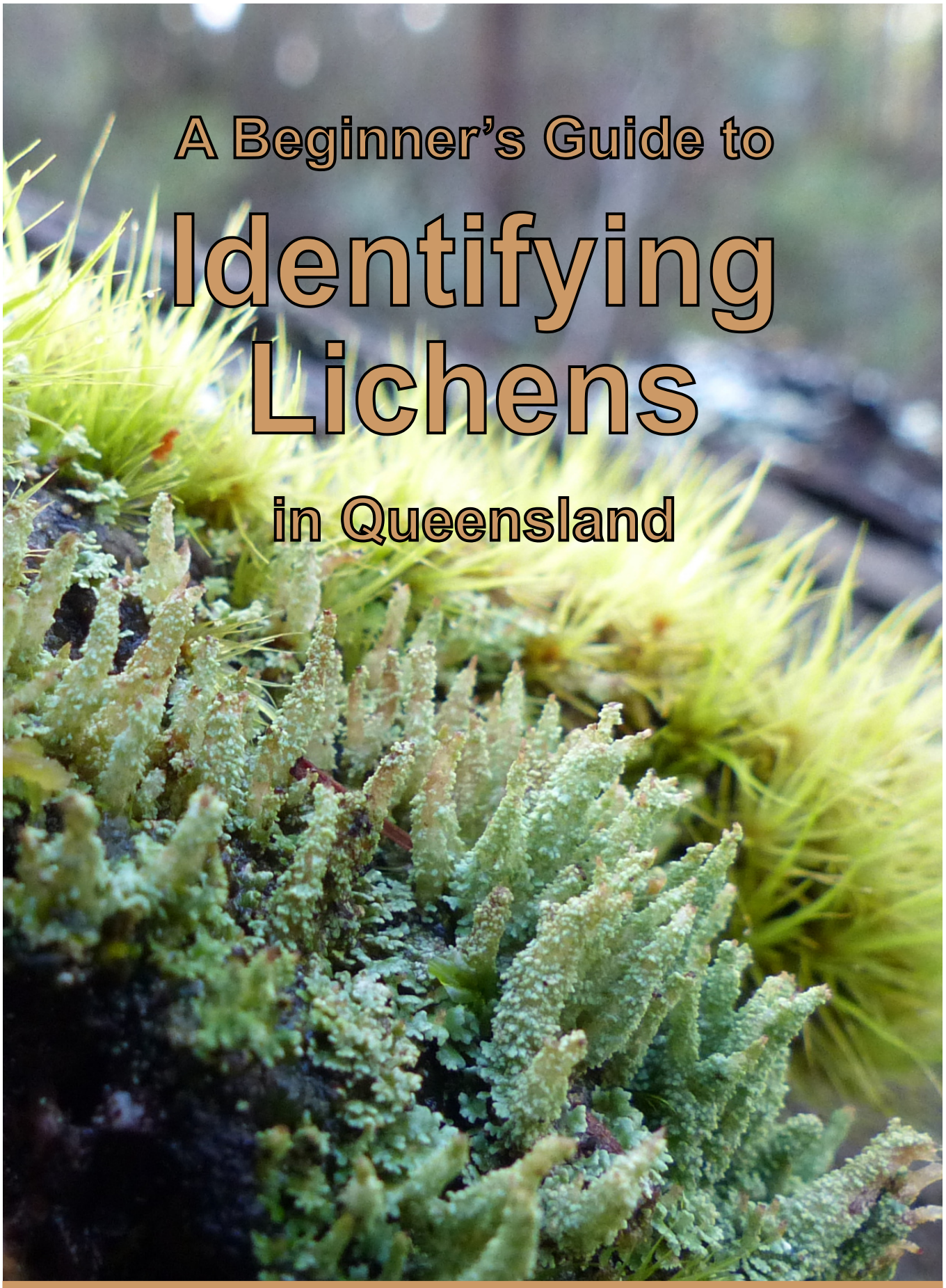

A Beginner's Guide to Identifying Lichens in Queensland

Queensland Mycological Society

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March 2023

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Lichen Taxonomy

Over the last fifty years the taxonomy of lichens has been in turmoil as new technologies have allowed investigations to proceed. Integrating the taxonomy of lichenized fungi with those of the non-lichenized fungi has also resulted in great change. Detailed anatomical studies, studies of development and studies in lichen chemistry have each resulted in major realignments of the lichens.

In common with other groups of organisms, the lichen forming fungi are now being examined using nucleic acid sequences and phylogenetic analysis. These powerful tools are producing new insights into the systematics of the lichens and will continue to do so.

Taxa and their classification are increasingly being defined by their genetic affinities, along with morphological and chemical attributes. This has resulted in numerous name changes and re-organisation of families. This new genetic information sometimes confirms the existing classification and sometimes can be quite surprising.

The extent to which the anatomy and morphology of crustose lichens is taxonomically informative is being investigated. It may well be that evolution and hence taxonomic arrangement has occurred at physiological or developmental levels, resulting in a diversity of apparently similar individuals in different taxa (sometimes called cryptospeciation).

Morphology and chemistry now allow a reasonable and practical approach to the identification of lichens. That era may eventually come to an end but not in the foreseeable future.

Getting started

Identification of lichens has the reputation of being very difficult. True, getting started can be a challenge!

Lichen identification works on both visible (morphological and anatomical) characters and on invisible chemical characters.

Lichens are small and many of the characters are barely visible to the naked eye. This makes lichen identification rather different from flowering plant identification.

The larger lichens, those that are shrubby (fruticose) and leafy (foliose) are the most obvious and the easiest to determine to species. The crustose lichens are still relatively poorly understood in Queensland, and their identification requires great patience, considerable skill and a good microscope.

Like all fields of study, lichenology has its own language which requires patience to learn but, once learned, makes the task much easier.

The materials you will need

- A dissecting microscope to view details of lichen structure (you could scrape by with a hand lens).
- A scalpel or razor blade to cut lichen thalli.
- A bottle of potassium hydroxide solution (10%) for the K test. This solution has a long shelf life. (This is caustic, so take care).
- Some domestic bleach as a source of calcium hypochlorite for the C test. This solution is only useful while it smells of chlorine. (This bleaches clothes and burns skin so take care.)
- Access to the chemical paraphenylinediamine that can be dissolved in alcohol for the P test. The colouring used for men's beards is a useful substitute, but lacks the delicacy of the real thing. This solution or gel must only be used while fresh and light coloured: it darkens in a few hours. (Beware! Paraphenylinediamine stains everything it touches a permanent deep brown.)
- The I test uses Lugol's iodine (iodine dissolved in potassium iodide) – the standard iodine solution sold as a disinfectant works well.
- The N test requires nitric acid.
- Glass dotting rods to add the test chemicals to the lichen. Straightened paper clips work well too.
- A long-wave UV lamp. Useful and quite cheap UV torches are available but are rather a blunt instrument.
- A compound microscope will be necessary at times to look at spores. If you ever plan to identify crustose lichens, such a microscope is essential.

Information you will need to know

What it was growing on

This isn't always evident after a lichen has been collected. Hopefully, the collector has included information about the substratum in their notes. Sometimes, different species can be identified by what they were growing on. It may even be important to know the species of the host tree or what kind of rock or soil it was.

Where it was growing

It is also helpful to know where the lichen was growing. Was it in a tropical rainforest, in a desert, or a temperate woodland? Was it growing in a high altitude? Location can matter!

Growth forms, types or morphs of lichens

Crustose

As their name suggests, the thalli of these lichens are thin crusts that are flat and are tightly attached to their substratum, so much so that they cannot be removed from it. Many are ringed by differently coloured fungal hyphae (the prothallus).

Calicioid

Calicioid or “pin” lichens all have mazaedia – a build up of mature spores on the surface of the fruiting body. Most pin lichens have crustose thalli, but some are fruticose without pins. Image: *Mycocalicium victoriae*

© 2019 Board of the Botanic Gardens and State Herbarium (Adelaide, South Australia) (CC BY 4.0)
https://data.environment.sa.gov.au/Content/Publications/JABG32P001_Kantvilas.pdf

Leprose

The thalli of these lichens have little or no structure. They have a powdery or granular appearance. These lichens are often mistaken for algae. Image: *Chrysothrix* sp.

Byssoid

Byssoid lichen have a very loose felty appearance, often described as looking like teased-out cotton wool. There are two types, one where the fungal partner is dominant and the other where the photobiont is dominant. Image: *Coenogonium implexum*

© Mike Lusk (CC BY-NC)
https://www.inaturalist.org/taxa/217296-Coenogonium-implexum

Squamulose

The thalli of these lichens appear to be halfway between being crustose and foliose. They are small and scale-like and are attached to their substratum by their lower surface or at one edge. They may look like scattered flakes, or a dense mat. Image: *Cladonia* sp.

© 2012 Australian National Botanic Gardens and Australian National Herbarium, Canberra. All Rights Reserved. https://www.anbg.gov.au/lichen/photos-captions/cladonia-f-270.html

Cladoniform

This type is a combination of a primary thallus that is squamulose and upright foliose structures (podetia) that support the apothecia. The morph is named after the genus *Cladonia* as most lichens in this genus have this structure. Image: *Cladonia* sp.

Placoid

Placoid or placodioid lichens have crustose centres that are firmly attached to the substratum and foliose edges that lift away from the substratum.

Foliose

These “leafy” lichens have leaf-like lobes. They form thalli with distinct upper and lower surfaces and usually the two surfaces are different colours. Reproductive structures are most often on the upper surface of the lobes, but some foliose lichen have them on the lower. Image: *Parmotrema tinctorum*

Gelatinous

“Jelly” lichens have a variety of morphs, but they all have a jelly-like texture. The bulk of their thallus is made up by the photobiont, a cyanobacteria.
Image: *Collema glaucophthalmum*

© Marley Ford (CC NC-SA)
https://inaturalist.ala.org.au/observations/53229460

Fruticose

Often described as “shrubby”, fruticose lichens are attached to their substrate at a single point and have tendrils that may be ribbon-like or round in cross-section with no distinguishable upper or lower surfaces. They are often found dangling from or sitting upright in tree branches. Image: *Usnea inermis*

Filamentous

These are a kind of fruticose lichen, but with very long hair-like tendrils. The thread-like structure is due the fact that unlike most lichens, the structure of these species is determined by its algal partner, not the fungal.
Image: *Bryoria fremontii*

© Stephen Sharnoff (CC0 1.0)
https://lichenportal.org/portal/collections/individual/index.php?occid=4931765

Some more about lichen growth forms

A crust doesn’t always have a smooth, continuous surface as if the lichen has been painted on. Sometimes the surface of the thallus may be cracked (rimose) or the body of the thallus is broken into tiny fragments (areolate, bullate).

Some lichens even grow just beneath the surface of their substratum, e.g. between the grains of a rock (endosubstratal).

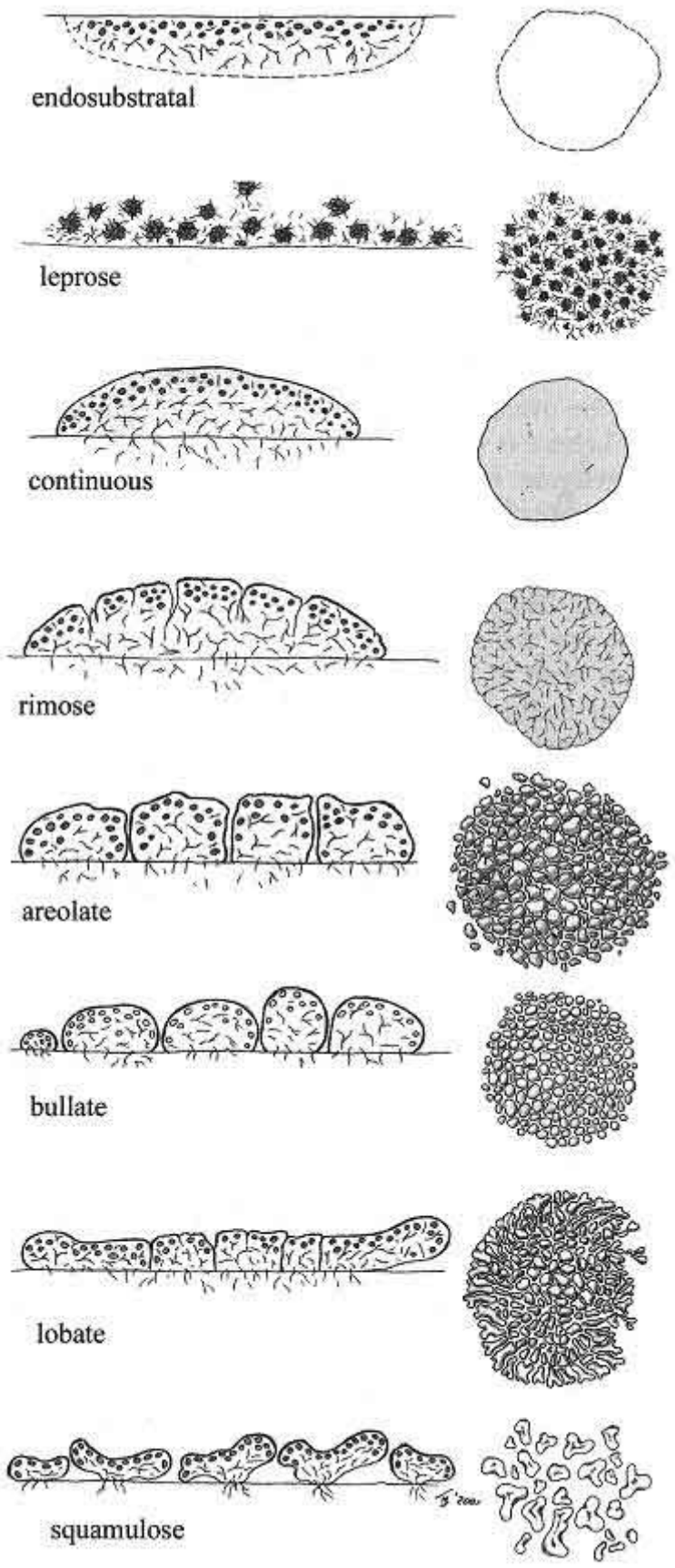


Figure 1. © 2012 Australian National Botanic Gardens and Australian National Herbarium, Canberra. All Rights Reserved https://www.anbg.gov.au/lichen/form-crustose.html

Parts of a lichen

The lichen thallus

The lichen body is termed a thallus. Three common growth forms are fruticose (shrubby) foliose (leafy) and crustose (Figs 14–58). The thallus contains two main components, a fungus and a photosynthetic organism, the photobiont. Green algal photobionts are usually present as single, bright green cells in a layer just below the cortex. Cyanobacterial photobionts are usually present as clumps of blue-black cells immediately below the cortex. The thallus of a leafy (foliose) or shrubby (fruticose) lichen usually has three distinct tissues. The outer layer is a cortex composed of tightly packed fungal cells that forms a protective layer around the thallus. In leafy lichens the upper and lower cortex are usually sharply differentiated. In shrubby lichens there is usually no such differentiation. Inside the cortex (upper only in foliose lichens) is found a layer of less dense fungal tissue with the photobionts incorporated into it. The colour of the lower cortex varies from white to jet-black: colour variation is taxonomically significant in some genera. Colour of the upper surface is also taxonomically significant because of the link between colour and chemical constituents.

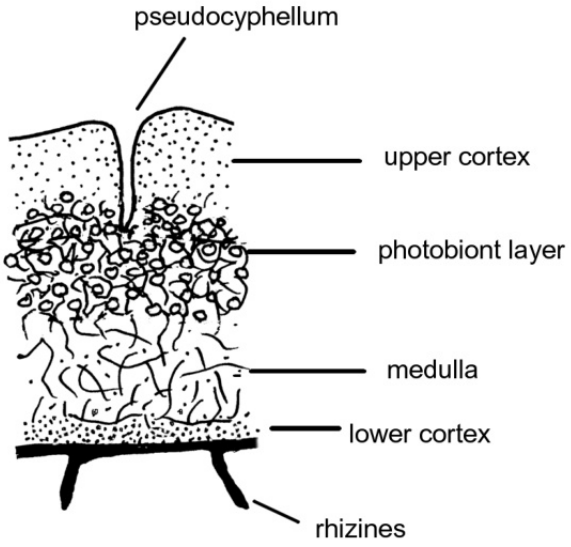


Figure 2. Vertical section through the thallus of a foliose lichen with a pseudocyphellum (pore or slit) in the upper cortex.

Crustose lichens are much simpler structures. They are basically a layer (or several layers) of lichen tissue over the surface of rock, soil, wood, bark or leaves. Internal differentiation may be quite minimal with the thallus consisting of a tangle of photobiont and fungal hyphae over the surface of the substratum. A distinct layering of medullary tissues with a defined photobiont layer may exist, and an upper cortex may also develop. A lower cortex is not found. A crustose lichen usually is inseparable from its substratum. In some cases the lichen thallus is actually within the substratum (rock or bark) in part or in full.

Peculiar lichen structures

Lichens have some distinctive asexual reproductive structures known as soredia and isidia. These are easily detached from the lichen, especially by raindrops, and when scattered may grow into a new thallus.

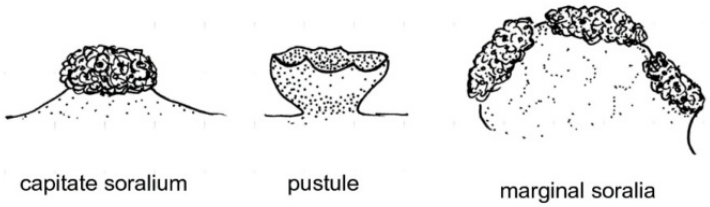


Figure 3. Soralia and pustules. Soralia are powdery masses usually on the upper surface or margins of a lichens thallus. They are composed of soredia which are reproductive structures. Pustules may sometimes develop soredia as well.

Soredia are made up of groups of photobiont cells loosely entangled with fungal hyphae. Soredia are usually gathered into restricted areas known as soralia. Soralia can be pin-points, small globular structures, or linear structures along the edge of lobes. Soralia sometimes spread to cover almost all of a thallus.

Blastidia are clusters of photobiont cells entangled with fungal hyphae but enclosed at least partially in a cortex. Blastidea are usually about the same size as soredia. They share some characteristics with both soredia and isidia. Some Blastidea grow and develop into isidia, some outgrow their cortex and become isidia. These clonal structures should not be confused with the blastidea that are vesicles in ascospores walls.

Dactyls are short finger-like structures that may be simple or branched, but that do not detach from the thallus. Dactyls may become sorediate.

Isidia are small globular to cylindrical to coralloid structures, usually less than 1 mm tall that are believed to be reproductive in nature. They have a cortex or pseudocortex and in some species swell at the tip producing a small cavity which may burst and become a pustule which in turn may produce soredia.

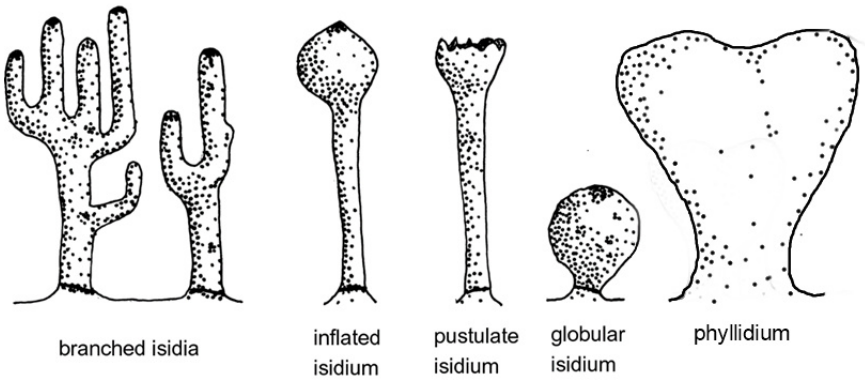


Figure 4. Forms of isidia and phyllidia commonly found on lichens. Isidia and phyllidia are corticate vegetative reproductive structures that appear on the surface of lichens. Isidia are rarely more than 1mm tall.

Rhizines are commonly present on the lower surface of foliose lichens. Rhizines may take a variety of forms that are taxonomically significant. In some cases the lower surface is quite naked, in others it is covered by a dense carpet-like tomentum, and in yet others by a light tomentum of hypha-like hairs. The distribution of rhizines on the lower surface can be significant – always note whether they come right to the lobe margins or leave a distinct bare zone around the edge.

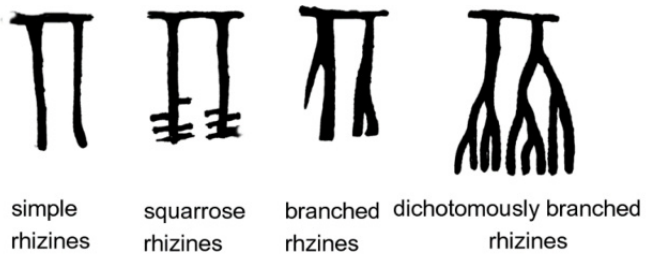


Figure 5. Variation in rhizines on the lower surface of lichens.
Rhizines occur on the lower cortex of lichens, attaching thalli to their substratum. The branching patterns have taxonomic significance.

Cyphellae and **pseudocyphellae** are pores occurring in both upper and lower surfaces (pseudocyphellae), or only on the lower surface (cyphellae). When these pores have a well-developed margin with a concave pore behind the lower cortex the structures are cyphellae. If the pore is formed simply by a thinning of the lower cortex or by the development of deep fissures through the upper cortex while the lobe is young these are called pseudocyphellae.

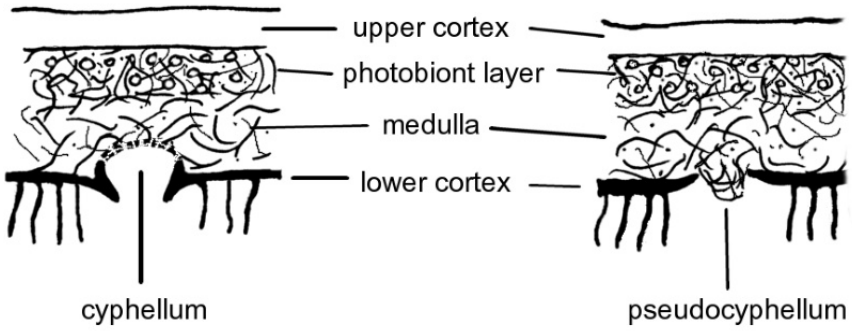


Figure 6. Structure of cyphellae and pseudocyphellae.
Cyphellae and pseudocyphellae are pores that occur in the lower cortex of some foliose lichens, especially the genera *Sticta* and *Pseudocyphellaria* which are common in parts of subtropical Queensland.

When pseudocyphellae occur in the lower cortex they are usually plugged with hyphae from the medulla, although they may not be the same colour as medullary hyphae. Take care not to confuse either the cracking that comes with age in the upper cortex or the fine, regular, reticulate cracking present in the upper cortex of some species with pseudocyphellae.

Cilia are hair like structures that occur on the margin of lobes and also sometimes on apothecia, arising from the line where the upper and lower cortex meet. Care must be taken not to confuse cilia with rhizines that protrude from the lower surface. In a few genera cilia have a distinct swollen bulb at their base: these are bulbate cilia. Cilia may be confined to the axils of lobes and may sometimes be very short.

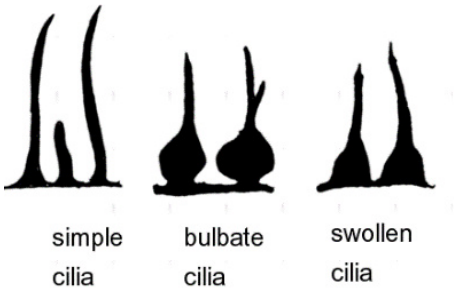


Figure 7. Forms of cilia found on thallus margins.
Cilia are hairs that occur on the margins of thalli and may take distinctive shapes. Care must be taken not to confuse them with projecting rhizines.

Ascocarps

The sexual reproductive body of an ascomycete fungus is an ascocarp. This is commonly an open disc, an apothecium. An apothecium can be up to 10 mm in diameter. An apothecium has at the centre of its structure a hymenium in which the spore-bearing asci are included. A range of sterile tissues including interascal filaments are present along with the asci, together composing the hamathecium. The Hamathecium is often surrounded by an exciple. Two common forms of exciple are lecanorine and lecideine which differ essentially in the presence of thallus tissue including photobiont cells in lecanorine exciples (a thalline exciple) and the absence of photoniont (a proper exciple) in the lecideine exciple. Zeorine exciples have both exciples, and biatorine exciples are a pale proper exciple. A thin layer, the epithecium, lies over the top of the hymenium and a hypothecium is present below the hymenium.

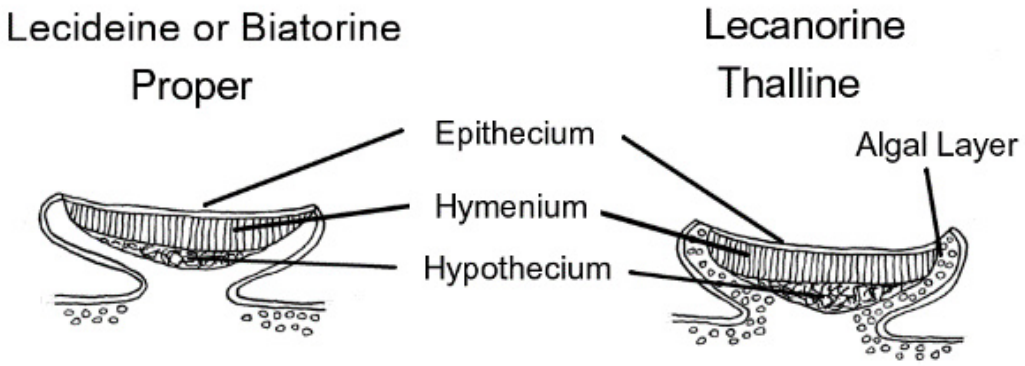


Figure 8. The structure of two common types of apothecium, the lecideine or biatorine (proper) exciple and the lecanorine or thalline exciple. Proper exciples involve tissues from within the thallus and include no photobiont. Thalline exciples are derived from the cortex and algal medullary layers of the thallus. Lecideine exiples are usually dark coloured and hard, whereas biatorine exciples are pale coloured and soft.

A second common form of ascocarp is a perithecium, which differs from an apothecium in that it is flask-shaped with the perithecial wall almost closing over the asci. These are usually much smaller than apothecia, usually only a millimetre or so in diameter.

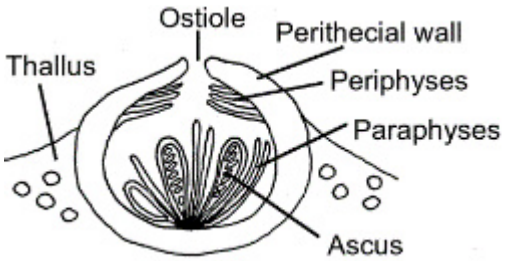


Figure 9. Section through a perithecium showing the ostiole, periphyses and interascal filaments in relation to the thallus and perithecial wall.

Ascus structure and variations

The ascus is the fungal reproductive structure in lichen formed as the result of fertilisation and producing usually eight ascospores, which are meiospores. The two common and most basically different ascus forms are the bitunicate form with a thick, rigid outer wall and a thin, elastic inner wall. Unitunicate asci have a single wall that is multi-layered and often has a complex apparatus at the tip which stains blue when treated with KOH and iodine.

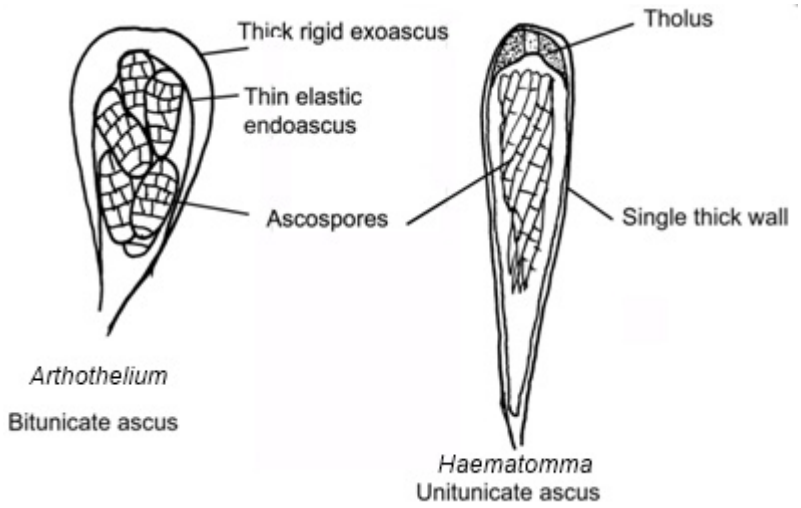


Figure 10. The structure of some asci found in lichens.
Bitunicate asci have a thin easily stretched endoascus and a thick exoascus and dehisce by simple splitting of the exoascus. Unitunicate asci show great variety of ascus tip (tholus) structure, apparently linked to spore release mechanisms and considered to have taxonomic significance.

There are many variations in ascus structure and these have been interpreted as taxonomically significant. The differences have sometimes been interpreted as family level differences, but it is now known that variation can occur in closely related taxa. Only a few of the many variants are referred to in this account, and these are illustrated below.

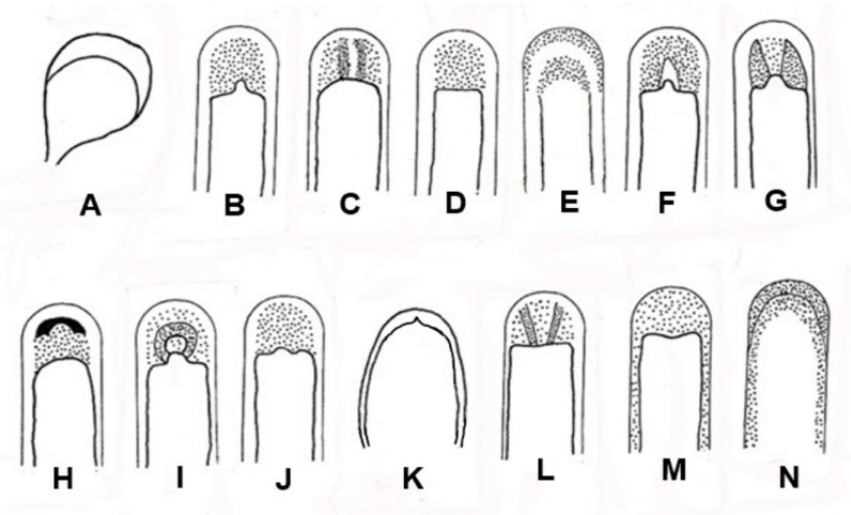


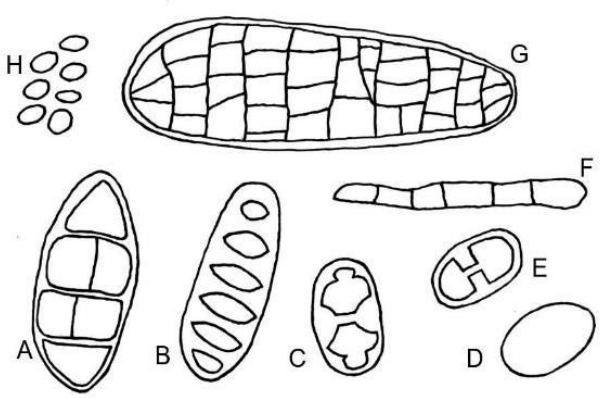
Figure 11. Perceived longitudinal sections through the ascus tip of selected ascus types.

A - *Arthonia,* **B** - *Bacidia,* **C** - *Byssoloma,* **D** - *Catillaria,* **E** - *Fuscidea,* **F** – *Lecania,* **G** - *Lecanora,* **H** - *Lecidea,* **I** - *Lecidella,* **J** - *Megalospora,* **K** - *Opegrapha,* **L** – *Porpidia,* **M** - *Trapelia,* **N** - *Teloschistes* as seen when stained with iodine.

Intensities of staining varies from specimen to specimen, as does the relative proportions of the zones and everything varies with age.

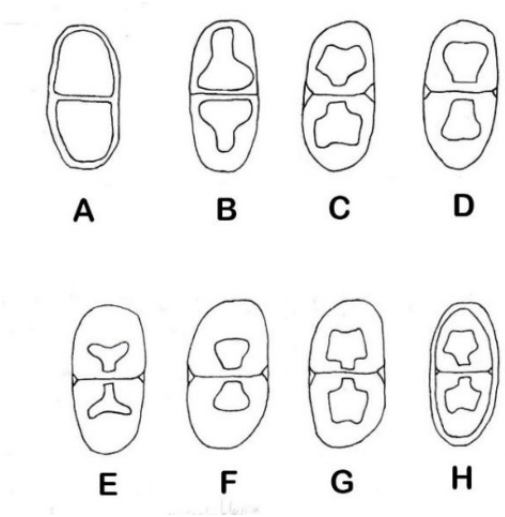
Ascospores

Figure 12.
Ascospores from a range of taxa.



A – muriform ascospore from *Diploschistes*
B – transeptate ascospore with thickened walls and lenticular lumina from *Graphis*
C – irregularly thickened one-septate ascospore from *Buellia*
D – simple ascospore from *Lecanora*
E – polarilocular one-celled ascospore from *Caloplaca*
F – elongate thin-walled ascospore from *Chiodecton*
G – muriform ascospore from *Graphis*
H – minute ascospores from *Acarospora*

Figure 13.
Some ascospores types in the Physciaceae.



Ascospores in the Physciaceae are very variable and are important in recognizing genera and species.

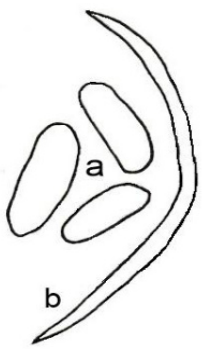
A – beltraminia type (walls uniformly but lightly thickened- often referred to as *Buellia* type, but *Buellia* spores are characteristically of the callispora type)
B – callispora type with sub-apical thickening which in an extreme results in four celled spores
C – *Dirinaria* type with apical and septal thickening
D – mischoblastia type with apical and septal thickening
E – milvina type with apical and septal thickening which may result in funnel shaped locules
F – pachysporia type with extensive thickening and upon which some other shapes converge with age
G – *Physcia* type with angular locules
H – tunicata type ascospores have a thick outer wall, whereas the other ascospore types have a thin outer wall. Spore types change with age.

Conidia and conidiomata

Conidia are non-motile fungal spores. They are produced by external budding from specialized structures, conidiophores. Conidia are not the product of sexual reproduction as are ascospores. Conidia (Fig. 14) apparently function as clonal reproductive structures, capable of being dispersed and subsequently germinating to produce fungal hyphae and thence new lichens. They also appear to act as spermatia which function as gametes in sexual reproduction. The nature of sexual reproduction in lichenized Ascomycota, however, is quite unclear.

Conidia are commonly single celled and globular to rod-shaped and of such a size that they may be mistaken for large bacilliform bacteria. Some conidia, however, are elongate to filiform or even star shaped. Conidia are produced in structures called conidiomata. The most common conidiomata are pycnidia – small flask-like structures (often black) that may be immersed in a thallus or sessile on the thallus. Pycnidia may be mistaken for minute perithecia, but the absence of asci and interascal filaments is easily seen.

Figure 14. Conidia.
Bacilliform conidia **(a)** and filiform conidium **(b)**. Filiform conidium is about 15 um long.



A less common form of conidiomata are hyphophores which occur as minute small stalked, cup-like or tent-like structures on the upper surface of some lichens, especially those growing on leaves. The forms of conidia and conidiomata are often used as taxonomic characters.

The photobiont

It is quite easy to tell if a lichen has an alga or cyanobacterium as its photobiont. Simply cut a piece of the thallus in half and examine the cut edge under magnification. Algae typically form a layer that is a bright grassy green colour. Cyanobacteria form a blue-green or blue-grey layer. Cyanobacteria also are usually in lichen that are jelly-like when wet and almost black in colour.

If the photobiont is a green alga, it is a species of Trebouxiophyceae or Ulvophyceae. The taxonomy of these enigmatic groups is not well advanced and molecular studies are portraying a complex story. That organisms from such diverse levels of taxonomy are involved is astonishing.

The number of genera and species of green algae involved in lichens is far from clear. The two largest genera are *Trebouxia* and *Trentepohlia*, each occurring in many genera, but *Coccomyxa* is another important member of the Trebouxiaceae that occurs especially in lichens with *Cladonia*. *Trebouxia* is distinctly green and unicellular, whereas *Trentepohlia* in lichens forms few-celled filaments or is unicellular and accumulates orange pigments and the cells are often yellowish. The chloroplast in *Trebouxia* is star-shaped in the centre of the cell, whereas in *Trentepohlia* the chloroplast is wrapped around the wall of the cell. Lichens including *Trentepohlia* sometimes become yellow to orange.

Trentepohlia-based lichens tend to occur in tropical and subtropical environments, especially with fungi from Graphidaceae and Arthoniaceae. *Cephaleuros* which is found in subcuticular leaf lichens may prove to be a variant of *Trentepohlia*. Lichens with *Trentepohlia* as a photobiont are almost all crustose. Lichens with *Trebouxia* as photobiont are widespread, penetrating extreme environments and include the bulk of foliose and fruticose species.

The most common cyanobacterial photobiont is *Nostoc*, a filamentous genus which fixes nitrogen from the atmosphere. *Nostoc* occurs alone or in combination with green algae in the families Collemataceae, Pannariaceae, Lobariaceae and Nephromatacae amongst others. A number of coccoid cyanobacteria (e.g. *Gloeocapsa*) also occur in lichens, especially in the family Lichinaceae. Many of the identifications of photobionts are tentative. The taxonomy of these organisms is incomplete making accurate classification impossible without much more information.

Fungus = *Fuscoderma* species
Cyanobacterium = *Nostoc* species

Lichen chemicals

Many lichens produce large quantities of unique lichen chemicals that are deposited around the hyphae. In most cases these chemicals are not water-soluble. The role of the compounds varies, some are apparently to do with management of the light regime, some have antibiotic properties, and some may be anti-herbivore compounds. The metabolic pathways that produce these chemicals are genetically based, which makes the chemicals themselves taxonomically useful.

The chemicals are deposited specifically in various tissues. A few chemicals are found only in the cortex, and these may influence the colour of the upper surface. Most lichen chemicals are found in the medulla, and a few pigment the medulla. Melanin derived pigments are found mostly in the lower cortex, but do occur in the upper cortex of some genera. Apothecial tissues may also accumulate specific chemicals in different layers. Fortunately, it has been discovered that some of the lichen chemicals show colour reactions with a variety of reagents. This makes chemical tests easy, and, since clear-cut taxonomic characters are few on a lichen, chemical tests are very useful indeed. How to carry out these tests is discussed below.

Performing colour tests

Lichens produce a wide range of chemicals that are taxonomically significant. In this respect lichens are similar to the fungi that produce antibiotics. The chemical variation is usually associated with visible variations, even if these are sometimes subtle. These chemicals are best detected by such techniques as Thin Layer Chromatography or Nuclear Magnetic Resonance. These techniques are beyond all but a few of us. A range of chemical colour tests, however, provide a lot of the information needed. Using colour tests is simple and safe if care is taken.

Tests are performed on either the upper surface (upper cortex) of the lichen, or on the medulla, a cottony layer beneath the cortex. The medulla is usually white, but is sometimes buff or even red.

To carry out a test use a dropping rod or straightened paper clip to put a small drop of liquid on the cortex, and watch for colour changes.

If you need to test the medulla, the most common test, cut away a small area of cortex to expose the medulla, then place a tiny drop of fluid (or gel if using beard colour for P tests) and watch for colour change.

A colour change may take 10 seconds or so – and the colour may first be one colour (e.g. yellow) and then turn another (e.g. red). Sometimes the colour appears then vanishes after a short time. Watch for changes!

Spot tests of foliose or fruticose lichens should be done under a dissecting microscope. On crustose lichens tests are best done under a compound microscope on a small portion of tissue under a cover-slip.

For a KC test first add a drop of K solution then a drop of C solution.

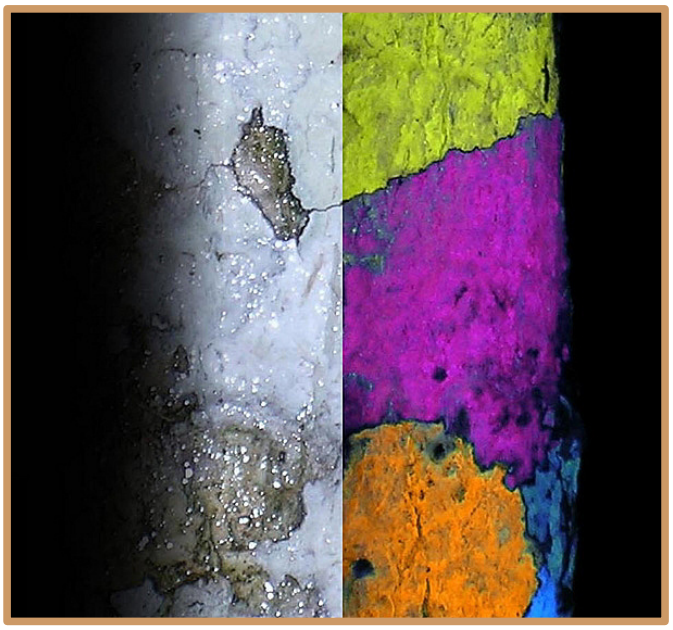
The colour of lichens

Lichens commonly have quite distinctive colours when they are air dry. All colour references in this account are for air-dry thalli.

The common colours of lichens can be attributed to the accumulation of complex organic chemicals in the upper and lower cortex. The colour of most lichens is therefore much the same whether living or dead. Some however, have no chemicals in their cortex or have radically different chemicals that may change with time after death of the lichen.

Below are some common chemicals in the cortex of lichens and the associated colours and tests:

Thallus colour	Chemical	Test
Grey	±Atranorin	K+ yellow
Grey	±Lichexanthone	K–, UV+ gold
Yellow-green	Usnic acid	K–, KC+ yellow
Gold	Parietin	K+ wine-red
Olive-brown	Melanins	



Some lichen chemicals are fluorescent under ultra-violet (UV) light.

© Robert Lücking
https://canadianmuseumofnature.wordpress.com/2014/08/28/fluorescent-lichens-dazzling-creatures-of-light/

Keys

- **Key to the Genera of Australian Macrolichens.**
  Flora of Australia Supplementary Series Number 23.
  https://www.anbg.gov.au/abrs/lichenlist/Macrolichens.pdf

- **Checklist of the Lichens of Australia and its Island Territories**
  https://www.anbg.gov.au/abrs/lichenlist/introduction.html

- **Flora of Australia Volumes 54, 55, 56A, 57 58A**
  Contain keys and species descriptions.

- **The Lichens of Subtropical Queensland**
  https://tinyurl.com/3s2yjurf
  Rogers, R.W. (2016)

Other Resources

Websites

- **Australasian Lichenology**
  The official publication of the Australasian Lichen Society.
  https://www.anbg.gov.au/abrs/lichenlist/Australasian_Lichenology.html

- **Australian Lichen Name Index – Name Check**
  https://lichen.biodiversity.org.au/nsl/services/search/taxonomy

- **Australian Lichens**
  https://www.anbg.gov.au/lichen/

- **Flora of Australia Glossary – Lichens**
  https://www.dcceew.gov.au/science-research/abrs/online-resources/glossaries/lichen

Books and brochures

- **A Guide to Lichens of Morwell National Park**
  Louwhoff, S. (2015) Brochure

- **Lichens of rainforest in Tasmania and south-eastern Australia**
  Kantvilas, G. & Jarman, S.J. (1999)

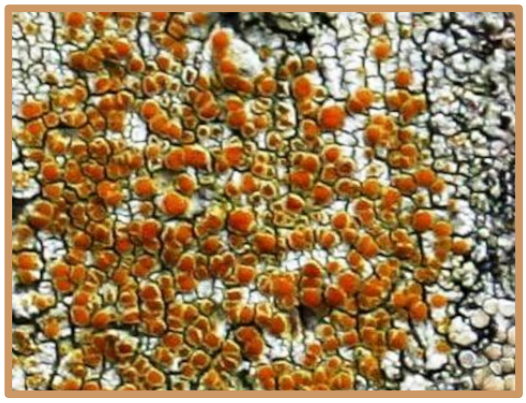
- **Lichens of South Australia**
  Filson, R.B. & Rogers, R.W. (1979)

- **Tasmanian Lichens Identification, Distribution and Conservation Status I. Parmeliaceae**
  Kantvilas, G., et al. (2002)

Photographs

Amandinea punctata showing the crustose growth habit. The thin white thallus is surrounded by a thin black margin, the prothallus emerging from beneath. The small black apothecia are densely crowded on the thallus and have a narrow, black lecideine exciple. On the trunk of a mangrove in Moreton Bay.

Caloplaca cerinella is commonly found on wood and bark. The thallus is white. Apothecia have orange discs with a white thalline margin surrounding the disc. On bark of a palm trunk in Brisbane.



Candelaria concolor is a minutely foliose species found on bark especially near roadsides and somewhat polluted areas. On *Cupressus* in Oxley.

Canoparmelia aptata is common on wood and bark and is often found on old fences. This foliose species is one of the few lichens that grow on charcoal. *C. texana* is morphologically identical, but differs in medulla chemistry.

Cladia glaucolivida occurs on soil (especially road cuttings) and termite mounds in south-eastern Queensland. The small, rather undistinguished brownish-green squamules often bear small, brown, pebble-like apothecia, many of which are visible in this picture. The apothecia may be densely white pruinose when young (upper centre). Road-cutting, Mt Coot-tha Forest Park.

Cladonia cervicornis subsp. ***verticillata*** is a striking species with podetia developed as regular tiers of cups arising from the margins of each layer. The apothecia grow on the margins of the cups. *C. kuringai-ensis* similar, but is differentiated by its irregularly split and torn cups.

Cladonia floerkeana is an extremely distinctive species with bright red apothecia on granular podetia. Squamules are visible on the left. On soil and dead wood. Rotting tree stump, Cooroy.

Coccocarpia erythroxyli growing on bark at Mt Glorious. *Coccoccarpia* is a foliose genus and has a cyanobacterial photobiont and a cortex comprised of longitudinal hyphae giving the upper surface a finely striate appearance.

Collema glaucophthalmum is a foliose thallus dominated by the photobiont – in this the cyanobacterium *Nostoc*. The thallus is very thin and crisp when dry, but when wet expands and becomes gelatinous.

Dibaeis arcuata is confined to bare soil in rainforest.. The thallus is a very thin pale crust on the soil surface with erect or recumbent pale pink podetia arising from the thallus with terminal globose apothecia.

Diorygma pruinosum is notable for its white-lipped elongate apothecia. Most graphid lichens, however, have black lipped apothecia which are commonly branched. The crustose thallus is thin and barely visible in this case.

Dirinaria applanata is very common on bark and wood in Subtropical Australia, and sometimes completely coats tree trunks.

Dirinaria applanata showing the detail of the laterally fused lobes and the orbicular soralia. *Dirinaria picta* differs in having lobes that remain separate.

Glyphis cicatricosa is a small crustose species with a thin green-brown to grey thallus. The ascocarps are immersed in a stroma which is much thicker than the thallus, usually white externally and black within. The irregularly elongate apothecia are scattered in the stroma and have a brown disc. Common on bark in subtropical Australia.

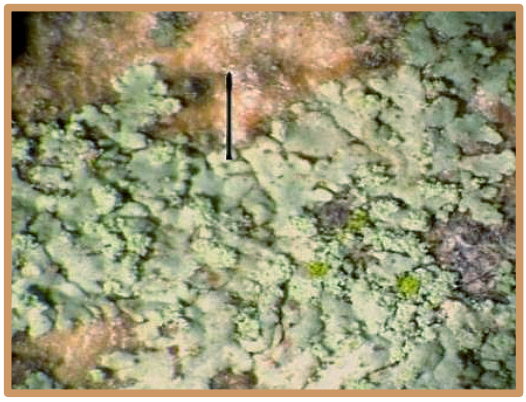
Graphis streblocarpa showing elongate and much branched (lirreliform) apothecia. The thallus is white, and the ascocarps have a black proper exciple. Most of the script lichens with black (carbonized) lips collected in subtropical Australia will turn out to be *Graphis* species.

Heterodea muelleri is possibly the most commonly collected lichen in subtropical Australia. It occurs in patches sometimes more than 50 cm diameter, lying loose on rocky surfaces, on the forest floor or on sand. When wet the foliose thallus is bright green and easily noticed with a contrasting cream to black lower surface. Apothecia are pale pink to dark red-brown. Mt Coot-tha Forest Park.

Heterodea muelleri when dry. In this condition the thallus is very brittle and is destroyed by trampling.

Heterodermia speciosa growing on rock in Mt Coot-tha Forest Park. This foliose species occurs on rocks, bark and wood throughout eastern Australia.

Hyperphyscia adglutinata occurs throughout Australia south of the tropic, and is found on all of the inhabited continents as far as the arctic circle. The thallus is rather variable but always has soralia on the lobe surface, and often on the margins too. Lobes are commonly less than 0.5 mm wide. This species is cryptically coloured, small and easily overlooked.



Lecanora argentata forms crusts on a great diversity of plants in south-eastern Queensland. It always has a dense covering of tiny apothecia. Subtropical Australia is rich in species of *Lecanora* which can only be identified by microscopic examination of apothecial structures, including the size and solubility of crystals in the apothecial margin.

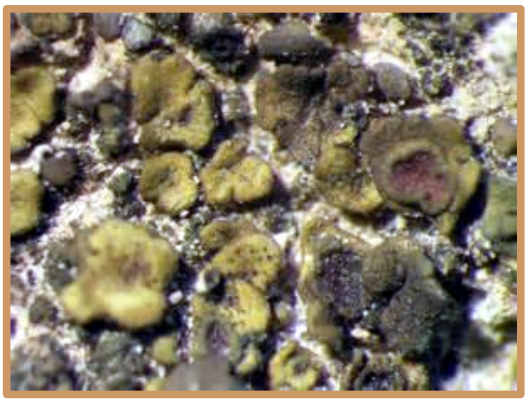
Lepraria jackii growing on soil in a crevice in rock. The thallus consists of a tangle of soredium-like bundles of photobiont and fungus forming a loose layer. Many other lichen genera may have extended sorediose patches, but examination will turn up patches of cortex.

Nadvornikia hawaiensis growing on the bark of *Lophostemon confertus* on Mt Glorious. The asomata are perithecium-like with the hymenium exposed near the top of an urn-shaped structure with a flange around the top of the urn. These structures are 1-2 mm tall. This species is almost always found on the bark of *Lophostemon*.

Marginal lobes of ***Parmotrema austrosinense*** showing the grey upper cortex and the broad white margin of the lower surface which is devoid of rhizines. Soralia are present on the margins of the rotund lobes.
P. austrosinense is found throught eastern Australia. Lobes may reach up to 15 mm wide.

Margin of the thallus of ***Parmotrema tinctorum***, perhaps the most common *Parmotrema* in subtropical Australia. This species has lobes up to 20 mm wide, and forms thalli up to 20 cm diameter on tree trunks. Masses of isidia occur on older lobes.

Peltula obscurans on rock showing an apothecium immersed in one of the squamules. The photobiont in *Peltula* is the cyanobacterium *Nostoc*. Squamules of *Peltula* are common on rock and soil in arid lands and on exposed dry rock faces.



Pertusaria xanthoplaca, a sterile yellow crust which is common on exposed rock surfaces in most of Australia. The thallus has small soralia but no isidia. The thallus may look like a thin smear of paint over the rocks or may be quite well defined.

Pertusaria growing on *Avicennia* in mangoves at Nudgee Beach. The apothecia are usually immersed in warts on the thallus surface, usually several apothecia per wart. Such crusts are very common in open woodlands in subtropical Australia. *Pertusaria* is a very species rich genus.

Lichens on a rainforest leaf. Foliicolous lichens (mostly ***Porina epiphylla***) growing on a long-lived leaf of *Wilkea macrophylla* in deep shade in rainforest at Mt Glorious. The small dots are perithecia with a thin thalline layer over them. This lichen is probably more than 10 years old. Different lichen assemblages occur on different plant species.

Pulchrocladia retipora is one of the most spectacular lichens in subtropical Australia. The white podetia which stands up to 10 cm tall with regular patterns of holes through the cortex to the medulla is highly characteristic. Found on rocks and soils which are wet for a large part of the year at high altitudes in the Border Ranges.

Pyxine australiensis is widely distributed in coastal regions, and usually occurs close to water. The thallus is usually fertile, the black discs sometimes retaining a pale grey thalline margin. *Pyxine* is a very common genus on wood, bark and on rock from the coast inland as far as Charleville.

Ramalina subfraxinea on bark of *Avicennia marina* in Moreton Bay, a shrubby (fruticose) lichen which is common in coastal subtropical Australia. The axes are flat in this and most species of *Ramalina*.

Ramboldia laeta showing the crustose growth habit and orange apothecia with biatorine (proper) margins coloured like the disc. This distinctive species is common on *Casuarina* trees near the coast.

Relicina planiuscula growing on dead wood in a eucalypt forest on Mt Nebo. The small-foliose thallus has grey, truncate lobes with marginal bulbate cilia. Isidia are visible as dots scattered over the upper cortex. The upper cortex reacts yellow with KOH (atranorin present).

Sticta diversa occurs in wet forests. The lobe margins usually have a well developed band of of squamiform isidia (phyllidia) making a dark band around the edge. The photobont is *Nostoc*, giving the algal layer a deep blue-black colour.

Lower surface of ***Sticta diversa*** showing the extensive light to dark-brown tomentum and the well-developed cyphellae through the lower cortex into the medulla.

Teloschistes flavicans has a fruticose thallus with a bright gold colour – the result of parietin in the cortex. The thallus may be erect or pendulous, sometimes up to 20 cm long. The pigmentation is characteristic of the family Caloplacaceae, and reacts purple with KOH. From mangroves at Nudgee beach.

Tephromela alectoronica is common in coastal subtropical Australia, especially on *Casuarina* trees. Most other species of the genus also have a white thallus with black apthecial discs and a white thalline margin but differ in medulla chemistry.

Thysanothecium scutellatum has a small fruticose ascocarp (up to 10 mm tall) which arises from a granular thallus. The disc is initially terminal on a stalk but becomes lateral with age. The species appears to be associated with charred wood, and even when found on soil, fragments of charcoal are found with it.

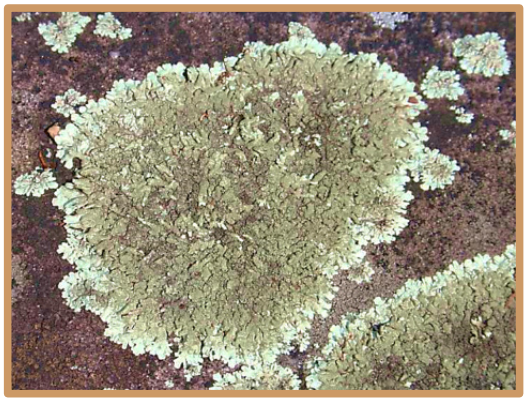
Trypethelium eluteriae a crustose species which has perithecia immersed in groups in short stromatic patches which are yellow within. The thallus is usually glossy and found on tree trunks in microphyll scrubs.

Usnea rubicunda is a shrubby or fruticose lichen which shows characteristic red pigmentation towards the base of the main axes. The more-or-less pendant axes are covered in isidiate fibrils. Apothecia are rarely seen.

Usnea scabrida* subsp. *elegans is a robust erect shrubby species that occurs in exposed locations and penetrates into dry areas. It is characterised by its large apothecia (up to 10 mm diameter) with rigid spines around the thalline margin on the back of the apothecium and over the entire thallus.

Xanthoparmelia fumarprotocetrarica. A grey coloured *Xanthoparmelia* on rock. This foliose species is fertile, has lobes up to 2 mm wide and produces neither isidia nor soredia. *Xanthoparmelia* species are almost exclusively restricted to rock and soil. Grey coloured taxa have atranorin in their upper cortex and therefore the cortex shows a yellow reaction to KOH.

Xanthoparmelia mougeotina is the most common green *Xanthoparmelia* in southern Queensland. The dense growth of isidia on the thallus may turn large areas black. Green coloured *Xanthoparmelia* contain usnic acid, not atranorin, and therefore show no cortical reaction to KOH.



Xanthoparmelia semiviridis. A foliose species which is unusual in having no rhizines to attach to a surface. This lichen rolls into a ball when dry and is free to blow around. When wet it unrolls into a flat, dichotomously branched thallus with a deep green upper surface and a straw-coloured lower surface. Long placed in its own genus (*Chondropsis*) DNA evidence showed it to be a *Xanthoparmelia*. *X. wilissii* differs in having very narrow lobes and a few rhizines. *X. semiviridis* is widespread in woodlands from Blackall to Toowoomba.

Glossary

Adnate	Attached to, joined to.
Amphithecium	Tissues surrounding the hymenium, especially exciples.
Amyloid	Reacting I+ blue with Lugol's iodine (IKI) (see Hemiamyloid).
Anastomosing	Branching and rejoining, netlike.
Angiocarpic	Having an exposed hymenium, for example an apothecium.
Anisotomic	Unequal branching, with a distinct main axis and smaller side branches.
Apical	At the tip.
Apothecium	Reproductive body having an open disc with a layer of asci and sterile structures. The disc of the apothecium may have a distinct margin that is said to be thalline (or lecanorine) if it has algae in its tissue and proper (or lecideine) if it does not. (Figure 8)
Apressed	Pushed against.
Arachnoid	Cobwebby.
Areolate	Cracked into tile-like portions, the cracks penetrating to the substratum. (Figure 1)
Ascomata	A generic term for the structure within which asci are found – e.g. apothecium perithecium.
Ascospores	Spores formed inside an ascus as the result of meioisis, usually producing 8 spores, but sometimes many more or less.
Ascus	Minute sac containing spores (usually 8) formed by a sexual process, characteristic of the Ascomycota. (Figures 10 and 11)

Axil	The angle made where one branch gives rise to another.
Axis	A major elongate strand of a fruticose lichen. (Photograph *Usnea scabrida* subsp. *elegans*)
Bacideine	Proper exciple which is pale coloured. (see Lecideine)
Bacilliform	Shaped like a bacillus (bacterium) with straight sides and rounded ends.
Biatorine	Of apothecia – with a pale or at least not carbonized proper exciple. (Photograph *Ramboldia laeta*)
Bitunicate	An ascus structure in which two distinct walls are apparent, and asci are commonly broadly clavate to sub-spherical. Spore release is by fission of the outer layer and protrusion of the inner layer through the tear. (Figure 10)
Blastidia	(1) Small secondary vesicles in an ascospore. (2) Small pustule-like structures on the upper cortex of some species.
Bulbate cilia	Cilia with an onion shaped bulb at the base where they arise from the margin of a lobe. (Figure 7)
Byssine	Composed of loosely tangled threads.
Campylidia	Erect clonal reproductive structures producing masses of conidia, sometimes erect and like a bell tower (campanile) sometimes prostrate or triangular or looking like a cat's ear.
Capitate	A sub-globular head-like shape.
Carbonized	Refers to tissues that have a dense black deposit in them.
Cartilagenous	Having the structure of cartilage; tough.
Cephalodia	Structures housing cyanobacteria within a lichen that otherwise has a green algal photobiont. Cephalodia may be on the thallus surface or embedded within the thallus.
Chondroid	Tough, cartilaginous

Cilia (sing. cilium)	A coarse hair-like structure growing on the margin or upper surface of lobes or on apothecia. (Figure 7)
Clavate	Shaped like a club.
Clypeus	Shield-like growth covering one or more perithecia.
Coccoid	Referring to photobionts that are globular or in spherical masses in contrast to filamentous forms.
Columella	A sterile patch of tissue within the disc of an apothecium, which may be round or irregular and may represent the remants of older discs.
Conidia	Minute spores (conidiospores) produced clonally that may have sexual funtcions or may be a mode of vegetative reproduction.
Coroniform	A crown-like structure with triangular points turned out around a more-or-less circular disc.
Cortex	A developed layer of compact fungal tissue enclosing other lichen tissues. (Figure 2)
Corticate	Having a cortex.
Corticolous	Sitting on bark.
Crustose	A thallus with the lower surface without a developed cortex, and the lower surface inseparable from the substratum.
Cryptolecanorine	An apothecium with a thalline exciple that is immersed within the thallus.
Cyanobacteria	Blue-green algae: photosynthetic bacteria.
Cyphellae	Pores in the lower surface of lichens that are cup-shaped and have a distinct, well-developed margin. (see Pseudocyphellae)
Dactyls	Finger-like protrusions on the upper cortex of a lichen that may burst or become sorediate. (see Isidia)

Decumbant	Resting on the substratum with the ends turned up.
Dimorphic	Thalli with two distinct phases, an initial vegetative crust or squamule from which erect fruiting structures arise forming podetia or pseudopodetia, often displacing the vegetative thallus. Common in the Cladoniaceae.
Ecorticate	Without a cortex.
Endolithic	Immersed in rock.
Endophloic	Growing within the bark. (see Epiphloic)
Entire	Smooth, continuous – for example, not toothed or crenate.
Epihymenium	A layer of tissue over a hymenium, often the ends of paraphyses.
Epilithic	Sitting on rock.
Epiphloic	Growing over bark. (see Endophlioc)
Epithecium	A layer on the surface of the hymenium of an apothecium. (Figure 8)
Epruinose	Without pruina.
Erumpent	Bursting out from within. Bursting at the tip, especially of dactyls and isidia.
Esorediate	Without soredia.
Euamyloid	Reacting I+ blue without pre-treatment with 10% KOH.
Exciple	Sterile tissue surrounding the hymenium of an apothecium. (Figure 8)
Fibril	A very small fibre. In *Usnea* – short simple branches perpendicular to the main branches.
Filiform	Like a line, long and very slender.
Flexuous	Wavy, especially of apothecial margins.

Foliicolous	Growing on leaves. (Photograph *Porina epiphylla*)
Foliose	Leafy; a thallus that is flat and thin with pronounced differences between the upper and lower surface, usually more-or-less attached to the substrate by rhizines along the length of the lobes. (compare with fruticose, crustose).
Foveolate	Delicately pitted, dimpled.
Fruticose	Shrubby; a thallus that has little or no dorsiventral differentiation, lobes or axes with radial symmetry; usually attached only by a holdfast. (see Foliose, Crustose)
Fusiform	An elongate spindle shape.
Geniculate	Bent at a sharp angle.
Glabrous	Smooth, without hairs.
Halonate	Having a layer of gelatinous material – e.g. surrounding a spore.
Hamathecium	An inclusive term for the sterile filaments that are associated with asci, including paraphyses and pseudoparaphyses.
Hemiamyloid	Reacting I+ red with Lugol's Iodine (see Amyloid) before treatment with KOH.
Holdfast	A well-developed structure attaching a lichen thallus to its substrate at a single point.
Homiomerous	Photobiont and mycobiont uniformly mixed, not forming distinct layers.
Hymenium	The layer in an apothecium that includes the asci and paraphyses. (Figure 8)
Hyphae	Fine strands of fungus.
Hyphophores	Structures housing minute asexual spores, often bristle-like but may be triangular and like a cat's ear, umbilicate, or flat.

Hypothallus	A layer of fungal tissue on the surface of a substratum upon which other tissues lie. Often visible at thallus margins.
Hypothecium	A layer of tissue below the hymenium in an apothecium. (Figure 8)
Immersed	Embedded in the thallus.
Indumentum	A layer of hairs or rhizines.
Inflated	Swollen, with loosely packed internal hyphae or hollow.
Inspersed	Having a large number of oil droplets, usually referring to the hymenium.
Interascal filaments	A descriptive term used to describe the sterile filaments between asci, often described as paraphyses or paraphysoids depending on their ontogeny. (Figure 9)
Isidia	Tiny cylindrical, coral-like or globular structures on thalli that have a developed cortex-like outer layer; serve as reproductive bodies. (see Dactyls) (Figure 4)
Isotomic	Branching into two or more branches all of equal diameter.
Labia	The lip-like structures including the exciple(s) of elongate apothecia (especially Graphidaceae). (see Lirella) (Photograph *Graphis streblocarpa*)
Laciniate	Appearing torn or shredded.
Laminal	On the surface, often in contrast to marginal.
Lateral	At or near edge, especially side or secondary branches.
Lax	Loosely arranged.
Lecanorine	Of exciples (thalline exciples) or margins that include photobiont cells. (see Lecanoroid)
Lecanoroid	Ascus of the same type as Lecanora. (see Lecanorine) (Figure 8)

Lecideine	Of exciples (proper exciples), usually dark coloured, that do not include photobiont cells. (see Lecidioid and Bacideine) (Figure 8)
Lecideoid	Of asci – like the ascus of Lecidea. (see Lecideine) (Figure 8)
Lenticular	Of spore lumina that are bi-convex or shaped like a lens. This implies thickening of spore walls. (Figure 12)
Leprose	Of algal cells loosely aggregated by fungal hyphae, like Lepraria. (Figure 1)
Lichenicolous	Growing on lichens.
Lignicolous	Sitting on wood.
Lirella	An elongate, sometimes branched apothecium, often with the exciples forming labia along the margins. (Photographs *Diorygma pruinosum* and *Graphis streblocarpa*)
Lobes	Major individual portions of the thallus. (Photographs *Parmotrema austrosinense* and *Xanthoparmelia fumarprotocetrarica*)
Lobules	Small lobe-like structures that may grow on the margin or upper surface of a lobe.
Locules	Cavities, especially cell cavities in spores. (Figure 13)
Lumen (pl. lumina)	The portion of a cell within the cell wall, especially of ascospores.
Maculate	Spotted or blotched.
Marginal	On the edge of the thallus where upper cortex meets the lower cortex.
Mazaedium	An ascoma in which asci disintegrate early leaving the ascospores to mature free amongst the remains of asci, paraphyses and other tissues. Usually a black amorphous mass.
Medulla	A usually cottony tissue within a lichen. (Figure 2)

Micacaeous	Glistening like the mineral mica.
Moniliform	Arranged like a string of beads.
Mucronate	With a small bump or extension, especially of spore ends.
Muriform	Of spores – having longitudinal and transverse septa. (see Transseptate) (Figure 12)
Ochraceous	Yellow to orange-brown, like ochre.
Ostiole	The opening of a perithecium or deeply cupular ascomata.
Papilla	A small pimple-like swelling on a lobe or axis.
Paraphyses	Sterile basally attached filaments found packed between asci. (see Interascal filments) (Figure 9)
Paraplectenchymatous	Tissue made up of isodiametric cells derived from hyphae.
Parenchymatous	For lichens, see paraplectenchymatous.
Pedicillate	On a short stalk.
Pendulous	Hanging.
Periphysoids	Erect paraphysis-like filaments found in the neck of perithecia or around the margin of some apothecium-like bodies, especially in the lotremoid Graphidaceae. (Figure 9)
Perithecium	A structure containing asci which is more-or-less globular (or semi-globular) and opens by a pore. (Figure 9)
Photobiont	The photosynthetic organism that provides energy for the lichen. These are either green algae (often *Trebouxia* or a close relative) or cyanobacteria (commonly *Nostoc*).

Phyllidia	Small, flattened lobule-like structures with distinct upper and lower surfaces that occur on the lobe margin or cortex of some foliose lichens.
Pilose	Having a pile, like a carpet.
Placodioid	Having distinct lobes at the margin (of crustose thalli).
Podetium	A stem-like structure derived from ascal tissues that supports the ascocarp and produces a fruticose thallus, especially in *Cladonia*. (Photograph *Cladonia cervicornis* subsp. *verticillata*)
Proper margin	An exciple derived from ascomatal material and devoid of photobiont. (Figure 8) (Photograph *Ramboldia laeta*)
Prothallus	A layer of fungal hyphae underlying a thallus, lacking photobiont, which may be visible through crack or joints in the thallus or extend beyond it. (Photograph *Amandinea punctata*)
Prototunicate	Of an ascus with a single simple, wall layer and no specialised dehiscence structures.
Pruina	Powdery material scattered on thalli or over discs of a lichen.
Pseudocyphellae	Openings through the upper or lower cortex of a lichen, the pores not having a developed margin (see Cyphellae). Pseudocyphellae may be pinprick size, small irregular pores or elongate crack-like structures that penetrate the upper or lower cortex. They are evident on young lobes and should not be confused with cracks that come with age or fine reticulate cracks that sometimes occur as a function of cortical structure. (Figure 6)
Pseudoisidium	An excrescence, similar to an isidium, on the surface of a lichen thallus. Also refers to an isidium lacking photosynthetic cells, as occurs in *Pseudocyphellaria* (Lecanorales).
Pseudoparaphyses	Paraphysis-like structures developing in the Hamathecium.

Pseudopodetia	Structures with the appearance of and serving the function of podetia in raising apothecia above the substratum (e.g. in *Cladia*).
Pseudothecium	Having asci aggregated in unwalled groups.
Punctiform	Like a dot.
Pustulate	Bursting open, sometimes to produce soredia.
Pustule	Small eruption in a surface. (Figure 3)
Pyrenocarpic	Having a perithecioid ascocarp. (Figure 9)
Reticulate	Cracked or otherwise marked in a net-like pattern.
Rhizine	Well-developed organ of attachment on the lower surface of a foliose lichen. These may be simple (unbranched), irregularly branched, dichotomously branched or terminate in a bushy branching system. (see Rhizoids) (Figure 5)
Rhizoids	Fine filaments (hyphae) attaching a lichen to a surface. (see rhizine)
Rimose	Cracked superficially forming tile-like segments.
Rosette	Grouped in a circular arrangement.
Rotund	With a broadly rounded end. (see Truncate)
Rugose	Rough, with ridges and depressions.
Schizidium	Propagule formed by splitting off upper layer of the thallus.
Secondary lobes	Small lobes that grow from the centre of an older thallus.
Septate	Of spores – having dividing walls. (Figure 13)
Septum	Dividing wall, especially in ascospores. (Figure 13)
Sessile	Without a stalk, sitting directly on a substratum.

Setiform	Bristle-like.
Simple	Not divided into several more or less similar parts.
Soralia	Aggregates of soredia to form powdery masses. (Figure 3)
Soredia	Small clusters of algal cells entangled in fungal hyphae to from granules: asexual reproductive structures. (Figure 3)
Sporoblastidia	Small locules within a thickened spore wall, often at the spore apex.
Squamule	A small discoid or scale-like structure. (Photograph *Peltula obscurans*)
Squamulose	Made of scale-like structures, usually a small thallus with an upper cortex but not a lower cortex and attached by rhizoids or an umbilicus.
Stellate	Star shaped.
Stipitate	On a stalk.
Stramineous	Straw yellow.
Striate	Having fine lines, rather like fine scratches.
Stroma	A pad of thalline tissue in which ascomata are immersed. (Photograph *Glyphis cicatricosa*)
Terete	Cylindrical, frequently circular in section but narrowing to one end.
Thalline margin	An exciple that includes tissue derived from the thallus and containing photobiont. (Figure 8)
Thallus	A term used loosely here to indicate the main photosynthetic body of the lichen, including podetia (in *Cladonia*) and pseudopodetia (in *Cladia*).
Tholus	Structures within the tip of an ascus related to spore release. (Figure 10)

Tomentum	A layer of hair-like structures other than discrete rhizines. (Photograph *Sticta diversa* underside)
Torus	A circular band, used especially of a band around the septum on some 2-celled ascospores (e.g. *Buellia*, *Rinodina*).
Transseptate	Ascospore with transverse (cross) septa but no longitudinal septa. (see Muriform) (Figure 12)
Truncate	The ends (usually of lobes) squared, having the appearance of having been cut off at right angles to the lobe axis. (see Rotund)
Umbilicus	A narrow central fastening or protrusion.
Unitunicate	An ascus with a single (often multi-layered) wall (see bitunicate). Unituncate asci are usually more or less cylindrical and often have a complex tholus. (Figure 10)
Zeorine	Having both a distinct proper exciple and thalline exciple.

Notes