tissue immediately surrounding the spore-producing hymenium and hypothecium of a spore body, and lacking photobiont cells (*compare with* **thalline exciple**, a jacket of sterile tissue surrounding the spore-producing hymenium and hypothecium of a spore body, either alone or *outside* the proper exciple, and containing photobiont cells).

prothallus — in lichens, fungal hyphae at the thallus margin, variously coloured and textured but lacking photobiont cells.

pruinose — with a frost-like surface coating, often consisting of minute crystals.

pseudocyphella (plural **pseudocyphellae**) — a break in the upper or lower cortex of a thallus. It exposes the medullary hyphae, and they protrude because the break is not lined with dense hyphae (*compare with* **cyphella**, a cup-like depression in the underside of a thallus. It exposes the medullary hyphae, but they don't protrude because the depression is lined with dense hyphae).

pubescent — covered or edged with soft, fine hairs.

punctate — point-like.

pycnidium (plural **pycnidia**) — a structure producing conidia, usually flask-shaped and partly or fully immersed in the thallus.

rhizine (adjective **rhizinate**) — a root-like cluster of hyphae on a lichen's underside adapted for attaching the thallus to its substratum. It can be simple (unbranched) or variously branched—squarrose (at a right angle), dichotomous (forked into two equal parts), or tufted at the tip (*compare with* **rhizohypha**, a single hypha adapted for attaching the thallus to its substratum, and **cilium**, a long, tapering, hair-like cluster of parallel fused hyphae on a lichen's upperside or margin, usually pigmented but sometimes colourless).

rhizohypha (plural **rhizohyphae**, adjective **rhizohyphate**) — a single hypha on a lichen's underside adapted for attaching the thallus to its substratum (*compare with* **rhizine**, a root-like cluster of hyphae adapted for attaching the thallus to its substratum, and **cilium**, a long, tapering, hair-like cluster of parallel fused hyphae on a lichen's upperside or margin, usually pigmented but sometimes colourless).

rhizomorph — a root-like structure of fused hyphae with a colourless centre of elongate cells surrounded by a rind of dark-pigmented shorter cells.

salazinic acid — a β-orcinol depsidone synthesized by many lichens, among them the foliose species of the genera *Everniastrum, Flavoparmelia, Heterodermia, Hypotrachyna, Parmelia, Parmelinopsis, Parmotrema, Pseudocyphellaria,* and *Xanthoparmelia*). It reacts yellow → red in a KOH spot-test, as does the chemically similar compound norstictic acid.

Scytonema — a genus of cyanobacteria. Species of *Scytonema* are photobionts of a few lichens.

simple — not divided or branched, hence used to describe a spore with no cross-walls or a rhizine or isidium with no branches.

sinus — the gap between adjacent lobes of a thallus.

soleiform — shaped like the sole of a foot or shoe.

soralium (plural **soralia**) — a soredia-producing structure or portion of a thallus.

soredium (plural **soredia**, adjective **sorediate**) — a lichen propagule containing both fungal hyphae and photobiont cells, but not covered by a cortex. A thallus completely covered with soredia looks powdery. Old isidia and phyllidia often break up into soredia on their tips or margins (*compare with* **isidium**, a lichen propagule containing both fungal hyphae and photobiont cells, and covered by a cortex, and **phyllidium**, a small, lobe- or leaf-like propagule formed on the upper surface or margin of a thallus that contains photobiont cells, has a distinct upper and lower cortex, is flattened, often constricted at the base, and readily drops off).

spore — a simple reproductive structure produced by fungi, bacteria, and cryptogamic plants. The spores of a lichen are produced by only its mycobiont, and they vary in size, shape, colour, and the number of cells they contain.

squamulose — scale-like, a growth form that's intermediate between foliose and crustose (*compare with* **crustose**, crust-like, and **foliose**, leaf-like).

squarrose — branching at about 90°.

sterile — not reproducing sexually (but variously defined as not producing spores even asexually, and with or without vegetative propagules such as phyllidia, soredia, and isidia).

sub- — a prefix meaning "not quite", "slightly", or "somewhat" as well as "under" or "below".

substratum (plural **substrata**) — the surface that a lichen or some other organism is growing on. Lichens colonize soil, plant debris, bark, living leaves, lignum (wood that has lost its bark), rock, and even man-made materials, among them concrete, plastic, glass, timber, metal, leather, and bitumen.

thalline exciple — a jacket of sterile tissue surrounding the spore-producing hymenium and the hypothecium of a spore body, either alone or *outside* the proper exciple, and containing photobiont cells (*compare with* **proper exciple**, a jacket of sterile tissue immediately surrounding the spore-producing hymenium and hypothecium of a spore body, and lacking photobiont cells).

thallus — the body of a lichen or other thallophyte.

tomentum (adjective **tomentose**) — in lichens, a felt-like mat of soft, hair-like fungal hyphae.

trans-septate (or **transseptate** or **transeptate**) — having septa (cross-walls) across the short axis.

Trebouxia (adjective **trebouxioid**) — a genus of coccoid green algae. Species of *Trebouxia* are found throughout the world, and are the photobionts of most of the world's lichens.

Trentepohlia — a genus of filamentous green algae. Species of *Trentepohlia* are the photobionts of some crustose and filamentous lichens.

truncate — ending abruptly as though having been cut off.

usnic acid — a yellow, mildly antibacterial secondary metabolite synthesized by many lichen-forming fungi. It's typically in the upper cortex, and reacts yellow in a KC spot-test.

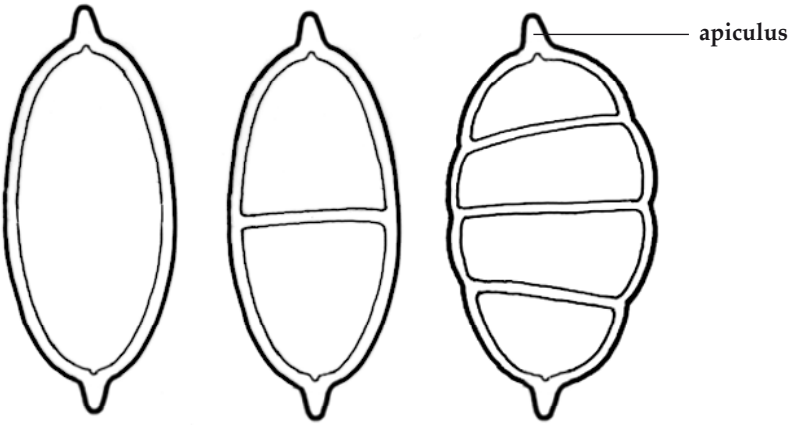
apex

apex (plural **apices**) — the tip or unattached end of a structure.

Siphula dissoluta underside (left), upperside (right)
1 mm

apiculate

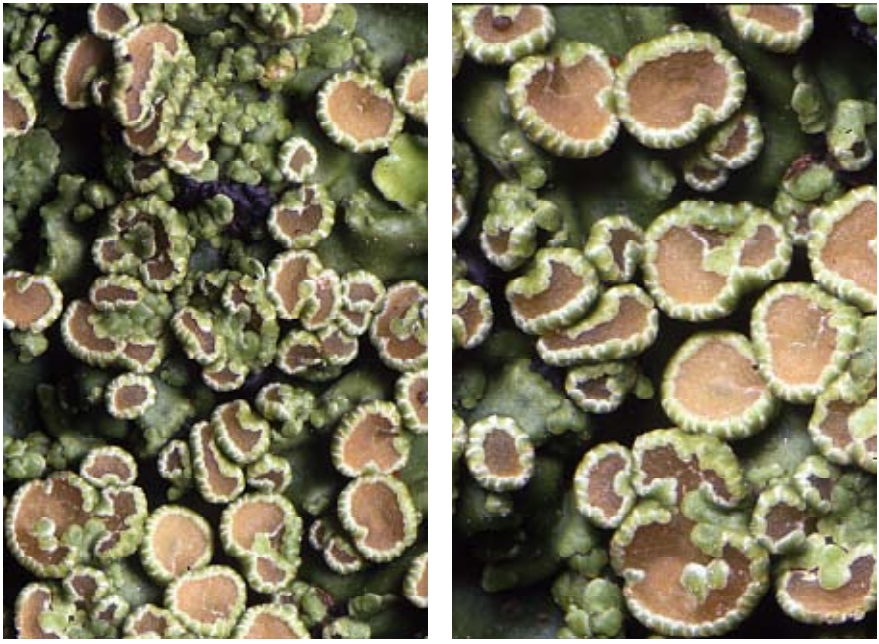
apiculate — ending abruptly in a short point (an apiculus).



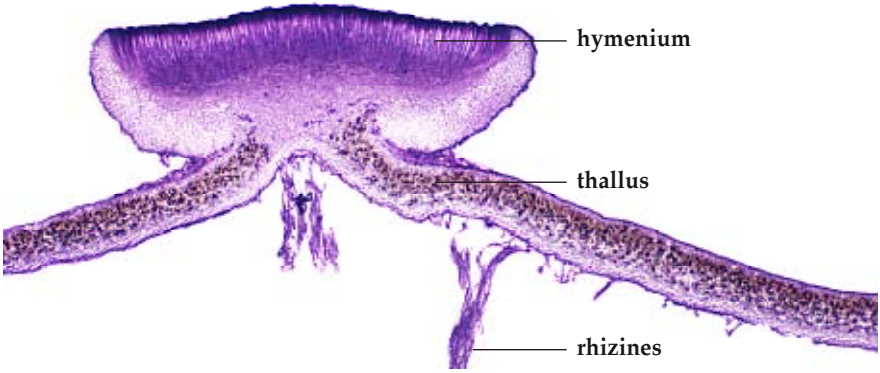
Apiculate ascospores — simple (left), 1-septate (middle), and 3-septate (right).

apothecium

apothecium (plural **apothecia**) — a type of spore-producing body of an Ascomycota fungus. It can be sessile or stalked and variously shaped, but in most foliose lichens it's roughly circular. The fertile portion (called a hymenium) is exposed when the spores are mature (*compare with* **perithecium**, a type of spore-producing body of an Ascomycota fungus that's flask-shaped and closed at the top except for a tiny pore through which the spores escape).



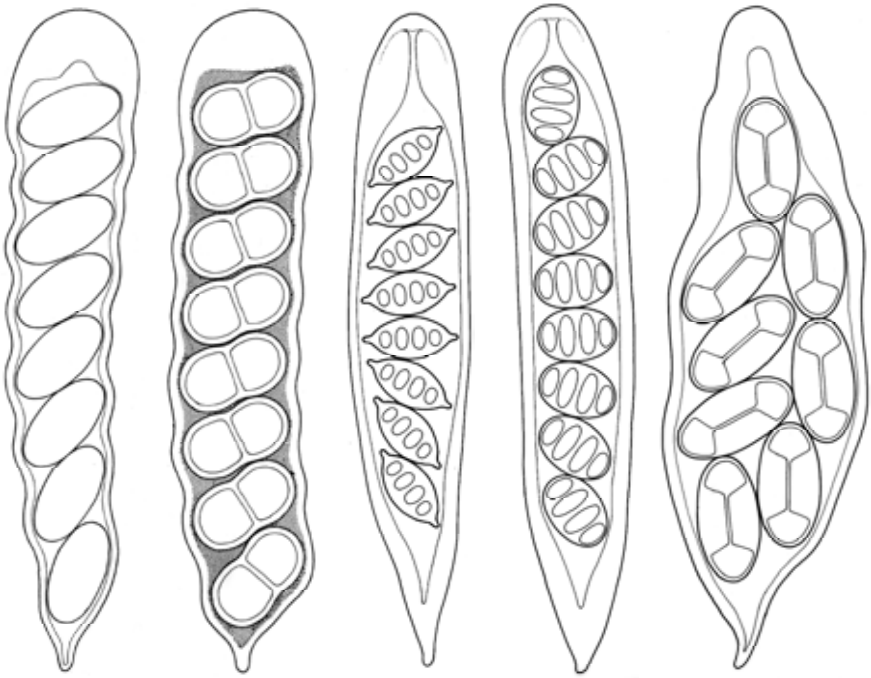
Pannaria allorhiza apothecia
1 mm (left), 1 mm (right)



Degelia gayana apothecium (vertical-section)
100 μm

ascospore

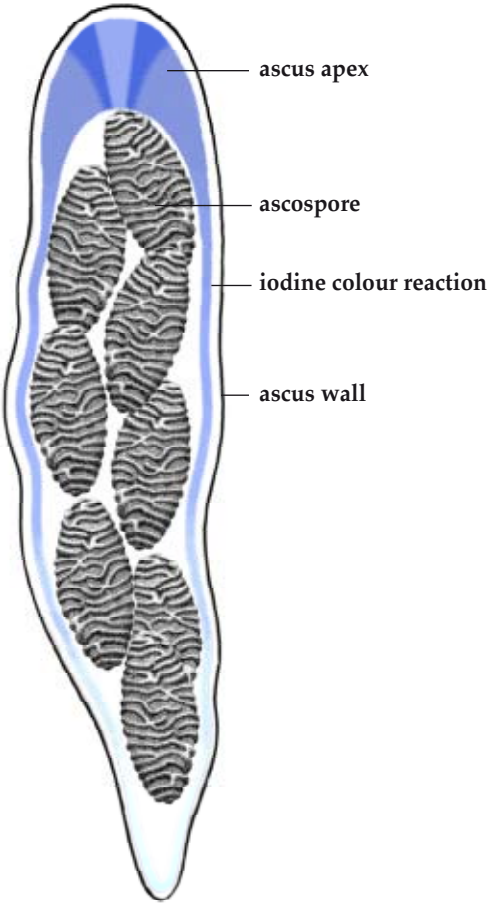
ascospore — in the Ascomycota fungi, a spore produced inside an ascus.



Ascospores (still inside the asci that produced them) of common Ascomycota fungi: (from left) *Lecanora, Buellia, Pyrenula* (2), and *Caloplaca* (various magnifications).

ascus

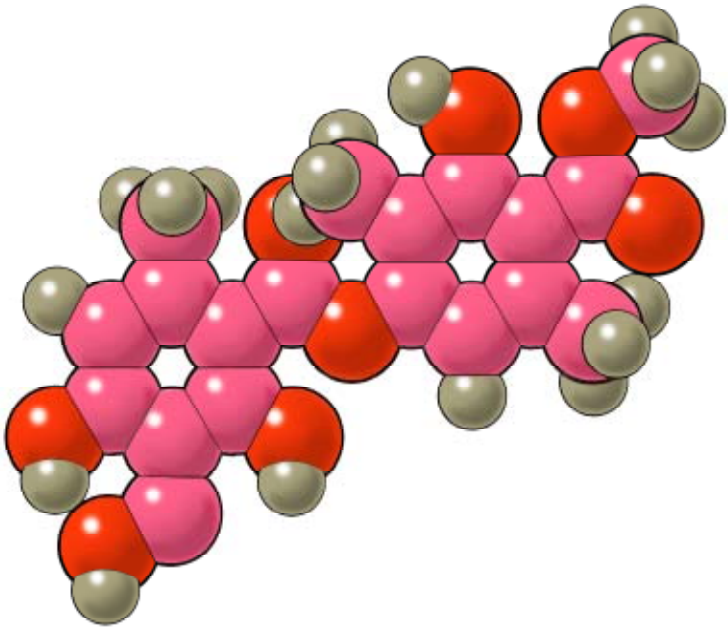
ascus (plural **asci**) — in the Ascomycota fungi, a sac-like cell that produces ascospores sexually.



Ascus and ascospores of a typical Ascomycota lichen fungus

atranorin

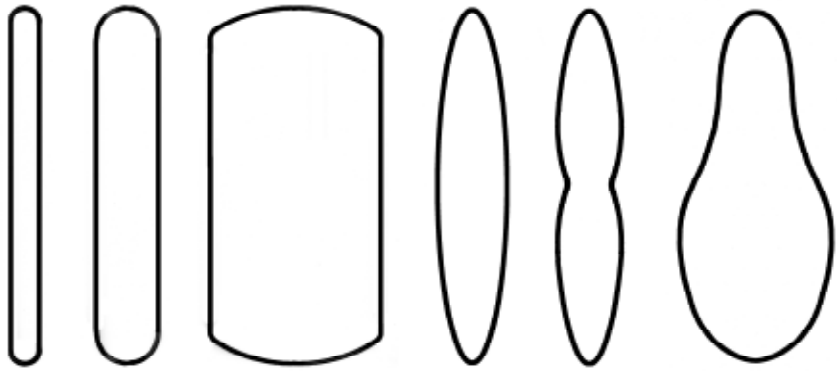
atranorin — a secondary metabolite of many lichen-forming fungi, responsible for the greyish colour of many species in the families Parmeliaceae (the genera *Canoparmelia, Cetrelia, Everniastrum, Hypotrachyna, Menegazzia, Parmelia, Parmelina, Parmelinopsis, Parmotrema*, and *Punctelia*) and Physciaceae (*Dirinaria, Heterodermia*, and *Physcia*).



atranorin, space-filling model (grey = hydrogen, red = oxygen, magenta = carbon)

bacillar

bacillar (or **bacilliform**) — shaped like a rod with rounded ends.

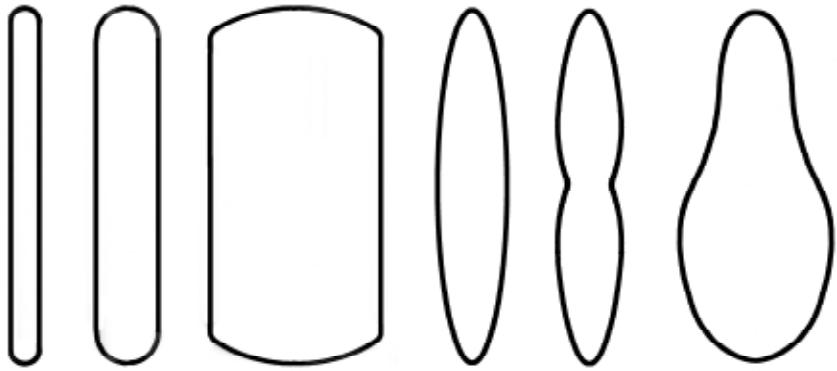


filiform **bacillar** **cylindrical** **fusiform** **bifusiform** **soleiform**

Common shapes of conidia

bifusiform

bifusiform — narrowed at both ends *and* in the middle.



filiform **bacillar** **cylindrical** **fusiform** **bifusiform** **soleiform**

Common shapes of conidia

cephalodium

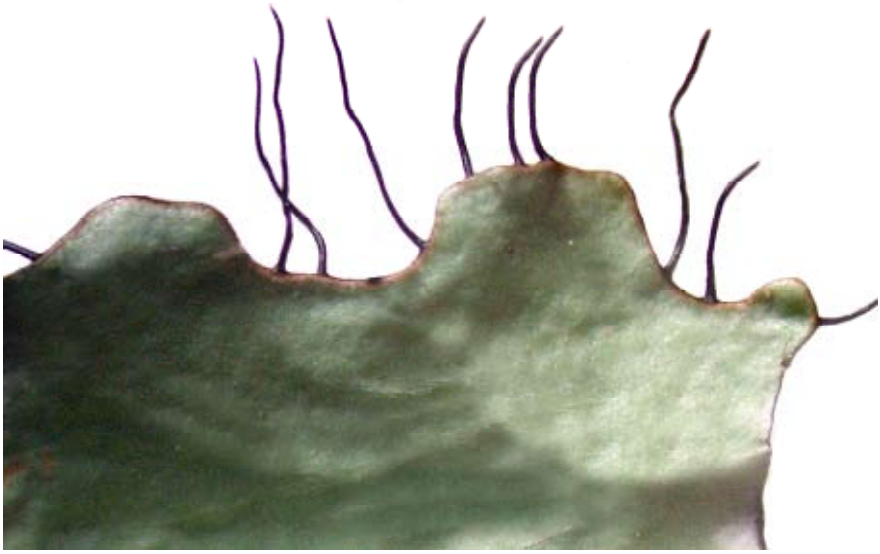
cephalodium (plural **cephalodia**) — in a lichen with a green algal photobiont, a part of the thallus containing a cyanobacterium. It can be on the surface of the thallus (usually the upperside) or inside, and variously shaped, but in section it often resembles a vertebrate brain.

Pannaria xanthomelana external cephalodium and apothecia
1 mm

Pseudocyphellaria glabra internal cephalodium, view of underside (left), section (right)
1 mm (left), 100 μm (right)

cilium

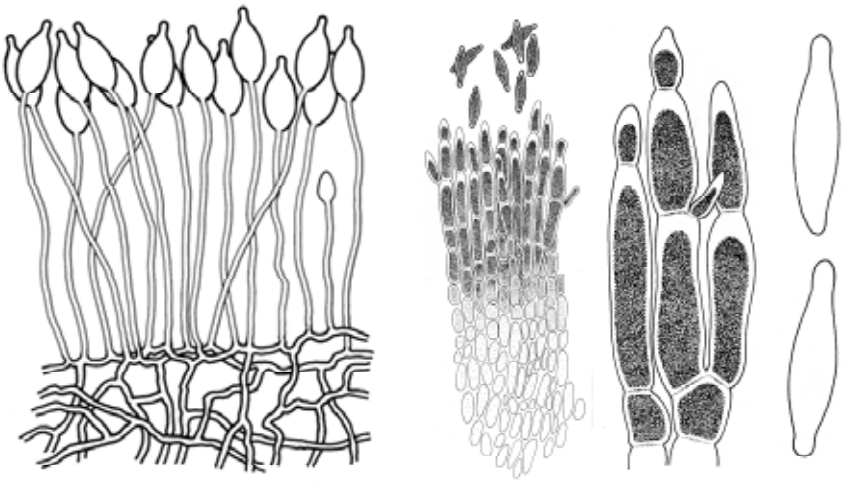
cilium (plural **cilia**, adjective **ciliate**) — a long, tapering, hair-like cluster of parallel and fused hyphae on a lichen's upperside or margin, usually pigmented but sometimes colourless (hyaline).



Parmotrema perlatum marginal cilia
1 mm

conidium

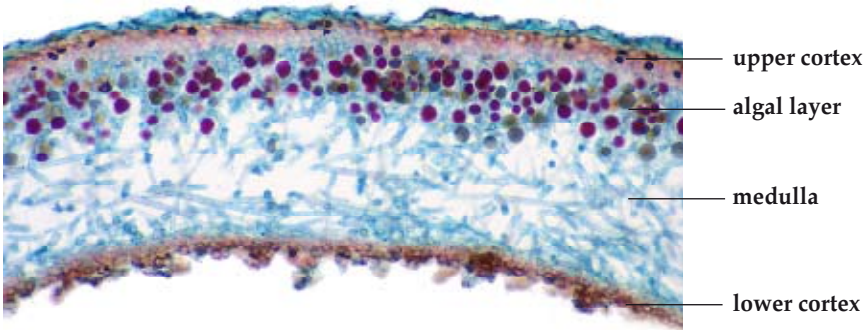
conidium (plural **conidia**, adjective **conidiate**) — a type of asexual fungal spore, in lichens often produced inside flask-shaped pycnidia.



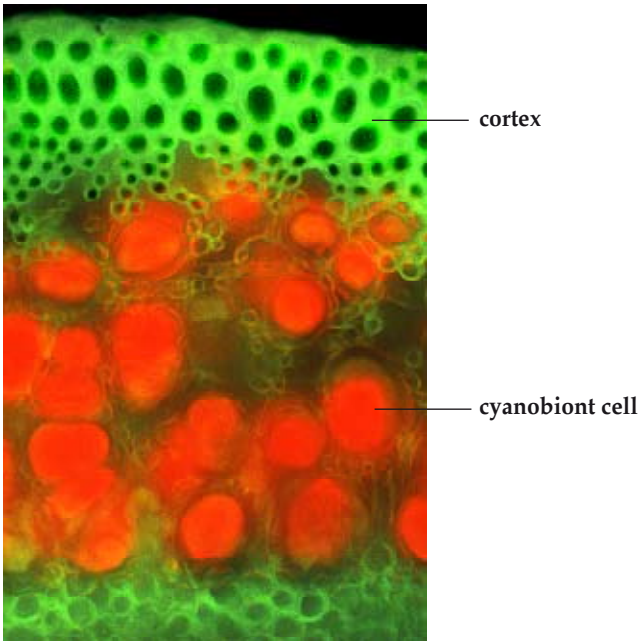
Conidia on conidiophores (left), *Labyrintha implexa* conidia (right)
5 μm (left), 5 μm (middle), 5 μm (right)

cortex

cortex (plural **cortices**, adjective **corticate**) — in lichens, a dense outermost layer that usually covers the exposed surface(s) of a thallus. Fruticose lichens, even if they're flattened top to bottom, typically have a continuous cortex covering their surface. Most foliose lichens do, too, but species of *Collema* have no cortex at all, and species of a few other genera lack a cortex on their lower surface, among them *Peltigera, Icmadophila*, most species of *Heterodermia*, and some species of *Leioderma, Pannaria, Physcia*, and *Physma*. Very few crustose lichens have a cortex on their lower surface.



Physcia sp. vertical-section through thallus
100 µm



Degelia gayana cortex (vertical-section) (the chlorophyll of the cyanobiont cells is autofluorescing blood-red in this ultraviolet microscope image) 10 µm

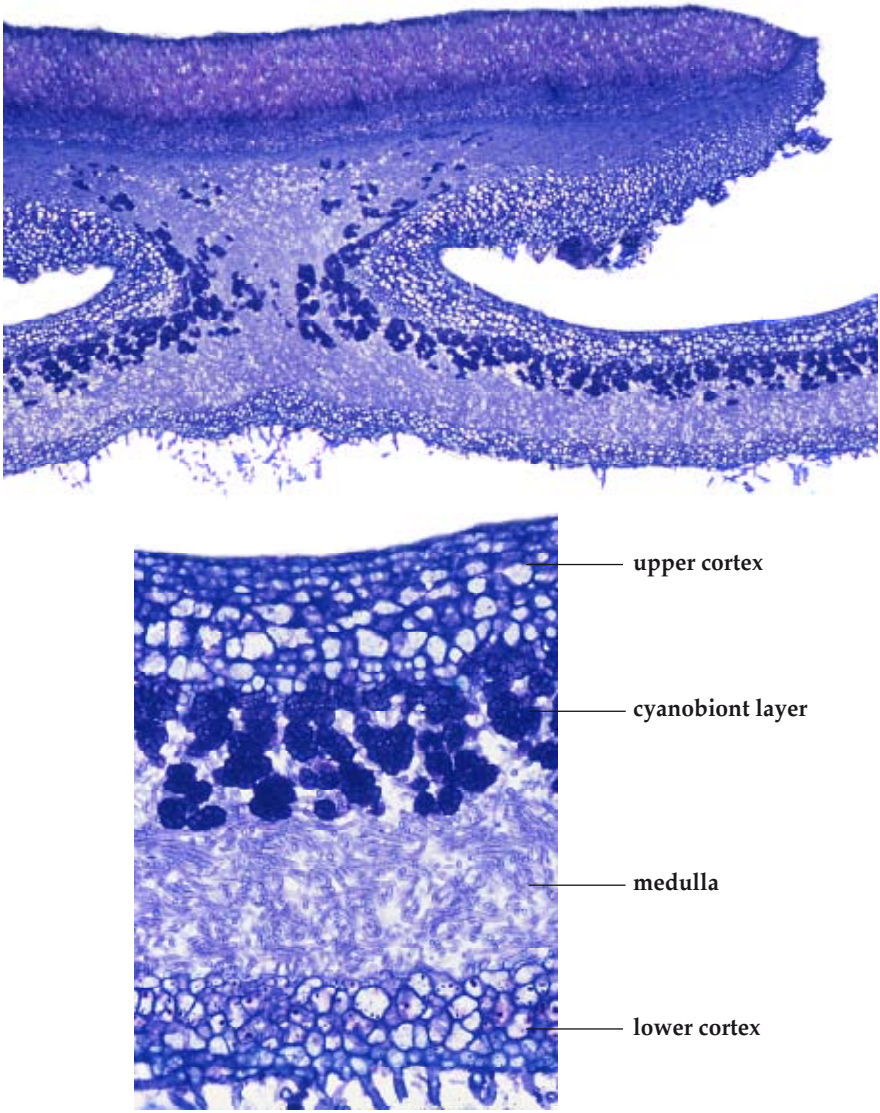
crustose

crustose — crust-like, one of the three main growth forms of lichens (*compare with* **foliose**, leaf-like, and **fruticose**, shrub-like).

Tephromela atra colonizing a pebble—the lower surface invades the substratum.
1 mm

cyanobacteria

cyanobacteria (singular **cyanobacterium**, adjective **cyanobacterial**) — a large group of photosynthetic bacteria formerly called the blue-green algae. Species of cyanobacteria that live as photobionts in lichens are called **cyanobionts**. Most belong to the genera *Nostoc*, *Scytonema*, *Spilonema*, and *Gloeocapsa*. They usually colour the lichen surface bluish grey, dark brown, or blackish. Many species are nitrogen-fixers.

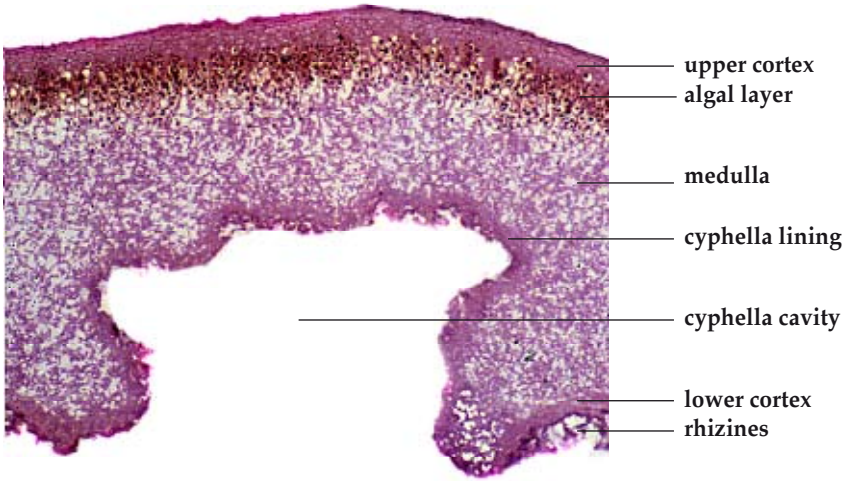


Pseudocyphellaria cinnamomea vertical-section through apothecium (above) and thallus
100 μm (above), 100 μm (below)

cyphella

cyphella (plural **cyphellae**) — a cup-like depression in the underside of a thallus. It exposes the medullary hyphae, but they don't protrude because the depression is lined with dense hyphae. Cyphellae are diagnostic for species of the genus *Sticta*.

Sticta latifrons cyphellae
1 mm



Sticta subcaperata cyphella cross-section
100 μm

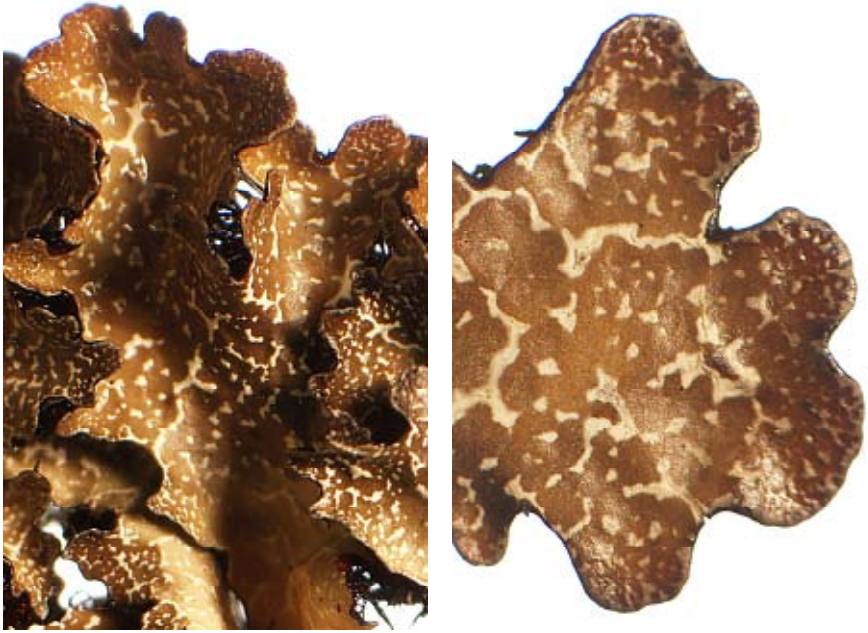
ecorticate

ecorticate — lacking a cortex.

Heterodermia leucomela ecorticate underside
1 mm (left), 1 mm (right)

effigurate

effigurate — forming a complex, irregular pattern.



Parmelia signifera effigurate laminal pseudocyphellae.
1 mm (left), 1 mm (right)

faveolate

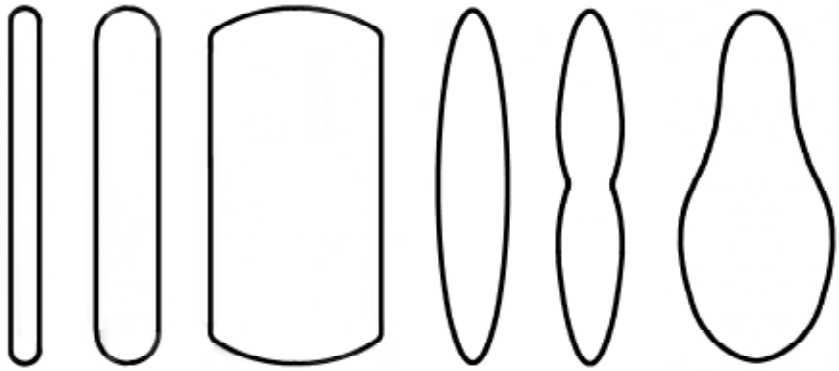
faveolate — honeycombed, with depressions separated by a network of ridges.

Pseudocyphellaria faveolata thallus
5 mm

Pseudocyphellaria rufovirescens thallus
1 mm

filiform

filiform — thread-like.



filiform **bacillar** **cylindrical** **fusiform** **bifusiform** **soleiform**

Common shapes of conidia

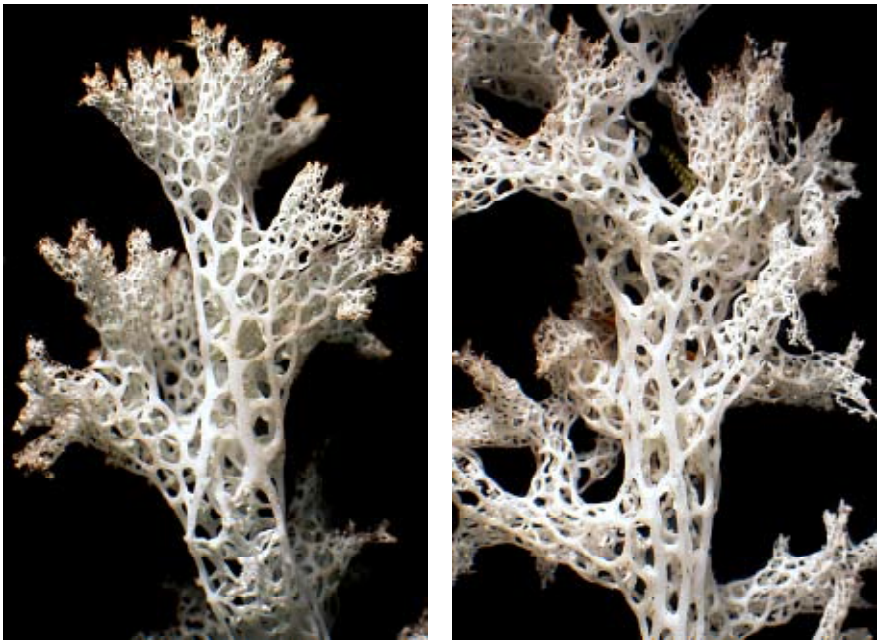
foliose

foliose — leaf-like, one of the three main growth forms of lichens (*compare with* **crustose**, crust-like, and **fruticose**, shrub-like).

Lobaria adscripta foliose thallus
1 mm

fruticose

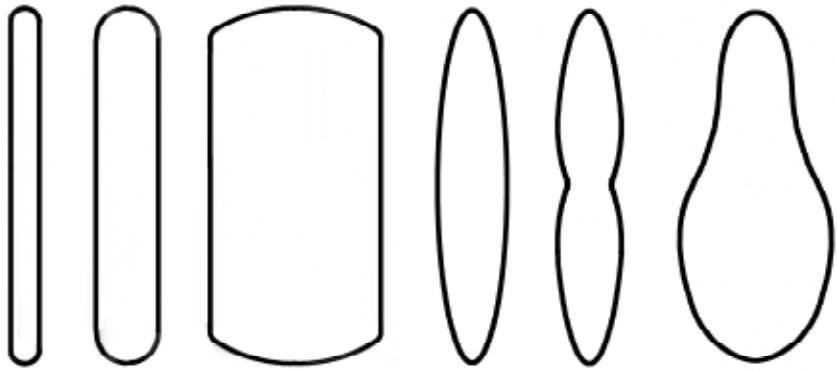
fruticose — shrub-like, one of the three main growth forms of lichens (*compare with* **crustose**, crust-like, and **foliose**, leaf-like).



Cladia retipora fruticose habit
1 mm

fusiform

fusiform — spindle-like, narrowed at both ends.

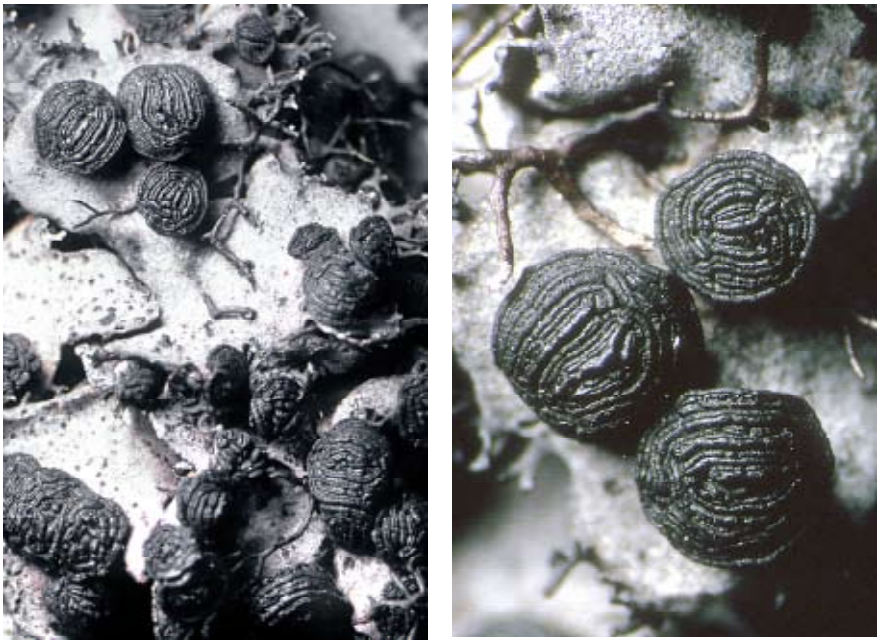


filiform **bacillar** **cylindrical** **fusiform** **bifusiform** **soleiform**

Common shapes of conidia

gyrose

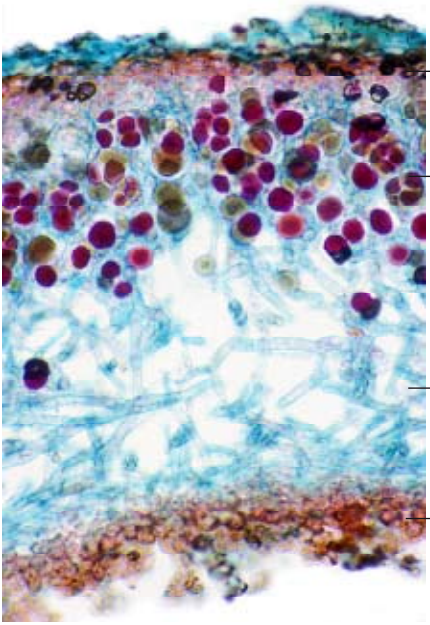
gyrose — concentrically ridged or folded.



Umbilicaria cylindrica gyrose apothecia
1 mm (left), 1 mm (right)

heteromerous

heteromerous — a lichen thallus anatomy in which the photobiont and mycobiont are arranged in distinct layers (*compare with* **homoiomerous**, a thallus anatomy in which the photobiont and mycobiont are intermixed).



Physcia sp. section through thallus
100 µm

hypothallus

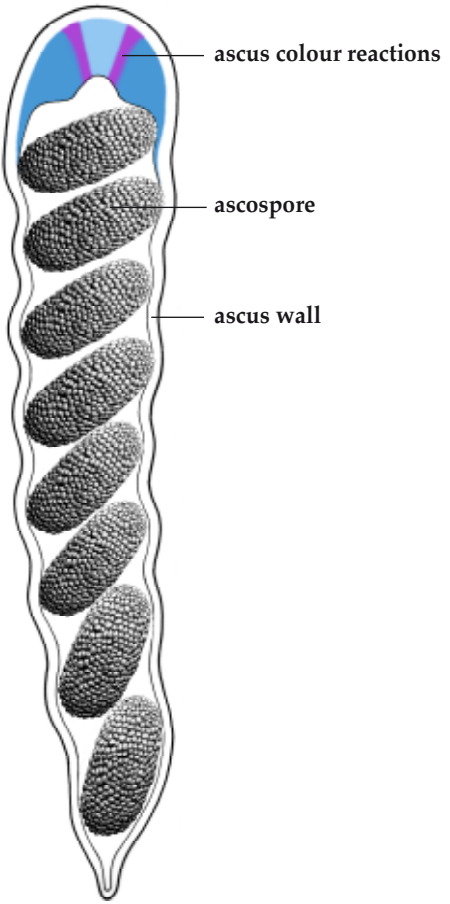
hypothallus (plural **hypothalli**) — a layer of woolly and often dark hyphae beneath a thallus. It typically lacks photobiont cells. In species of *Pannoparmelia*, it's broken up into bead-like clumps, whereas in species of *Anzia*, it's continuous.

Pannoparmelia angustata beaded hypothallus
1 mm

Anzia jamesii continuous hypothallus
1 mm

iodine colour reaction

iodine colour reaction — a colour change (usually blue, purple, or red) caused by iodine reacting with amyloid portions of the ascus, best seen after pretreatment with KOH.



Iodine-induced colour reactions in an ascus apex

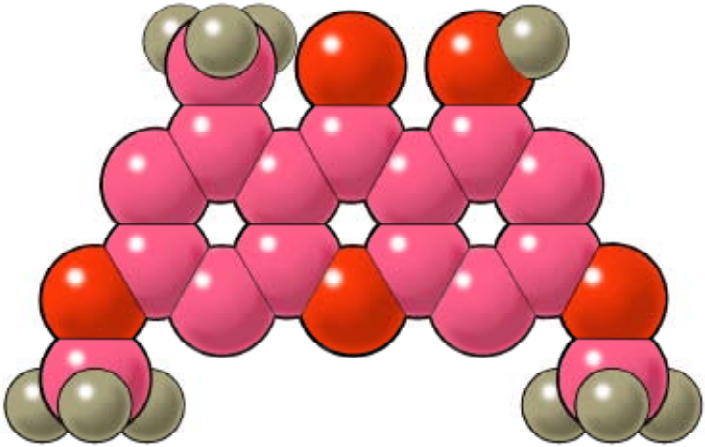
isidium

isidium (plural **isidia**, adjective **isidiate**) — a lichen propagule containing both fungal hyphae and photobiont cells, and covered with a cortex. It grows out of the parent lichen's cortex and can be variously shaped (simple or branched, warty, scaly, cylindrical, club-shaped, or coral-like) (*compare with* **soredium**, a lichen propagule that contains both fungal hyphae and photobiont cells but is not covered by a cortex, and **phyllidium**, a small, lobe- or leaf-like propagule formed on the upper surface or margin of a thallus that contains photobiont cells, has a distinct upper and lower cortex, is flattened, often constricted at the base, and readily drops off).

Pseudocyphellaria glabra isidiate margins
1 mm

lichexanthone

lichexanthone — a secondary metabolite of some lichen-forming fungi.



lichexanthone, space-filling model (grey = hydrogen, red = oxygen, magenta = carbon)

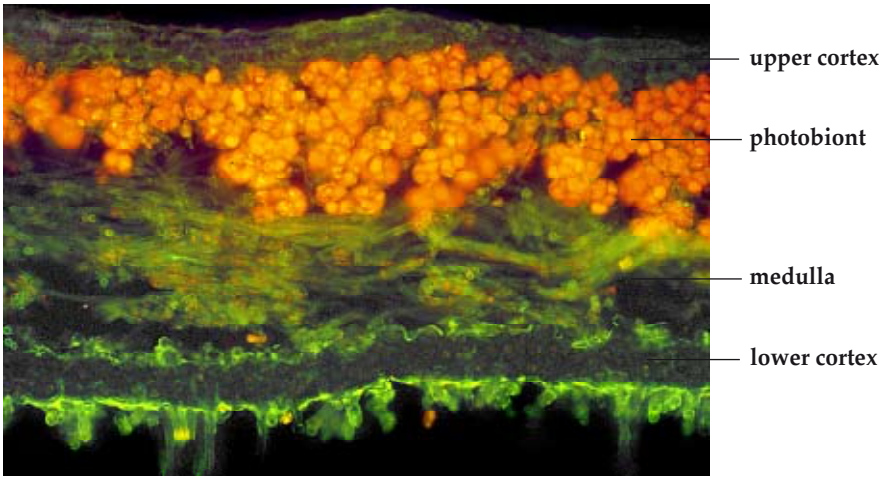
mazaedium

mazaedium (plural **mazaedia**) — a dry, loose, powdery, and often dark mass of spores and sterile hyphae that forms on the fruiting bodies of some lichens, among them species of the genera *Bunodophoron* and *Calycidium*.

Bunodophoron insigne mazaedium, upperside (left), underside (right)
1 mm

medulla

medulla — in a heteromerous lichen, a layer of ± loose hyphae below the upper cortex and photobiont layers.



Pseudocyphellaria sp. thallus section (ultraviolet microscope image)
100 μm

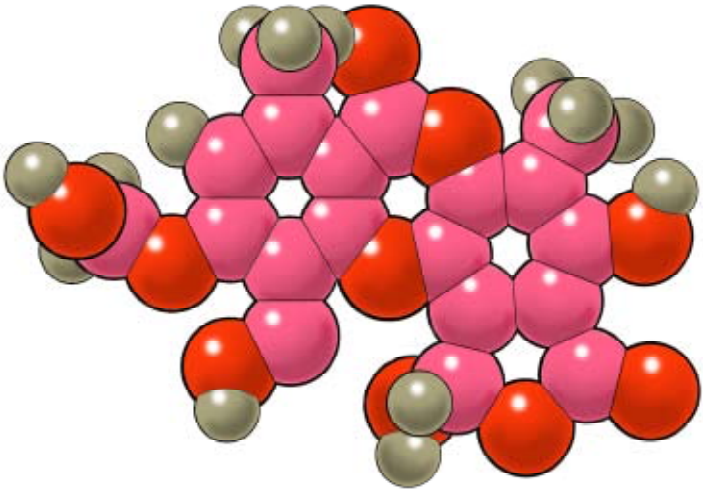
muriform

muriform — (of a spore) having both trans-septate and longitudinal or oblique cross-walls.

Lopadium monosporum muriform ascospores
10 µm

norstictic acid

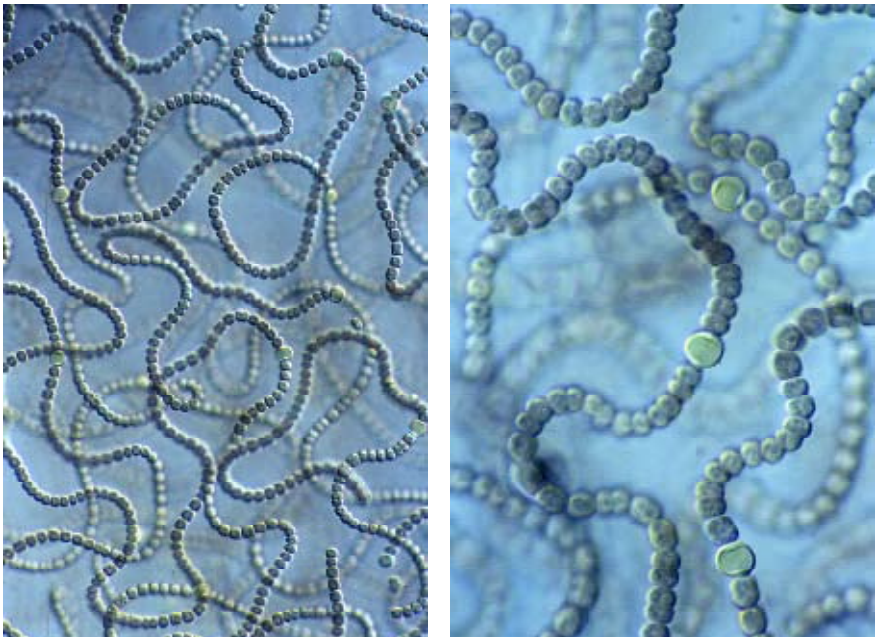
norstictic acid — a β-orcinol depsidone synthesized by many lichens, among them the foliose species of the genera *Heterodermia, Hypotrachyna, Menegazzia, Pseudocyphellaria, Umbilicaria,* and *Xanthoparmelia.* It reacts yellow then red in a KOH spot-test, as does the chemically similar compound salazinic acid.



norstictic acid, space-filling model (grey = hydrogen, red = oxygen, magenta = carbon)

Nostoc

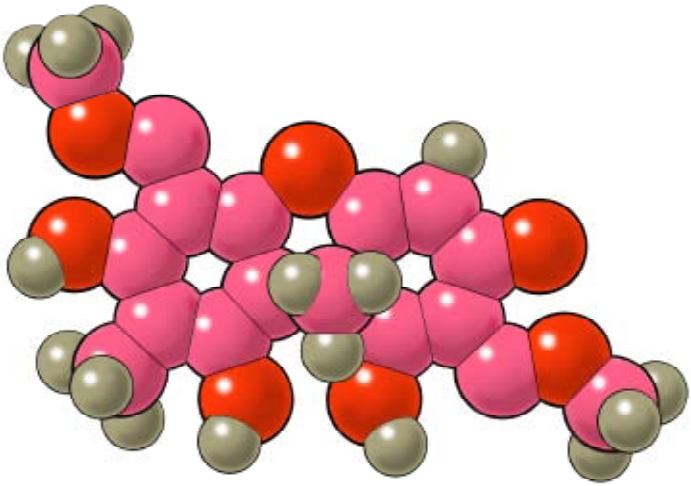
Nostoc — a genus of cyanobacteria. Species of *Nostoc* are found throughout the world and are the photosynthetic symbionts of nearly one-tenth of the world's lichens.



Nostoc (microscope view)
100 μm (left), 50 μm (right)

parietin

parietin — a lichen pigment, one of the few found in fungi that do or don't lichenize, and in vascular plants as well. It reacts purple-red in KOH.



parietin, space-filling model (grey = hydrogen, red = oxygen, magenta = carbon)

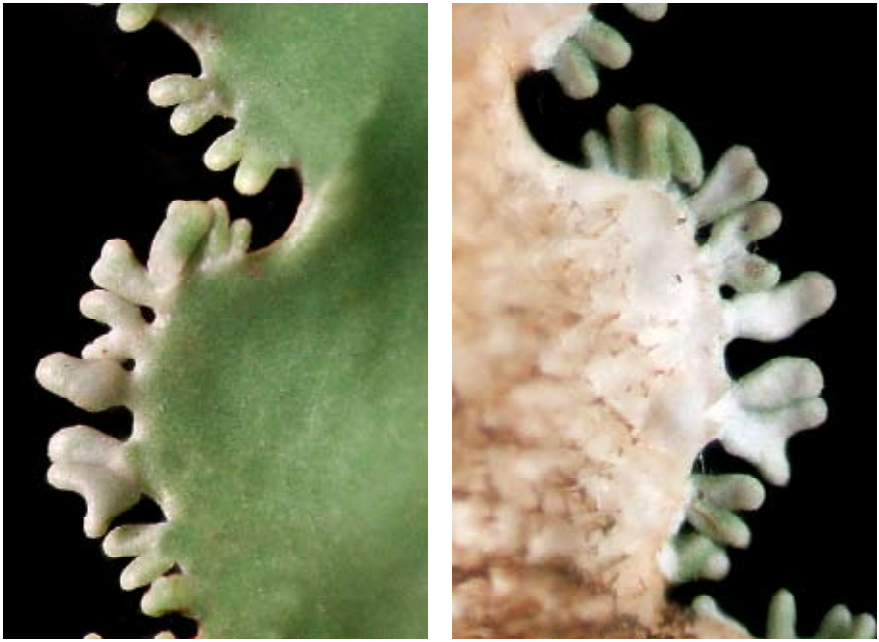
perforate

perforate — pierced by one or more holes.

Menegazzia pertransita perforate thallus
1 mm

phyllidium

phyllidium (plural **phyllidia**, adjective **phyllidiate**) — a small, lobe- or leaf-like propagule formed on the upper surface or margin of a thallus. It contains photobiont cells, has a distinct upper and lower cortex, is flattened, often constricted at the base, and readily drops off (*compare with* **isidium**, a lichen propagule containing both fungal hyphae and photobiont cells, and covered by a cortex, and **soredium**, a lichen propagule containing both fungal hyphae and photobiont cells, but not covered by a cortex).



Pseudocyphellaria multifida marginal phyllidia, upperside (left), underside (right)
1 mm

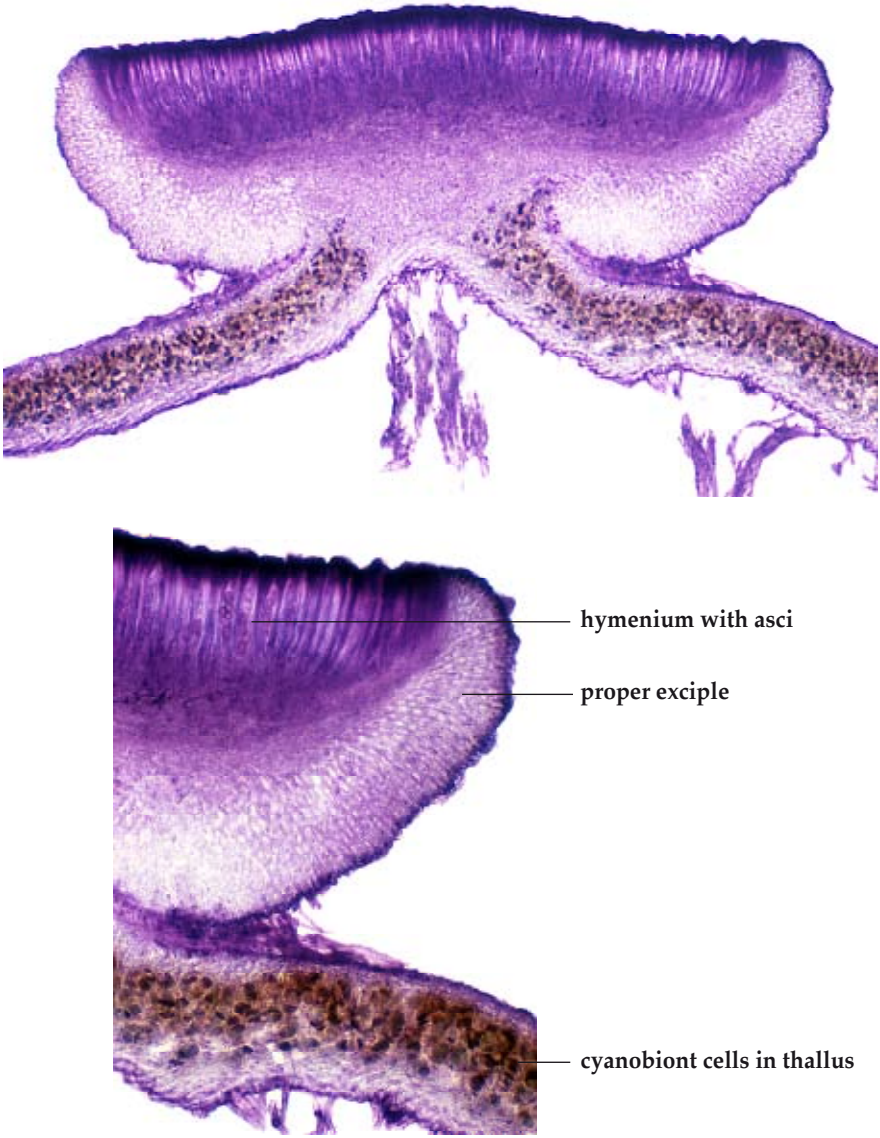
polarilocular

polarilocular — (of a spore) two-celled, with the two locules separated by a thick septum that has a narrow canal running through its centre.

Caloplaca sp. polarilocular ascospores (still inside the ascus that produced them).

proper exciple

proper exciple — a jacket of sterile tissue immediately surrounding the spore-producing hymenium and hypothecium of a spore body, and lacking photobiont cells (*compare with* **thalline exciple**, a jacket of sterile tissue surrounding the spore-producing hymenium and hypothecium of a spore body, either alone or *outside* the proper exciple, and containing photobiont cells).



Degelia gayana apothecium, proper exciple (vertical-section)
100 μm (above), 100 μm (below)

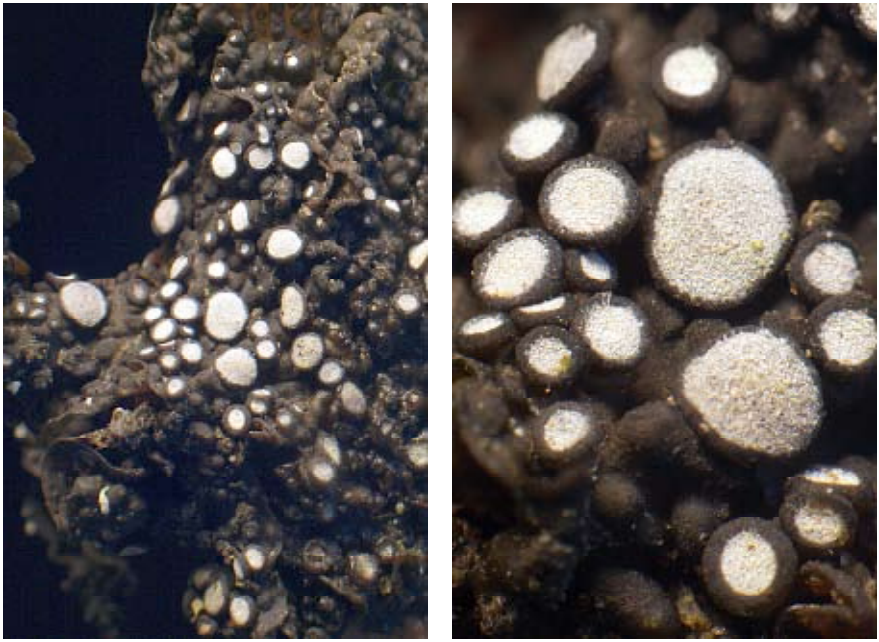
prothallus

prothallus — in lichens, fungal hyphae at the thallus margin, variously coloured and textured but lacking photobiont cells.

Pannaria sp. prothallus on bark.

pruinose

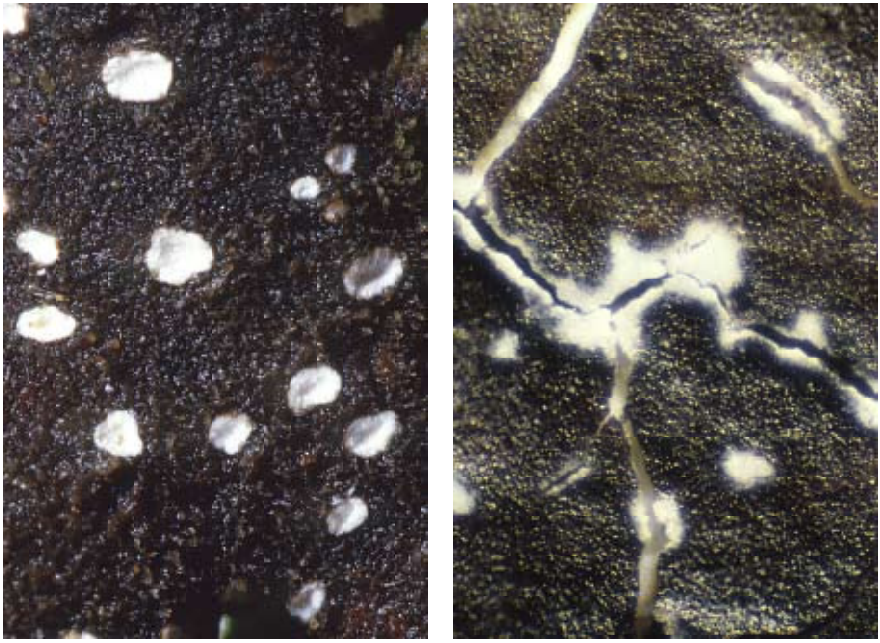
pruinose (noun **pruina**) — with a frost-like surface coating, often consisting of minute crystals of calcium oxalate.



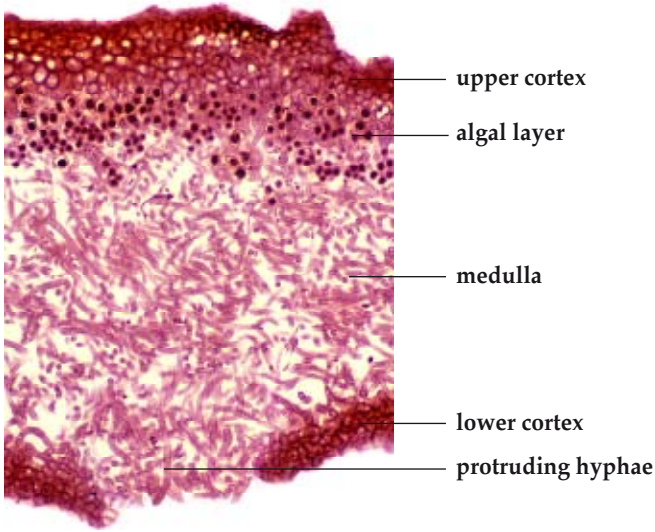
Collema glaucophthalmum white-pruinose apothecial discs.
1 mm (left), 1 mm (right)

pseudocyphella

pseudocyphella (plural **pseudocyphellae**) — a break in the upper or lower cortex of a thallus. It exposes the medullary hyphae, and they protrude because the break is not lined with dense hyphae as in a cyphella.



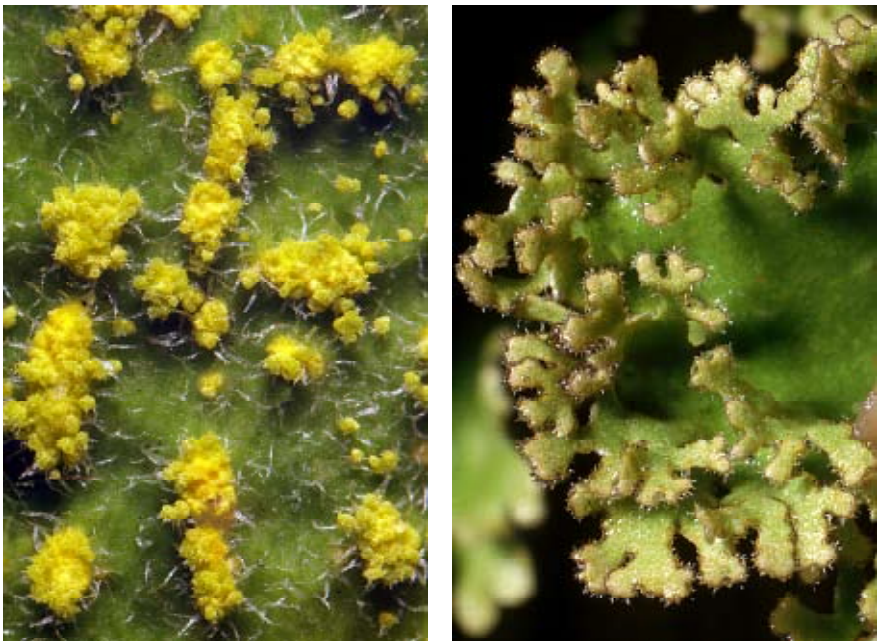
(left) *Pseudocyphellaria* sp. pseudocyphellae, underside, (right) *Parmelia signifera* laminal elongate pseudocyphellae.
1 mm (left), 1 mm (right)



Pseudocyphellaria sp. pseudocyphella cross-section
100 μm

pubescent

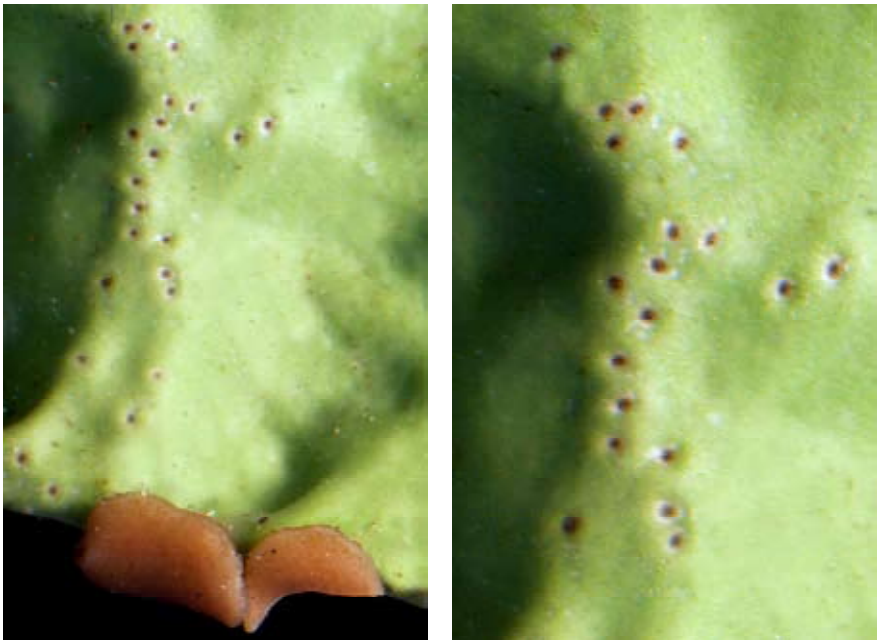
pubescent — covered or edged with soft, fine hairs.



(left) *Pseudocyphellaria rubella* laminal pubescence and soredia, (right) *Pseudocyphellaria fimbriata* pubescent phyllidia.
0.5 mm (left), 1 mm (right)

pycnidium

pycnidium (plural **pycnidia**) — a structure producing conidia, usually flask-shaped in section and partly or fully immersed in the thallus.



Pseudocyphellaria rufovirescens pycnidia
1 mm (left), 1 mm (right)

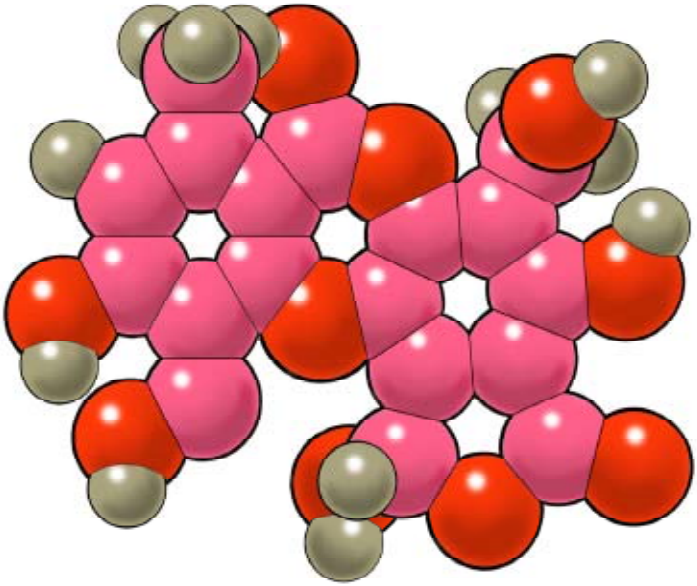
rhizine

rhizine (adjective **rhizinate**) — a long, tapering, hair-like cluster of parallel and fused hyphae on a lichen's upperside or margin, usually pigmented but sometimes colourless (hyaline).

Degelia gayana rhizines projecting from lower surface
1 mm

salazinic acid

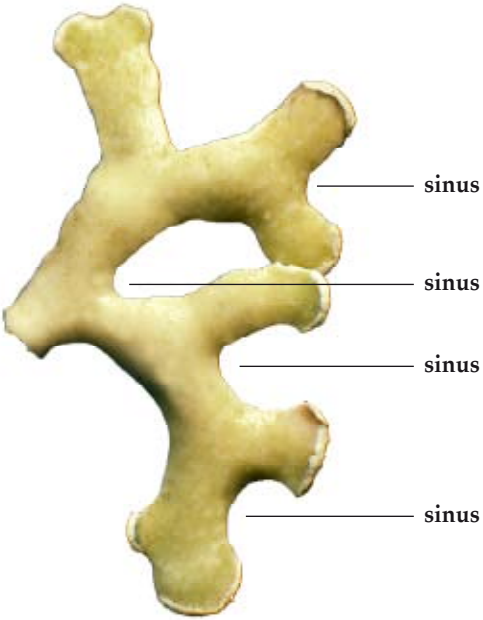
salazinic acid — a β-orcinol depsidone synthesized by many lichens, among them the foliose species of the genera *Everniastrum*, *Flavoparmelia*, *Heterodermia*, *Hypotrachyna*, *Parmelia*, *Parmelinopsis*, *Parmotrema*, *Pseudocyphellaria*, and *Xanthoparmelia*. It reacts yellow then red in a KOH spot-test, as does the similar compound norstictic acid.



salazinic acid, space-filling model (grey = hydrogen, red = oxygen, magenta = carbon)

sinus

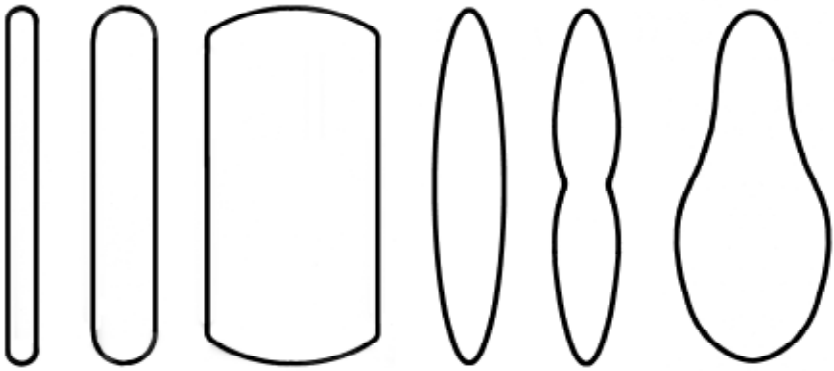
sinus — the gap between adjacent lobes of a thallus.



Xanthoparmelia sorediata fragment (moist)
1 mm

soleiform

soleiform — shaped like the sole of a foot or shoe.

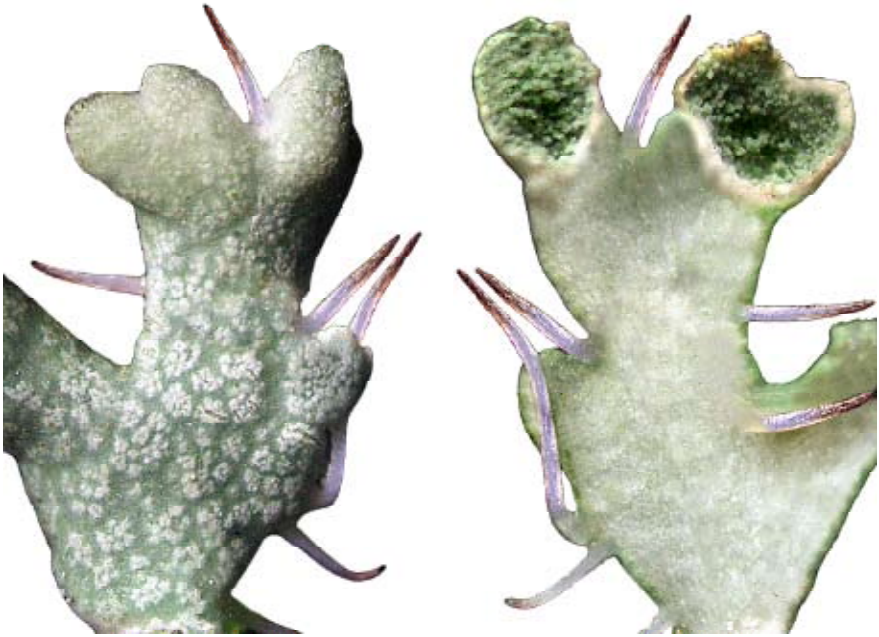


filiform **bacillar** **cylindrical** **fusiform** **bifusiform** **soleiform**

Common shapes of conidia

soralium

soralium (plural **soralia**) — a soredia-producing structure or portion of a thallus.



Physcia adscendens helmet-shaped soralia, upperside (left), underside (right)
1 mm

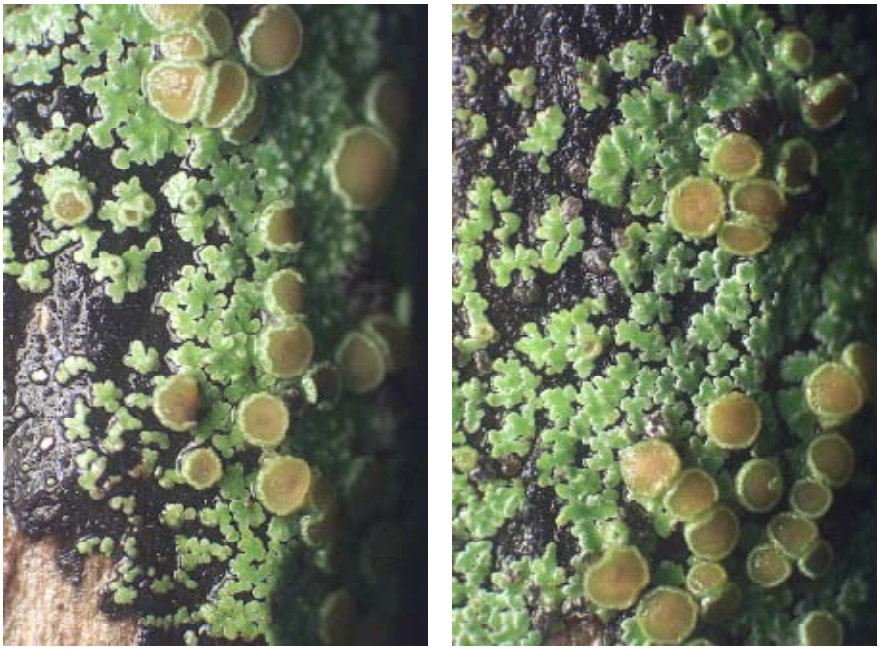
soredium

soredium (plural **soredia**, adjective **sorediate**) — a lichen propagule containing both fungal hyphae and photobiont cells, but not covered by a cortex. A thallus completely covered with soredia looks powdery. Old isidia and phyllidia often break up into soredia on their tips or margins (*compare with* **isidium**, a lichen propagule containing both fungal hyphae and photobiont cells, and covered by a cortex, and **phyllidium**, a small, lobe- or leaf-like propagule formed on the upper surface or margin of a thallus that contains photobiont cells, has a distinct upper and lower cortex, is flattened, often constricted at the base, and readily drops off).

Pseudocyphellaria rubella yellow laminal soredia and white pubescent hairs.
0.1 mm

squamulose

squamulose — scale-like, a growth form that's intermediate between foliose and crustose (*compare with* **crustose**, crust-like, and **foliose**, leaf-like).



Psoroma caliginosum thallus of green squamules on a black prothallus.
1 mm

substratum

substratum (plural **substrata**) — the surface that an organism is growing on, with lichens usually soil, bark, living leaves, lignum (wood that has lost its bark), rock, and sometimes man-made materials, among them concrete, plastic, glass, timber, metal, and bitumen.

Xanthoparmelia scabrosa growing on three substrata—rock, treated timber, and bitumen.
5 mm

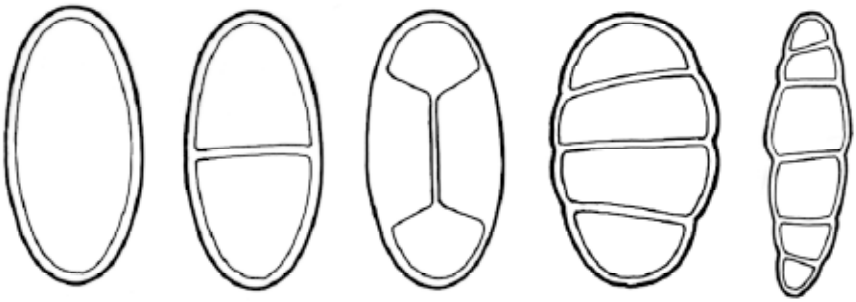
tomentum

tomentum (adjective **tomentose**) — in lichens, a felt-like mat of soft, hair-like fungal hyphae.

Pseudocyphellaria sp. thin, dark brown tomentum (underside of thallus) (left), and *Erioderma leylandii* subsp. *leylandii* scattered white laminal tomentum (right)
1 mm (left), 1 mm (right)

trans-septate

trans-septate (or **transseptate** or **transeptate**) — (of spores) having one or more septa (cross-walls) across the short axis.



A sampler of simple and trans-septate spores

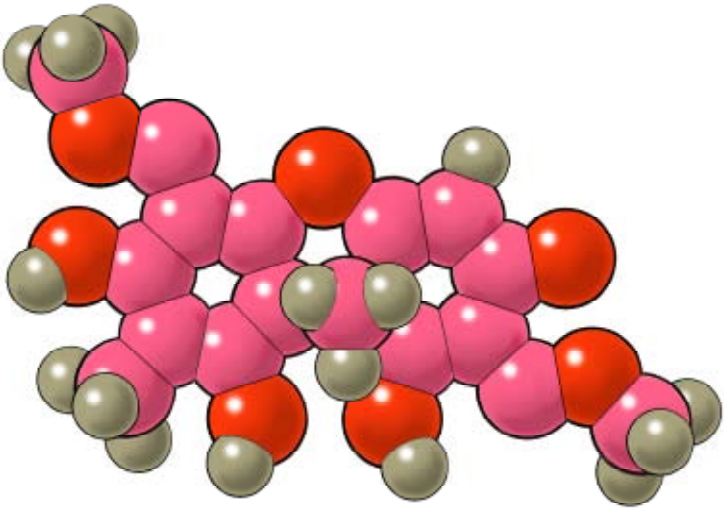
Trentepohlia

Trentepohlia — a genus of filamentous green algae. Species of *Trentepohlia* are the photobionts of some crustose lichens.

Trentepohlia iolithus habit on rock (left), filaments (right)
5 mm (left), 0.5 mm (right)

usnic acid

usnic acid — a yellow, mildly antibacterial secondary metabolite synthesized by many lichen-forming fungi. It's typically located in the upper cortex, and reacts yellow in a KC spot-test.



usnic acid, space-filling model (grey = hydrogen, red = oxygen, magenta = carbon)

vein

vein (adjective **veined**) — a strand of strengthening tissue, as on the ecorticate underside of the thallus in species of *Peltigera*.

Peltigera nana veined underside
1 mm (left), 1 mm (right)

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index (**red** = page/couplet in the key; **brown** = page of description/illustration)