LICHEN FLORA OF GREECE

including lichenicolous fungi

Version: 17 September 2020

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Note: This is a draft. Some sections need revision and improvement. There are probably still some errors. Use with caution.

Note: I would be happy to consider collaborating with others with a view to improving this Flora. The main need at present is for full descriptions, from Greek material, of those species that I have not seen myself.

Copyright: Some rights reserved. For details see the Introduction section.
This Flora is dedicated to my husband,  
Reay Sutherland 
without whose unwavering support, 
throughout nearly 40 years, it would not 
have appeared.  

**Warning:** This is a draft. It is 
incomplete and it may contain errors.
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Introduction

Scope

This is the first lichen Flora written for Greece. Because the whole of SE Europe and the Mediterranean Basin are poorly served for lichen Floras at present, it will also be of use to workers beyond the borders of Greece itself. It can be supplemented with the Greek lichen checklist, Abbott (2009), and the Atlas of Greek Lichens, downloadable from www.lichensofgreece.com/atlas.

The lichens of SE Europe and large parts of the Mediterranean are not well known, and there are outstanding taxonomic problems in many groups. Those problems can not be solved here, but I have tried at least to indicate where the problems are. Their solution will require monographic revisions of the groups concerned, revisions which include far more material from SE Europe and the eastern Mediterranean than has been usual in the past.

Keys include all species reported for Greece, except for a few poorly known ones, and also include, in a different font, many species that have not been reported for Greece but which might be expected to occur here. Inclusion of the latter is important, because the serious worker will eventually encounter species not previously reported for Greece. The broad scope of the keys will also make the Flora of use for determining collections from other countries in the region.

Information on distribution and ecology is provided for all Greek species. Detailed descriptions are provided for a selection of the Greek species. They are based on my own observations of Greek material unless otherwise stated or clearly implied (e.g. with the phrase 'said to be ...'). For some species I have seen few collections, and the descriptions may indicate smaller variation in some characters than you may observe yourself. For the remaining Greek species, information in the keys amounts to a brief description, and I cite references that can be used by those requiring more detailed descriptions. I hope eventually to add my own detailed descriptions for many of those species too. Published descriptions prepared from material collected outside Greece should be used with caution; I have found that they do not always fit Greek collections well.

Generic delimitations in lichenology have changed frequently in recent decades, and the process continues, leading to instability in nomenclature. The new generic concepts are themselves often unstable. For practical reasons, therefore, I prefer here to use conservative generic concepts in some groups, even if they are problematic from a strict taxonomic viewpoint. In my view a Flora need not, and probably should not strive to be on the leading edge of taxonomic opinion; the aims of a Flora, and the needs of its users, differ from those of a taxonomic monograph. I am particularly wary of new, monospecific genera, as Arcadia (2009) demonstrated that lichenologists have introduced far more monospecific genera than is biologically plausible. I am also uncomfortable with the increasing tendency to delimit genera on the basis of DNA evidence alone, absent any clear morphological delimitation, as such genera are of little use for the practical matter of determining collections. To strive to make taxonomy always reflect phylogeny is to confuse two matters that are distinct. Taxonomy is, at least in part, a matter of convenience, and when it is convenient to do so I am perfectly willing to use genera that cladistic purists would reject. The claim that "taxonomy should always reflect phylogeny" is merely an opinion, not an observable fact or even a scientific hypothesis (it is not falsifiable), and I may legitimately hold a different opinion. In fact, we never know the true phylogeny, and operationally the claim amounts to "taxonomy should always reflect the latest phylogenetic hypotheses", which seems less than compelling. Perhaps a more robust observation is also in order. The unstable nomenclature that lichen taxonomists have created continuously for two and a half centuries, and continue to create, has caused, and continues to cause, a huge amount of unnecessary work for other scientists. A group whose ideas have proved in the past to be wrong far more often than they are right has little claim to any credibility when they present their latest hypotheses.

The biological scope of the Flora is the same as that of Abbott (2009), i.e. 'lichens' as usually understood, lichenicolous fungi, and a few miscellaneous taxa that have often been studied by lichenologists.

The online version of the Flora will be updated regularly. To simplify updating, sections are largely independent of each other, and may be updated independently. As a result, there may be minor inconsistencies between different sections.

Feedback is welcomed

I would, of course, be grateful to learn of any errors in this document. They will be corrected in the next update, if possible. All other suggestions for ways in which this Flora could be improved will be gratefully received. Feedback is a sign that a reader is taking a serious interest in a work, and I always regard it as a compliment, never as a criticism. Although it may not be possible to implement all suggestions, especially those that would require a lot of labour, all will receive serious consideration. Feedback on the keys would be particularly welcome, as I have no other way of learning whether they work well for people other than myself.
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Citation

I suggest you cite as:


The website holds only the current version of the Flora, and I may not keep a copy of every old version, so if it is important that you can consult a cited version in the future, then I suggest that you take and archive your own copy.

Acknowledgments

I was astonished to see multiple instances of my own unpublished scholarship concerning lichens epithets appear, without acknowledgment or permission, in a national checklist published recently by an eminent Italian lichenologist. In this Flora I have tried to acknowledge all contributions. If you feel that you have contributed to this Flora and that your contribution has not been adequately acknowledged, please let me know and the matter will be rectified immediately.

In constructing the keys I have drawn on many published works. In most cases acknowledgments are impractical, because most keys incorporate input from several sources as well as a contribution from myself, and have been modified many times over a period of 20 years. However, where a key draws heavily on a single publication, with only minor modifications, I have tried to acknowledge the fact. If I have inadvertently overlooked any cases where an acknowledgment would be appropriate, please bring them to my attention.

For specific help of various sorts on the many matters relevant to the Flora I am indebted to: Rebecca Abbott, Steen Christensen, Brian Coppins, Sandy Coppins, Alan Fryday, Josef Hafellner, David Hawksworth, Paul Kirk, Kerry Knudsen, John McNeill, Mark Powell, Claude Roux, Ayhan Şenkardeşler, Harrie Sipman, Reay Sutherland, Ulrik Søchting, Anders Tehler, Jan Vondrák and Olga Vondráková.

Bella, Chica and Spotty continue to provide support in their own way. Binty, Oscar and Priscilla are, alas, now chasing mice only in the Elysian Fields.
A note for beginners

There has not been a tradition of lichenology in Greece, so any Greek person wishing to take up the study of lichens will have to be largely self-taught. Unfortunately, there is no guide to Greek lichens for beginners; the sort of book that includes a limited number of species with some good photographs and drawings has yet to be written for Greece. Books of that nature written for other countries will be helpful as an introduction to lichens in general, and will explain some of the technical terminology, but will lead to errors if used to identify Greek species. This Flora assumes some previous knowledge of lichens, and beginners will find it challenging to use, though the Glossary section provides some help with terminology and technique. I can merely offer the following general advice to any Greek person who wishes to study the lichens of the country.

First, buy a good hand lens with x10 (linear) magnification. This is absolutely essential. Good lenses are not expensive. Then, with this Flora in hand, go and look at some lichens. With practice you will be able to identify some of the foliose and fruticose species. You won't be able to identify many crustose species, as those usually require use of a microscope. You will make lots of mistakes, but don't worry about that. Experienced lichenologists make lots of mistakes too. They just don't advertise the fact.

One problem to be aware of when trying to identify your collections is that different, but superficially similar, species sometimes grow in close proximity. Examine your material carefully before using the keys. If it looks as though two species even might be present, then use the characters from only one of them. Note too that ample material of a species, in good condition, is always easier to identify than a scanty collection. Trying to determine scanty material is usually a waste of time; just discard it.

Second, join the British Lichen Society. It caters for people of all levels of ability and, despite its title, is international. Membership is open to anyone interested in lichens; you don't need a proposer or formal qualifications. Membership is not very expensive. Members receive the Society's Bulletin, which contains many helpful articles.

Third, if at all possible, attend one of the Field Courses for beginners held by the British Lichen Society, usually in the British Isles. There you will learn far more than I could explain in many pages of words. You will also meet people who will be willing to assist you with lichens long-term, especially if you demonstrate genuine enthusiasm. These courses are not cheap, but if you are serious about lichens they are an excellent investment. There is nothing comparable in Greece.

Fourth, once you have acquired some experience, embark on a project that has a purpose to it. This will maintain your interest, and could also make a real contribution to science. A useful project would be to compile a thorough checklist or mini-Flora of some limited region, such as a dimos or nomos, or of some particular habitat, e.g. the Abies cephalonica (ο έλατο) forests of Greece. Except for a handful of islands, nowhere in Greece has received this sort of thorough coverage. Even if you have to restrict your scope, e.g. to corticolous macrolichens, it would still be of value. Make sure you publish your results, so that others can benefit from them.

I would advise against attempting work of an “applied” lichenological nature, such as using lichens as ecological indicators, to start with. That sort of work can be valuable, but to do it well requires a good knowledge of the lichens themselves, and that is best acquired through a period of “pure” botanical study.

The study of lichens is not dangerous, but you do need to take a few simple precautions. When collecting crustose lichens from rocks, you will have to use a hammer and chisel, and sometimes considerable force. Always wear goggles, or at least glasses, to protect your eyes from flying rock splinters. When collecting from bark with a knife, take the usual care you would in any circumstances with a sharp knife. If collecting in remote areas, take all the usual precautions you would at any time in the outdoors. In the laboratory you may need to work with a few chemicals and with ultra-violet light: see the entries in the Glossary under C, K, N, P and UV for remarks on safety. Reagents for chromatography would pose substantial additional health hazards, but chromatography is beyond the scope of this Flora.

I can offer further assistance, preferably by email in the first instance, to any student of Greek lichens. As you would expect, I will be more willing to help those who demonstrate a serious commitment to the subject.
Keys to genera

These keys include all genera that have been reliably reported for Greece, and some others that might occur in the country. They are intended for use in the laboratory, not the field. It is not possible, in the present state of our knowledge, to construct keys that are safe for field use in Greece.

The keys are artificial; they do not mirror the overall taxonomy of the ascomycetes. A natural key, if one could be written at all, would be of little use, as ascomycete taxonomy at the level of families and above is based on characters that are often not readily observable.

The keys do not usually go as far as individual species. For keys to species within a genus, see that genus in the taxonomic section.

If a name is in bold font in a key, e.g. Parmelia, then at least one species in that genus has been reliably reported for Greece. If the name is in regular font in parentheses, e.g. (Thermutis), the genus has not been reported for Greece but, from its known distribution and ecology, I consider that it might occur in Greece.

Some terminal branches of a key list more than one genus, when none of those genera has been reported for Greece. Such branches will be expanded to key out individual genera if the need arises.

The keys use an indented format with the number of choices available at each step being apparent on arriving at that step. This type of key, familiar to lichenologists from Clauzade & Roux (1985) is, in my opinion, the most elegant of all possible formats. It deserves to be more widely used.

In these keys, and in the keys to species in the taxonomic section, the right hand margin is not justified. That is deliberate, as I find that it makes the keys easier to use. Feedback on this point from other users would be welcomed.

The meaning of technical terms is explained in the Glossary. For simplicity, the keys may use informal terminology if there is no risk of confusion, e.g. upper cortex hyphal versus upper cortex cellular rather than the more correct upper cortex prosoplectenchymatous versus upper cortex paraplectenchymatous.

Keys which included only taxa already reported for Greece would be of limited use, as serious investigations will encounter additional taxa. On the other hand, the more taxa that are included, the harder a key is to use. In deciding which lichens to include, in both the keys to genera and those to species, I have been guided by the distribution in other regions, especially Europe, North Africa and western Asia. I have examined with particular care the distribution in Italy, and have not normally included taxa which are present in that country only in the Alps.

For lichenicolous fungi I have had to taken a different approach, as the distribution of most of them is poorly known. I have therefore assumed that any described species should be included unless I can see a good reason not to. This does mean that the keys to lichenicolous fungi are quite lengthy, and out of proportion to the rather few species reported for Greece, but this may at least raise the profile of these organisms in Greece and encourage their study.

Unfortunately, the number of described species of lichenicolous fungi is increasing rapidly. Relevant information is very scattered and often hard to obtain. Generic dispositions are unstable. This makes it almost impossible for someone like myself, who is not a specialist in these organisms, to provide good, workable, up-to-date keys. I have done my best, but the results are inevitably far from satisfactory. The last global keys to these organisms were produced over 30 years ago, and there is a real need for the specialists to produce a modern replacement.

These keys, and the keys to species in the taxonomic section, are intended for use with typical mature specimens that are in good condition. They may not work for specimens that are damaged, parasitised, juvenile or scanty, or which have very atypical morphology, anatomy, chemistry or ecology. I could write keys that would cover a broader range of specimens, but they would be much longer, harder to use, and probably less useful overall.

Colours used in the keys refer to fresh material. The same applies for the keys to species in the taxonomic section. In some species, colours change after a few years in the herbarium, usually becoming browner and/or duller. It is good practice to note the colour of fresh collections before filing them in the herbarium.

If you are unfamiliar with keys, note that keying out a specimen is not the same as correctly determining the specimen. (You may have made a mistake, or the key itself may be imperfect.) After keying out a collection it is essential to compare your material with a description of that species. If it doesn't fit the description, something is wrong and you need to go through the key(s) again. Don't "force" a specimen into a species. If you have determined it correctly, it won't need forcing. I frequently make mistakes on my first attempt to determine an unfamiliar species, and so will you.

Note also that the presence of a character carries more weight than its absence. For example, if a couplet contrasts "cilia present" with "cilia absent" and your specimen has cilia, it is obvious which branch to take. If it lacks cilia then (1) you should examine it again, in case you have overlooked any inconspicuous cilia, and (2) if you still can't find any, take the "cilia absent" branch of the key, but remember that you might just happen to have a non-ciliate specimen of a normally ciliate species. (This is why scanty material is best discarded: it often lacks important characters.)

Generic key: Main groups
Before using these keys it is advisable to examine the Glossary, especially the entries under 'colours' and 'photobionts'.

11 Fungus forming a lichenised thallus. See Notes 1 and 2.

22 Fungus a basidiomycete or hyphomycete. All species rare. **Generic key 0: Basidiolichens and hypholichens**

2 Fungus an ascomycete. All lichens commonly encountered in Greece belong here.

33 Thallus gelatinous or subgelatinous when wet, without a true medulla. Both symbionts embedded in a continuous gelatinous matrix. Photobiont not confined to a distinct layer in most species. Thallus usually ±blackish in colour; or with a brownish, olive or dark reddish tinge in a few species. Prothallus absent. Photobiont a cyanobacterium in most species. On various substrates, but not usually on strongly acidic ones. **Generic key 1: Gelatinous lichens** (See Note 3.)

3 Thallus not gelatinous or subgelatinous when wet; a true medulla present in most species. Symbionts not embedded in a gelatinous matrix. Photobiont confined to a distinct layer in most species. Thallus colour various. Prothallus present or absent. Photobiont various. Substrate various, acidic or not.

44 Thallus not firmly attached to the substrate everywhere.

5555 Thallus of two distinct growth forms. Primary part squamulose or crustose; secondary part fruticose, or of ±vertical tubes or columns. **Generic key 2: Bipartite lichens**

55 Thallus shrub-like or beard-like; attached to substrate at only a few points, or unattached; formed of ±cylindrical or ribbon-shaped parts. If ribbon-shaped, upper and lower surfaces ±identical. **Generic key 3: Fruticose lichens**

55 Thallus of leaf-shaped lobes, or of ribbons with distinctly different upper and lower surfaces; usually separable from the substrate over a large part of their area. **Generic key 4: Foliose lichens**

5 Thallus of small scales, sometimes only separable from the substrate at their edges. **Generic key 5: Squamulose lichens**

4 Thallus a crust, firmly attached everywhere to the substrate, or thallus absent.

55555 Ascomata perithecia. **Generic key 6: Crustose lichens with perithecia**

5555 Ascomata mazaedia or stalked apothecia. **Generic key 7: Calicioid genera**

55 Ascomata apothecia that are ±rounded or, in a few genera, irregular but not obviously elongate. **Generic key 8: Crustose lichens with elongate apothecia**

66 Thallus and/or apothecia yellow, orange or red. (See Note 4.) **Generic key 9: Yellow crustose lichens with apothecia**

6 Neither thallus nor apothecia yellow, orange or red. **Generic key 10: Crustose lichens with rounded apothecia**

5 Ascomata absent. **Generic key 11: Sterile crustose lichens** See Note 5.

1 Fungus not forming a lichenised thallus, but parasitic or commensalistic on other lichens. **Generic key 12: Lichenicolous fungi** See Notes 6 and 7.

(1) A few fungi that are neither lichenised nor lichenicolous, but that are commonly encountered by lichenologists and traditionally studied by them, are also included here. All of them superficially resemble some lichens.

(2) Lichens are usually easy to recognise, but if in doubt examine a thin section. No lichen is composed of closely-packed, angular cells with distinct cell walls and an internal green pigment. (Some lichen algae have internal green pigment, but the cells are usually ±globose and there is usually space between some of them. A diffuse green pigment occurs in parts of some lichens, but never throughout the lichen.) Every lichen consists of fungal hyphae intimately associated with photobiont cells that the fungus does not damage. Algal or cyanobacterial crusts may resemble lichens, but either they lack fungal hyphae, or the hyphae are not intimately associated with the other cells, or the fungus damages them (‘algicolous fungi’).

(3) If you find this couplet too difficult, take the second branch. The common genera in Collemataceae are also keyed there and the remaining elements in the first branch are rare.

(4) In a few species in this branch the apothecia are dark and the K+ purple reaction may not be apparent in a spot test. Any species in which the epithecium reacts K+ red-purple in section and diffuses a red-purple pigment into solution belongs here.

(5) Sterile, crustose lichens are difficult to identify, and reliable determination often requires use of chromatography. These keys therefore include only common or distinctive species that often occur sterile and can usually be recognised when sterile.

(6) A fungus that damages the host lichen, or that modifies its growth form, e.g. by forming galls, is likely to belong here. However, damage and galls can be caused by organisms other than fungi. Damage-causing fungi that are themselves lichenised (‘lichenicolous lichens’) are keyed out under lichens, though some with inconspicuous thalli
are included here. Any fungus that produces fruiting structures within the ascomata of the host belongs here.

(7) Lichenicolous fungi are hard to identify. They are small, so are hard to manipulate. Study of a thin section requires a good microscope; an inexpensive one is not adequate. Lichens are often infested with only a small quantity of a lichenicolous fungus, but scantly material is difficult to determine. The literature on lichenicolous fungi is scattered and inaccessible, or too dated to be useful. Most of my own attempts to determine Greek lichenicolous fungi end in failure - and so will most of yours.

**Generic key 0: Basidiolichens and hypholichens**

Thallus lichenised; fungus not an ascomycete.

11 Fungus a hyphomycete. If present in Greece, then probably restricted to the north.
   22 Sporodochia red-brown. (Reichlingia)
   2 Sporodochia grey or blue-grey. (Cheiromycina)
1 Fungus a basidiomycete.
   22 Thallus of bracket-shaped lobes. If present in Greece, then probably restricted to humid maritime localities. (Dictyonema)
   2 Thallus not of bracket-shaped lobes. Fruiting body not lichenised, growing out of a lichenised thallus.
   33 Fruiting body a mushroom with gills. Lichenised thallus of dark green, spherical granules or green, lobed squamules. **Lichenomphalia**
   3 Fruiting body club shaped, usually unbranched. Lichenised thallus a gelatinous, dark green, algal film. If present in Greece, then probably restricted to the north. (Multiclavula)

**Generic key 1: Gelatinous lichens**

Thallus gelatinous or subgelatinous when wet, without a true medulla.

This is a simplified version of the key in Schultz & Büdel (2002). Genera in this group can be difficult to separate, and in case of difficulty it may be worth consulting Schultz & Büdel's original key.

Free-living colonies of cyanobacteria are not uncommon, and may superficially resemble small gelatinous lichens. However, they lack fungal hyphae.

111 Photobiont green, sometimes also with cyanobacteria. (Harpidium)
11 Photobiont Nostoc (see Note 1). Many species very common. A large lichen with globose photobiont cells that are clearly in chains one cell wide is likely to belong here.
   222 Thallus of small filaments, about 0.1 mm wide. Thallus appearing cushion-like. Overgrowing bryophytes, usually on siliceous rock. **Polychidium muscicola**
   22 Thallus appearing fruticose but not filamentous. Thallus cushion-like or not. On various substrates. **Scytinium**
   2 Thallus foliose, squamulose or crustose.
   333 Thallus with a distinct cortex. Cortex precisely one cell thick in most species. Thallus often with a reddish or greyish tinge. Ascospores septate to muriform. On various substrates.
   444 Thallus foliose, with lobes at least 1 mm wide. See **Leptogium** key.
   44 Thallus small foliose with lobes less than 1 mm wide, or small squamulose. **Scytinium**
   4 Thallus crustose.
   55 Thallus of blackish, discrete, placoid areoles, often forming radiating patterns. On dry calcareous rocks or walls. **Pseudoleptogium diffraction**
   5 Thallus less well developed, crustose or sub-squamulose, without radiating marginal lobes. On rock or soil. **Scytinium biatorinum**
33 Thallus without a true cortex, but fungal hyphae more closely aggregated near surface of thallus, forming a pseudocortex, at least in places. Thallus black or green-black. Ascospores simple. On bark of broad-leaved trees. **Staurolemma**
3 Thallus without a cortex. Thallus black or green-black; never with a reddish or greenish tinge. Ascospores various. On various substrates.
   44 Ascospores simple. Apothecia inconspicuous and deeply immersed. Hormocystangia (see Glossary) sometimes present. Not common. **Lempholemma**
   4 Ascospores septate to muriform. Apothecia conspicuous if present. Hormocystangia absent. Some species
common.
55 Ascospores 10 - 15 - septate, acicular or vermiform, sometimes spirally twisted, 50 - 95 x 5 - 6 µm. Exciple hyphal. On bark or bryophytes on bark. **Arctomia fascicularis**
5 Ascospores 1- to multi-septate, or muriform, usually not acicular or vermiform, size various. Exciple hyphal or cellular. Substrate various.
66 Lobes swollen, at least at tips, and ± pleated. Usually on calcareous rock or soil. **Enchylium**
6 Lobes not swollen. On various substrates. See **Collema** key.
1 Photobiont a cyanobacterium other than Nostoc (see Note 1). All species uncommon.
222 Thallus small foliose, with narrow (0.5 mm wide), elongated, stellate-radiating lobes. Photobiont Scytonema (see Note 1). **Koerberia**
22 Thallus small foliose, with lobe margins covered in fine white hairs. Photobiont confined to two distinct layers, separated by a photobiont-free zone. **Leptochidium albociliatum**
2 Thallus growth form not foliose; or foliose but not as above. Photobiont various.
333 Thallus ± gelatinous, green-brown, of small (1 - 2 mm) inconspicuous squamules, each of which may contain 1 to several immersed apothecia. On non-calcareous soil. **Epiphloca**
33 Thallus subgelatinous, not distinctly swollen when wet; dark brown-olive to yellow-olive, rarely white or grey pruinose, usually not jet-black; sometimes eroded or sorediate; squamulose to crustose-subquamulose. Usually on soil or soil crusts.
44 Thallus squamulose, without large internal air spaces, with an upper and/or lower cortex. Photobiont Scytonema (see Note 1). **Heppia**
4 Thallus squamulose or squamulose-crustose, sometimes with large internal air spaces, without a cortex. Photobiont of isolated, rounded cells. **Gloeoheppia**
3 Not as above. Thallus either gelatinous, distinctly swollen when wet, usually jet-black, never sorediate; OR subgelatinous and foliose to fruticose or effigurate-crustose. On various substrates.
44 Growing on rocky sea-shores, clearly exposed to salt spray or even submerged at high tide. Thallus dwarf-fruticose to fruticose. **Lichina**
4 Growing elsewhere. Thallus various.
55 Thallus filamentous; photobiont filamentous and shape of entire thallus resembling that of the photobiont. 66 Photobiont Stigonema (see Note 1). On siliceous rock that is at least periodically wet. (Ephebe)
5 Photobiont single-celled.
6688 Thallus fruticose. 99 Lobes distinctly flattened. **Lichinella**
9 Lobes ±rounded in cross-section.
AA Lobes with a central strand of hyphae; heteromerous in longitudinal section.
BB Thallus usually fertile. Hymenium with conspicuous red or brown spots. Conidia large, 15 - 40 x 1 µm. **Peccania**
B Thallus often sterile. If fertile, hymenium without red or brown spots. Conidia small, ellipsoid or bacilliform. **Lichinella**
A Lobes without a central strand; ±homoiomerous in longitudinal section. **Synalissa symphorea**

88 Thallus foliose or squamulose, with a central hyphal strand in cross-section.

99 Disc of apothecia black or red-black when wet. Hymenium with conspicuous red or brown spots.

Conidia large, 15 - 40 x 1 µm. Thallus often grey pruinose. **Peccania**

9 Disc of apothecia yellow or brown when wet. Hymenium without conspicuous red or brown spots.

Conidia small, bacilliform. Thallus pruinose or not. **Thyrea**

88 Thallus squamulose, often rosette-shaped or forming small cushions attached by a minute umbilicus; without a central hyphal strand in cross-section.

99 Asci with 8 ascospores. **Anema**

9 Asci with more than 8 ascospores.

AA Paraphyses with thickened apices, with external brown pigmentation. **Pterygiopsis**

A Paraphyses slender. **Synalissa**

8 Thallus crustose; at most crustose-squamulose.

99 Disc of apothecia umbonate when mature, or hymenium divided by conspicuous, sterile hyphal bands. Disc of apothecia wide open.

**Cladonia**

22 Primary thallus squamulose. **Cladonia**

2 Primary thallus crustose, sometimes disappearing early.

33 Vertical part of thallus ±hollow.

44 Primary thallus disappearing early. Vertical part grey-green, yellow-green, green-brown, or green-grey, but never white; not tooth-like. **Cladonia**

4 Primary thallus granular, persistent. Vertical part white or grey; tooth-like, rather short and robust. (Pycnothelia)

3 Vertical part of thallus solid (or too fragile to section).

44 Primary thallus leprose, not corticate. Secondary thallus not exceeding 4 mm tall, unbranched or sparsely branched, with leprose granules, generally rather fragile. Ascomata never present. **Leprocaulon microscopicum**

4 Primary thallus not leprose, corticate. Secondary thallus taller than 5 mm in most species, unbranched to very branched, with corticate outgrowths (phyllolodia), ±robust. Apothecia sometimes present. **Stereocaulon**

**Generic key 2: Bipartite lichens**

Thallus not gelatinous, of two distinct growth forms.

11 Apothecia and pycnidia red. **Cladonia**

1 Apothecia and pycnidia brown or absent.

22 Primary thallus squamulose. **Cladonia**

2 Primary thallus crustose, sometimes disappearing early.

33 Vertical part of thallus ±hollow.

44 Primary thallus disappearing early. Vertical part grey-green, yellow-green, green-brown, or green-grey, but never white; not tooth-like. **Cladonia**

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44 Primary thallus leprose, not corticate. Secondary thallus not exceeding 4 mm tall, unbranched or sparsely branched, with leprose granules, generally rather fragile. Ascomata never present. **Leprocaulon microscopicum**

4 Primary thallus not leprose, corticate. Secondary thallus taller than 5 mm in most species, unbranched to very branched, with corticate outgrowths (phyllolodia), ±robust. Apothecia sometimes present. **Stereocaulon**

**Generic key 3: Fruticose lichens**

Thallus not gelatinous; shrub-like or beard-like.

11 Thallus yellow or orange, K- or K+ purple.

(1) See the Glossary for a brief description of each genus. Note, however, that determining cyanobacterial photobionts to genus can be difficult, because inside lichen thalli they may not take their typical form. In case of difficulty, it may be necessary to check all relevant branches of the key.

**Generic key 2: Bipartite lichens**
22 Thallus K+ purple.
   33 Cilia and/or rhizines present. Ascospore septum 4 - 10 µm long. **Teloschistes**
3 Cilia and rhizines absent. Ascospore septum 2 - 4 µm long. **Seirophora**
2 Thallus K- (Letharia)
1 Thallus not yellow or orange; K reactions various but not K+ purple.
22 Thallus small, to 1 cm long.
33 Photobiont blue-green.
   444 Thallus very branched and bush-like. Ascomata absent. Blue-green morphotype of **Lobaria amplissima**
   44 Thallus appearing to consist of numerous, very small, isidia-like structures, but not filamentous. Apothecia common. **Scytinium**, especially **S. teretiusculum**.
   4 Thallus filamentous. Apothecia present or not.
   55 Thallus shining brown, ±erect. Apothecia frequent. Amongst mosses on trees and rocks. **Polychidium muscicola**
   5 Thallus matt, blackish or greenish, ±prostrate or erect. Apothecia rare. On damp siliceous rock. **Spilonema**
3 Photobiont green. **Stereocaulon**
2 Thallus not small, more than 1 cm long when mature.
33 Thallus thread-like, with thin, often pointed, apices.
   44 Thallus with a tough axial strand, not easily broken when branches are stretched.
   55 Thallus green or green-grey. **Usnea**
5 Thallus grey. **Lethariella**
4 Thallus without a tough axial strand, breaking easily when branches stretched.
   55 Thallus some shade of grey or green.
   66 Pseudocyphellae present. Thallus KC- or KC+ orange-red.
   77 Pseudocyphellae uncommon, punctiform to slightly elongate. Soredia sometimes present on tips of fine branchlets. Apothecia very rare. Medulla KC- (see Note 1). On bark or rock. Not restricted to montane forests. A few species of **Ramalina**
   7 Pseudocyphellae common, distinctly elongate. Soredia very rare. Apothecia uncommon but not very rare. Medulla KC+ red (see Note 1). On bark in montane forests. **Alectoria**
   6 Pseudocyphellae absent. Thallus KC+ yellow. **Evernia**
5 Thallus brown to black.
   66 Thallus densely divergently branched, forming a spreading decumbent mat. Soralia absent. On siliceous rock in montane regions. **Pseudephebe**
   6 Thallus not densely branched, or if so then ±erect. Soralia present or absent. On various substrates. **Bryoria**
3 Thallus not thread-like. Apices pointed, blunt, or expanding into cups.
   44 Thallus uniformly brown or black-brown, often shiny. Conspicuous pseudocyphellae often present. Not on calcareous substrates and, in Greece, probably restricted to upland habitats.
   55 Thallus forming compact tufts, to 2 cm tall, firmly attached to siliceous rock. Pseudocyphellae absent. Apothecia frequent, terminal. **Cornicularia normoerica**
   5 Thallus not forming tufts. Terricolous on non-calcareous soil. Pseudocyphellae often present. Apothecia rare. **Cetraria**
4 Thallus not uniformly brown, usually not shiny. Pseudocyphellae absent or inconspicuous (except in Circinaria fruticulosa). On various substrates. Not restricted to upland habitats.
   55 Photobiont **Trentepohlia**. Cortex or medulla or soralia C+ red. Always at or close to the coast. **Roccella**
5 Photobiont green (not **Trentepohlia**). All parts C-. Coastal or inland.
   66 Surface of thallus tomentose or finely pubescent. Ascospores brown, 1-septate. **Tornabea**
6 Surface of thallus not tomentose. Ascospores colourless in most species; if brown then simple.
   77 Branches ±circular in cross-section, erect or prostrate, never pendent. On various substrates.
   88 Branches hollow; apices pointed or with cups. Apothecia, if present, red or brown. On various substrates; often on soil or decaying vegetation. Very common. **Cladonia**
8 Branches solid; apices not distinctly pointed, without cups. Apothecia never red. On various substrates. Not common.
   99 Usually on calcareous soil, sometimes on calcareous rock. Thallus sometimes transitional to crustose forms. A few species of **Circinaria**
9 On non-calcareous rock. Thallus not transitional to crustose forms.
AA Surface of thallus with many wart-like projections. Apothecia not mazaediate. **Stereocaulon**

A Surface of thallus without wart-like projections. Apothecia mazaediate. (Sphaerophorus)

7 Branches ±flattened in cross-section, pendent or erect. On bark or rock. See Note 2.

88 Thallus stiff, with a thick tough cortex. Apothecia common in some species. Ascospores 1-septate.

On bark or rock. **Ramalina**

8 Thallus soft and pliable, with a thin cortex. Apothecia rare. Ascospores simple. Usually on bark.

**Evernia**

(1) It is difficult to test medulla and cortex separately, but a KC+ medulla reaction easily shows through the cortex, so you can apply the reagents to the surface of the thallus.

(2) Sterile, corticolous specimens of Evernia and Ramalina are common, but can be difficult to separate. The two-layered cortex of Ramalina is diagnostic, but not easy to observe. In case of difficulty, note the following. (i) A mature corticolous specimen without apothecia or soralia probably belongs to Evernia. (ii) Soralia in the very common Ramalina farinacea react (P+, K-) or (P+, K+) in the chemotypes that I have seen in Greece (mainly Peloponnese); those in Evernia react (P-, K-). (iii) Ramalina species are never pure grey; they always have some greenish tinge. (iv) Evernia usually occurs on acidic to neutral bark, Ramalina usually on neutral to basic bark, occasionally on slightly acidic bark. (v) Collections with a *distinctly* white lower surface, contrasting *strongly* with the colour of the upper surface, belong to Evernia. In Ramalina the two surfaces do not differ much. However, in Ramalina the lower surface may be *slightly* paler than the upper one, and in Evernia the lower surface may be *slightly* greenish if algal cells occur near the lower cortex.

**Generic key 4: Foliose lichens**

Thallus not gelatinous, of leaf-shaped lobes, or of ribbons with different upper and lower surfaces.

11 Thallus distinctly orange or yellow.

22 Thallus orange, K+ purple. **Xanthoria**

2 Thallus yellow, K-.

33 Lobes small, to 0.5 (1.5) mm wide. **Candelaria**

3 Lobes large, to 10 mm wide. **Vulpicida**

1 Thallus not orange or yellow. (Rarely, medulla may be yellow or orange.)

22 Thallus attached by an umbilicus (a central attachment organ).

33 Ascomata, if present, perithecia. Upper surface usually white-pruinose. Soralia, isidia and pustules absent. Hyphae of upper and lower cortex ±distinctly vertically oriented. On calcareous or siliceous rock. **Dermatocarpon**

3 Ascomata, if present, apothecia. Upper surface pruinose or not. Some species with soralia, isidia or pustules. Hyphae of upper and lower cortex not distinctly vertically oriented. On siliceous rock.

44 Thallus with convex pustules on upper surface, and corresponding depressions on lower surface. **Lasallia**

4 Thallus without pustules. **Umbilicaria**

2 Thallus not attached by an umbilicus.

33 Cilia present on lobe margins.

44 Thallus small, 1 - 3 cm diameter, fairly compact. Lobes less than 1 cm long. Upper cortex cellular. Upper surface not tomentose, K+ yellow. Ascospores less than 25 µm long, wall often thickened at both septum and tips (Physcia type). **Physcia**

4 Thallus usually larger, forming loose tufts to 10 cm diameter. Lobes often more than 1 cm long. Upper cortex hyphal. Upper surface tomentose or not, K- or K+ yellow. Ascospores more than 30 µm long, not Physcia type.

55 Upper surface pigmented (pale grey or pale brown, sometimes darker), usually at least slightly tomentose, K-. Soredia absent. Cilia white to pale brown, sometimes dark brown to black near tips. Ascospore wall thickened only at septum (Physcia type). Very common. **Anaptychia**

5 Upper surface white, not tomentose, K+ yellow. Soredia sometimes present in central parts. Cilia grey to black. Ascospore wall thickened everywhere (Pachysporaria type). Very rare. Probably restricted to sites with a humid microclimate. **Heteroderma leucomes**

3 Cilia not present on lobe margins.

44 Thallus of ribbon-like lobes, many times longer than wide and more than 1 cm long, attached only loosely to the substrate along most of their length. On bark. (Note 1.)

55 Isidia absent. Lower surface usually white, occasionally green-grey or grey-green, but never black; not
strongly channeled. **Evernia**

5 Isidia usually present on mature thalli. Lower surface usually at least partly black; if entirely white (as occasionally in Pseudevernia furfuracea) then strongly channeled.

66 Tips and sometimes edges of lobes very ragged, often with abundant cylindrical or coralloid isidia.

**Platismatia glauca**

6 Tips and edges of lobes smooth to irregular, but not ragged. Isidia, if present, mostly laminal, globose to cylindrical but not usually coralloid.

77 Lower surface without rhizines. Isidia globose when young but soon becoming distinctly cylindrical. **Pseudevernia**

7 Lower surface with rhizines. Isidia remaining subglobose. Small soralia often present. **Parmelia submontana**

4 Thallus of ±leaf-shaped lobes, or lobes less than 1 cm long, or lobes well attached to substrate over much of their length (though not necessarily firmly adpressed). On various substrates.

55 Photobiont blue-green. **Generic key 4A: blue-green foliose lichens**

5 Photobiont green.

666 Lower surface with tomentum, with or without veins.

77 Lower surface with a distinct network of veins.

88 Upper surface with distinct ridges, which may become sorediate and/or isidiate. Upper surface not tomentose. **Apothecia laminal. Lobaria pulmonaria**

8 Upper surface without ridges. Upper surface tomentose or not. **Apothecia marginal. Peltigera**

7 Lower surface without veins, or veins indistinct.

88 **Apothecia sunken into the lobes. On calcareous rock or calcareous soil. Solorina**

8 **Apothecia sessile. Usually on bark. Lobaria**

66 Lower surface without tomentum or veins, but with rhizines (which may be few and/or confined to centre of thallus).

77 Ascospores brown, 1-septate. Thallus grey, blue-grey or brown, matt, pruinose or not. Lobes less than 5 mm wide. Disc of apothecia brown to black, never with a red tinge. **Pseudocyphellae absent.**

**Generic key 4B: Physcia and similar genera**

7 Ascospores colourless, simple. Thallus grey, blue-grey, brown, yellow-green or dark green, matt or shiny, not pruinose. Lobes large or small, but usually more than 5 mm wide in species with a grey, blue-grey or matt brown surface. Disc of apothecia red-brown. **Pseudocyphellae present or absent.** **Generic key 4C: parmelioid lichens**

6 Lower surface without veins, tomentum or rhizines.

777 Upper surface brown to brown-grey. Lower surface not easily visible because thallus closely adpressed. Thallus not exceeding 2 cm diameter. **Hyperphyscia**

77 Upper surface yellow-green. Lower surface white or pale yellow. **Cladonia**

7 Upper surface blue-grey, grey, brown or black. Lower surface black.

88 Soredia usually present. Medulla of loosely-woven hyphae; lobes sometimes hollow as a result. Upper surface usually blue-grey to grey. **Hypogymnia**

8 Soredia absent. Medulla of densely-woven hyphae; lobes not hollow. Upper surface grey to grey-black. **Brodoa**

(1) At a first glance these species look like, and could be confused with, medium to large fruticose lichens.

**Generic key 4A: Foliose lichens with blue-green photobiont**

Photobiont blue-green.

111 Lower surface with a ±well-developed network of veins (see Note 1). Apothecia marginal, on upper surface. Lower cortex absent. **Peltigera**

11 Lower surface without veins but with tomentum, or with a dense development of rhizines that ±resembles tomentum. Apothecia laminal on upper surface or marginal on lower surface. Lower cortex present, though in some genera not sharply differentiated from medulla and/or rhizine layer.

22 Thallus with a felted appearance. Tomentum, when well-developed, blue-black and extending beyond the lobes (see Note 2). Apothecia often present, on upper surface of lobes.

33 Apothecia without a thalline margin. Thallus P-.. **Pectenia***
3 Apothecia with a thalline margin. Thallus P+ orange or red-orange. **Pannaria**

2 Thallus without a felted appearance. Tomentum white or brown, ± confined below lobes. Apothecia rarely present on upper surface of lobes (but may be present on lower surface).

33 Cyphellae present, forming concave depressions on lower surface. (Sticta)

3 Cyphellae absent. (White, ± circular, tomentum-free areas may be present on lower surface, but they are flat to convex.)

44 Thallus grey to yellow-green when dry. Soralia usually present. Apothecia rare, laminal, on upper surface of lobes. **Lobaria scrobiculata**

4 Thallus brown when dry. Soralia present or absent. Apothecia common, marginal, on lower surface of lobes (which may be reflexed). **Nephroma**

1 Lower surface without veins or tomentum, though some white rhizines may be present.

22 Lobe margins with fine white hairs. Lower surface often with white, fasciculate rhizines. **Leptochidium albociliatum**

2 Lobe margins without white hairs. Rhizines present or absent.

33 Photobiont confined to a single well-defined layer. Apothecia marginal, on lower surface of lobes. **Nephroma**

3 Photobiont distributed ± uniformly throughout most of thallus, not confined to a single well-defined layer. Apothecia not on lower surface of lobes.

44 Thallus with a distinct cortex that is precisely one cell thick in most species. Thallus often with a reddish or greyish tinge. Ascospores septate or muriform.

55 Lobes at least 1 mm wide. See **Leptogium** key.

5 Lobes less than 1 mm wide. **Scytinium**

4 True cortex absent. Thallus black or green-black. Ascospores various.

55 Hyphae more closely aggregated near lower surface of thallus surface, forming a pseudocortex at least in places. Ascospores simple. On bark of broad-leaved trees. **Staurolemma**

5 Pseudocortex absent. Ascospores septate or muriform. On various substrates.

66 Ascospores 10 - 15 - septate, acicular or vermiciform, sometimes spirally twisted, 50 - 95 x 5 - 6 µm. Exciple hyphal. On bark or bryophytes on bark. **Arctomia fascicularis**

6 Ascospores 1- to multi-septate, or muriform, usually not acicular or vermiciform, size various. Exciple hyphal or cellular. Substrate various.

77 Lobes swollen, at least at tips, and ± pleated. Usually on calcareous rock or soil. **Enchylium**

7 Lobes not swollen. On various substrates. See **Collema** key.

(1) Veins are absent in *Peltigera elisabethae*, a species which is only doubtfully reported for Greece.

(2) When well-developed, the tomentum (actually a well-developed mat of rhizines) is unmistakable. However, it begins as a dense mat of rhizines that are white towards the tip and pale orange-brown near the base, and which do not extend beyond the thallus. Careful examination may reveal a few rhizines that are starting to develop a blue-black colouration. Otherwise, note that rhizines in the other branch are not normally white at the tip and pale orange-brown towards the base.

**Generic key 4B: Physcia and similar genera**

Photobiont green. Lower surface without veins or tomentum, but with rhizines. Ascospores brown, 1-septate.

11 Apothecia with internal stipe that reacts K+ red in upper part. Medulla yellowish, at least in places, K-. Soredia present. If present in Greece, probably restricted to moist, cool habitats. (Pyxine)

1 Apothecia without internal stipe. Medulla white in most species; if yellowish then K+ strongly yellow. Soredia present or absent.

22 Thallus K+ yellow (Note 1). Rhizines simple or branched, never squarrose. Margin of apothecia never with lobules. Thallus colour various.

33 Upper cortex of ± isodiametric cells. Thallus grey or blue-grey. Rhizines simple. Lower cortex present. Very common. **Physcia**

3 Upper cortex not cellular. Thallus white, brown, grey or blue-grey. Rhizines simple or branched. Lower cortex present or absent. Very rare. **Heteroderma**

2 Thallus K-. Rhizines simple or squarrose. Margin of apothecia with or without lobules. Thallus grey, green or brown.

33 Lobes and thalline margin with many lobules. **Physconia**
3 Lobes with few or no lobules; thalline margin without lobules.

44 Conidia thread-like, more than 10 µm long (Note 2). Thallus very closely adpressed with ±radiating lobes, brown-grey to dark brown, to 2 cm diameter, not pruinose. Soralia present. Rhizines absent or few. Lobes without cilia. Lower surface pale everywhere. Lower cortex colourless, of hyphae parallel to surface, sometimes absent in central parts of thallus. Usually on ±nutrient-enriched bark at altitudes below 400 m.

**Hyperphyscia adglutinata**

4 Conidia not thread-like, to 7 µm long (Note 2). Thallus various, pruinose or not. Soralia present or absent. Rhizines usually well-developed and abundant. Cilia present or absent. Lower surface pale or dark. Lower cortex various. On various substrates at all altitudes.

555 Upper cortex of thin walled horizontal (Note 3) hyphae. Upper surface not pruinose. Rhizines various. Ascospores without apical wall thickenings. Conidia bacilliform to shortly cylindrical, 3 - 6 µm long. Lower cortex, if present, of horizontal hyphae. **Anaptychia**

5 Upper cortex cellular, or of rather thick walled hyphae that are not all horizontal (Note 3). Upper surface pruinose, at least at margins. Rhizines squarrose or simple. Ascospores with apical wall thickenings. Conidia ±cylindrical, 4 - 7 µm long. Lower cortex, if present, of horizontal hyphae. Generally rather large, robust lichens. **Physconia**

5 Upper cortex cellular, of ±isodiametric cells. Upper surface not pruinose. Rhizines simple. Ascospores with apical wall thickenings, at least when mature. Conidia ellipsoid, 2 - 4 µm long. Lower cortex various. Generally rather small or at most medium-sized lichens.

66 Lower cortex usually of ±isodiametric cells. Lower surface usually ±black in central parts. **Phaeophyscia**

(1) The common Physcia biziana reacts K+ yellow, but often faintly. The thallus is pruinose, like Physconia. A pruinose species with simple rhizines, without soredia or isidia, and without lobules on the apothecial margin is likely to be this species. Its ascospores have distinct apical wall thickenings, at least at some stages of development, whereas those in Physconia do not. Ascospores in Physcia biziana are 15 - 21 (23) x 7 - 10 µm, those in Physconia grisea are 22 - 30 x 14 - 15 µm.

(2) Pycnidia are not always obvious, especially in pruinose species. Any small (around 0.2 mm diameter) convex bump on the lobe surface that is not obviously an incipient apothecium or lobule is worth sectioning to see if it is a pycnidium.

(3) See Glossary for "horizontal".

**Generic key 4C: Parmelioid genera**

Photobiont green. Lower surface without veins or tomentum, but with rhizines.Ascospores colourless, simple.

111 Upper surface predominantly grey (grey, white-grey, blue-grey, occasionally brown-grey in places but not uniformly brown), occasionally with a slight greenish tinge, never very dark. See Note 1.

22 Upper surface without pseudocyphellae (Note 2). Cilia absent.

33 Pseudocyphellae mainly punctiform.

44 Thallus to 20 cm diameter, lobes to 2 cm wide. Soralia marginal, not derived from pseudocyphellae.

(Cetrelia)

4 Thallus to 5 cm diameter, lobes to 1 cm wide. Soralia laminal or marginal, derived from pseudocyphellae.

**Punctelia**

3 Pseudocyphellae mainly linear or irregular, sometimes forming a network. **Parmelia**

2 Upper surface without pseudocyphellae, though sometimes with maculae or cracks (Note 2). Cilia present or absent.

33 Thallus ±loosely attached. Lobe margins strongly ascending, sometimes distinctly ragged and irregular. Cilia absent.

44 Lobes broad, to 15 mm wide. **Platismatia glauca**

4 Lobes narrow, to 3 (5) mm wide.

55 Soredia present. Isidia absent. **Parmeliopsis hyperopta**

5 Soredia absent. Isidia present. (Imshaugia aleurites)

3 Thallus ±closely adpressed at least at centre. Lobe margins adpressed or ±ascending, rounded, crenulate or incised, not usually ragged or irregular. Cilia present or absent.

44 Lobes broad, (3) 6 - 20 mm wide. Lower surface in most species with a broad (more than 1 mm wide) brown margin lacking rhizines. Cilia usually present. **Parmotrema**
4 Lobes narrower, usually less than 6 mm wide. Rhizines present to lobe margin, or lower surface with a narrow (less than 1 mm wide) brown margin lacking rhizines. Cilia present or absent.

55 Rhizines branched. (Hypotrachyna)
5 Rhizines simple.

66 Margins and apices of lobes with cilia. Rare, in sites with mild humid microclimate. Parmelinopsis
6 Cilia, if present, confined to axes of lobes. Very common throughout Greece. Parmelina

11 Upper surface with distinct yellow or green tinge (white-green, yellow-green or yellow-grey), never dark.

22 Upper surface with punctiform pseudocyphellae, which may be poorly developed. Soralia usually present. (Flavopunctelia)

2 Upper surface without pseudocyphellae. Soralia present or absent.
33 Rhizines usually dichotomously branched. Hypotrachyna
3 Rhizines usually simple or tufted.

44 On soil. Thallus with marginal, white soralia. Allocetraria
4 On bark, wood or rock, not usually on soil. Soralia present or absent.

55 Lobes mostly more than 5 mm wide, apices rounded. Ascospores more than 15 µm long. Flavoparmelia
5 Lobes mostly less than 5 mm wide, apices often indented. Ascospores less than 15 µm long

66 On siliceous rock. Isidia present or absent. Soralia usually absent (present only in X. mougeotii).

Xanthoparmelia
6 On acidic bark or wood. Isidia absent. Soralia usually present. Parmeliopsis ambiguа

1 Upper surface dark: olive-brown, brown, black-brown, dark grey-green, dark brown-grey or dark oily green.

22 Lobes very much longer than broad. On soil. Cetraria
2 Lobes not very much longer than broad. Usually on bark, wood or rock; rarely on base-poor soil or overgrowing bryophytes thereon.

33 Lobes ascending, at least at margins. Isidia absent. Upper surface never very dark brown. On bark or wood.

44 Upper surface brown when dry, brown-green when wet. Lobes with irregular margins. Soredia sometimes present. Lower surface with few rhizines. Apothecia rare; if present, marginal or apical. Medulla K-

Tuckermannopsis chlorophylla
4 Upper surface dark grey-green to brown-grey when dry, dark oily green when wet. Lobes with wavy margins and incised rounded ends. Soredia absent. Lower surface with many rhizines. Apothecia usually present, laminal. Medulla K+ red. Pleurosticta acetabulum

3 Lobes ±adpressed in most species (if distinctly ascending, then abundant flattened isidia present). Isidia present or absent. Upper surface brown, dark brown or black-brown. Usually on bark or rock, rarely on base poor soil, or overgrowing bryophytes thereon.

44 Upper cortex N+ blue-green (Note 4), C+ blue-green (Note 4). Pseudocyphellae absent (Note 6). Soredia absent. Upper cortex without hair-like projections (Note 7). Usually on ±siliceous rock, rarely on base-poor soil or overgrowing bryophytes thereon. Neofuscelia
4 Upper cortex usually N-, rarely N+ pale red, C-. Pseudocyphellae present or absent. Soredia present or absent. Upper cortex sometimes with hair-like projections (Note 7). On bark or siliceous rock.

55 Medulla C+ instantly bright red (Note 8). Melanelixia
5 Medulla C- or C+ pink.

66 Medulla KC+ pink or orange. Isidia or soralia present. On siliceous rock. Montanelia
6 Medulla KC- or KC+ yellow-orange; if KC+ then isidia and soralia absent. On various substrates.

77 On bark or wood. Isidia and soralia present or absent. Melanohalea
7 On siliceous rock. Isidia and soralia absent. Melanelia

(1) Species with many dark isidia may look dark at first glance, but the surface between the isidia is not very dark.
(2) At a pseudocyphella, the cortex is absent or at least noticeably thinned. At a macula, its thickness is unchanged.
(3) Cilia resemble rhizines, and are probably homologous. However, rhizines extend downwards from the lower surface whereas cilia extend outwards from the lobe margin.
(4) Observe in thin section. The N+ blue-green reaction is sometimes faint and is not always permanent, sometimes being succeeded by a ±permanent dull mauve.
(5) Observe in thin section. The C+ blue-green reaction is fleeting. Use of a dilute solution of C will slow the reaction.
(6) Some collections of Neofuscelia have a network of ridges on the upper surface, usually most apparent near the lobe tips. These may develop into cracks in the cortex in older parts of the lobes. At an intermediate stage they may superficially resemble a network of white pseudocyphellae as in Parmelia. However, they are not true pseudocyphellae, as the medullary hyphae do not grow up into the crack.
(7) Cortical hairs are not visible in the stereo-microscope. In thin section they appear as colourless, ±erect projections
from the cortex, about 6 - 10 x 2.5 µm.
(8) The reaction is unmistakeable but may be confined to upper part of medulla. Do not test where thallus has been abraded, exposing the medulla, as upper part of medulla may then be missing.

**Generic key 5: Squamulose lichens**

Thallus not gelatinous, of small scales, sometimes only separable from the substrate at their edges.

11 Fruiting bodies perithecia. Photobiont green. **Generic key 5A: squamulose lichens with perithecia**

1 Fruiting bodies apothecia or absent. Photobiont green or blue-green.

22 Photobiont blue-green. **Generic key 5B: squamulose lichens with cyanobacterial photobiont**

2 Photobiont green.

33 Apothecia present. **Generic key 5C: squamulose lichens with green photobiont & apothecia**

3 Apothecia absent. **Generic key 5D: sterile squamulose lichens with green photobiont**

**Generic key 5A: Squamulose lichens with perithecia**

11 Ascospores muriform.

22 Hymenial gelatin containing algae. Ascospores usually brown when mature. **Endocarpon**

11 Ascospores septate.

22 Thallus squamulose. Ascospores 1-septate. Usually on calcareous rock or soil. **Placidiopsis**

2 Thallus areolate-subsquamulose. Ascospores 1 - 3-septate. Usually on siliceous rock. **Placopyrenium buceki**

1 Ascospores simple, rarely with a pseudoseptum.

22 Thallus distinctly squamulose.

33 Involucrellum present. Perithecia between the squamules. *(Involucropyrenium)*

3 Involucrellum absent. Perithecia on the squamules. See Note 1.

44 Upper cortex less than 30 µm thick, unevenly delimited against algal layer (algal cells ± protruding into cortex), of small (5 - 8 µm) roundish-angular cells. **Catapyrenium**

4 Upper cortex 25 - 100 µm thick, clearly delimited; of larger (6 - 20 µm) cells.

55 Medulla and lower cortex not very distinct. Cellular structure extending through a large part of the squamule. Asci clavate. Ascospores ± biseriate. Squamules small. **Heteroplacidium**

5 Medulla and lower cortex distinct. Cellular structure not extending through a large part of the squamule. Asci and ascospores various. Squamules larger.

66 Lower surface of squamules with a well-developed mat of rhizohyphae. **Placidium**

6 Rhizohyphae absent or poorly developed (though rhizines may be present).

77 Perithecial wall black, friable, carbonaceous. **Anthracocarpon**

7 Perithecial wall not carbonaceous. **Neocatapyrenium**

2 Thallus areolate-subsquamulose. **Placopyrenium** and **Placocarpus schaereri**. (The latter is keyed out under Placopyrenium.)

(1) The poorly known species Dermatocarpon convexum and D. subcrustosum might key out here. Both occur on calcareous rock. The latter has been reported for Greece. Unfortunately, the descriptions I have seen are inadequate and I can not include them in this key.

**Generic key 5B: Squamulose lichens with cyanobacterial photobiont**

11 Photobiont Nostoc (Note 1). In habitats that are not very dry. Usually on bark or bryophytes, occasionally on soil.

22 Photobiont cells not confined to a distinct layer, usually forming distinct chains. Ascospores muriform. Many species with an upper and lower cortex of ± rectangular cells, precisely one cell layer thick. **Scytinium**

2 Photobiont cells confined to a ± distinct layer, usually not in chains. Ascospores simple. Upper and lower cortex various, but not precisely one cell thick.

333 Thallus subfoliose, P+ orange or red. **Pannaria**

33 Thallus foliose to placodioid, P-. **Degelia**

3 Thallus small squamulose to subcrustose, P-. Note 2.

44 Hypothallus blue-black, very well developed. Squamules flat, pale brown, adpressed, sometimes almost
areole-like. Very pale brown soralia usually present. Apothecia absent. All reactions negative. **Nevesia sampaiana**

4 Hypothallus present or absent, but not very conspicuous. Other characters various.

5 Hypothallus thin, blackish. Apothecia with or without a thalline margin. **Protopannaria**

6 Apothecia without a thalline margin. **Fuscopannaria**

7 KI+ blue region of ascus apex forming a sheet at top of ascus. **Vahliella**

8 KI+ blue region of ascus forming a ring at top of ascus, central part of ring KI- or only weakly KI+ blue. **Buellia badia**

9 Thallus squamulose, without large internal air spaces, with an upper and/or lower cortex. **Parmeliella**

10 Thallus squamulose or squamulose-crustose, sometimes with large internal air spaces, without a cortex. **Gloeoheppia**

11 Asci with about 100 ascospores. **Acarospora**

12 Asci with 8, or about 8, ascospores. **Peltula**

13 Thallus squamulose, without large internal air spaces, with an upper and/or lower cortex. **Heppia**

14 Thallus squamulose or squamulose-crustose, sometimes with large internal air spaces, without a cortex. **Gloeoheppia**

(1) Nostoc has small rounded cells, but is only easy to recognise when the cells form chains. The lichens in branch 11(2) of the key (Pannariaceae) have an overall appearance that is very different from those in branch 1, though the difference is easier to recognise than to put into words. The reader is advised to study some photographs online to get a 'feel' for these two groups.

(2) Genera in this branch can be difficult to separate, especially for sterile specimens, which are common. In case of doubt consult the keys to species for each genus.

(3) Do not pre-treat with K, which suppresses any +blue-green shade.

**Generic key 5C: Squamulose lichens with green photobiont and apothecia**

11 Asci with about 100 ascospores. **Acarospora**

12 Asci with 8, or about 8, ascospores.

13 Thallus squamulose. **Buellia badia**

14 Thallus squamulose or squamulose-crustose. **Waynea**

15 Photobiont layer present below hypothecium. **Circinaria**

16 Photobiont layer not present below hypothecium. **Toninia**

17 Paraphyses ±conglutinated, without a swollen apical cell or external pigment cap. **Bilimbia lobulata**

2 Ascospores simple.
33 Apothecia brown-orange or red, K+ purple.
   44 Apothecia brown-orange. (Protoblastenia macrocarpa)
   4 Apothecia red. **Psora testacea**

3 Apothecia variously coloured, not K+ purple.

   44 Apothecia brown-orange. (Protoblastenia macrocarpa)
   4 Apothecia red. **Psora testacea**

55 Cephalodia often present. Thalline margin often with numerous squamules. Lower part of thalline margin covered with dense hairs. On or among mosses in moist habitats. **Psoroma**

5 Cephalodia absent. Thalline margin with or (usually) without squamules. Thalline margin without dense hairs. On various substrates.

66 Thallus distinctly squamulose.
   77 Medulla ±loose. On siliceous or at most weakly calcareous rock. **Rhizopla**
   7 Medulla often very thick, dense and chalky. On ±calcareous rock or soil. **Squamarina**

6 Thallus subsquamulose, sometimes areolate in central parts.

66 Thallus distinctly squamulose.
   77 Medulla ±loose. On siliceous or at most weakly calcareous rock. **Rhizopla**
   7 Medulla often very thick, dense and chalky. On ±calcareous rock or soil. **Squamarina**

7 Cephalodia present. Thalline margin often with numerous squamules. Lower part of thalline margin covered with dense hairs. On or among mosses in moist habitats. **Psoroma**

7 Asci Bacidia type. **Squamarina**

4 Apothecia without a thalline margin but with an exciple.

55 On bark or wood.

66 Thallus distinctly squamulose, grey to brown, C- or C+ red.
   77 Squamules ±regularly ascending, at least at margins.
   88 Thallus C+ red. **Hypocenomyce scalaris**
   8 Thallus C-. **Carbonicola**

6 Squamules white to pale grey, C+ red. **Trapeliopsis wallrothii**

5 On rock, soil or decaying vegetation on the ground.

66 Squamules white to pale grey, C+ red. **Trapeliopsis wallrothii**

6 Squamules variously coloured, C-.
   777 Epithecium brown or red-brown.
   88 Hymenium I+ green, orange-brown or blue, KI+ blue (Notes 2 and 3). **Romjularia lurida**
   8 Hymenium I-, KI- (Note 2). **Psora**

7 Squamules ±adpressed; if ascending then irregularly so. **Xylopsora**

6 Thallus minutely squamulose, dark green to dark green-brown, C-. (Lecidea holopolia)

5 On rock, soil or decaying vegetation on the ground.

66 Squamules white to pale grey, C+ red. **Trapeliopsis wallrothii**

6 Squamules variously coloured, C-.
   777 Epithecium brown or red-brown.
   88 Hymenium I+ green, orange-brown or blue, KI+ blue (Notes 2 and 3). **Romjularia lurida**
   8 Hymenium I-, KI- (Note 2). **Psora**

7 Squamules ±adpressed; if ascending then irregularly so. **Xylopsora**

6 Thallus minutely squamulose, dark green to dark green-brown, C-. (Lecidea holopolia)

(1) The thalline margin may be excluded very early. Collections with only mature apothecia may lack any trace of one.

(2) Romjularia lurida can be separated from Psora without testing the hymenium. See the key to Psora.

(3) In some specimens of Romjularia lurida, the hymenium only reacts I+ blue after pre-treatment with K. Without pre-treatment it may react I+ very slowly greenish > orange-brown.

**Generic key 5D: Sterile squamulose lichens with green photobiont**

Not all sterile squamulose lichens can be identified reliably. This key is far from complete and includes only a few common or distinctive taxa, so check your determination against a description.

11 Squamules C+ red.
   22 Squamules ±ascending, at least at margins. **Hypocenomyce scalaris**
   2 Squamules adpressed. **Trapeliopsis wallrothii**

1 Squamules C-.

2 Squamules ±ascending, at least at margins.
   333 Squamules pale green, shiny. On bark. **Waynea stoechadiana**
   3 Squamules grey, green-grey or blue-grey; rounded or ear-shaped. On mosses or overgrowing other lichens in humid places. **Normandina pulchella**

3 Squamules yellow-green to yellow-grey; not rounded or ear-shaped. Usually terricolous or on rotting wood or bases of trees, not restricted to humid places. **Cladonia**

2 Squamules ±adpressed.

33 On calcareous rock or calcareous soil.
   44 Squamules blue-white pruinose, at least at tips. See **Toninia** key.
   4 Squamules not blue-white pruinose.

555 Squamules bright pink-red or pink-brown or red-brown. **Psora decipiens**
55 Squamules brown; rounded, or angular by compression; very thick; not overlapping; slightly convex, or flat with slightly raised margins; white lower surface visible at margins, margins sometimes white-pruinose.

**Acarospora cervina**

5 Squamules green, white-green or brown-green. Medulla usually P+ yellow, rarely P-.

66 Thallus distinctly squamulose, with a thick, chalky medulla. **Squamarina cartilaginea**

6 Thallus placodioid-squamulose, centre sometimes distinctly crustose. Medulla not particularly thick.

**Protoparmeliopsis**

3 On non-calcareous rock. Consider **Stereocaulon** and **Protoparmeliopsis**

**Generic key 6: Crustose lichens with perithecia**

Thallus not gelatinous, crustose. Ascomata perithecia.

11 Asci with 30 or more ascospores.

22 Photobiont Trentepohlia. Ascomata not yellow or green-yellow pruinose. **Thelopsis**

2 Photobiont chlorococcoid. Ascomata (actually apothecia with punctiform discs) very small, pale yellow to green-yellow pruinose in most species. **Thelocarpon**

1 Asci with 8 or fewer ascospores.

22 Inter-ascal hyphae not persistent, dissolving into a poorly differentiated hymenial gel. Not usually on bark or wood (Note 1). Very common. **Generic key 6A: Crustose lichens with perithecia, impersistent paraphyses.**

2 Inter-ascal hyphae persistent. On various substrates; many species on bark or wood. Not common.

333 'Perithecia' in fact apothecia, with an exciple and thalline margin. Ascospores colourless, multi-septate or muriform, elongate, often with pointed ends, at least 40 \( \mu m \) long. Photobiont Trentepohlia. Hymenium KI+ blue. On calcareous rock. **Gyalecta**

33 'Perithecia' in fact apothecia, with an exciple that tends to arch over disc; in section, disc clearly apparent. Ascospores brown when mature, muriform, ellipsoid. Photobiont green. Hymenium KI-. On rock, soil, bryophytes or other lichens, never on bark. **Diploschistes**

3 Ascomata true perithecia. Ascospores various. Photobiont various or (rarely) absent. Hymenium KI- in most genera (sometimes KI+ blue or orange in Lithothelium). Most species on bark, wood, leaves or bryophytes, only a few on rock.

444 Ascospores simple. **Thrombium**

44 Mature ascospores septate. **Generic key 6B: Crustose lichens with perithecia, persistent paraphyses, septate ascospores.**

4 Mature ascospores muriform.

55 Ascospores distoseptate, brown when mature. **Pyrenula**

5 Ascospores euseptate, usually remaining colourless.

66 Interascal filaments not anastomosing. 77 Thallus not lichenized. **Julleda**

6 Thallus lichenized. **Topelia**

6 Interascal filaments anastomosing.

77 Ascus apex KI+ distinctly blue. If present in Greece then probably restricted to alpine levels. (Protothelenella)

7 Ascus apex KI-. **Thelenella**

(1) Blastodesmia nitida is corticolous. Also a few other species not yet reported for Greece.

**Generic key 6A: Crustose lichens with perithecia, impersistent paraphyses**

11 Perithecia colourless or pale brown, only rarely dark in colour. Not on rock and not parasitic on lichens on rock.

22 Involucrellum indistinct. Ascospores fusiform. On various substrates. (Psoroglaena)

2 Involucrellum well developed. Ascospores oblong to cylindrical. Usually folicicolous. (Phylloblastia)

1 Perithecia dark brown to black. Usually on rock, some species on soil, some parasitic; only Blastodesmia on bark.

22 Hymenial gelatin containing algae. Ascospores muriform, usually brown at maturity. **Staurothele**

2 Hymenial gelatine not containing algae. Ascospores various.

33 Thallus areolate-subsquamulose.

44 Thallus appearing thickly crustose, but areoles with lateral and lower cortices, attached by stipe-like holdfasts.
Ascospores 0-1 (3) septate. On calcareous or siliceous rock, sometimes parasitic. **Placopyrenium.**

4 Areoles not attached by stipe-like holdfasts. Ascospores simple. On calcareous rock, sometimes parasitic. **Placocarpus schaereri**

55 Thallus dark brown, not pruinose. Parasitic when young on Circinaria calcarea. **Heteroplacidium fusculum**

5 Thallus pale grey to brown-grey, densely pruinose.

66 Ascospores 20-30 x 6-11 µm. Parasitic when young on Protoparmeliopsis muralis. **Placocarpus schaereri**

6 Ascospores 13-16 x 6-8 µm. Not associated with Protoparmeliopsis muralis. **Dermatocarpon subcrustosum**

3 Thallus strictly crustose, superficial or endolithic. On various substrates.

4444 Ascospores submuriform or muriform, often becoming brownish.

5 Perithecia ± completely covered by thallus up to ostiole, but not immersed in substrate. Thallus well developed. By lakes or streamshores, on rocks or overgrowing mosses. (Sporodictyon)

5 Perithecia not covered by thallus (or, in a few bryicolous species, partly covered by thallus), immersed in substrate or not. Thallus well developed to immersed. On various substrates.

66 Cortical cells ± papillate. Perithecial wall multi-layered. Some species of **Agonimia** not yet recorded for Greece.

6 Cortical cells not papillate. Perithecial wall not multi-layered. **Polyblastia**

4444 Ascospores 5-9-septate. On bark. Probably not lichenised. **Blastodesmia nitida**

44 Ascospores (0) 1-septate or 3-septate. **Thelidium**

4 Ascospores simple.

55 Parasitic on anthraquinone-containing species of Caloplaca s. lat. or on Xanthoria elegans.

66 Exciple brown only near ostiole, colourless elsewhere. **Verrucula**

6 Exciple pale brown in lower part, dark brown in upper part. **Verruculopsis**

5 Not parasitic, or parasitic on other hosts.

66 On marine rocks. Median length of ascospores generally less than 12 µm. Thallus usually with a green tinge, sometimes with black carbonaceous ridges. Upper surface of involucrellum smooth. (Wahlenbergiella)

66 On marine or freshwater rocks. Ascospores 10-18 (20) µm long. Thallus with punctiform to column-like carbonaceous structures that remain discrete (never fusing or forming elongated ridges). Upper surface of involucrellum rough and uneven. **Hydropunctaria**

6 Not marine or aquatic, or if marine or aquatic then not as above. See Note 1.

77 Thallus not endolithic on calcareous rock. See **Verrucaria** key.

7 Thallus endolithic on calcareous rock.

88 Involucrellum with fine radial cracks (Note 2). **Bagliettoa**

8 Involucrellum absent or without fine radial cracks.

999 Pseudoparaphyses short. Upper cortex fairly well differentiated. Perithecia ± immersed. Involucrellum present or absent. Oil cells often present in lower part of medulla (Note 3). **Bagliettoa**

99 Pseudoparaphyses short. Upper cortex not well differentiated. Perithecia superficial or semi-immersed. Involucrellum present. Oil cells absent. **Parabagliettoa**

9 Not as above. See **Verrucaria** key, which also includes Bagliettoa and Parabagliettoa species.

(1) All species in this branch are included in the key to Verrucaria species, so you may proceed directly to that.

(2) In species with a radially split involucrellum, some perithecia may not display this character. It is advisable to examine a number of perithecia before concluding that the involucrellum is not radially cracked.

(3) Oil cells, sometimes called macrospheroids, are individual cells of hyphae that store oil. They are ± spherical and wider than other hyphal cells.

**Generic key 6B: Crustose lichens with perithecia, persistent paraphyses, septate ascospores**

11 Mature ascospores dark brown.

22 Ascospores distoseptate.

33 Ascospores with small, often angular lumina. Asci without ocular chamber.

44 Ascospore wall markedly thickened with ± lens-shaped inner compartments. Brown macroconidia absent. **Pyrenula**
4 Ascospore wall slightly thickened with inner compartments not lens-shaped. Brown macroconidia often present. (Eopyrenula)
3 Ascospores with larger, rounded lumina. Asci often with ocular chamber. (Lithothelium)
2 Ascospores euseptate.
33 Young ascomata ± globose. Perithecial wall of rather large, angular cells. Centrum I-. Usually on wood. (Kirschsteiniothelia)
3 Young ascomata ± hemispherical. Perithecial wall of small, rounded cells. Centrum I+ blue. Usually on bark. Peridiothelia
1 Mature ascospores colourless, only sometimes brown when over mature.
22 Ascospores more than 5 times as long as wide.
33 Not lichenised, or associated with just a few Trentepohlia cells. Ascospores 1 - 5 -septate, at least 25 \( \mu \)m long. On bark. Leptorhaphis
3 Lichenised with Trentepohlia. Ascospores 3 - 17 -septate, length various. On various substrates.
44 Asci with a distinct apical dome. Interascal filaments sometimes branched. Macroconidia sometimes present, more than 5 \( \mu \)m long, often with gelatinous appendages (use Indian ink). (Microconidia may also be present.) On bark or calcareous rock. Strigula
4 Asci without an apical dome, with a minute refractive ring. Interascal filaments unbranched. Macroconidia absent. Microconidia sometimes present, to 3 \( \mu \)m long, without gelatinous appendages. On various substrates. Porina
2 Ascospores less than 5 times as long as wide.
33 Tissue between asci almost cellular. Asci globose.
44 Asccarps in groups of 2 - 8 below a layer of blackened tissue (a clypeus). Tomasellia
4 Asccarps usually solitary, only occasionally aggregated. Clypeus absent. (Cyrtidula)
3 Tissue between asci of thread-like filaments. Asci clavate to cylindrical.
44 Asci cylindrical. Ascospores shortly ellipsoid, ornamented.
55 Photobiont Trentepohlia. On bark or rock. Acrocordia
5 Photobiont cyanobacterial. On rock. (Collemopsidium)
4 Not as above.
55 Interscal hyphae unbranched. (Lithothelium)
5 Interscal hyphae branched and often anastomosed.
66 Involucrellum ± cellular, not containing bark cells. Anisomeridium
6 Involucrellum not cellular, often containing bark cells. Arthopyrena

Generic key 7: Calicioid genera

Thallus not gelatinous, crustose. Ascomata mazaedia or stalked apothecia.

11 Asci disintegrating early, leaving a loose mass of spores.
22 Ascospores simple.
333 Ascospore mass black or dark brown. Wall of ascospores dark brown. Ascospores uinseriate in ascus. Photobiont absent.
44 Ascospores ellipsoid, to 10 \( \mu \)m long. Not parasitic. Myccalicium
4 Ascospores globose or subglobose in most species; if ellipsoid then more than 10 \( \mu \)m long. Often parasitic on other lichens, especially species of Pertusaria Sphinctrina
33 Ascospore mass green. Wall of ascospores green with spirally arranged ridges. Ascospores septate when mature. Photobiont absent. (Microcalicium)
3 Ascospore mass brown or pink. Wall of ascospores colourless or pale brown, ornamented or not. Photobiont present.
44 Ascospores globose, wall colourless and warded. Photobiont Trentepohlia. (Sclerophora)
4 Ascospores globose or ellipsoid, wall pale brown, smooth or ornamented. Photobiont green or Trentepohlia. Chaenotheca
2 Ascospores septate to submuriform.
33 Spore mass brown. Chaenotheca
3 Spore mass black or green-black.
443 Ascomata immersed.
55 Exciple strongly thickened at base. Fertile verruciae 1.5 - 2.0 mm diameter. Thallus with areas of black, granular isidia. Medulla I+ blue. Thelomma
5 Exciple thin throughout. Fertile verrucae to 1 mm diameter. Isidia absent. Medulla I. **Cyphelium**

44 Ascomata sessile.

55 Ascospores cylindrical, 1 - 3 (7) -septate, ornamented with spirally arranged ridges. Spore mass green-black. (Microcalicium)

5 Ascospores ellipsoid to broadly ellipsoid, 1-septate, smooth or with spirally arranged ridges or irregular cracks. Spore mass black. **Cyphelium**

4 Ascomata distinctly stalked.

55 Photobiont absent. Ascospores with a thick gelatinous coat at intermediate stages of development. **Sphinctrina**

5 Photobiont green. Ascospores without a gelatinous coat. **Calicium**

1 Asci persistent, no spore mass formed.

22 Ascospores brown.

33 Ascii unevenly thickened, apex in semi-mature ascii penetrated by a thin canal. Ascii usually less than 55 µm long. **Chaenothecopsis**

3 Ascus apex strongly and uniformly thickened. Length of ascii various.

444 Ascospores simple, fusiform. Ascii less than 45 µm long. **Mycocalicium**

44 Ascospores simple or 1-septate, ellipsoid. Ascii more than 65 µm long. (Phaeocalicium)

4 Ascospores (1) 3-septate, broadly to narrowly fusiform. Ascii more than 65 µm long. (Stenocybe)

2 Ascospores colourless.

33 Apothecia on solid stalks that are rarely branched and not swollen.

44 Apothecia pink. (Dibaeis)

4 Apothecia brown. **Baeomyces**

3 Apothecia on hollow, simple or branched, ±swollen stalks. (Pycnothelia)

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**Generic key 8: Crustose lichens with elongate apothecia**

Thallus not gelatinous, crustose. Ascomata elongate apothecia.

Some genera here have a few species that are not lichenised. Lichenised taxa have Trentepohlia, except for Xylographa and a few species of Arthonia,

111 Apothecia with a thalline margin.

22 Exciple thick, dark brown. (Limonaea)

2 Exciple poorly developed. **Schismatomma graphidioides**

11 Apothecia without a thalline margin but with an exciple.

222 Ascospores simple.

33 Exciple colourless to pale brown, thin. Paraphyses distinct. On wood or bark. **Xylographa**

3 Exciple black. Paraphyses distinct or not. On various substrates.

44 Paraphyses distinct. On bark or wood. **Elixia**

4 Paraphyses often indistinct. On rock. (Lithographa)

22 Ascospores 1-septate.

33 On bark or wood. **Melaspilea**

3 On calcareous rock.

44 Ascospores 12 - 16 x 4 - 6 µm. **Encephalographa elisae**

4 Ascospores 22 - 26 x 9 - 11 µm. **Melaspilea graeca**

2 Ascospores multi-septate, submuriform or muriform.

33 On bark or wood. **Melaspilea**

3 On calcareous rock.

44 Ascospores 12 - 16 x 4 - 6 µm. **Encephalographa elisae**

4 Ascospores 22 - 26 x 9 - 11 µm. **Melaspilea graeca**

2 Ascospores 1-septate.

33 Mature ascospores colourless. Apothecia with longitudinally grooved or ridged surface. Disc narrow. **Graphis**

4 Mature ascospores grey-brown. Apothecia flat. Disc widely expanded. (Phaeographis)

3 Ascospores I-; cells with cylindrical or cuboid lumina. Paraphyses branched and anastomosed. On various substrates.

44 True exciple black and friable.

55 Apothecia round to elongate even in a single specimen, pruinose. Exciple extending to medulla or substrate. **Lecanographa**
5. Apothecia elongate, pruinose in only a few species. Exciple more delimitated. **Opegrapha**

4. True exciple thin, brown or colourless.

55. Ascospores colourless. **Enterographa**

5. Ascospores brown. **Roccellographa**

1. Apothecia without a thalline margin. Exciple absent or very poorly developed.

22. Ascomata grouped together in a stroma, at least when mature. **(Symcisia)**

2. Ascomata single, not grouped in a stroma. **Arthonia**

**Generic key 9: Yellow crustose lichens with apothecia**

Thallus not gelatinous, crustose. Ascomata rounded apothecia. Thallus and/or apothecia yellow, orange or red.

11. Yellow, orange or red part(s) clearly and distinctly K+ purple.

222. Ascospores multiseptate.

33. On calcareous rock. **Caloplaca**

3. On siliceous rock.

44. Asci Lecanora type. Paraphyses branched and anastomosed. **Haematomma**

4. Asci with a shallow, uniformly KI+ blue apical dome, without a distinct ocular chamber or apical cushion. Paraphyses mostly simple. **(Ophioparma)**

22. Ascosporas polarioculor or clearly derived from a polarioculor state, or 1-septate. **Caloplaca**

2. Ascosporas simple.

33. Thallus K+ purple, usually well-developed; margin lobed in some species. Ascospores ellipsoid, pyriform or irregular. **Asci Teloschistes type.** On rock, soil or overgrowing bryophytes. **Caloplaca**

3. Thallus K-, often poorly developed or absent; margin never lobed. Ascospores ellipsoid. **Asci Porpidia type.** On rock. **Protoblastenia**

1. Yellow, orange or red part(s) K- or K+ faintly pinkish or reddish; if strongly K+ then not +purple.

22. Ascospores septate.

333. Ascosporas appearing 1-septate, but in fact simple with 2 locules. **Candelariella**

33. Ascosporas (1) 3-septate. **(Chrysothrix)**

3. Ascosporas with 7 or more septa. If present in Greece, then strictly montane. **(Arthrorhaphis)**

2. Ascosporas simple.


44. Apothecia ± punctiform, immersed in thallus. Thallus yellow, superficial, with radiating marginal lobes. **Asci with at least 50 ascospores.** Ascospores less than 5 µm long. On siliceous rock at high altitude. **Pleopsidium**

4. Apothecia not punctiform, immersed or not. Thallus yellow, orange or grey, superficial or immersed, with or (more usually) without radiating marginal lobes. **Asci with 8 - 32 ascospores.** Ascospores more than 5 µm long. On various substrates; not restricted to high altitudes.

55. Apothecia with a thalline margin. Exciple and often also disc distinctly yellow or orange. **Apothecia never deeply immersed in thallus or substrate.** Thallus, if present, yellow or orange, at least in part (Note 1). **Asci 8 - 32 spored. Candelariella**

5. Apothecia without a thalline margin. Exciple and disc orange or brown-orange, without a yellow tinge. **Apothecia deeply immersed in thallus or substrate in some species.** Thallus white, grey, grey-green, brown or immersed, but never yellow or orange. **Asci 8-spored. Porpidia type.** On limestone.

66. Ascospores with gelatinous perispore (usually ±prominent at x400). Hypothecium without violet pigment. **Thallus immersed or superficial. Apothecia immersed in pits in substrate in some species, fairly dark (red-brown to black), flat to convex, K- to strongly K+. Epithecium orange-brown to brown, without brown-orange granules, K- (though K may send some epithecial pigment into solution). Clauzadea**

6. Ascospores without perispore. Hypothecium sometimes with a violet pigment. **Thallus immersed.** **Apothecia not in pits, not very dark (brown-orange), soon becoming convex, K- or K+ weakly reddish. Epithecium brown-orange, with many brown-orange granules (like many Caloplaca species); granules weakly K+ purple in places. Protoblastenia lilacinia**

1. Do not confuse a black prothallus, present in some species, with a thallus.

**Generic key 10: Crustose lichens with rounded apothecia**
Thallus not gelatinous, crustose, with rounded apothecia. Not yellow, orange or red

11 Apothecia without a thalline margin; exciple absent or strongly reduced. **Generic key 10A: Crustose with rounded immarginate apothecia**

1 Apothecia with a distinct exciple and/or thalline margin.
2 Thallus with marginal lobes, or areolate with marginal areoles distinctly radiating. **Generic key 10B: Crustose with rounded apothecia and marginal lobes.**

2 Thallus without marginal lobes.
333 Photobiont blue-green. **Generic key 10C: Crustose with rounded apothecia and cyanobacteria**
33 Photobiont Trentepohlia. **Generic key 10D: Crustose with rounded apothecia and Trentepohlia**
3 Photobiont green, not Trentepohlia.
44 Mature ascospores coloured. **Generic key 10E: Crustose with rounded apothecia; ascospores coloured**
4 Mature ascospores colourless.
55 Mature ascospores submuriform or muriform. **Generic key 10F: Crustose with rounded apothecia; ascospores colourless, muriform**
5 Mature ascospores septate or simple.
66 Epithecium and hymenium with distinct blue granules. Ascospores mostly simple or 1-septate. Asci Porpidia type. Usually overgrowing bryophytes or decaying vegetation.
77 Apices of paraphyses to 3 μm wide. **Bryobilimbia**
7 Apices of paraphyses to 6 μm wide. **Mycobilimbia berengeriana**
6 Epithecium and hymenium without blue granules (though epithecium may have blue-green or blue-black pigment in a few species). Ascospores and asci various. On various substrates.
777 Mature ascospores polarilocular. **Caloplaca**
77 Mature ascospores septate (Note 1).
88 Apothecia with thalline margin (which may become excluded). Asci Bacidia or Catillaria type.
99 Hymenium with distinct purple tinge. Most ascospores simple, only occasionally 1-septate. **Tephromela atro**
9 Hymenium without purple tinge. Most ascospores septate.
AA Ascospores 1-septate, with perispore that swells in K. Asci Catillaria type. On rock or parasitic on lichens on rock. Very rare in Greece. **Halecania**
A Ascospores (0) 1 - 3 (7) -septate, without perispore. Asci Bacidia type. On various substrates. Some species fairly common in Greece. **Lecania** Note 2.
8 Apothecia without thalline margin. **Generic key 10G: Crustose with rounded apothecia; ascospores colourless, septate**
7 Mature ascospores simple.
888 Ascospores very large, 30 - 200 μm long, thick walled, 1 - 8 per ascus.
99 Apothecia immersed in thalline warts. Disc often not widely exposed. See **Pertusaria** key.
9 Apothecia not in thalline warts. Disc widely exposed.
AA Apothecia ±immersed in thallus. Disc black. **Megaspora**
A Apothecia sessile. Disc not black. **Ochrolechia**
88 Ascospores very small, less than 8 μm long, many per ascus (30 to more than 100). See Note 3. **Generic key 10H: Crustose with rounded apothecia; ascospores colourless, simple, small**
8 Ascospores not as above; usually medium sized, 10 - 30 μm long, (4) 8 per ascus.
99 Thalline margin present; algae visible in section of apothecia. See Note 4. Paraphyses distinctly moniliform in some genera with immersed apothecia. **Generic key 10I: Lecanorine genera**
9 Thalline margin absent; apothecial sections without algae. Paraphyses not strongly moniliform.
AA Epithecium orange-brown with many orange-brown granules (like many Caloplaca species), at least some of which react faintly K+ purple. Mature apothecia convex, brown-orange, 0.4 - 0.7 mm diameter. Thallus immersed in calcareous rock. **Protoblastenia ilacina**
A Epithecium without orange-brown, K+ purple granules. **Generic key 10J: Lecideine genera**

(1) Septa may be absent in immature ascospores. Any ascospore with very granular cell contents is immature (but immature ascospores are not always granular). Examine carefully any ascospores that are narrowly ellipsoid and appear simple: they may be 1-septate with a thin septum. Take particular if paraphyses are capitate with an internal pigment cap, as in Catillaria and related genera, a group with thin, inconspicuous septa. Septa generally become
clearer in K. Thin septa can be made more prominent by adjusting the condenser to alter the contrast.

(2) Collections with a large, well-developed thallus should be checked against Solenopsora. In some placodioid species of that genus, marginal lobes are sometimes poorly developed.

(3) Immature asci in Circinaria and related genera often appear granular and the contents could be mistaken for small ascospores. However, the epithecium is usually greenish and the paraphyses are usually moniliform, unlike any genus in key 10H.

(4) In some species, especially those with immersed apothecia, algae may only be apparent microscopically, in a thin section.

Generic key 10A: Crustose with rounded immarginate apothecia

11 Photobiont Trentepohlia or absent.
   22 Ascospores septate. Photobiont present or absent. Arthonia

22 Ascospores simple. Photobiont absent. Agyrium

1 Photobiont green, not Trentepohlia.

   22 Ascii with 8 ascospores.

   33 Ascii ellipsoid, subglobose or clavate, with a large apical dome and usually distinct ocular chamber. Paraphyses richly branched and anastomosed. Arthonia

   3 Asci cylindrical or cylindrical-clavate, wall not noticeably thickened above. Paraphyses branched, sometimes sparingly anastomosed in lower third of hymenium.

   44 Apothecial tissues bound by a gel matrix. Ascus apex with KI+ blue outer layer and apical dome; ascus wall KI-. Paraphyses not wrapped around individual asci. Micarea and Brianaria. Species are keyed under Micarea.

   4 Apothecial tissues lacking gel matrix. Ascus wall KI+ blue except for an apical pore. Paraphyses sometimes wrapped around individual asci. (Vezdaea)

2 Asci with about 100 ascospores. (Biatoridium)

Generic key 10B: Crustose with rounded apothecia and marginal lobes

11 Photobiont blue-green.

   222 Ascospores simple. Prothallus absent. Isidia absent. Soralia present or absent. Thallus olive-green to olive-brown, rarely black; most species not pruinose. Peltula

22 Ascospores septate. Prothallus present or absent. Isidia present or absent. Soralia absent. Thallus variously coloured, sometimes pruinose. Placynthium

2 Ascospores muriform. Prothallus, isidia and soralia absent. Thallus brown or olive-brown, not pruinose. Pseudeptogium diffractum

1 Photobiont green.

22 Ascospores brown.

   33 Ascospores muriform. Thallus grey-white, very thick and well-developed. Diploschistes ocellatus

   3 Ascospores 1-septate. Thallus various.

   44 Thallus actually foliose (lower cortex present), but very closely adpressed. Hyperphyscia adglutinata

   4 Thallus not foliose, strictly crustose-placodioid.

   55 Ascospores without internal wall thickenings (Buellia type). Thallus green-yellow or with a brown or grey tinge, not usually uniformly grey-white; pruinose or not. Dimelaena

   5 Ascospore wall thickened at septum and apex (Dirinaria type). Thallus ±uniformly grey-white, strongly white pruinose. Diploicia

2 Ascospores colourless.

   33 Medulla orange, K+ purple. Placolecis opaca

   3 Medulla white, K- or K+, but not K+ purple.

   44 Ascospores 1-septate, with a thin (and easily overlooked) septum. Solenopsora

4 Ascospores simple.

   55 Ascus apex KI-. Thallus white, grey or brown, never green. Epithecm with green and/or brown pigment, green pigment (Aspicilia green) N+ distinctly green or blue-green. Disc black or almost.

   66 Marginal lobes often well developed. Very common. Lobothallia

   6 Marginal lobes not well developed. Occasional collections of Aspicilia or Circinaria

5 Ascus apex KI+ blue with a central KI- region (Lecanora type). Thallus variously coloured, some species
green or greenish. Epithecium without Aspicilia green pigment. Disc various. See Lecanora key.

**Generic key 10C: Crustose with rounded apothecia and cyanobacteria**

111 Ascospores submuriform or muriform. On rock or soil.
   22 Thallus or thalline margin of apothecia with 1-cell thick cortex. **Scytinimum biatorinum**
   2 Thallus and thalline margin of apothecia without 1-cell thick cortex. See Collema key.

11 Ascospores septate.
   22 Thallus ±immersed. Disc pale. **Petractis clausa**
   2 Thallus superficial. Disc dark brown to black. **Placynthium**

1 Ascospores simple.
   22 Photobiont Nostoc, in a distinct layer.
      33 Ascospores 13 - 15 x 6 - 8 µm, without a perispore. Apothecia to 1 mm diameter. Thallus consisting entirely of blue-grey to grey-brown, coarse granules 0.03 - 0.1 mm diameter, somewhat resembling isidia. Usually on soil. **Fuscopannaria**
      3 Most ascospores more than 15 µm long, with or without a perispore. Apothecia to 2 mm diameter. Other characters various.
         44 Thallus pale grey to dark brown, without isidia but sometimes with granules. Ascospores with a perispore, 19 - 25 x 8 - 10 µm excluding perispore, 25 - 30 x 9 - 12 µm including perispore. Usually overgrowing bryophytes on bark or rock. **Protopannaria pezizoides**
      4 Thallus dark grey with rather shiny true isidia. Ascospores without a perispore, 15 - 25 x 6 - 8 µm. Usually on soil. (V. atlantica) Greek report tentative.

2 Photobiont not Nostoc, in a distinct layer or not.
   33 Asci with at least 24 ascospores. **Peltula**
   3 Asci with 8 ascospores.
      44 Photobiont cells without a gelatinous covering. Thallus not, or only weakly, gelatinous when wet. Thallus subsquamulose, not strictly crustose. **Gloeohelppia**
      4 Photobiont cells with a distinct, gelatinous covering. Thallus ±gelatinous when wet. Thallus various.
         55 Exciple thick. Thalline margin excluded very early.
            66 Apothecia arising from below pycnidia. On moist siliceous or calcareous rock. (Porocyphus) **Lemmopsis**
            6 Apothecia not arising from below pycnidia. On dry calcareous rock or calcareous soil crusts. **Lemmopsis**
         5 Exciple thin or lacking. Thalline margin distinct. **Psorotichia**

**Generic key 10D: Crustose with rounded apothecia and Trentepohlia**

11 Exciple and/or hypothecium dark. Ascospores septate or submuriform.
   22 Apothecia with a thalline margin (which may be poorly developed).
      33 Ascospores submuriform. (Diploschistella)
      3 Ascospores septate.
         44 Thallus C+ red. On bark or rock. **Dirina**
         4 Thallus C-. On bark or wood; not on rock (in Greece).
            55 Thallus conspicuously sorediate. Soralia punctiform to maculate. Apothecia rarely present. **Dendrographa decolorans**
            5 Thallus not conspicuously sorediate; if soredia present then in confluent soralia and apothecia present.
               66 Ascospores 29 - 38 x 2 - 3 µm. **Schismatomma**
               6 Ascospores 19 - 29 x 4 - 6 µm.
                  77 Apothecia generally elongate. Microconidia thread-like. **Dendrographa decolorans**
                  7 Apothecia generally circular. Microconidia ±ellipsoid.
                     88 Thallus corticate. Apothecia immersed or semi-immersed. **Diromma dirinellum**
                     8 Thallus without a cortex. Apothecia erumpent, becoming sessile later. **Ocelomma picconianum**
   2 Apothecia without a thalline margin.
      33 Paraphyses simple or weakly branched. Ascospores 1-septate or 3-septate.
         44 Ascospores 1-septate. Asci Lecanora type. On bark. **Megalaria**
         4 Ascospores 3-septate when mature. Asci KI- at apex, wall KI+ blue. On hard limestone. **Sagiolechia**
      3 Paraphyses richly branched and anastomosed. Ascospores 3-septate to multi-septate.
         44 Ascospores more than 50 µm long and/or fragmenting into part spores, usually more than 12-septate.
**Bactrospora**

4 Ascospores less than 50 µm long, not fragmenting into part spores, 3 - 12 -septate.

55 Asci with small but distinct KI+ blue cone at apex, ascus wall KI-. On rock. (Bactrospora thyrsodes)

5 KI+ blue apical cone absent or poorly developed, ascus wall faintly KI+ blue. On bark, rock or parasitic on lichens on rock.

66 Ascus without distinct apical structures. Ascospores with gelatinous perispore, which may be weakly developed. Apothecia pruinose. **Lecanographa**

6 Ascus with distinct KI+ blue apical ring. Ascospores without perispore. Apothecia pruinose or not.

77 Exciple carbonised, hyphae not visible. Young apothecia with thin greenish pruina, mature apothecia not pruinose. If apothecia pruinose, granules K+ orange or purple in section. **Cresponea**

7 Exciple dark, but hyphae visible (at least in K). Apothecia with thick, yellow-grey pruina. Epithecial granules K-.

88 Thallus UV+ yellow or grey. Apothecia often present. On bark. (Lecanactis abietina) Greek reports in need of confirmation.

8 Thallus UV+ ice blue. Apothecia always absent. On rock. (Dendrographa latebrarum)

1 Exciple and hypothecium pale. Ascospores simple, septate or muriform.

22 Disc at first completely covered by exciple; apothecia sometimes resembling perithecia.

33 Apothecia immersed in thalline warts. **Thelotrema**

3 Apothecia urceolate.

44 On calcareous rock. Thalline covering splitting radially, so exciple may appear fissured or crenulate. Ascospores septate. **Petractis**

4 Usually on bark or wood. Thallus covering not splitting radially; exciple smooth. Ascospores septate or muriform. (Ramonia)

2 Disc never completely covered by exciple; apothecia urceolate, immersed or aspicilioid, resembling perithecia or not.

33 Ascospores brown. **Roccellographa**

3 Ascospores colourless.

44 Ascospores simple. Apothecia ±immersed, aspicilioid. On rock (usually calcareous for Greek species). **Hymenelia**

4 Ascospores septate to muriform. Apothecia immersed to urceolate. On various substrates.

55 Apothecia deeply immersed, resembling perithecia. Hymenium, at least in lower part, with orange-yellow oil droplets. On calcareous rock. **Gyalecta**

5 Apothecia immersed or not, but not resembling perithecia. Hymenium without orange-yellow oil droplets. On various substrates.

66 Exciple well developed. Disc colourless to brown or orange-red. Apothecia rounded.

77 Ascospores 1-septate. **Coenogonium**

7 Ascospores at least 3-septate.

88 Asci 8-spored. **Gyalecta**

8 Asci at least 16-spored. **Pachyphiale**

6 Exciple poorly developed, thin. Disc brown to black. Apothecia punctiform to elongate. **Enterographa**

**Generic key 10E: Crustose with rounded apothecia; ascospores coloured**

11 Asci with thin KI+ blue crescent near apex (Rhizocarpon type). Thallus variously coloured, green or yellow-green in some species. Apothecia without thalline margin. Vegetative propagules absent. Hypothecium brown. Paraphyses strongly branched and anastomosed. Ascospores with a perispore, at least when young (Note 1). Saxicolous or parasitic on saxicolous crustose lichens. **Rhizocarpon**

1 Asci not Rhizocarpon type. Thallus not green or yellow-green. Thalline margin present or absent. Vegetative propagules present or absent. Hypothecium colourless or brown. Paraphyses branched or not. Ascospores with (only in Diplotomma) or without a perispore. On various substrates.

2222 Ascospores simple. Asci Rimularia type (like Lecanora type, but with small KI+ blue plug at top centre of ocular chamber). **Lambiella**

222 Ascospores 1-septate. Asci Lecanora or Bacidia type.

33 Ascospore septum less than 1 µm thick. Ascospores pale brown. Ascospore wall of uniform thickness, smooth. On calcareous rock. **Rinodinella**

3 Ascospore septum more than 1 µm thick. Ascospores dark brown when mature. Ascospore wall often varying
in thickness from place to place and/or at different stages of development, often ornamented. On various substrates.

44 Apothecia with a thalline margin. **Rinodina**

45 Apothecia without a thalline margin.

55 Asci Lecanora type (central KI- part of apex reaching to top of ascus) (Note 2). Ascospores with or without wall thickenings; of various types, but rarely Buellia type. **Rinodina**

56 Asci Bacidia type (central KI- part of apex not reaching to top of ascus, and with a thin, KI+ strongly blue band between it and the rest of KI+ blue part of apex) (Note 2). Ascospores usually without wall thickenings when mature, never with apical thickenings (a few species may show some wall thickening at the sides or near the septum when immature); ±Buellia type. Norstictic acid present or absent.

66 Conidia thread-like, to 30 µm long (Note 3). **Amandinea**

6 Conidia bacilliform, to 10 µm long (Note 3). **Buellia**

2 Ascosporae usually multi-septate or submuriform, not usually muriform. Asci Lecanora type. Apices of paraphyses often swollen. Apothecia not punctiform or urceolate. Thallus not especially thick, C-

33 Conidia distoseptate (see Glossary). Calcium oxalate crystals present in thallus. Apothecia often heavily pruinose. On all substrates. **Diplotomma**

22 Conidia euseptate (see Glossary). Calcium oxalate crystals generally not present. Apothecia pruinose or not, but rarely heavily pruinose. Not on rock (though may be parasitic on saxicolous lichens). **Buellia**

33 Ascospores muriform. Asci without apical apparatus. Apices of paraphyses not swollen. Apothecia punctiform to open, urceolate to sessile. Thallus usually thick and well developed, C- or C+ red.

33 Asci with 2 ascospores. **Ingvariella**

33 Asci with 4 or more ascospores. **Diploschistes**

(1) A perispore is often difficult to see. Brodo et al. (2001) suggest use of Indian ink, but that is now hard to obtain. I prefer to vary the focal plane of the microscope. A perispore, if present, will be more prominent in some planes than others. It may also give rise, by diffraction, to prominent concentric ellipses around the ascospore.

(2) It is difficult to distinguish between Lecanora and Bacidia ascus types. For routine identification it is usually more convenient to use other characters.

(3) Collections of Amandinea and Buellia commonly lack conidiomata, so keys to species under Buellia include Amandinea species.

(4) If parasitic on Lecanora albescens, consider also the poorly known, non-lichenised species Buellia lecanorae.

**Generic key 10F: Crustose with rounded apothecia; ascospores colourless, muriform**

11 Thallus with hyphophores (see Glossary).

22 Hyphophores spine-like. Apothecia orange-red to black-brown. Usually on bark, sometimes on wood or overgrowing bryophytes, rarely on rock in underhangs. **Jamiella anastomosans**

2 Hyphophores squamiform. Apothecia yellow-green or grey-brown. Usually foliicolous. (Galectidium)

1 Thallus without hyphophores. Apothecia black.

22 Thallus K+ red. Ascospores more than 45 µm long, ±ellipsoid but often with distinctly pointed ends. **Phlyctis**

2 Thallus not K+ red. Ascospores less than 45 µm long in most species (to 60 µm in a very few), ellipsoid with rounded ends.

33 Hymenium I+ blue. On rock; not ephemeral. Common. **Rhizocarpon**

3 (?Hymenium I-). On acid clay soil; ephemeral. Very rare. (Diploschistella)

**Generic key 10G: Crustose with rounded apothecia; ascospores colourless, septate (not polarilocular). Apothecia without thalline margin.**

1111 Ascus apex when stained in KI without a distinct vertical central part that stains distinctly more intensely blue or distinctly less intensely blue than sides of apex.

22 Ascus apex staining strongly blue in a hemispherical cap (Catillaria type). Ascospores 1-septate. Paraphyses mostly simple, sometimes with a few branches. On bark or rock.

33 Paraphyses strongly capitate, with dark-coloured apical cap. Ascospores without layered walls. Apothecia usually black. On bark or rock, not restricted to humid sites. Common. **Catillaria**

3 Paraphyses only weakly capitate. Ascospores with layered walls to 1.5 µm thick, outer wall resembling a halo. Apothecia red-brown to black. On bark in humid sites. Rare. **Catinaria**

2 Ascus apex KI+ strongly blue only in thin layer near top, sometimes staining more weakly blue below
(Rhizocarpon type). Ascospores 1-septate or 3-septate. Paraphyses distinctly anastomosed, especially in lower part. On siliceous rock.

11 Ascus apex KI- except for KI+ blue apical tube (Porpidia type). Not usually on bark.
22 On soil, detritus, or decaying bryophytes. Ascospores 0 - 3 -septate. Some species presently treated in

**Mycobimbia**

22 On calcareous rock. Ascospores 0 - 1 -septate. **Porpidinia tumidula**

11 Ascus apex KI+ blueish, containing a darker blue tubular ring structure (Byssoloma type). Ascospores 1 - 7 -septate. Paraphyses branched and anastomosed. Usually on bark.
22 Exciple tomentose, loosely structured in section. Ascospores 3 -septate. (Byssoloma)

2 Exciple not tomentose, compact in section. Ascospores 1 - 7 -septate.

33 Conidia pyriform. Exciple of ellipsoid to globose cells, not arranged in rows. Apothecia pale in most species. Fellhaneran

3 Conidia bacilliform or elongate. Exciple of ellipsoid to angular cells, ± arranged in rows. Apothecia dark. (Fellhaneropsis)

1 Ascus apex KI+ blue but with central KI- ocular chamber (Bacidia, Biatora, or Lecanora type) (Note 1). Ascospores 1- to multi-septate.

22 Paraphyses much branched or anastomosed. **Scoliciosporum**

2 Paraphyses mostly simple, sometimes sparingly branched or anastomosed in upper part.

33 Hyphae of exciple ± abundantly anastomosed (Note 2). Apothecia black, sometimes pruinose. Thallus often pruinose. Epithecium distinctly pigmented, usually grey, green or black.
44 Ascii with 8 ascospores. Usually on rock or soil, occasionally lichenicolous, not normally on bark. Ascospores various. See **Toninia** key.

4 Ascii with 8 - 16 ascospores. On bark. Ascospores 10 - 18 x 4 - 5 µm, usually 3-septate, usually curved.

**Arthrosorum**

3 Hyphae of exciple simple or forked; anastomosed or not. Apothecia variously coloured but pure black in only a few species, not pruinose. Thallus not pruinose. Epithecium ± colourless to pale yellow, pale orange-brown, brown, purple-brown, green or grey-green.
44 Rim of exciple covered by rather thick gelatinous layer that swells markedly in K and finally almost dissolves. Ascospores with warted perispore in some species. On soil, detritus or decaying bryophytes. **Bilimbia**

4 Rim without such a gelatinous layer. Ascospores without warted perispore. On various substrates.

55 Excipular hyphae with thick gel coat. Disc black. Ascospores 1-septate, ellipsoid, 20 - 30 x 10 - 15 µm. Epithecium, hypothecium and outer part of exciple with blue-black to green-black pigment. On bark. **Megalaria** (See Note 3.)

5 Excipular hyphae without thick gel coat. Disc not black in most species. Ascospores 1- to multi-septate, other characters various. Apothecial pigments absent or various. On various substrates.

66 Cell lumina in exciple wide and irregularly shaped. Pycnidia often present and conspicuous. Usually on bark or wood. **Cliostomum**

6 Cell lumina in exciple narrow, and ± regularly shaped; or if broad then only so in outermost part of exciple. Pycnidia usually absent or inconspicuous. On various substrates.

77 Excipular hyphae moderately branched but not anastomosed, running closely parallel to each other; cell lumina narrowly cylindrical, evenly thick; crystals absent. Ascospores 1 - 3 -septate. On soil, detritus, or decaying bryophytes. **Mycobimbia**

7 Excipular hyphae not as above; crystals present or absent. Ascospores 1- to multi-septate. On various substrates.
88 Ascospores ± ellipsoid, 1 - 3 -septate.

99 Ascospores narrowly ellipsoid, 1 - 3 -septate. On various substrates. Morphs of **Lecania** species without a thalline margin.
9 Ascospores broadly ellipsoid, 1-septate with a thin septum. On calcareous rock. Some species present treated under **Catillaria**

8 Ascospores usually elongated, not ellipsoid, 3- or more-septate.
99 Pycnidia usually abundant, large, usually with open ostiole. Conidia often with 2 lumina (biguttulate) or with a constriction at centre. Thallus UV+ pink or P+ red. Apothecia not common. On shaded substrates, usually close to water. See note 4. (Aquicidia)

9 Not as above.

AA Ascospores 15 - 25 x 2 - 2.5 µm, with blunt ends. Hypothecium and inner part of exciple dark red-brown, K+ purple. Apothecia 0.3 - 0.8 mm diameter, dark purple-brown to black. Thallus
±granular. On bark. **Bellicidia incompta**

A Ascospores with rounded or pointed ends in most species; if with blunt ends then other characters not as above.

BB Cortex of thallus usually with crystals. Exciple with or without crystals. Excipular hyphae distinctly radiating, at least in outer part, not or sparingly anastomosed. Exciple sometimes formed of two distinct layers. Cell lumina in radiating part of exciple narrow cylindric, 8 - 25 x 1 - 3 µm, 5 - 11 times as long as broad. Walls of excipular hyphae thick (distance between two adjacent cell lumina 1 - 2.5 times width of a lumen). Terminal cells of excipular hyphae enlarged in some species. **Bacidia**

B Cortex and exciple without crystals. Excipular hyphae radiating or not, sparingly to (usually) abundantly anastomosed. Exciple not formed of two distinct layers. At least some cell lumina in interior of proper exciple short and wide (width more than 2.5 µm, length/width ratio less than 4). Walls of excipular hyphae thin (distance between two adjacent cell lumina usually less than width of a cell lumen). Terminal cells of excipular hyphae not enlarged. **Bacidina**

(1) An ocular chamber can sometimes be seen clearly in unstained ascus in water.

(2) It may be difficult to observe anastomoses, as the exciple is strongly pigmented in many species in this branch. Cut a very thin section, using a fresh blade. For routine determination it is easier to use the other characters.

(3) The photobiont in Megalaria is Trentepohlia, but that is not always obvious.

(4) Species of Aquicidia are rarely fertile. Unfortunately, Greek lichens are not sufficiently known at present for me to be able to provide a good key to sterile crustose species, and species of Aquicidia, if present in Greece, are likely to be overlooked.

**Generic key 10H:** Crustose with rounded apothecia; ascospores colourless, simple, small

111 Apothecia compound. On rock in arid, cold regions. Thallus areolate to umbilicate foliose. If present in Greece, probably restricted to high altitude. (Glypholecia)

11 Apothecia simple, globose to egg-shaped and resembling perithecia, very small, pale yellow to green-yellow pruinose in most species. On various substrates. **Thelocarpon**

1 Apothecia simple, not resembling perithecia. On various substrates.

22 On bark, wood, soil or overgrowing bryophytes.

33 Apothecia with a thalline margin; algae present at least when viewed in section. Apothecia distinctly sessile. Ascus apex KI+ blue, staining in distinct layers. On bark.

44 Thalline margin well defined. Apothecia dark. Ascus apex with outer layer KI+ strongly blue, inner layer KI+ faintly blue (Teloschistes type). (Maronea)

4 Thalline margin not well defined. Apothecia pale. Ascus apex with outer layer KI+ faintly blue, inner layer KI+ strongly blue. (Biatoridium)

3 Apothecia without a thalline margin; algae absent even in section. On various substrates.

44 Apothecia ± pale. Ascospores various. On bark or soil.

55 Ascospores ± globose. On bark. (Biatoridium)

5 Ascospores ellipsoid or bacilliform. On bark or soil. (Bitorella)

4 Apothecia orange, red or red-brown. Ascospores ± globose. On bark or wood, or overgrowing bryophytes.

55 Epithecium with many granules that react K+ scarlet or + purple and then dissolve. Apothecia orange, densely pruinose, K+ red-purple. **Piccolia**

5 Epithecium without granules, K-. Apothecia brown-red, scarlet-red, brown or black, not pruinose, K-.

**Strangospora**

2 On rock or parasitic on lichens on rock.

33 Apothecia with a thalline margin; algae present at least when viewed in section. Apothecia usually immersed, occasionally ± sessile. Ascus apex KI+ blue or KI-, not staining in distinct layers.

444 Ascii Porpidia type, apex KI+ blue. Thallus pale brown to white-grey, but often thin and indistinct. True cortex absent, only epinecral layer present. All reactions negative. On calcareous rock. (Caeruleum)

44 Ascii close to Lecanora type, apex KI+ blue. Thallus yellow. Cortex present, cellular. Thallus UV+ orange, other reactions negative. On siliceous rock. **Pleopsidium**

4 Ascus apex KI- or almost. Thallus variously coloured. Cortex present, cellular. Reactions various. On calcareous or siliceous rock. **Acarospora** and **Myriospora** which is keyed out under Acarospora.

3 Apothecia without a thalline margin; algae absent even in section. Apothecia dark brown to black.

44 Thallus well developed, areolate, C+ red. Prothallus distinct. Ascospores subglobose or globose. Apical dome
of asci uniformly KI+ blue. Epithecium brown, or with a green or blue tinge. On siliceous rock. Probably confined to northern and/or montane regions. **Sporastatia**

4 Thallus often poorly developed, C-. Prothallus absent. Ascospores ellipsoid. Apical dome of asci KI-, but outer coat KI+ blue. Epithecium brown, without a green or blue tinge. On calcareous or siliceous rock. Widely distributed.

55 Paraphyses richly branched and anastomosed, generally without visible septa, not capitate. Apothecia black. Disc umbonate, often becoming gyrose. **Polysporina**

5 Paraphyses simple, sometimes with visible septa, sometimes ±capitate. Apothecia red-brown to black. Disc not umbonate, not gyrose. **Sarcogyne**

**Generic key 10I: Lecanorine genera.**


22 Apical dome of asci uniformly KI+ blue. Apothecia 0.15 - 0.3 mm diameter. Epithecium blue-green. Paraphyses sometimes clavate, but not distinctly moniliform. On calcareous rock. If present in Greece, then strictly montane. (Eiglera)

22 Apical dome of asci KI+ blue with central KI- region (Lecanora type). Apothecia usually more than 0.3 mm diameter. Epithecium usually brown, never with a blue tinge. Paraphyses not moniliform. On various substrates at all altitudes. A few species in **Lecanora** key with only weakly emergent apothecia.

2 Apical dome of asci KI-. Apothecia usually some more than 0.3 mm diameter. Epithecium various, but never with a blue tinge. Paraphyses various, often distinctly moniliform. On calcareous or siliceous rock. At all altitudes.

33 Epithecium ±green (olive-green to olive-brown). Thallus usually well developed. Never aquatic. Very common.

44 On bark or wood. Thallus ±crustose. (Teuva uxoris)

4 On rock, or parasitic on saxicolous lichens.

55 Ascospores more than 15 µm long. Algae not present below apothecia. See **Aspicilia** key.

5 Ascospores 10 - 15 µm long. Algae present or absent below apothecia.

66 Algal cells not forming a well-defined layer below apothecia (a few scattered cells or groups of cells may be present).

77 Epithecium strongly N+ bright green. On non-calcareous or weakly calcareous rock. Strictly montane. **Aspicilia**

7 Epithecium N- or weakly N+ pale green. On calcareous rock. Not strictly montane. **Lobothallia**

6 Algal cells forming a well-defined layer below apothecia. **Lobothallia**

3 Epithecium colourless or not ±green. Thallus usually thin, sometimes endolithic. Some species aquatic. Not common.

444 Disc yellow-brown or grey-brown. **Ionaspis**

44 Disc pinkish. **Hymenelia**

4 Disc black.

55 On calcareous rock. Epithecium N-, N+ red or N+ purple. **Hymenelia**

5 On siliceous rock. Epithecium N-. **Ionaspis**

1 Apothecia emergent, at least eventually. Paraphyses not, or only weakly, moniliform. On various substrates.

22 Hymenium distinctly purple or brown-purple. **Tephromela atra**

2 Hymenium ±colourless, at least in lower part. Upper part may contain some epithelial pigment.

33 Thallus brown or green-brown, usually ±shiny (Note 1). On siliceous rock or parasitic on lichens on siliceous rock. **Protoparmelia**

3 Thallus usually not brown. On various substrates.

44 Ascii Porpidia type. Thallus white to pale grey, pruinose. On calcareous rock. (Koerberiella pruinosa)

4 Ascii Bacidia or Lecanora type. Thallus and substrate various.

55 Thalline margin often inconspicuous. Apothecia small, to 0.5 mm diameter. Ascospores usually narrow, to 4 µm, narrowly ellipsoid, without a thick wall, sometimes more than 8 per ascus. Asci Bacidia type. Not commonly keying out here (since most specimens have at least some septate ascospores). **Lecania**

5 Thalline margin usually conspicuous. Apothecia small or large. Ascospores often broader than 4 µm, usually ±ellipsoid rather than narrowly ellipsoid, often with a prominent wall (about 1 µm wide), usually 8 per ascus. Asci Lecanora type. Very common. See **Lecanora** key.

(1) Some specimens of Protoparmelia in the montagnei group have white patches where the cortex is missing. If these
are numerous, the thallus may appear pale grey or white-grey and not shiny. However, close inspection will reveal some brown or green-brown areoles.

**Generic key 10J: Lecideine genera**

Many genera here are difficult to separate. The key uses the KI test on the ascus apex, which is definitive if good observations can be made, but hard to carry out. (The procedure is described under "KI" in the Glossary.) Note 1 gives short-cuts that can sometimes avoid the KI test.

11 Exciple strongly contorted (gyrose). Central part of apothecia often with a raised area of sterile tissue (umbonate). Ascospores eventually becoming brown. On siliceous rock. **Lambiella**

1 Exciple smooth to crenulate but not gyrose. Apothecia not umbonate. Ascospores remaining colourless. On various substrates.

22 Exciple carbonised, i.e. black and opaque even in a very thin section. Epithecium and upper part of hymenium blue. Asci Lecanora type. **Carbonea**

2 Exciple not carbonised. Epithecium and asci various.

33 Asci without any apical apparatus; discharging by splitting. On siliceous rock. **Schaereria**

3 Asci with apical apparatus. On various substrates.

44444 Asci apex KI- or weakly and ±uniformly KI+ blue.

55 Apothecia in clusters, proliferating from hymenium and margins of older apothecia. Asci with an inconspicuous, darker blue central tube. On bark or wood. **Hertelidea**

54 Apothecia usually not in clusters, never proliferating from older apothecia. Apothecia without a darker blue central tube. On various substrates.

666 Sides of asci with a strongly KI+ blue layer. Paraphyses strongly capitate. Thallus not rust-coloured. On siliceous, but not iron-rich rock, at alpine levels. **Cephalophysis leucospila**

666 Sides of asci overlain by thin, I+ blue gelatinous layer. Paraphyses not strongly capitate. Thallus usually distinctly rust-coloured. On iron-rich siliceous rock. **Tremolecia atrata**

6 Sides of asci with a weakly KI+ blue layer (Trapelia type). Paraphyses not or moderately capitate. On ±acidic substrates, usually soil, bark or wood.

77 Paraphyses ±capitate, with dark brown cap. Exciple of brown-walled hyphae. **Placynthiella**

7 Paraphyses not capitate, without dark brown cap. Exciple of colourless or pale hyphae.

88 Apothecia yellow-brown to almost black. Thallus usually conspicuous. **Trapelia and Trapeliopsis**. Species are keyed out under Trapelia.

8 Apothecia pale orange, orange-brown or pale pink. Thallus inconspicuous. (Coppinsia)

4444 Asci Catillaria type. On wood, perhaps also on bark, in montane forests. Apothecia 0.2 - 0.3 mm diameter. Ascospores 10 x 3 - 4 µm. **Lecanora hypopta**

444 Asci Lecidea type. **Lecidea** sensu stricto.

444 Asci ±Teloschistes type. On nutrient-poor siliceous rock. **Fuscidea**

44 Asci Porpidia type. Usually on rock, rarely lichenicolous.

55 Cortex brown. Thallus of brown areoles. Apothecia immersed in areoles of thallus, often separated from areole by a distinct crack. Exciple reduced. **Immersaria**

5 Cortex not brown. Thallus variously coloured, areolate or not. Apothecia sessile or immersed. Exciple ±well developed.

66 Medulla and ascospores (perispore) I+ blue. Apothecia ±immersed in thallus. On siliceous rock. **Bellemerea**

6 Medulla and ascospores I-. Apothecia and substrate various.

77 On siliceous rock. Apothecia sessile. **Porpidia**

7 On calcareous rock. Apothecia sessile, or immersed in thallus or in pits in substrate.

88 True exciple friable. Apothecia sessile. Epithecium and hypothecium sometimes with a green tinge. Pycnidia often present. **Farnoldia**

8 True exciple not friable. Apothecia sessile or immersed. Epithecium and hypothecium colourless, brown or red-brown, without a green tinge. Pycnidia uncommon. **Clauzadea**

4 Asci Bacidia, Biatora, Lecanora or similar type. See Note 2.

55 Epithecium or exciple K+ purple, purple-red or red-purple, reaction often fleeting. On bark.

66 Apothecia brown-black or black-red. Thallus ±entirely granular-sorediate. **Pyrrhospora quernea**

6 Apothecia bright red; or if brown-black to black then soredia absent. **Ramboldia**
5 Epithecium and exciple not K+ purple (but may be K+ violet in some species). On various substrates.

66 Paraphyses branched and anastomosed; apices clavate and surrounded by closely adhering pigmented hood. KI+ reaction of ascus apex not very strong. On rock. **Miriquidica**

6 Paraphyses simple, or only sparingly branched or anastomosed; apices not clavate, not surrounded by pigmented hood in most species (except sometimes in Calvitimela). KI+ reaction of ascus apex strong. On various substrates.

77 KI+ part of asci ± arched, not ± hemispherical; central KI- region open above or not (Lecanora and Lecidella types). Apothecia never very pale. Exciple often persistent.

88 Central KI- of asci convergent towards apex, not open above. Epithecium usually with a green-black, blue-green or black-blue pigment. Very common. **Lecidella**

8 Central KI- of asci open above. Epithecium various, including some shades of green, but not normally green-black. Rare except for Lecanora sulphurea.

999 Epithecium dark brown, K+ violet, N- or N+ red. On bark or wood. **Pycnora**

9 Epithecium dark green, N+ purple-red. Parasitic on Lecanora varia. (Ramboldia insidiosa)

9 Epithecium various, but not K+ violet or purple-red. On various substrates.

AA Exciple of radiating, narrow hyphae. A few species in **Lecanora** key.

A Exciple of radiating, conglutinated, branched and anastomosing hyphae. (Ramboldia)

7 KI+ part of asci ± hemispherical; central KI- region spiky, conical, not open above (Bacidia and Biatora types). Apothecia and exciple various.

88 Epithecium usually pale. Exciple pale to dark, excluded early. Apothecia very pale to almost black. On bark, wood or decaying vegetation, never on rock. The couplet below is provisional, and may not work well: consult the keys to both genera.

99 Thallus well developed. Ascospores with epispore. **Mycobilimbia** s. lat.

9 Thallus poorly developed; granular or inconspicuous. Ascospores without epispore. **Biatora**.

8 Epithecium distinctly pigmented, some shade of green. Exciple black, but sometimes thin and inconspicuous. Apothecia black. On siliceous rock at high altitudes. (Calvitimela)

(1) The following characters also help to separate these genera.

**Apothecia, immersion:** Deeply immersed in substrate in some Clauzadea species. Immersed in thallus in Immersaria and, occasionally, Clauzadea.

**Ascospores, size:** Porpidia often has ascospores that are noticeably larger than the other genera.

**Disc, colour:** Pure black in Lecidella (except some shade specimens) and Porpidia; black to very dark red-brown in Clauzadea. Often pale in Biatora. Pyrrhospora quernea has distinctive dark red-brown discs.

**Epithecial pigment:** Often a distinctive blue-green-black in Lecidella.

**Hypothecium:** Always dark brown in Porpidia.

**Isidia:** Only in Placynthiella.

**Exciple:** Black in Clauzadea (most species), Lecidella and Porpidia; often shiny in Lecidella.

**Rarity:** Clauzadea and Lecidella are common. Other genera are rarer.

**Soredia:** Never in Clauzadea.

**Substrate:** Clauzadea, Immersaria, Miriquidica, Porpidia and Schaereria only on rock. Biatora, Mycobilimbia and Placynthiella never on rock.

(2) Many species of the former Lecidea s. lat. do not belong in Lecidea s. str. but have not yet been placed elsewhere. Some of them will key out in this branch. Because they are such a heterogeneous group, it is impractical to write a good key to them here. If a collection that appears to belong in this branch does not key out properly, try the generic key to Lecidea s. lat.

**Generic key 11: Sterile crustose lichens**

**Caution**. This key is incomplete and includes only common and distinctive species that can often be recognised, at least to genus, when sterile. It should be regarded as making suggestions, rather than enabling definitive determinations. Check any determination against a good description.

11 Margin of thallus distinctly lobed.

222 Thallus distinctly yellow or orange.

33 Thallus K+ purple. Thallus forming a ± circular patch; lobes radiating and confined to margin of patch. **Caloplaca**.

3 Thallus K-. Thallus of flattened granules, each of which may have small lobes, but lobes not radiating relative
to thallus as a whole. Candelariella, especially C. vitellina.
22 Thallus brown, medulla orange. Placolecis opaca
2 Neither thallus not medulla yellow or orange.
33 Photobiont blue-green. Placynthium
3 Photobiont green.
444 Thallus some shade of green.
55 Thallus brown-green or olive green, never black, not pruinose. Soralia rounded, green, delimited. Lobes rounded, not elongated. On calcareous rock at altitudes to 1000 m, usually in shaded sites, never very far from the sea. Solenopsora olivacea subsp. olivacea
5 Thallus not olive green, sometimes with black margins, sometimes pruinose, Soralia various. Lobes sometimes elongated. On calcareous or siliceous rock at all altitudes, not restricted to shaded sites, not restricted to maritime sites. Protoparmeliopsis
44 Thallus grey to dark grey. Lobothallia radiosa
4 Thallus white to grey-white.
55 Thallus C+ orange. Soralia absent. Lecanora pruinosa
5 Thallus C- or C+ red. Soralia usually present.
66 Thallus uniformly ±white to green-grey; K+ yellow, C- or C+ red, UV+ orange-ish. Soralia sometimes coalescing eventually. On bark or rock. Diploicia canescens
6 Thallus often with a blue tinge around and in the central part; K-, C-, UV-. Soralia remaining discrete. On calcareous rock. (Coscinocladium gaditanum)
1 Margin of thallus not lobed.
222 Isidia or structures resembling isidia present.
33 Photobiont blue-green. Placynthium nigrum
3 Photobiont chlorococcoid.
444 Thallus C+ persistent orange, UV+ orange. On bark or wood.
55 Isidia globose to cylindrical, abut 0.1 mm wide. 0.1 - 0.3 mm tall. Thallus green-grey, sometimes with a yellow tinge. Not restricted to the uplands. Pertusaria flavida
5 "Isidia" actually blastidia; globose, to 0.1 mm diameter. Thallus white to pale grey, without a green or yellow tinge. Probably restricted to the uplands (800 m altitude and above). Lecidella pulveracea
44 Thallus C+ fleeting red or pink. (For dark thalli, test a squash preparation under the microscope).
55 Thallus composed entirely of dark brown to black, isidiate granules. Placynthiella icmalea
5 Thallus ±white. Isidia soft. Ochrolechia subviridis
4 Thallus C-.
55 Thallus K+ yellow > red (norstictic acid). Pertusaria coccodes
5 Thallus K-. Lepra albsesens var. corallina
22 Isidia (or similar) absent but soredia present.
33 Thallus or soralia distinctly orange or yellow.
44 Orange or yellow part K+ purple. Caloplaca
4 Orange or yellow part K-. Candelariella
3 Neither thallus nor soralia distinctly orange or yellow, though soredia may be orange-brown or yellow-green.
44 Photobiont Trentepohlia.
55 Thallus and soralia C+ or KC+. Consider Dirina and Opegrapha gyrocarpa
5 Thallus and soralia C-, KC-. Consider Dendrographa decolorans
4 Photobiont green, not Trentepohlia.
55 Thallus and/or medulla and/or soralia K+ eventually red, red-brown or orange-brown, sometimes after first becoming yellow.
66 True soralia absent. Easily eroded, globose isidia, sometimes resembling soralia present. Thallus robust, thick, well delimited, sometimes bordered by a white or pale brown prothallus; thallus typical of Pertusaria. Pertusaria coccodes
6 True soralia present. Thallus fairly thin or immersed, well delimited or not; not Pertusaria type.
77 Soralia mostly delimited. Thallus superficial or immersed, C+ slightly yellowish. Prothallus, if present, black. Buella griseovirens
7 Soralia often coalescing. Thallus superficial, C-. Prothallus usually absent; white if present. Phlyctis argena
5 Thallus and/or soralia K- or K+ yellow.
666 Thallus and/or soralia C+ persistent orange (occasionally initially +red, colour then fading to orange or
red-orange, and persisting as that colour).
77 Soredia covering entire thallus, at least eventually.
   88 Thallus thin. Soredia farinose. Prothallus inconspicuous, blue-grey. On wood or bark. **Lecanora expallens**
   8 Thallus thicker. Soredia granular, to 0.15 mm diameter. Prothallus often conspicuous, black.
   Usually on bark. **Pyrrhospora quernea**
7 Soredia remaining ± delimited, or coalescing but never covering entire thallus. On various substrates. **Lecidella**
66 Thallus and/or soralia ± red or pink, usually not persistent.
   77 Young soralia excavate (never convex), surrounded by a prominent, upturned thalline margin, never very large, UV+ whiteish (never orange). Thallus not wARTeD, K-. On bark. **Pertusaria dalmatica**
   7 Young soralia concave or convex, if concave then not surrounded by a prominent upturned thalline margin, small or large, UV+ whiteish or + orange. Thallus wArTeD or not, K- or K+ yellow. On various substrates. **Ochrolechia**
6 Thallus and soralia C- or C+ yellow.
   77 Thallus with some coralloid fruticose structures, to about 1 mm tall. **Leprocaulon microscopicum**
7 Thallus entirely crustose.
88 Thallus consisting entirely of soredia, never corticate.
   99 Photobiont cells in small clusters at tips of hyphae, not entirely enclosed by hyphae. All spot test reactions negative. Thallus distinctly green. In shaded habitats. **Botryolepraria**
   9 Photobiont cells not in clusters, ± complete enclosed by hyphae. Spot test reactions positive or negative. Thallus of various colours. In sunny or shaded habitats. **Lepraria**
8 Thallus not consisting entirely of soredia, cortex present in non-sorediate parts, at least when young.
   99 Thallus P+ yellow or orange. **Lepospora elatina**
9 Thallus P-.
   Consider **Lepra albescens** or **Ochrolechia**.

2 Isidia and soredia absent.
33 Pycnidia abundant, black, about 60% immersed, 0.15 mm diameter. Photobiont Trentepohlia. Thallus pale grey, sometimes tinged brown, K-, C-, KC-, UV-. Conidia colourless, curved, 5 - 7 x 1 µm. On neutral to basic bark in ± humid sites. (Not strictly coastal, but not found far inland.) **Opegrapha niveoatra**
3 Not as above. Not keyed out here.

**Generic key 12: Lichenicolous fungi**

The keys are based on Clauzade, Diederich & Roux (1989). I have added some information from more recent publications and from my own observations.

11 Without asci or ascospores
   222 With basidia, bearing basidiospores, and often gall-forming; or sterile with only sclerotia present. Ascomata and conidiomata absent. All species rare. **Generic key 12A: Lichenicolous basidiomycetes**
   22 Without basidia but with conidia. Some species common. See Note 1.
   33 Conidia formed within pycnidia. See Note 2. **Generic key 12B: Lichenicolous coelomycetes**
   3 Conidia not formed within pycnidia. **Generic key 12C: Lichenicolous hyphomycetes**
2 Without basidia, ascomata, conidia or even mycelia. Forming bulbils 0.1 - 0.25 mm diameter overgrowing lichen thalli. (Burgoa angulosa)
1 With asci, enclosing ascospores.
222 Asci not enclosed in ascomata.
   33 In hymenium of Umbilicaria crustulosa. (Phacopsis)
   3 Not in hymenium of Umbilicaria crustulosa. **Arthonia**
22 Asci in apothecia or similar, hymenium exposed at maturity.
   33 Apothecia at first entirely closed, later with a ± irregular pore, sometimes eventually opening entirely to expose hymenium; sometimes stalked, sometimes mazaediate. **Generic key 12D: Lichenicolous ascomycetes, apothecia initially closed**
   3 Apothecia with hymenium clearly exposed from the beginning; never stalked or mazaediate.
   44 Apothecia with an exciple, often visible externally at least in young apothecia. **Generic key 12E: Lichenicolous ascomycetes, apothecia open, exciple present**
   4 Apothecia without an exciple. **Generic key 12F: Lichenicolous ascomycetes, apothecia open, exciple absent**
2 Asci in perithecia or similar, hymenium not exposed at maturity.  
33 Perithecia pale (white, pink, yellow, orange or red).  
**Generic key 12G: Lichenicolous ascomycetes, perithecia pale**

3 Perithecia brown or black.  
44 Perithecia grouped in a stroma.  
55 Ascospores mostly 1-septate.  
66 Apothecia without true inter-ascal filaments.  
**Lichenostigma**

5 Perithecia dark, with hairs

55 Upper part of perithecia with numerous black, brown or grey hairs, cilia or spines.  
**Generic key 12H: Lichenicolous ascomycetes, perithecia dark, with hairs**

6 Hairs, cilia and spines absent, or if present then few or confined to lower part of perithecia.  
66 Ascospores brown, at least eventually.  
**Generic key 12I: Lichenicolous ascomycetes, perithecia dark, ascospores brown**

6 Ascospores colourless.  
**Generic key 12J: Lichenicolous ascomycetes, perithecia dark, ascospores colourless**

(1) Conidial fungi are here treated within their own anamorphic genera. Their classification is gradually being integrated with that of the teleomorphic states, but the process is incomplete. At present it is more convenient to treat them separately.  
(2) Be careful not to confuse lichenicolous coelomycetes with the pycnidia of the host. A pycnidium that causes obvious damage, or that occurs within the ascoma of the host, does not belong to the host. In other cases, it is advisable to compare the characters of the pycnidia and conidia with those reported for the host.

**Generic key 12A: Lichenicolous basidiomycetes**

111 Colonies appearing as dispersed or aggregated bulbils, 0.1 - 0.25 mm diameter, overgrowing lichen thalli.  
Basidiomata absent.  
**Burgoa angulosa**

11 Sclerotia present. Basidiomata present or absent.  
22 Sclerotia brownish, ellipsoid. Basidiomata, if present, thin, white, easily separable from substrate.  
**Athelia**

2 Sclerotia pale orange, subspherical, 50 - 150 µm diameter. Basidiomata light orange, thin, adnate, granulose.  
**Erythricium auranticum**

1 Bulbils and sclerotia absent. Basidiomata present, often inducing formation of galls or gall-like fruiting bodies, with a distinct hymenium of basidia bearing basidiospores.  
22 Basidia simple.  
33 Basidiospora with warts or small spines. On Lecanora carpinea.  
**Heteroacanthella**

3 Basidiospores smooth.  
44 Basidia often many times longer than broad. Basidiospores forming a tight cluster at apex of basidium.  
**Chionosphaera**

4 Basidia only a few times longer than broad. Basidiospores separate. Haustorial filaments arising from a subspherical or ellipsoid mother cell.  
**Heterocephalacria**

2 Basidia septate.  
33 Mature basidium of two parts; lower part with thick wall, upper part with thin wall.  
**Cyphobasidium**

3 Mature basidium of one part.  
44 Basidia claviform to cylindrical, 20 - 44 x 3 - 6.5 µm, with 1 - 3 transverse septa, not constricted at septa, without basal clamps.  
**Biatoropsis**

4 Basidia subspherical, ellipsoid or capitulate, often constricted at septa; if claviform and with transverse septa then basidia shorter than above; with basal clamps.  
**Tremella**

(1) Haustorial filaments are the hyphae that penetrate the hyphae of the host. They are most readily observed when they are outside the host.

**Generic key 12B: Lichenicolous coelomycetes**

11 Conidiomata almost saucer-shaped; black, but appearing white from superficial hairs; with black, columnar cirrus of
Conidia extending vertically to 150 µm above conidioma. (Vagnia)
1 Conidiomata ±flask-shaped pycnidia.
22 Conidia branched. (Spirographa), (Cladoniicola)
2 Cladonia not branched, septate or simple.
33 Pycnidia pale (except sometimes at ostiole). (Bachmanniomyces), (Epaphroconidia), (Karsteniomyces), (Lawalrea), (Libertiella), (Scutula miliaris)
3 Pycnidia black or dark brown.
444 Conidia of two types within the same conidium: 1-septate, ±ellipsoid macroconidia, and simple bacilliform microconidia. On Ramalina. (Mixtoconidium)
44 Conidia of one type, mostly septate.
55 Conidia colourless. (Epicladonia), (Everniicola)
5 Conidia some shade of brown.
66 Conidia arising singly. Lichenodiplis
6 Conidia arising in chains. (Nigromacula)
4 Conidia of one type, simple (but may contain multiple guttules).
55 Conidia brown, green-brown or blackish.
66 Ostiole eventually opening widely and pycnidia becoming almost cup-shaped. Conidiophores present or absent.
77 Conidiophores present. Conidia arising in chains. On a wide range of hosts. Vouauxiella
7 Conidiophores absent. Conidia not in chains. On thallus of Phaegeraphis species, leaving holes in thallus when dead. (Coniambigua phaeographidis)
6 Ostiole irregular, often remaining almost closed. Conidiophores absent.
77 Conidia with smooth walls. Wall of pycnidia colourless to pale brown. Not on Cladonia.
88 Ostiole surrounded by a distinct collar. (Acaroconium)
8 Ostiole not surrounded by a distinct collar. Lichenodiplis
7 Conidia with verrucose or spiny walls. Wall of pycnidia dark brown. On various genera, including Cladonia. Lichenocconium
5 Conidia colourless.
66 Ostiole surrounded by many hairs. (Pyrenoachaeta)
6 Ostiole not surrounded by hairs.
7777 Pycnidia growing on mazaedia of Caliciales species. (Asterophoma)
777 Pycnidia on thallus or podetia of Cladonia species, and there often forming galls. Pycnidia often with a flattened base. (Epilcladonia)
77 On thallus of Brodoa intestiniformis. (Libertiella obscurior)
7 Not as above.
88 Conidiophores distinct; long, irregularly branched. On Cladonia. (Lichenosticta)
8 Conidiophores absent. On various hosts (including Cladonia).
99 Conidia flattened at basal end. On Ramalina or foliwise Parmeliaceae. (Vouauxiomyces) See Note 1.
9 Conidia not flattened at base. On various hosts.
AA Conidia more than 10 µm long. (Didimocyrtis), (Pseudoseptoria)
A Conidia less than 10 µm long.
BB Conidia eventually becoming very pale brown, 3.5 - 5 µm wide. On Acarospora or Sarcogyne. (Acaroconium)
B Conidia remaining colourless. (Didimocyrtis), (Phoma)

(1) The name Vouauxiomyces has been used for the anamorphs of Abrothallus, and its species should be treated under that name. There are no Greek reports of Vouauxiomyces, so for the present it is simpler to retain the old name in the key.

Generic key 12C: Lichenicolous hyphomycetes

11 Conidiophores clustered on the mycelium, in sporodochia or similar structures.
22 Sporodochia stalked, resembling small ascomata of Calicium. (Arborillus), (Graphium), (Leightonomyces)
2 Sporodochia not stalked.
33 Conidia very irregular in shape, apparently simple. Sporodochia not exceeding 0.1 (0.12) mm in diameter. On squamules of Cladonia or on crustose lichens with photobiont Trentepohlia. Milospium
3 Conidia regular or somewhat irregular, never very irregular, simple or septate. Diameter of sporodochia various.
On various hosts.

44 Sporodochia not dark brown or black. Hyphae and conidia pale-coloured.
55 Conidia simple.
66 Sporodochia powdery, of conidiophores that are not densely packed. Sporodochia 0.5 - 5 mm diameter; white or whitish. (Refractohilum peltigerae)
6 Sporodochia compact. (Erythricium), (Marchandiomycetes), (Pronectria robergei)
5 Conidia septic. (Fusarium), (Illosporiopsis)
4 Sporodochia dark brown or black.

555 Conidia septic.
66 Sporodochia with a marginal structure resembling an exciple. (Minutoexcipula)
6 Sporodochia immarginate.
77 Conidia cylindirical or clavate. (Lichenopuccinia)
7 Conidia globose to ellipsoid. Scleroccucum
55 Conidia not septic but with an oblong, pale zone that resembles a window. (Fenestroconidia)
5 Conidia not septic, without internal structure.
666 Conidia colourless. (Epithamnolia)
66 Conidia with a green tinge. (Bloxamia)
6 Conidia dark brown.
77 "Sporodochia" actually raised stromata. Lichenostigma maureri
7 Sporodochia adpressed or immersed.
88 On Lecidella species. (Feltgeniomyces)
8 On Pertusaria species. Scleroccum

1 Conidiophores and conidiogenous cells spread evenly over the surface of the mycelium, not clustered.
22 Hyphae and conidia colourless or pinkish. (Acremonium), (Aspergillus), (Hawksworthiana), (Kalchbrenneriella), (Nectria rubifaciens), (Refractohilum), (Trichoconis), (Trichothecium)
2 Hyphae and conidia brown to black.
33 Conidia palmately arranged. (Psammina)
3 Conidia not palmately arranged.
444 Conidia simple.
555 Conidia globose and regular in shape; at least initially massed together.
66 Conidia long remaining massed together. (Monodictys)
6 Conidia separating early. Xanthoriicola
55 Conidia distinctly longer than wide, but forming a well-defined shape; not massed together. (Alysidiom), (Ampullifera), Intralichen, (Taenirolella), (Talpapellis)
5 Conidia very irregularly shaped, appearing warty. (Milospium)
44 Many conidia septic. (Some simple conidia may also be present.)
555 Conidia arising singly at ends of conidiophores. (Codonmyces), (Endophragmiella), (Pseudocercospora), (Sporidesmium)
55 Conidia arising in chains at ends of conidiophores.
66 Vegetative hyphae mostly on surface of host lichen. (Ampullifera)
6 Vegetative hyphae mostly within host lichen.
77 Chains of conidia eventually disintegrating into separate conidia. Intralichen
7 Chains of conidia persistent. (Taenirolella), (Taeniolina), (Talpapellis), (Verrucocladosporium)
55 Conidia arising in irregular masses at ends of conidiophores.
66 Conidial mass at first enclosed in colourless gelatinous sheath. (Calongeomyces)
6 Conidial mass not enclosed. Intralichen
5 Conidia arising in groups, but not irregular masses, near ends of conidiophores. On Peltigera rufescens (Fusicladium peltigericola)
4 Conidia submuriform to muriform. (Monodictys)

Generic key 12D: Lichenicolous ascomycetes, apothecia initially closed

11 Asci disintegrating eventually, leaving a loose mass of spores.
22 Mature ascospores blue-green, 1 - 3 (7) -septate. (Microcalicium)
2 Mature ascospores brown.
33 Ascospores simple. Sphinctrina
3 Ascospores 1-septate.
44 Apothecia stalked. **Calicium**
4 Apothecia sessile. **Cyphelium**

1 Ascii persistent, no spore mass formed.
22 Ascospores brown, at least eventually.
333 Ascospores simple. **Chaenothecopsis**
333 Ascospores 1-septate.
44 Apothecia stalked. **Chaenothecopsis**
4 Apothecia not stalked. (Buelliella)
3 Apothecia multi-septate or submuriform. (Polyschistes mairei)
2 Ascospores ±colourless.
33 Ascospores at least 10 times longer than broad. (Stictis) (Spirographa)
3 Ascospores less than 10 times as long as broad.
44 Apothecia initially on surface of host thallus (though may be very concave). (Hyphodiscus), (Llimoniella), (Pezizella)
4 Apothecia immersed in host thallus, at least at first.
55 Ascospores usually simple, rarely to 3-septate.
666 Apothecia ±black.
77 Asci elongate cylindrical; wall distinctly thickened at apex. (Skyttea)
7 Asci clavate to clavate-cylindrical; wall not or slightly thickened at apex. **Rhombocarpus**
66 Apothecia brown or (when moist) orange. **Unguiculariopsis**
6 Apothecia yellow-red to violet-red. (Orbilia),
5 Ascospores usually 1 - 3 -septate, rarely submuriform or muriform. (Corticifraga), (Paralethariicola), (Sphaeropezia)

**Generic key 12E: Lichenicolous ascomycetes, apothecia open, exciple present**

11 Ascospores brown.
22 Ascospores with perispore. **Rhizocarpon**
2 Ascospores without perispore.
333 Ascospores mostly submuriform or muriform. (Tryblidaria)
33 Ascospores mostly multi-septate.
44 Paraphyses branched or anastomosed. **Opegrapha**
4 Paraphyses simple, or only occasionally branched.
55 Asci with outer gelatinous I+ blue layer, but without I+ blue apical cap. **Sclerococcum**
5 Asci without outer gelatinous I+ blue layer, but with I+ blue apical cap. **Diplotomma**
3 Ascospores mostly 1-septate.
44 Apothecia elongate.
55 Exciple continuous below hymenium. **Labrocarpon**
5 Exciple not continuous below hymenium. (Hemigrapha)
4 Apothecia ±rounded.
55 Paraphyses frequently branched or anastomosed.
66 Apothecia closed at first, later often surrounded by radial cracks. (Buelliella)
6 Apothecia open from the beginning, not surrounded by radial cracks. **Karschia**
5 Paraphyses simple or occasionally branched.
66 Ascospores wall irregularly thickened. **Rinodina**
6 Ascospore wall thin and regular.
77 Asci with outer gelatinous I+ blue layer, but without I+ blue apical cap. **Sclerococcum**
7 Asci without outer gelatinous I+ blue layer, but with I+ blue apical cap. **Buellia**

1 Ascospores colourless.
222 Disc and exciple both white, yellow, pink or red, never very dark.
33 Apothecia with pale yellow to green-yellow pruina. **Thelocarpon**
3 Apothecia without pale yellow to green-yellow pruina. (Cryptodiscus), (Hyphodiscus), (Orbilia), (Nanostictis), (Pezizella), (Polydesmia)
22 Disc white but exciple thick and black. (Stictis)
2 Disc and exciple dark brown to black.
333 Ascospores multi-septate.
44 Apothecia elongate. **Opegrapha**

4 Apothecia rounded.
55 On Protoparmelia. (Phacographa protoparmeliae)

5 On other hosts.
66 Apothecia to 0.6 mm diameter. Epithecium greenish. Ascospores 3 - 4.5 µm wide. (Toninia plumagina)

6 Apothecia 0.4 - 1.3 mm diameter. Epithecium brown. Ascospores 5 - 7 µm wide. **Mycobilimbia tetramera**

33 Ascospores mostly 1-septate.
44 Length/width ratio of ascospores 10 or more. (Spirographa)

4 Length/width ratio of ascospores 5 or less.
55 Apothecia ± regularly rounded.

5 Apothecia to 0.6 mm diameter. Epithecium greenish. Ascospores 3 - 4.5 µm wide. **Tetraphis**

66 Exciple continuous below hymenium. **Labrocarpon**

5 Usually on Peltigera or related genera. (Scutula)

5 Apothecia elongate

6 Exciple not continuous below hymenium. **Hemigrapha**

3 Ascospores simple.
44 Ascii with 100 or more ascospores.

55 Paraphyses richly branched and anastomosed, generally without visible septa, not capitate. Apothecia black. Disc umbonate, often becoming gyrose. **Polysporina**

6 Paraphyses simple, sometimes with visible septa, sometimes ± capitate. Apothecia red-brown to black. Disc not umbonate, not gyrose. **Sarcogyne**

4 Ascii with 8 or fewer ascospores.
55 Hypothecium ± colourless.

6 Exciple carbon-black. **Carbonea**

6 Exciple not carbon-black. **Nesolechia**

5 Hypothecium brown.

66 Disc usually with a sterile central umbo. Usually forming galls on host thallus. (Cecidonia)

6 Disc without a sterile central umbo. Not forming galls on host thallus.

77 Pigment of epithecium, exciple and hypothecium coarsely granular, brown to violet-brown. (Bachmanniomycetes),

7 Not as above. **Lecidea**

**Generic key 12F: Lichenicolous ascomycetes, apothecia open, exciple absent**

11 Ascospores simple.

22 Apothecia pale, at least when young. (Corticiruptor), (Skytella)

2 Apothecia dark, usually black.

33 Hymenium and exciple with violet pigment reacting K+ blue-grey, N+ red-orange. On Lecania. (Echinodiscus lesdainii)

3 Hymenium and exciple without violet pigment. On various hosts.


4 Not on Parmelia. Other characters various. (Phacopsis)

1 Ascospores septate, rarely submuriform.

22 Apothecia without true hymenium or paraphyses. **Lichenostigma**

2 Apothecia with true hymenium and paraphyses.

33 Hymenium I-. Mature ascospores brownish. **Abrothallus**

3 Hymenium I+ blue or red. Mature ascospores usually colourless.

44 Apothecia grouped in a stroma. Hymenium usually containing groups of blackish, sterile hyphae. **Plectocarpon**

4 Apothecia not grouped in a stroma. Hymenium not containing groups of blackish, sterile hyphae. **Arthonia**

**Generic key 12G: Lichenicolous ascomycetes, perithecia pale.**
1. Ascomata entirely within a stroma, ostiole indistinct. (Broomella)
2. Ascomata not in a stroma, or at least not entirely immersed within one.
   22 Ascospores fan-shaped, 165 - 175 x 5 - 6 µm. (Neobarya)
   2 Ascospores not fan shaped, much smaller than above.
   333 Ascospores simple. **Thelocarpon**
   33 Ascospores mostly 1-septate. (Cercidiospora epicallopisma), (Nectria), **Nectriopsis**, (Pronectria), (Trichonectria), (Xenonectriella). I have insufficient information to be able to separate these genera reliably, but to date only one is reported for Greece.
   3 Ascospores multi-septate, submuriform or muriform.
   44 Ascospores tapered and extending as hair-like projection. (Paranectria)
   4 Ascospores not strongly tapered at ends.
   555 Ascospores 2 – 3-septate. (Hymenobia), (Trematosphaeriopsis)
   55 Ascospores multi-septate, 45 - 120 x 4 - 8 micons. (Trichonectria)
   5 Ascospores submuriform or muriform. (Pleonectria)

**Generic key 12H: Lichenicolous ascomycetes, perithecia dark, with hairs**

111 Ascospores simple. (Trichosphaeria)
11 Ascospores mostly 1-septate.
   2222 Ascospores 4 - 8 x 1 - 2 µm. (Niesslia)
   22 Ascospores 8 - 11 x 3 - 5 µm.
   33 On Cladonia. (Niesslia cladoniae)
   33 On Parmeliaceae. (Sphaerellothecium reticulatum)
   2 Ascospores more than 12 µm long. (Lichenopeltella santessionii), (Neocoleroa)
   1 Ascospores mostly 1 - 3-septate. (Capronia), (Knufia), (Lichenopeltella peltigericola)

**Generic key 12I: Lichenicolous ascomycetes, perithecia dark, ascospores brown**

11 Asci with 16 or more ascospores.
   22 Inter-ascal hyphae clearly distinct. **Rosellinula**
   2 Inter-ascal hyphae indistinct in mature perithecia.
   33 Perithecium with a depression around ostiole. Wall of perithecium with two distinct layers. Pseudoparaphyses elongated, with rounded basal cell and 1 - 3 apical elongated cells. If present in Greece, then probably rare. (Bellemerebella)
   3 Perithecium without a depression around ostiole. Wall of perithecium without two distinct layers. Pseudoparaphyses short, cells not differing greatly from each other. Common. **Muellerella**
1 Asci with 8 or fewer ascospores.
   2222 Ascospores simple. (Adelococcus), (Phaeosporis), (Reconditella), (Rosellinia), (Roselliniella), (Roselliniopsis)
   222 Ascospores mostly 1-septate.
   33 Inter-ascal hyphae clearly distinct.
   444 Forming galls in thallus of Leptochidium albociliatum. Ascospores 14 - 18 x 7 - 10 µm, swelling strongly in K. (Lichenopyrenis galligena)
   44 Parasitic on thallus of Squamarina cartilaginea, forming white spots with black margin. Ascospores 18 - 22 x 7 - 9 µm. **Clypeococcum psoromatis**
   4 Not as above. **Polycoccum**
3 Inter-ascal hyphae indistinct in mature apothecia.
   44 Hymenium I+ red or orange. Perithecia more than 100 µm diameter. Vegetative hyphae colourless and inconspicuous, or absent.
   55 Ascospores distoseptate. On Aspicilia s. lat. (Gemmaspora)
   5 Ascospores euseptate. On various hosts. **Endococcus**
   4 Hymenium I-. Perithecia less than 100 µm diameter. Vegetative hyphae brown, conspicuous, forming network in epinecrotic layer of host. **Sphaerellothecium**
22 Ascospores mostly multi-septate.
   33 Asci with fewer than 8 ascospores (usually 4).
   44 Inter-ascal hyphae indistinct. Ascospores I6 - 21 x 7 - 13 µm, not constricted at septa. (Lasiosphaeriopsis supersparsa)
4 Interascal hyphae clearly visible. Ascospores distinctly constricted at septa in some species. **Pyrenidium**

3 Ascii with 8 ascospores.

44 Interascal hyphae indistinct. **Phaeospora**

4 Interascal hyphae clearly visible. (Didymocyrtis), (Leptosphaeria), (Weddellomyces), (Wernerella)

2 Ascospores mostly submuriform or muriform.

33 Inter-asal hyphae indistinct.

44 Ascospores with a perispore at least initially. On saxicolous crustose lichens. **Halospora**

4 Ascospores without a perispore. On terricolous, muscicolous or corticolous lichens, not usually on saxicolous. (Merismatium)

3 Inter-ascal hyphae clearly visible. (Dacampia), (Didymocyrtis physciae), (Pleospora)

**Generic key 12J: Lichenicolous ascomycetes, perithecia dark, ascospores colourless**

111 Hymenium of ± globose cells, without inter-ascal filaments. **Lichenostigma**

11 Hymenium not of globose cells, with numerous oil droplets 3 - 8 \( \mu \)m diameter. Ascii with 4 or 8 ascospores. Interascal filaments indistinct. Preferred hosts in Physciaceae and Teloschistaceae. **Lichenochora**

1 Hymenium not of globose cells, without or with few oil droplets. Ascospore count various. Inter-asal filaments distinct or indistinct. Hosts various.

22 Length/width ratio of ascospores 8 or more.

33 Ascii with more than 8 ascospores. (Neolamya)

3 Ascii with at most 8 ascospores.

44 Interascal filaments becoming indistinct in mature perithecia. **Sarcopyrenia**

4 Inter-ascal filaments persistent. (Sagediopsis)

2 Length/width 6 or less.

33 Ascospores simple. (Myxophora), (Gyrophthorus), (Obryzum), (Physalospora), (Plagiostoma), (Reconditella), (Spoverinavia), (Telogalla), (Thamnogalla)

3 Ascospores sepiate, submuriform or muriform.

44 Ascomata catathelia. Ascospores with several lateral appendages. (Lichenopeltella)

4 Ascomata true perithecia. Ascospores without lateral appendages.

55 Ascospores mostly 2- or more -septate, or submuriform or muriform.

66 Ascospores usually with at least one longitudinal septum. On Peltigera. (Leptosphaerulina), (Norrlinia)

6 Ascospores strictly septate. On various hosts.

77 Inter-asal filaments present at maturity. On Xanthoparmelia or Megaspora.

88 Forming galls on thallus of Xanthoparmelia. (Trematosphaeriopsis)

8 On Megaspora verrucosa. Not forming galls. (Zwackhiomacromyces constrictocarpus)

7 Inter-asal filaments absent at maturity. On thallus or in apothecia of a wide range of species.

**Stigmidium**

5 Ascospores mostly 1 (2) -septate.

66 Inter-asal filaments distinct, at least initially.

77 Ascospores more than 30 \( \mu \)m long. (Rhzagadostoma)

7 Ascospores less than 30 \( \mu \)m long. (Note 1)

88 Ascomatal pigment mainly between cells of exciple. Ascospores ornamented or not. **Zwackhiomyces**

8 Ascomatal pigment mainly in walls of exciple cells. Ascospores not ornamented.

99 Ascomatal pigment brownish, greenish or blueish. On various hosts, but not Collema s. lat., Catapyrenium or Endocarpon. **Cercidiospora**

9 Ascomatal pigment brownish, never with a green or blue tinge. On Collema s. lat, Catapyrenium or Endocarpon. **Didymelopsis**

6 Inter-asal filaments indistinct, even in young perithecia.

77 Ascii with 8 ascospores. **Stigmidium**

7 Ascii with more than 8 ascospores. See Note 2.

88 Perithecium with a depression around ostiole. Wall of peritheium with two distinct layers.

Pseudoparaphyses elongated, with rounded basal cell and 1-3 apical elongated cells. (Bellemereella)

8 Perithecium without a depression around ostiole. Wall of peritheium without two distinct layers.

Pseudoparaphyses short, cells not differing greatly from each other. **Muellerella**

(1) The poorly known “Didymella” sphinctrinoides var. aspiciliicola probably keys out somewhere in this branch. It does not belong in Didymella, but its correct placement is uncertain. It is parasitic on species of Aspicilia s. lat.
The only modern description is by Grube & Hafellner (1990: 329-331).
(2) Ascospores in Bellemerella and Muellerella are brown when mature, but may remain colourless for a long time.
Taxonomic section

Genera are treated in alphabetical order. So far as possible, the treatment of each genus follows a standard format.

The place of publication and the type species are listed in all cases for which I can determine them. The author(s) who designated the type is indicated where it is not obvious, if I have been able to determine that information. However, no such indication is given for names of new genera published in 1958 or later, for which specification of the type in the protologue is a requirement for valid publication, or for names that are conserved, for which the type is listed in the Appendices to the International Code of Nomenclature.

Useful literature is noted for each genus, though publications are usually limited to those that I have seen. Publications in languages that I do not easily read myself, such as German, are under-represented.

I usually include a brief description of the genus if I have seen more than one species of the genus in Greece. I also include, where possible, an estimate of the number of taxa in the genus, both worldwide and in Europe, and sometimes a note on the usual ecology of members of the genus. In some cases estimates of the number of species are influenced by how one regards the status of poorly known taxa (which are numerous in some genera), and what view one takes on recent taxonomic revisions and redispositions of species, so other publications may quote different totals.

Each genus has a key to species, unless the genus has only one species, or only one species is likely to occur in Greece. The same principles apply as for the keys to genera.

Every species and infra-specific taxon that has been reliably reported for Greece is discussed individually. The place of publication is listed. Synonyms listed include the basionym if there is one, all the names under which the taxon has been reported for Greece, and occasionally a small number of additional synonyms that are likely to be helpful. All other synonyms are ignored. I do not list details of the type, as few readers will need that information and it would take up too much space.

I include a description if I have collected and studied the taxon myself in Greece, unless my collections were too scanty to prepare a good description, or my determinations were tentative. These descriptions are based solely on my own observations of Greek material, unless otherwise stated or clearly implied (e.g. with the phrase "said to be....."). If ascomata or conidiomata are not mentioned for a particular species, it means that I have not seen them, at least not in Greek material. Where descriptions are incomplete in other respects, it is usually because I have not yet been able to make the relevant observations for one reason or another. The descriptions are, of necessity, based on fewer specimens and fewer measurements than a good taxonomic monograph would use, as it is impractical for me to provide both the depth of study appropriate for a monograph and the breadth of coverage required in a Flora. Descriptions may therefore not indicate the full range of variation that each species may display. Many of your collections will deviate slightly from the descriptions and measurements given here; a few may deviate substantially. Also, you should not extract from the descriptions apparent differences between species in non-critical characters and use those differences to help determine your collections, unless you have independent evidence that they can safely be used for that purpose. Use only the characters in the keys.

Information on chemistry is based on spot tests and UV reactions only, as I do not have facilities for more critical investigation. If you require more detailed information, it can usually be found somewhere in the published literature. Reactions of the "thallus" mean the reaction seen when the reagent or UV light is applied to the external surface of the lichen, without having removed any part. Where reactions are also given for "medulla", the "thallus" reaction may be understood as referring to the cortex. In other cases, the lichen may be too thin to test cortex and medulla separately, and in such cases the "thallus" reaction might refer to either cortex or medulla or both.

The description of photobionts is intentionally brief, and I have not provided more than basic information even in those cases in which I have observed more. The subject of lichen photobionts merits a much more thorough and extensive treatment than is provided here, but as I can not do that job well I prefer not to do it at all.

If no description is provided, I indicate where those who require more descriptive information than is contained in the keys themselves can find it. I have preferred to cite mainly well-known European or North American Floras, but for taxa that are not well treated in those Floras, or for which a much better description exists elsewhere, I sometimes cite other kinds of publications.

In some cases, I note any other species with which the one under discussion might be confused, and how to avoid such confusion.

This is followed by information on ecology and distribution within Greece. Hosts are cited for lichenicolous taxa. For lichens, any lichenicolous fungi recorded from them are noted.

Information on worldwide distribution is also included. The European distribution is treated first, even if that is not explicitly stated, followed by the distribution on other continents. The word widespread, when used here without qualification, e.g. North America (widespread), means widespread in places where the climate is suitable for the species concerned. Climatic requirements can often be deduced from the range in Europe. For example, if a species is common in northern and central Europe, but south of the Alps present only in the mountains, and it is said to be widespread in
Asia, that should be understood as *widespread in cool and cold* parts of Asia, not as present everywhere on that continent. "Widespread" means reported from a reasonably large number of places that are well separated; a widespread species is not necessarily common, nor does it necessarily occur in all parts of the region. Regions are listed according to a consistent geographic arrangement as used in my own database: the order may appear random, but it is not. The reported distribution outside Greece takes no account of recent extinctions due to human activity. Where I state that a taxon is "perhaps" or "possibly" reported for some region this means either that it is reported under a different name and the synonymy is not certain, or that I have concerns about the reliability of the report. Many parts of the world have received little recent study from lichenologists, and some reports cited are based on old sources that may have used outdated taxonomic concepts or that may be unreliable for other reasons. Reports that seem very disjunct or that seem unexpected on climatic grounds should be regarded with scepticism. A reported global distribution that "doesn't make sense" is probably wrong somewhere.

I have paid particular attention to determining the correct place of publication and the correct authorship of names included in this Flora. If what you see here disagrees with some other source, this Flora is more likely to be correct. For more detailed information on nomenclature and synonymy that can be included in this Flora, see the nomenclature document downloadable from lichensofgreece.com.

**Abrothallus De Not. (1846)**


Literature: There is no modern treatment, and the genus is in need of revision. The best starting points are Clauzade, Diederich & Roux (1989), Galloway (2007a), Nash et al. (2004), and Suija et al. (2018).

A genus of non-lichenised, lichenicolous fungi. Species presently referred here occur on several host genera, including *Cladonia*, *Ramalina*, *Sticta*, and members of the *Parmeliaceae*, but when the genus has been properly delimited it may prove to be restricted to the latter. The taxonomy of species on *Parmeliaceae* is largely host-based at present, and may need revision.

As presently delimited, about 26 species, of which about 17 occur in Europe. There are very few Greek records.

The key draws heavily on the one in Clauzade, Diederich & Roux (1989).

11 *Host lichen not belonging to Parmeliaceae.*

22 Ascospores 1 - 3 -septate. On Ramalina. If present in Greece then probably montane. (A. suecicus)

2 Ascospores 1-septate, splitting into semi-spores while still in asci. On apothecia of *Cladonia*. (A. cladoniae)

1 *Host lichen belonging to Parmeliaceae*

22 Vegetative hyphae I+ blue, not modifying thallus of host. (A. bertianus), (A. caerulescens)

2 Vegetative hyphae I-, often modifying thallus of host.

33 Hymenium K-. Epithecium K+ yellow. On Pleurosticta or Parmelia.

44 On Pleurosticta acetabulum. **A. acetabuli**

4 On Parmelia. **A. buellianus**

3 Hymenium or epithecium K+ green, blue-green or olive-green, at least in places; no part K+ yellow. On various hosts.

44 On Usnea. (A. usneae)

4 Not on Usnea.

555 Ascospores 7 - 11 µm wide. On Xanthoparmelia. (A. tulasnei)

55 Ascospores 3 - 5.5 µm wide. On Flavoparmelia. (A. microspermus)

5 Ascospores 5 - 8 µm wide. On other hosts.

66 Hymenium entirely K+ green. On Parmotrema. (A. parmortrematis)

6 Hymenium K+ green in upper part only, K- in lower part.

77 Hymenium colourless or pale green. On various hosts. **A. parmiarius**

7 Hymenium with brown tinge. On Hypogymnia. (A. prodiens)

**Abrothallus acetabuli** Diederich (1990)

_Mycotaxon_ 37: 298-300.

Descriptions: Clauzade, Diederich & Roux (1989), or see the protologue.

Samothraki and perhaps Naxos. The report from Samothraki was an altitude of 890 m, apparently directly on bark of *Quercus pubescens*.

Western Europe, from Spain to Belgium. The Greek record(s) are disjunct. Also N. America (California).
Abrothallus buellianus De Not. (1846)
  
  Description: Suija et al. (2018).
  
  Naxos, on *Parmelina tiliacea*, at an altitude of 500 m.
  
  Known from a few localities in Europe, from Belgium to Greece. Also N. America (California).

Abrothallus parmeliarum (Sommerf.) Arnold (1874)
*Flora* 57: 102; *Lecidea parmeliarum* Sommerf. (1826), *Suppl. Fl. Lapp.* 176 as 'parmeliorum'.

  The earliest legitimate name is *Endocarpon parasiticum* Ach. (1814), but Sommerfelt's name. has been proposed for conservation.

  Descriptions: Clauzade, Diederich & Roux (1989); Galloway (2007a); Nash et al. (2004); Suija et al. (2018).

  Scattered on the mainland at altitudes 10 - 750 m.  Reported hosts are: *Melanelia subaurifera*, (?)*Neofuscelia perrugata* (as *Parmelia perrugata* subsp. *petitmeningii*), and *Parmelia sulcata*.

  *A. parmeliarum* has been reported from many species in *Parmeliaceae*, though it may prove to be restricted to *Parmelia sensu stricto*. It prefers cool to temperate regions. Widely distributed in central and northern parts of Europe, but there are few reports for the south. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, S. Africa), N. America (widespread), S. America (widespread), Australasia (Tasmania, NZS), Pacific (Hawaii).

Acarospora A. Massal. (1852)

  Literature: Roux et al. (2019) is the best starting point for European species, though it has a bias towards western Europe.

  Thallus: of small squamules but often appearing areolate, brown in most species, pruinose or not, without vegetative propagules. Cortex: well developed and usually thick, distinctly cellular, brown in upper part and colourless below, overlain by a well developed, colourless, usually structureless epicortex. Medulla: white. Apothecia: immersed, rounded to irregular, with brown to black disc, pruinose or not. Exciple: not visible externally in most species. Epithecium: orange-brown or brown. Paraphyses: simple. Ascii: narrowly clavate to almost cylindrical, KI-.

  Ascospores: colourless, ellipsoid, 2 - 3 x 1 µm. Chemistry: in spot tests thallus and medulla C- or C+ red, K- or K+ red (norstictic acid). Photobiont: green.

  About 230 species worldwide, though the taxonomy of the genus is not well understood, in part because many species have been narrowly defined. Some names may eventually be reduced to synonymy. The genus is well represented in Europe. Most species occur on rock, occasionally on soil or parasitic on saxicolous lichens, but are never corticolous. Although they generally show a preference for slightly nutrient enriched habitats, most species occur on siliceous rather than calcareous rock.

  Recently resurrected segregates from *Acarospora* s. lat. include *Pleopsidium* for some yellow species, and *Myriospora* for the *smaragdula* group, both present in Greece. Other recent segregates, not present in Greece, are *Caeruleum* and *Timdalia*. Along with *Polysporina* and *Sarcogyne*, both present in Greece, and a few other less well known genera, they form the family *Acarosporaceae*.

  *A. marcii* is not included in the keys, as I have insufficient information.

Key to Acarospora main groups

11 Thallus yellow or with a yellowish tinge. Group 1.

1 Thallus not yellow; usually brownish, sometimes whitish, rust-red or blackish.

22 Upper cortex and/or medulla C+ red or KC+ red (see Note 1).

33 Thallus of distinctly umbilicate squamules, easily separated from substrate, chalky white with thick white pruina. See (*Glypholecia*).

3 Squamules not umbilicate, ±adpressed, usually some shade of brown but never chalky white, sometimes pruinose. Group 2.

2 Upper cortex and medulla C-, KC-.

33 Thallus or apothecia with norstictic acid, usually K+ red (see Note 1). Group 3.

3 Thallus and apothecia without norstictic acid, K-.

44 Most ascospores 7 or more µm long; 30 - 100 per ascus. Thallus never strongly pruinose. Group 4.

4 Most ascospores shorter than 7 µm (see Note 2); 100 - 200 per ascus. Thallus pruinose or not.

555 Thallus distinctly orange or rust red. *A. sinopica*
55 Thallus white, grey, pale grey-brown or pale brown. Group 5.
5 Thallus ± dark brown. Group 6.

(1) Spot tests are often unreliable here. If they give negative reactions, test a thin section under the compound microscope.
(2) The common A. cervina, keyed out in this branch, has ascospores 4 - 8 μm long. However, its thallus is always very pruinose at least at the margins of squamules.

Key to Acarospora group 1: thallus yellow or ± yellow.

11 Thallus margin distinctly lobed. Not parasitic.
22 Thallus distinctly yellow. On rock.
33 Marginal lobes distinctly elongated. A. hilaris
3 Marginal lobes not elongated, about as broad as long.
44 Thallus distinctly yellow, not pale yellow. Apothecia remaining punctiform. Hymenium 100 - 120 μm tall.
On non-calcareous rock. A. sulphurata
4 Thallus often pale yellow. Apothecia punctiform when young, later more open. Hymenium 170 - 200 μm tall.
On calcareous or non-calciteous rock. (A. maroccana)
55 On soil, or parasitic on terricolous lichens. A. schleicheri
5 On rock, or parasitic on saxicolous lichens.
66 Medulla and thallus K–. Squamules not pruinose.
777 Parasitic on, or closely associated with, Protoparmelia montagnei or Dimelaena oreina. (A. flavisparsa)
77 Parasitic, usually on Diploschistes actinostoma. A. microcarpa
7 Not parasitic. (A. contigua) Greek report probably incorrect. (The poorly known (A. lavicola), said to be confined to volcanic rocks, would probably also key out here.)
6 Medulla, and eventually thallus, K+ red (norstictic acid). Squamules pruinose or not. (A. heufleriana)
4 Disc black. (A. areolata)
2 Thallus not well-developed, consisting only of a few, small, pale yellow granules. (A. clauzadeana)

Key to Acarospora group 2: thallus not yellow; at least in places, C+ or KC+ red.

11 Thallus with distinct marginal lobes.
22 Squamules ± flat. Disc with 1 - 20 small umbos. (A. assimulans)
2 Squamules strongly convex. Apothecia not umbonate. (A. bullata)
1 Marginal lobes absent or poorly developed. (Some individual squamules may be lobed, but the thallus overall is not.)
22 Thallus pruinose, usually densely. Squamules distinctly convex. Disc 0.1 - 0.5 mm diameter. A. umbilicata
2 Thallus usually not pruinose. If some pruinosity present, then squamules flat. Disc exceeding 0.5 mm diameter in some species.
33 Squamules pale brown, not lobed or overlapping. Margin of lower surface pale (pale brown to white). A. gallica
3 Squamules pale or dark brown, lobed or not, overlapping or not. Margin of lower surface dark (brown to black), at least in most places (Note 1).
44 Ascospores globose or subglobose. (A. bornmuelleri)
4 Ascospores ellipsoid.
55 Upper cortex conspicuously C+ red, KC+ red. A. fuscata
5 Upper cortex weakly C+ red, KC+ red.
66 In montane sites. (A. squamulosa)
6 In regions with a true Mediterranean climate. A. complanata

(1) It is not usually necessary to turn a squamule over to examine the lower surface. If the dark lower surface is not
visible externally, around the margin of some squamules, sectioning a squamule will reveal it. Sometimes it has the form of a ±vertical dark edge rather than a "lower surface" (because some squamules are not very "squamulose").

**Key to Acarospora group 3**: thallus not yellow; C-, KC-, with norstictic acid.

11 Parasitic on Diploschistes. Norstictic acid in thallus or hypothecium.
   22 Norstictic acid present in thallus but not hypothecium. **A. reagens**
   2 Norstictic acid present in hypothecium but not thallus. **A. nodulosa**

1 Not parasitic. Norstictic acid confined to thallus.

21 Squamules pale. Base of paraphyses 1.5 - 3 µm wide. Ascospores ±globose, 50 - 100 per ascus. (A. trachytica)
   2 Squamules dark brown or grey-brown. Base of paraphyses to 2 µm wide. Ascospores cylindrical or ellipsoid, about 200 per ascus.
   33 Hymenium 60 - 100 µm tall.
      44 Squamules not entirely occupied by apothecium and sometimes just forming a rim to it. **A. subrufula**
      3 Squamules not entirely occupied by apothecium. **(A. rufotestacea)**

21 Squamules dark brown or grey-brown. Apothecia often more than one per squamule. Probably confined to high mountains. **A. macrospora**
2 Squamules pale brown or green-brown (Note 1). Apothecia usually one per squamule. Not confined to high mountains. **A. murorum**
1 Thallus dark brown. Ascospores 9 - 16 x 6 - 9 µm, 16 - 32 per ascus. Base of paraphyses 1.5 - 2 µm wide. On non-calcareous or weakly calcareous rock. (A. oligospora)

1 Thallus brown, never very dark. Ascospores 6 - 13 x 3 - 6 µm, 30 - 100 per ascus. Base of paraphyses 2 - 3 µm wide. On strongly calcareous rock.
22 Squamules red-brown, occasionally brown-grey. Apothecia often more than one per squamule. Probably confined to high mountains. **A. macrospora**
2 Squamules pale brown or green-brown (Note 1). Apothecia usually one per squamule. Not confined to high mountains. **A. murorum**
1 Thallus dark brown. Ascospores 9 - 16 x 6 - 9 µm, 16 - 32 per ascus. Base of paraphyses 1.5 - 2 µm wide. On non-calcareous or weakly calcareous rock. (A. oligospora)

(1) Fresh material of A. murorum may have a green tinge, especially when wet. The green colour fades in the herbarium.

**Key to Acarospora group 4**: thallus not yellow; C-, KC- without norstictic acid. Ascospores large (for *Acarospora*).

11 Thallus brown, never very dark. Ascospores 6 - 13 x 3 - 6 µm, 30 - 100 per ascus. Base of paraphyses 2 - 3 µm wide. On strongly calcareous rock.
22 Squamules red-brown, occasionally brown-grey. Apothecia often more than one per squamule. Probably confined to high mountains. **A. macrospora**
2 Squamules pale brown or green-brown (Note 1). Apothecia usually one per squamule. Not confined to high mountains. **A. murorum**
1 Thallus brown. Ascospores 9 - 16 x 6 - 9 µm, 16 - 32 per ascus. Base of paraphyses 1.5 - 2 µm wide. On non-calcareous or weakly calcareous rock. (A. oligospora)

2 Thallus distinctly pruinose. Some species not restricted to montane levels.
33 Photobiont layer discontinuous and very irregular. (A. bulgarica)
3 Photobiont layer ±continuous and regular.
   44 Paraphyses 2.5 - 3 µm wide at base. (A. laqueata)
   4 Paraphyses 1 - 1.5 µm wide at base.
      55 Squamules with thin, radiating cracks. Ascospores subglobose, 3 - 3.5 x 2 - 3 µm. Parasitic on Aspicilia. **A. aeginiaca**
      5 Squamules not cracked. Ascospores ellipsoid, 4 - 5 x 1.5 - 2 µm. Not parasitic. **A. versicolor**

**Key to Acarospora group 5**: thallus yellow or dark brown; all reactions negative; ascospores small. I am not familiar with these species, and this key probably needs improvement.

11 Thallus poorly developed, forming only a small zone around apothecia. See (Caeruleum).
1 Thallus well developed.
22 Thallus white, grey or pale grey-brown, not pruinose. If present in Greece then probably restricted to montane levels.
   33 Soralia present. (A. moenium)
   3 Soralia absent. (A. tongletii), (A. tongletii v. paupera)
2 Thallus distinctly pruinose. Some species not restricted to montane levels.
33 Photobiont layer discontinuous and very irregular. (A. bulgarica)
3 Photobiont layer ±continuous and regular.
   44 Paraphyses 2.5 - 3 µm wide at base. (A. laqueata)
   4 Paraphyses 1 - 1.5 µm wide at base.
      55 Squamules with thin, radiating cracks. Ascospores subglobose, 3 - 3.5 x 2 - 3 µm. Parasitic on Aspicilia. **A. aeginiaca**
      5 Squamules not cracked. Ascospores ellipsoid, 4 - 5 x 1.5 - 2 µm. Not parasitic. **A. versicolor**

**Key to Acarospora group 6**: thallus dark brown; all reactions negative; ascospores small.

11 Apothecia of very diverse shapes, even on the same thallus: round, elongated, angular to irregular.
22 Not parasitic. Alpine or subalpine on non-calcareous rock. **A. impressula**
2 Parasitic on saxicolous lichens. Montane or not. On calcareous or non-calcareous rock.
33 On lichens on calcareous rock, not confined to montane regions. (A. tominiana)
3 On lichens on siliceous rock, montane. **A. hospitans**
1 Apothecia ± round.
2 Squamules with raised black margin.  A. scotica
22 Squamules without raised black margin but subdivided by a network of cracks.  A. insolata
2 Squamules without raised black margin or network of cracks.
33 Algal layer very irregular and discontinuous.
44 Disc not pruinose. Thallus pruinose or not.
55 Margins of squamules densely white pruinose; pruina sometimes extending over central part of squamules.
A. cervina
5 Squamules not pruinose.  A. irregularis
4 Disc pruinose. Thallus not strongly pruinose, though some pruina may be present on margins of squamules.
A. glauocarpa
3 Algal layer fairly regular, continuous in most places.
444 Base of paraphyses 1 - 1.5 µm wide. (Consider Myriospora smaragdula or other species in group 3 key.)
44 Base of paraphyses 1.5 - 2 µm wide.
55 Ascospores ± globose. (A. placenta), (A. sphaerospora)
5 Ascospores ellipsoid or subcylindrical.
66 Disc roughened (Note 1). Thallus of contiguous squamules. In Greece, probably restricted to the uplands.  A. nitrophila s. lat. In the couplet below, the first two characters refer to the names as used correctly. The characters in parentheses refer to the names as often applied in southern Europe.
77 Algal layer not interrupted by narrow bands of hyphae. Squamules mostly 0.5 - 1 mm wide. (Margin and lower surface of squamules dark brown to black. Squamules ± dark brown. Apothecia 1 - 4 per squamule. On sunny, nutrient-enriched rock.)  A. nitrophila subsp. nitrophila
7 Algal layer interrupted by narrow bands of hyphae. Squamules mostly 1 - 2 mm wide. (Margin and lower surface of squamules pale. Squamules ± pale brown. Apothecia 1 - 2 (rarely more) per squamule. On shaded, not especially nutrient-enriched rock.)  A. nitrophila subsp. praeruptarum
6 Disc ± smooth. Thallus of scattered or contiguous squamules. Not restricted to uplands.
7 Hymenium less than 120 µm tall.
88 Cortex 30 - 50 (100) µm thick.  A. complanata
8 Cortex less than 30 µm thick.
99 Squamules ± scattered or in groups, ± dark chestnut brown. Disc red-brown or black-brown. Usually at altitudes below 800 m (Note 3).  A. veronensis
9 Squamules forming a squamulose-areolate thallus that is often clearly delimited, dark brown, red-brown or black-brown. Disc dull brown, with red tinge only when wet. Probably restricted to (sub)alpine levels.  A. helvetica
4 Base of paraphyses 2 - 3 µm wide.
55 Apothecia usually occupying most or all of a squamule. (A. modenensis)
5 Apothecia not occupying most of a squamule.  A. badiofusca

(1) The disc in A. nitrophila is roughened but otherwise fairly regular. It is not ridged, umbonate or gyrose.
(2) A. magnussonii may be a synonym of A. veronensis, but the reported differences are so large that I prefer to distinguish them for the present. I have not seen material corresponding to A. magnussonii myself, so can not express any firm opinion.
(3) There are reports of A. veronensis from altitudes up to 2454 m, but it is unclear whether reports from high altitude are reliable.

Acarospora aeginaica  H. Magn.  (1956)
Description: See the protologue.
Aegina, at fairly low altitude. Overgrowing (? parasitic on) an undetermined species of Aspicilia. Unfortunately, it was not stated whether the underlying rock was calcareous or siliceous, and both kinds are present on Aegina.
Known only from the type collection. The name was synonymised with A. strigata, a species described from Chile and not (otherwise) known from Europe, by Clauzade & Roux (1985), but more recently treated as an independent species by Nurtai et al. (2017).
Acarospora badiofusca (Nyl.) Th. Fr. (1860)
Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Roux (2007); Smith et al. (2009).
Central Macedonia at an altitude of about 200 m. The substrate was not stated.
Northern and central Europe. Very rare south of the Alps. Also Macaronesia (Canary Is), central Asia (Kazakhstan, Tajikistan, Russia, Mongolia), N. America (widespread in cooler regions), southern S. America (Argentina, Chile), Australasia (NZS), Antarctica (subantarctic islands).

Acarospora cervina A. Massal. (1852)
This is a superfluous name for Lichen squamulosus Schrad., and conservation is required.
Thallus: squamulose (though often appearing areolate), squamules: brown to dark brown, always heavily white pruinose at margins and sometimes elsewhere, contiguous, usually rounded though sometimes angular by compression, slightly concave to flat, 0.5 - 3 mm wide, 0.4 - 1 mm thick. Epicortex: colourless, 10 - 50 µm thick, occasionally with distinct hyphae as in the cortex, but these hyphae soon gelatinise and in most collections the epicortex appears structureless. Cortex: 35 - 50 µm thick, pale orange-brown to dark brown in outermost 10 - 20 µm, colourless below, usually distinctly hyphal, hyphae in upper part oriented irregularly but predominantly horizontally, those in lower part more uniformly vertical, and these occasionally reach the surface and produce a regular palisade plectenchyma; cortex only occasionally developing a weak cellular structure; C-, K-. Medulla: white. Lower cortex: absent. Lower surface: white. Apothecia: usually present, immersed, usually rounded when mature, but sometimes irregular when young or later by compression, flat to slightly convex, 0.35 - 2 mm diameter, not pruinose. Disc: red-brown to very dark brown or almost black, always darker than squamules. Exipyle: 40 - 80 µm wide, orange-brown in a layer 15 - 20 µm thick at surface, colourless within, lower part of parallel hyphae, upper part of less regularly oriented hyphae with many small lumina, and appearing cellular; cells rounded, 2 - 3 µm diameter. Epitheicum: pale brown to orange-brown, K-, pigmented almost unchanged in K. Hymenium: 70 - 110 µm, colourless. Hypothecium: colourless. Paraphyses: simple, 1.5 µm wide at base, 3 - 4 µm at apex, not capitate or moniliform, with visible septa. Ascospores: colourless, simple, ellipsoid, 4 - 7 x 2 - 4 µm, many per asci. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K-, C-, KC-, P-, I-. Photobiont: green, cells globose to ellipsoid, (6) 10 - 14 µm diameter; photobiont layer 60 - 200 µm thick, discontinuous and very irregular, often with groups of vertical hyphae passing up between the photobiont clumps.
In var. conspersa, recognised by some authors, the thallus is reduced to little more than an apothecial margin. I have not seen that, but in the literature there is some material with some squamules of that kind together with others in which the apothecia occupy only part of the squamule. Var. conspersa may be just an extreme morph of ordinary A. cervina.
The robust brown squamules with a white pruinose margin, and the non-pruinose apothecia are distinctive. The tendency to grow in crevices in limestone also helps characterise this lichen.
Throughout Greece, but commoner in the south. On limestone, or at least moderately calcareous rock, in the uplands. Usually above 900 m, but occasionally as low as 200 m. Sometimes host to the lichenicolous lichen Caloplaca inconnexa.
Wide distribution in Europe to as far north as southern Scandinavia. Also Macaronesia (Madeira), Asia (widespread in warm, dry regions from to Israel to Mongolia and Inner Mongolia), Africa (widespread in N. Africa, also present in S. Africa), N. America (scattered, with no clear pattern), Australasia (warm temperate parts of Australia).

Acarospora complanata H. Magn. (1924)
The names A. africana de Lesd. (1921) and A. crozalsii de Lesd. (1923) may be synonymous, and have priority.
Descriptions: Clauzade & Roux (1985); Roux (2007); Roux et al. (2019).. Islands of the Aegean, on siliceous rock at altitudes 50 - 300 m.
Scattered from Greenland to northern Italy and northern Greece. Also Asia (Siberia), N. Africa (Morocco, perhaps Algeria), N. America (Montana, Washington), C. America (Mexico).

Acarospora contigua H. Magn. (1929)
Mycologia 21: 256.
Although the single Greek report, in Vondrák et al. (2008), was accepted by Abbott (2009), it seems that A. contigua, which was described from Texas, may be restricted to the Americas (and perhaps to North America), and that the name has been misapplied by Asian and European lichenologists; see Nash et al. (2007). The Greek report is the only one for Europe. Vondrák et al. themselves suggest that their collection is close to A. lavicola, a poorly known species of southern Europe and western and central Asia. Additional collections are needed to clarify the situation.
Crete, on calcareous rock at an altitude of 700 m.

The true distribution of *A. contigua* is unclear, owing to confusion with other species, but reported for Asia (Israel, China), Africa (Morocco, S. Africa), N. America (Alabama, Arizona, Kansas, Texas), C. America (Mexico), S. America (Argentina, Bolivia, Chile, Colombia), Pacific (Hawaii).

**Acarospora fuscata** (Schrad.) Arnold (1871)

*Flora* 53(30-31):469; *Lichen fuscatus* Schrad. (1794), Spic. Fl. Germ. 83. The basionym has a conserved type, and is also conserved against *Lichen fuscatus* Lam. (1792).

Thallus: squamulose, pale brown, usually not pruinose, but some collections with well-developed pruina on some (rarely all) squamules. Squamules: flat to slightly convex, discrete or contiguous but not forming a radiating thallus, 0.4 - 1.8 mm diameter, angular when surrounded by others, otherwise ±rounded (the larger ones usually rounded), 700 - 750 µm thick, lower surface usually black. Upper cortex: 60 - 70 µm thick, pale brown in upper half, colourless below, formed of hyphae perpendicular to surface, giving a finely cellular appearance; cells 3 - 4 µm diameter, those in lower half ±square (hyphae with visible septa), those in top half rounded (a result of hyphae swelling); C+ rather faintly red, KC+ red, K- pigment soluble in K. Epicortex: present above cortex, colourless, structureless, 7 - 10 µm thick, without hyphae. Medulla: white. Apothecia: immersed, 0.2 - 0.3 mm diameter in material seen (said to be 0.2 - 1 mm), 1 - 2 (4) per squamule, usually rounded when mature, sometimes elongated or irregular when young. Disc: brown to black. Exciple: poorly developed, 15 - 20 µm wide, hyphal. Thalline margin: not really developed, though photobiont cells are present below apothecia. Epithecium: not sharply separated from hymenium, brown, K-, some pigment dissolving in K. Hymenium: 120 - 180 µm tall, colourless except where it grades into epithecium, KI+ blue. Hypothecium: 50 - 60 µm tall, colourless. Paraphyses: simple, 1 µm wide at base, 1.5 - 2 µm at apex, not capitate or moniliform. Ascii: 60 - 100 x 20 - 25 µm, clavate, KI- (or almost). Ascospores: colourless, simple (but often with 2 lumina), ellipsoid, 4 - 5 x 1.5 - 2 µm, many per ascus (probably more than 100). Pycnidia: not visible externally; in section: 100% immersed, pyriform to almost cylindrical, 240 µm tall, 110 µm wide. Conidia: colourless, ellipsoid, 2 x 1 µm. Chemistry: in spot tests thallus C+ red (reaction sometimes faint), KC+ strongly red, K-; medulla C-, KC-, K- (but pigment mobilised from the lower cortex by K can cause confusion!). Photobiont: green, cells globose, 7 - 8 µm diameter, forming a ±continuous, ±regular layer 90 - 125 µm thick.

Non-pruinose collections can usually easily be recognised by the strong KC+ red reaction of the thallus, squamules that have a tendency to become lobate and even overlapping, and the black lower surface. Lightly pruinose morphs can generally be recognised in the same way. In collections with moderately well developed pruina, it is advisable to consider carefully all the characters mentioned in the key.

Widely distributed, but absent from the southernmost parts of the country. On siliceous rock. Most records are from altitudes below 400 m, but present up to 1924 m.

Widely distributed outside tropical regions. Throughout Europe. Also Macaronesia (Canary Is), Asia (widespread), Africa (Morocco, Algeria, Egypt, perhaps Namibia), N. America (widespread), Caribbean (PR), perhaps S. America (Argentina, Bolivia), Australasia (SE Australia, NZS).

**Acarospora gallica** H. Magn. (1929)


Thallus: crustose, appearing areolate rather than squamulose, grey to brown, not pruinose. Areoles: flat, not lobed. Cortex: present, C+ red, overlain by a structureless epicortex. Apothecia: immersed, usually rounded, 0.3 - 0.5 mm diameter, not pruinose. Disc: dark brown. Exciple: poorly developed; in section: 20 µm wide, hyphal, scarcely distinct from hymenium. Thalline margin: dark brown, much darker than other parts of thallus. Epithecium: brown, K- (as are all parts of apothecial sections), pigment not dissolving much in K. Hymenium: 65 - 150 µm tall, colourless, KI+ blue. Hypothecium: 25 - 50 µm tall, colourless. Paraphyses: simple, sometimes with visible septa in upper part, not capitate, or not or scarcely moniliform, 1.5 µm wide at base, 2.5 µm at apex. Ascii: 100 - 105 x 15 - 22 µm, narrowly clavate to ±cylindrical, KI- (or almost). Ascospores: colourless, simple, ellipsoid, 3 - 5 x 1.5 µm, many per ascus (probably at least 100). Chemistry: in spot tests thallus C+ faintly and obscurely red, KC+ distinctly red, K-; medulla K-, C-, KC-. Photobiont: green, cells globose, 8 - 10 µm diameter, forming a regular layer, also present below apothecia.

Not accepted by Abbott (2009) owing to the uncertainty in the determination of the only Greek collection. That collection does not agree in all respects with published descriptions. Further collections are needed to clarify the matter.

Northern Peloponnese, on siliceous rock at an altitude of 700 m.

Widely distributed in mid-latitude Europe, from Denmark to the Alps, but very rare south of the Alps. Also Macaronesia (Tenerife), Asia (Turkey, eastern Russia), N. Africa (Morocco), N. America (Colorado, New Mexico), perhaps C. America, Australasia (NZS).
Acarospora glauccarpa (Ach.) Arnold (1858)


Descriptions: Clauzade & Roux (1985) as *A. cervina* var. *glaucocarpa*; Nash et al. (2007); Roux (2007); Smith et al. (2009).

Scattered throughout Greece. Present on Crete but not recorded from any of the smaller islands, perhaps because they are not high enough. On calcareous rock at altitudes of 1000 m and above. Not recorded in Greece since 1959.

Throughout Europe, but uncommon south of the Alps. Also Asia (widespread), N. Africa (Morocco), Australasia (NSW, S. Australia, NZS). Reports for N. America are incorrect, so those for C. America (Mexico) and S. America (Argentina) may be doubtful.

Acarospora helvetica H. Magn. (1924)


Description: Knudsen & Kocourková (2020) is best.

Known from a single site in Epiros, on serpentine at an altitude of 2030 m.

Central Europe, and montane southern Europe. Reports for other continents are in need of confirmation.

Acarospora hilaris (Dufour ex Nyl.) Hue (1909)


Description: Clauzade & Roux (1985); Magnusson (1929a).

Islands of the southern Aegean, including Crete. On siliceous rock at altitudes 50 - 220 m.

In Europe, there are scattered reports for Portugal, Spain, Italy and Greece. Also Macaronesia (Canary Is), Asia (Turkey, Siberia, Mongolia), N. Africa (Morocco, Algeria), perhaps N. America.

Acarospora hospitans H. Magn. (1924)


Description: Clauzade & Roux (1985) as *Acarospora impressula* var. *hospitans*; Magnusson (1929a).

Island of Samothraki, on siliceous rock at an altitude of 870 m.

Scattered in northern and central Europe, though absent from British Isles. Very rare south of the Alps. Also Macaronesia (Canary Is), Asia (Turkey, Syria, widespread in Russia), North Africa (Morocco), Pacific (Hawaii).

Acarospora impressula Th. Fr. (1871)


Not accepted into the Greek checklist by Abbott (2009), pending a revision of Peloponnesian collections of *Acarospora*. That revision has now been undertaken, and the presence of this species in Greece is confirmed.

Thallus: squamulose, squamules dark brown or dark red-brown (including margin), not pruinose, 0.5 - 1 mm wide, smooth. Epicortex: rather irregular, colourless, 10 - 50 µm, swelling to 90 µm in K, structureless or with faint traces of hyphae visible. Cortex: 35 - 60 µm tall, brown or orange-brown in upper part, colourless below, of small rounded cells, C-, K-, pigment scarcely changed in K. Apothecia: submersed to subsessile, rounded to elongate, slightly concave, 0.3 mm diameter, not pruinose. Disc: dark red-brown to black, smooth. Exciple: black, sometimes slightly shiny, raised well above level of disc, prominent; in section: 25 - 40 µm wide, dark brown near surface, colourless in inner part, of radiating hyphae that broaden in outer part. Epithecium: orange-brown to brown, K-, scarcely changed in K. Hymenium: 60 - 105 µm tall, colourless, KI+ blue. Hypothecium: 45 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, 2.5 µm at apex, not capitate or moniliform. Asci: 60 - 75 x 15 - 22 µm, clavate, KI-. Ascospores: colourless, simple, ellipsoid, many per ascus (certainly more than 50), 4 - 5 x 2 - 3 µm. Chemistry: thallus and medulla C-, K- in spot tests. Photobiont: green, forming a layer that is usually continuous, usually fairly regular, but in places with an irregular upper surface.

The combination of a dark brown, non-pruinose thallus, with round to elongated apothecia, and a prominent raised black exciple is distinctive.

Mt. Mikri Ziria, northern Peloponnese, on siliceous rock at 1750 m.

Central and northern Europe; the Greek report appears to be the only one from south of the Alps. Also Asia (widespread from Turkey to Mongolia and southern Siberia), Africa (Morocco, Egypt; mid Atlantic island of St Helena), N. America (Ellesmere Is), Antarctica (subantarctic Marion Is).

Acarospora insolata H. Magn. (1924)

Description: Clauzade & Roux (1985); Magnusson (1929a).
Island of Samothraki, on siliceous rock at an altitude of 870 m.
Scattered in northern and central Europe, from Norway to Ukraine, but absent from British Isles. Very rare south of the Alps. Also Asia (Turkey, Siberia, Mongolia).

**Acarospora irregularis** H. Magn. (1929)
Description: Knudsen et al. (2014).
Reported from a single unspecified locality in Attica, at an altitude of 850 m.
Scattered in central Europe from France to Russia, rare in Italy and Greece. Absent from northern Europe. Also Asia (Turkey, Siberia).

**Acarospora macrospora** A. Massal. ex Bagl. (1857)
Description: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).
Mt. Olympus, on calcareous rock at altitudes above 1500 m. Abbott (2009) also cited a report from central Greece (Kutupa); this was from an altitude of about 500 m, on siliceous rock, but it might refer to a different species as A. macrospora usually occurs on calcareous substrates.
Throughout Europe, except for arctic regions. Also Macaronesia (Canary Is), Asia (widespread as far east as Mongolia and Yunnan), Africa (Morocco, Algeria, S. Africa), N. America (Ontario, scattered in USA).

**Acarospora marcii** H. Magn. (1929)
Description: See the protologue. According to K. Knudsen (pers. comm), this species is close to A. squamulosa. It is poorly known, as the type was lost in the bombing of Dunkirk.
Recently collected in Epirus, on serpentine rock at an altitude of 2227 m. The record has not yet been formally published, but was communicated to me by K. Knudsen.
Known only from France, Germany, Sardinia and Greece.

**Acarospora microcarpa** (Nyl.) Wedd. (1875)
Islands of the Aegean. On siliceous rock at altitudes up to 200 m.
SE Spain, southern France, Italy, and Greece. Also Macaronesia (Canary Is, CVI), N. Africa (Morocco).

**Acarospora murorum** A. Massal. (1853)
*A. murorum* has often been subsumed under A. macrospora, and some Greek reports of that species may belong here.
Thallus: squamulose, pale brown (green-brown when fresh), not pruinose. Squamules: 0.6 - 1.5 mm wide, ±rounded, ±flat, 400 - 600 µm thick. Upper cortex: 35 - 60 µm thick, mostly colourless, sometimes pale brown in outer 10 - 15 µm, cellular, cells subrounded or slightly elongated perpendicular to surface, 5 - 7 x 5 µm, C-, K-, pigment fading slightly in K; overlain by a colourless, structureless epicortex 5 - 7 µm thick, without hyphae. Medulla: white. Apothecia: 0.65 - 1.7 mm diameter, immersed to subsessile, rounded, not pruinose, 1 per squamule. Disc: red-brown to black. Exciple: not visible externally; in section: 20 - 50 µm thick, hyphal. Thalline margin: present, persistent; in section: 110 - 150 µm thick with well developed cortex. Epithecium: brown to orange-brown, not sharply differentiated from hymenium, K-; pigment little changed in K. Hymenium: 135 - 170 µm tall, colourless, KI+ blue. Hypothecium: 35 - 50 µm tall (including a weakly developed subhymenium), colourless to very pale yellow. Paraphyses: simple, 1.5 µm wide at base, 3 - 5 µm at apex, upper part with visible septa. Ascii: 100 - 110 x 13 - 15 µm, cylindrical, KI-.
Ascospores: colourless, simple but often with 2 lumina, ellipsoid, 6 - 9 x 3 - 4 µm, many per ascus (at least 50). Pycnidia: not visible externally, entirely immersed, either aggregated into groups or multi-chambered (not clear which), individual 'chambers' ellipsoid, 140 µm tall, 60 µm wide, the whole group rather irregular in shape, 250 x 130 µm. Conidia: colourless, ellipsoid, 3 x 1 µm. Chemistry: thallus K-, KC- in spot tests. Photobiont: green, cells globose, 8 µm diameter, forming a layer 80 - 125 µm thick that is almost continuous, but upper part sometimes with deep, steep sided 'valleys' that are occupied by vertical hyphae.
The rather large ascospores easily distinguish *A. murorum* from other Peloponnesian species of the genus.
Chios and central Peloponnese, on limestone at altitudes around 800 m.
Southern Europe and parts of central Europe. Present in British Is but not the Nordic countries. Also western Asia.
(Israel, Iran, Russia), N. Africa (Morocco, Algeria), S. America (Argentina), Australasia (NZS).

**Acarospora nitrophila** H. Magn. (1924) subsp. *nitrophila*

Monogr. Scand. Acar. 74.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Chios, on siliceous rock at altitudes 110 - 525 m. The lichenicolous fungus *Stigmidium fuscatae* has been reported once from this species. The name has often been employed in a broad sense, and Greek material may not belong to *A. nitrophila* s.str. See Knudsen & Kocourcová (2017) for a summary of the present state of knowledge concerning *A. nitrophila* and similar species.

Throughout Europe, though scarce in the south. Also Asia (Iran, Russia, Mongolia), North Africa (Morocco).

**Acarospora nitrophila** subsp. *praeruptarum* (H. Magn.) ined.


Reports of this taxon for southern Europe may be incorrect, as confirmed reports of subsp. *praeruptarum* are confined to northern, and perhaps central Europe. See Knudsen & Kocourcová (2017)

Descriptions: Clauzade & Roux (1985) as *A. nitrophila* var. *praeruptorum*; Magnusson (1929a) as *A. praeruptarum*; Roux (2007)

Limnos and Samothraki, on siliceous rock at altitudes 20 - 870 m.

There are scattered reports of this subspecies from central Europe, the British Is, and Scandinavia. The Greek reports are the only one I have seen from south of the Alps. Also Asia (Jammu & Kashmir, Mongolia).

**Acarospora nodulosa** (Dufour) Hue (1909)


Descriptions: Nash et al. (2007) is best. See also: Clauzade & Roux (1985); Nimis & Martellos (2004); Roux (2007).

Gavdos Island (south of Crete) at an altitude of 100 m. The substrate was not reported.

Only ± southern Europe: Spain, France, Switzerland, Italy, FYROM, Greece. Also Macaronesia (Fuerteventura), Asia (widespread in dry regions from Turkey to Inner Mongolia), N. Africa (Morocco), N. America (scattered in western USA), C. America (Mexico), Australasia (scattered in Australia, NZS).

**Acarospora reagens** Zahlbr. (1902)


Some authors subsume this taxon within *A. nodulosa*; see Nash et al. (2007).

Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004), both as *A. nodulosa* var. *reagens*.

Meteora, in central Greece, on conglomerate at an altitude of 500 m.

Southern Europe, from Portugal to Cyprus. Also Macaronesia (Canary Is), Asia (widespread in middle latitudes as far east as Tibet), Africa (Morocco, Algeria, Tunisia, Egypt), N. America (California, perhaps elsewhere in USA), Australasia (S. and E. Australia).

**Acarospora schleicheri** (Ach.) A. Massal. (1852)


Islands of the southern Aegean, including Crete. On soil at altitudes 245 - 900 m.

Southern Europe, to as far north as Switzerland (though there is an anomalous report for Greenland). Also Macaronesia (Canary Is), Asia (widespread in middle latitudes as far south as the moist tropics), N. America (widespread, mainly in western half), Caribbean (Guadeloupe), C. America (Mexico), S. America (widespread), Australasia (NZS), Pacific (Hawaii). Some reports may be erroneous, and the result of excessive lumping in the past.

**Acarospora scotica** Hue (1909)


Description: Clauzade & Roux (1985); Nash et al. (2007).

Islands of Chios, Paros and Samothraki, on siliceous rock at altitudes 250 - 760 m. Not accepted onto the Greek list by Abbott (2009), but since confirmed for Greece.

Mediterranean regions of Europe. Also Asia (Armenia), N. America (Arizona, Californial, New Mexico), C. America (Mexico).
Acarospora sinopica (Wahlenb. ex Ach.) Körb. (1855)
Syst. Lich. Germ. 156; *Endocarpon sinopicum* Wahlenb. ex Ach. (1803), Methodus (Supplementum) 30.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Chios, on metal-rich rock at an altitude of 670 m.

Throughout cold and temperate Europe, but very rare south of Alps and Pyrenees. Also Asia (Russia, Tajikistan Afghanistan), N Africa (Morocco), N America (widespread), Australasia (S. and W. Australia).

Acarospora subrufula (Nyl.) H. Olivier (1900)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the Aegean, on siliceous at altitudes below 150 m.

Mediterranean regions and the temperate Atlantic coast of Europe: SW Britain (Scilly Islands, Channel Islands), France, Portugal, Spain, Italy (Sardinia) and Greece.

Acarospora sulphurata (Arnold) Arnold (1886)

Description: Clauzade & Roux (1985); Magnusson (1929a).

Crete, at an altitude of 600 m. The substrate was not reported.

Southern Europe, from France to Greece Also Macaronesia (Madeira), Asia (Turkey, Jordan, southern Siberia, Mongolia), northern Africa (Morocco, Algeria, Tunisia, perhaps Chad).

Acarospora umbilicata Bagl. (1857)


Peloponnesian collections that were referred to this species by Abbott (2009) have proved, on closer study, either to belong to pruinose morphs of *A. fuscata*, or to be indeterminable. Some of the other Greek reports might also refer to pruinose morphs of *A. fuscata*.

Islands of the southern Aegean, including Crete, on siliceous rock at altitudes to 125 m. All records are from close to the sea.

Throughout Europe to as far north as British Is and southern Scandinavia. Also Macaronesia (widespread), Asia (Turkey, Israel, southern Siberia), northern Africa (Morocco, Algeria, Ethiopia), N. America (Virgina), Australasia (NZS, where it may be introduced).

Acarospora veronensis A. Massal. (1852)

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Roux (2007); Smith et al. (2009).

Following a revision of Peloponnesian material of *Acarospora*, it is clear that the three recent Peloponnesian collections cited in Abbott (2009) do not agree well with published description of *A. veronensis*. They may belong to more than one taxon, but their identity is not clear at present. Clarification of the matter will require collection of substantial additional material. Published reports for the Dodecanese islands are also slightly uncertain. However, all of these uncertain reports are included on the map.

Widespread, but commoner in the southern half of Greece. On siliceous rock. Usually at altitudes below 400 m, but scattered reports up to 2454 m. The lichenicolous fungus *Muellerella pygmaea* has been recorded once on Peloponnesian material referred by Abbott (2009) to this species.

Throughout Europe. Also Macaronesia (Azores, Canary Is), Asia (throughout the northern half), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico), Australasia (ACT, NSW, Tasmania, NZS), Antarctica (subantarctic Heard Is).

Acarospora versicolor Bagl. & Car. (1864)

Description: Clauzade & Roux (1985); Roux (2007).

Island of Samothraki, on siliceous rock at an altitude of 350 m.

Mostly central Europe, though extending north to Denmark and Finland. Absent from British Isles. Very rare south of the Alps. Also Macaronesia (Hierro, Tenerife), Asia (Turkey, southern Siberia, Mongolia), N. Africa (Morocco). Reports for N. America are incorrect.
Acrocordia A. Massal. (1854)


Literature: There is no good monograph, but Poelt & Vězda (1977) and Smith et al. (2009) both treat the widespread European taxa.

About 7 species, 6 of which occur in Europe. There are few Greek records.

11 Wall of perithecia appearing entirely black, owing to tightly incurved involucrulum. Usually on calcareous rock, rarely on soil. (A. salweyi)

1 Wall of perithecia appearing ± colourless at base, clearly distinct from black involucrulum. On various substrates.

22 Ascospores less than 20 µm long and less than 10 µm wide.

33 Perithecia 0.5 - 1 mm diameter. On calcareous rock. A. conoidea s. lat.

44 Ascospores 12 - 19 x 6 - 9 µm. A. conoidea var. conoidea

4 Ascospores 12 - 13 x 5 - 6 µm. A. conoidea var. glacialis

2 Many ascospores at least 20 µm long and at least 10 µm wide.

33 Thallus ± immersed, white or pale grey. On bark. A. gemmata

3 Thallus superficial, grey to grey-brown. On rock. (A. macrospora)

Acrocordia conoidea (Fr.) Körb. var. conoidea (1855)


Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Poelt & Vězda (1977); Smith et al. (2009).

Evia and Mt. Olympus, on calcareous rock at 1000 - 1100 m. It is surprising that there are not more reports of this species from Greece, as elsewhere in Europe it does not seem to be especially rare. Possibly overlooked among the many other endolithic pyrenocarpous lichens.

Widely distributed in Europe as far north as southern Scandinavia. Also western Asia (Israel, Syria), N. Africa (Morocco), N. America (Ontario, scattered in USA).

Acrocordia conoidea var. glacialis (Bagl. & Car.) Vězda (1977)


Description: Poelt & Vězda (1977).

Athos, on calcareous rock at an altitude of 1800 m.

The only other record of this taxon that I have seen is for the type collection from the Italian Alps.

It is not clear to me that var. glacialis is a good taxon. Its slightly smaller ascospores may merely reflect slower growth in the colder conditions prevailing at high altitude. However, as I have not seen material of either variety, I maintain this variety for the present.

Acrocordia gemmata (Ach.) A. Massal. (1854)


Description: Clauzade & Roux (1985); Poelt & Vězda (1977); Smith et al. (2009).

Throughout most of Europe wherever humidity is not too low, though absent from truly arctic regions. Also Macaronesia (widespread), Asia (widespread but not very common), Africa (Morocco, Algeria, Tunisia, perhaps Reunion Is), N. America (Quebec, scattered in USA), perhaps Caribbean (Bahamas), Australasia (both islands of NZ).

Agonimia Zahlbr. (1909)


Family: Verrucariaceae.

Literature: There is no monograph, but Smith et al. (2009) is a good starting point.

About 13 species, 10 of which occur in Europe. There are few Greek records.
11 Asci with 1 or 2 ascospores. Thallus of small squamules.
   22 Blastidia often present. Perithecia usually absent. **A. opuntiella**
   2 Blastidia absent. Perithecia usually common. Ascospores 60 - 120 µm long. **A. tristicula**

1 Asci with 8 ascospores. Thallus squamulose or crustose.
   22 Ascospores 60 - 75 µm long. Thallus of very small squamules. **A. octospora**
   2 Ascospores less than 60 µm long. Thallus squamulose or crustose.
      33 Thallus crustose or squamulose, with rounded sterile globules 0.1 - 0.2 mm diameter. Ascospores 35 - 50 x 15 - 25 µm. (A. globulifera)
      3 Thallus ± crustose, without sterile globules.
   44 Ascospores 30 - 35 x 10 - 15 µm. **A. allobata**
   4 Ascospores 40 - 55 x 18 - 24 µm. (A. borystenica)

**Agonimia allobata** (Stizenb.) P. James (1992)
   Description: Smith et al. (2009).
   Island of Iraklia, on bark of *Prunus dulcis* at an altitude of 245 m.
   Mainly central Europe, but reaching southern Scandinavia and present but uncommon south of the Alps and Pyrenees. Also Asia (Turkey), N. America (Michigan).

**Agonimia octospora** Coppins & P. James (1978)
   Description: Clauzade & Roux (1985); Smith et al. (2009).
   Chios and Ikaria, on bark, at altitudes 200 - 1280 m.
   Western parts of Europe to as far north as Scotland, and in humid parts of the south. Absent from the Nordic countries; in central Europe it occurs no further east than Switzerland. Also Macaronesia, western Asia (Syria), and perhaps South America (Brazil).

**Agonimia opuntiella** (Poelt & Buschardt) Vězda (1997)
   Descriptions: Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).
   Crete, on bark of *Quercus macrolepis* at an altitude of 370 m.
   Widely distributed in central and southern Europe, but scattered; not common. Absent from Nordic countries and Baltic States, and very rare in British Is. Also Macaronesia (Canary Is), Asia (Turkey, Japan, Vietnam, perhaps Taiwan), N. America (eastern USA), C. America (CR, Guatemala, Mexico), S. America (Brazil, Ecuador, Peru), Australasia (Queensland).

**Agonimia tristicula** (Nyl.) Zahlbr. (1909)
   Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).
   Scattered throughout Greece, but commoner in the northern half. Usually on bark, less commonly on bryophytes or siliceous rock. At altitudes 10 - 1850 m, but most reports are from below 500 m.
   Most of Europe except for arctic regions. Also Macaronesia, Asia (widespread but very scattered), Malesia (PNG, Philippines), "Africa" (Ascension Is), N. America (scattered in the west, from Alaska to Arizona and Colorado), C. America (CR), S. America (Colombia), Australasia (NSW, Lord Howe Is), Antarctica (S. Georgia).

**Agyrium Fr.** (1822)
   Literature: Smith et al. (2009)
   Many species formerly assigned here are now placed elsewhere, and *Agyrium* probably now contains only one species, *A. rufum*. It is not lichenised, but is encountered by, and commonly studied by, lichenologists.

**Agyrium rufum** (Pers.) Fr. (1822)
   Description: Smith et al. (2009)
Mt. Olympus, on wood at altitudes of 1700 m and above.
Scattered in Europe north of the Alps and Pyrenees, the Macedonian record being the most southerly. Also Asia (Siberia, Japan), N. America (BC, New Brunswick, N. Carolina), Australasia (Victoria, Tasmania).

**Alectoria Ach. (1809)**


Literature: European taxa are treated by Smith et al. (2009). The best introductions to the genus as a whole are Hawksworth (1972a) and Brodo & Hawksworth (1977).

Nine species, of which 3 occur in Europe. *Alectoria* is restricted to cool or cold habitats, and so is montane in Mediterranean regions. One species is known for Greece.


**Thallus:** fruticose, pendent, or unattached and draped over branches, to 20 cm long, green-grey, sometimes becoming dark grey or brown at extreme tips of branches, smooth, not pruinose, without vegetative propagules.

**Branches:** mostly 0.1 - 0.25 mm diameter, sometimes reaching 0.6 mm diameter on main stems, usually ± rounded but sometimes slightly flattened, sometimes dark grey to black in basal 0.5 mm near attachment point, solid; branching frequent, often anisotomic. 

**Pseudocyphellae:** present, conspicuous, white, flat to slightly concave, distinctly elongate, usually oriented along axis of branch, but occasionally corkscrewing around it, 0.2 - 1.2 x (0.05) 0.1 - 0.2 mm.

**Spinules:** absent, but incipient new branches, 0.05 - 0.5 mm long, commonly resemble spinules.

**Cortex:** 12 - 26 µm thick, of periclinal hyphae, K-. 

**Medulla:** not well developed. 

**Chemistry:** thallus K- or faintly + yellow, C-, KC+ orange-red or red, P-, UV+ greenish (in both short-wave and long-wave UV). 

**Photobiont:** green, trebouxioid, occupying most of the branch interior: cells globose, 0.08 - 0.1 mm diameter.

The thallus in this species is said to be UV+ ice-blue, but all Peloponnesian material reacts + greenish, without any trace of blue. (Peloponnesian material is not *Ramalina thrausta*; the very elongate pseudocyphellae and the KC+ reaction rule out that species. Not does it seem to belong to *Lethariella intricata*; I can find no trace of a central axis, and the lichen is invariably corticolous.)

Montane forests of Peloponnesse, Epiros and Kefallonia. On bark (or, quite often, as detached thalli draped over branches) at altitudes of 1150 - 1650 m. Most reports are from *Abies cephalonica*, but occasionally on *Juniperus oxycedrus*.

Widely distributed in cool, moist parts of Europe, but absent from truly arctic regions. In southern Europe probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia, Mongolia, China), N. America (cool to temperate oceanic regions on both coasts, but absent from centre of continent), perhaps C. America (CR), S. America (Argentina). A report for Africa (Reunion Is) seems very doubtful.

The other subspecies, subsp. *vexillifera*, is a northern taxon known in Europe no further south than England.

**Amandinea M. Choisy ex Scheid. & H. Mayrhofer (1993)**


Literature: Scheidegger (1993) is the best starting point, but the widespread species are treated in all the standard Floras (before 1993 under *Buellia*).

About 43 species, 7 of which occur in Europe. They are usually corticulous or saxicolous. The genus was delimited on conidial characters, but unfortunately most collections lack pycnidia.

As presently circumscribed, differs from *Buellia* mainly in its conidia. It is not certain that the group of species presently included in it merit recognition at generic rank.

11 Ascospores 17 - 20 x 8.5 - 10.5 µm. Thallus thick, crustose to subsquamulose. Apothecia 0.4 - 0.7 mm diameter. On bark or wood. (A. crassiuscula)

1 Ascospore to 15 µm long. Thallus thin or thick, but not subsquamulose. Apothecia 0.2 - 0.6 mm diameter. On various substrates.

22 Ascospore wall of ± uniform thickness everywhere, not thickened at septum. Not restricted to coastal sites. 

Pycnidia uncommon. *A. punctata*
2 Ascospore wall thickened internally near septum (Physconia type). Restricted to coastal sites. Pycnidia common.
33 On bark. (A. maritima)
3 On siliceous rock. (A. pelidna)

Amandinea punctata (Hoffm.) Coppins & Scheid. (1993)
in: Scheidegger, Lichenologist 25(4): 343; Verrucaria punctata Hoffm. (1796), Deutschl. Fl. 2: 192; Buellia aequata (Ach.) Szatala; (?) Buellia aequata f. perminuta (Arnold) Szatala; Buellia aequata var. virens (J. Steiner) Szatala; Buellia myriocarpa var. stigmatae sensu H. Olivier; Buellia myriocarpa var. virens J. Steiner; Buellia punctata (Hoffm.) A. Massal.; (?) Buellia punctata var. perminuta (Arnold) Zahli.; Buellia punctiformis (Hoffm.) A. Massal.; Buellia punctiformis f. aequata (Ach.) Arnold; Buellia punctiformis var. aequata (Ach.) Arnold; Buellia punctiformis f. depauperata (Anzi ex Arnold) Szatala, nom. inval.; Buellia stigmatae sensu Körb., non (Ach.) Körb.

Thallus: crustose, inconspicuous, forming small patches to 1 cm diameter, white to pale grey, not pruinose, ±smooth but often cracked, thin (50 - 75 µm). Cortex: 30 - 35 µm thick, mostly colourless, sometimes pale brown in upper part. Medulla: poorly developed. Apothecia: sessile, flat to slightly convex, 0.2 - 0.5 mm diameter, not pruinose. Disc: black, matt. Exciple: black, thin (about 0.02 mm), becoming eventually, in section: 20 - 40 µm wide, pale brown to dark brown, inner part usually paler than outer, of radiating hyphae with broad lumina; K-, pigment not soluble in K. Thalline margin: absent. Epithecium: brown to dark brown, K-, pigment not soluble in K. Hymenium: 50 - 80 µm tall, colourless, occasionally with a few oil droplets, KI+ blue. Hypothecium: 50 - 100 µm tall, almost colourless to dark brown, usually with a distinct cellular texture in at least some parts, pigment (when present) K-, not soluble in K. Paraphyses: 1 µm wide, simple, capitulate, apex 3 - 5 µm with an internal brown crescent-shaped or hemispherical pigment cap. Ascii: 60 - 65 x 17 - 19 µm, clavate, Buellia type. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, 12 - 17 x 5 - 8 microns, septum 1 - 2 µm broad, wall of ±uniform thickness. Chemistry: medulla I-; thallus K-, KC-, UV-. Photobiont: green, cells globose, 7 - 18 µm diameter, forming a continuous, regular layer 20 - 30 µm thick.

Another common corticolous species that is superficially similar is Lecidella elaeochroma. However, the thallus of A. punctata is never bounded by a black line, and the exciple is never shiny; the two species also have very different ascospores.

Very common throughout Greece. At altitudes 0 to about 1900 m, but commonest below 400 m. Usually on bark (75% of records), sometimes on siliceous rock or wood. Recorded from a fairly wide range of phorophytes, with no distinct preferences.

Cosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, S. Africa), N. America (widespread), Caribbean (Bermuda, Guadeloupe), C. America (Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Tuamotu), Antarctica (widespread).

Anaptychia Körb. (1848)


Literature: The only monograph, Kurokawa (1962), is dated, and many species treated are now placed in other genera. Clauzade & Roux (1985), and Poelt & Vězda (1977) are the best starting points for Greek taxa. Smith et al. (2009) treat A. ciliaris and A. runcinata.

Diffsers from Physcia in having a distinctly hyphal (prosplectenchymatous) rather than cellular (paraplectenchymatous) upper cortex. The genus is monophyletic, according to Lohtander et al. (2008).

A revision of the three ciliate species said to occur in Greece is desirable, to clarify their delimitation.

About 18 species. Perhaps as many as 9 occur in Europe.

11 Thallus appearing subfruticose to fruticose. Marginal or apical cilia present.
22 Lobes narrow, 0.3 - 0.6 wide, only broader (to 1.5 mm) near points of branching. Thalline margin with abundant cilia. Ascospores 33 - 44 x 15 - 17 µm. A. crinalis

2 Lobes broader, more than 0.7 mm wide. Thalline margin with or without cilia. Ascospores various.
33 Apothecia absent. A. ciliaris. (Note 1)
3 Apothecia present.
44 Thalline margin with abundant cilia. Ascospores 48 - 52 µm long. A. setifera
4 Thalline margin without cilia (Note 2). Ascospores 27 - 35 µm long. A. ciliaris

1 Thallus foliose, sometimes appearing subfruticose. Cilia absent.
22 Soralia present. (A. desertorum)
2 Soralia absent.
33 Upper surface of lobes, especially near tips, with fine colourless hairs or spines. (A. roemerii), (A. ulotrichoides)
3 Lobes without hairs.
4 On coastal siliceous rock. **A. runcinata**
4 On bark, or on shaded rocks in forests (Note 3). (A. palmulata)

(1) Because A. ciliaris is very common throughout Greece, whereas A. setifera is very rare, sterile collections may safely be assigned to the former.
(2) Older apothecia in A. ciliaris sometimes develop irregular extensions of thalline tissue that may bear occasional cilia, and occasionally a cilium may appear to arise directly from the exciple, but the exciple is never abundantly ciliate.
(3) A. palmulata has been reported a few times for Europe, but may be restricted to North America and eastern Asia.

**Anaptychia ciliaris** (L.) Flot. (1850)


Thallus: foliose but often appearing ±fruticose, to 10 cm diameter. Lobes: (0.3) 0.7 - 2.5 (4.5) mm wide, to 2 cm long, 400 µm thick, convex in transverse section (so lower surface channeled). Upper surface: grey to brown, not pruinose, finely tomentose everywhere. Lower surface: white, channeled, usually with a reticulate network of raised ridges, at x16 clearly not corticate in places, especially between ridges, but ridges usually appearing corticate. Cilia: always abundant, arising from margins and tips of lobes, never laminal, usually simple, rarely forked or multiply branched towards tip, usually brown to black, sometimes white at base, 0.5 - 5.5 mm long, 0.05 - 0.15 mm wide at base, tapering towards tip, usually with distinct fine white tomentum. Rhizines: occasional, similar to the cilia but arising from lower surface, usually 0.5 - 2.5 x 0.05 - 0.1 mm. Upper cortex: present, 50 - 100 µm thick, usually colourless (sometimes pale brown at extreme surface), of horizontal hyphae in longitudinal section, with many small hyphae or groups of hyphae projecting from surface; these are colourless, 12 - 30 x 5 - 10 µm, and the source of the tomentum; pigment, when present, K-, N-.
Medulla: white; in section 100 - 200 µm thick, of loosely interwoven hyphae about 5 µm wide. Lower cortex: present in places, 70 µm thick, of horizontal hyphae in longitudinal section; hyphae narrower (about 2 µm wide) and more densely packed than those in medulla. Apothecia: usually present, apical or laminal, laminal ones often shortly stalked, concave (sometimes strongly so when young, with thalline exciple folded over disc, though not completely enclosing it), 2 - 5 mm diameter. Disc: dark brown, sometimes white pruinose.
Exciple: poorly developed, not visible externally; in section 15 - 45 µm wide, formed of hyphae that are much broader than paraphyses. Thalline margin: present, persistent, smooth in young apothecia, later becoming crenulate and sometimes developing long extensions which occasionally bear cilia; in section 350 µm wide, of which cortex 50 - 80 µm; cortex of randomly oriented hyphae. Epithecium: brown to orange-brown, K-, N- (pigment not soluble in K or N).
Hymenium: 105 - 145 µm tall, colourless to very pale brown, KI+ purple-blue. Hypothecium: 30 - 80 µm thick, colourless to very pale orange-brown. Paraphyses: 1 µm wide at base, not capitate but broadening to 3 - 4 µm wide at apex, usually simple, sometimes branched near tip, with a very thin layer of brown pigment at extreme top. Ascii: 100 - 112 x 27 - 52 µm, clavate; apex KI+ blue (see note below). Ascospores: ellipsoid, brown, 1-septate, 30 - 35 x 15 - 22 µm, septum 1.5 µm thick, 8 per ascus, often slightly constricted at septum, sometimes slightly curved, without internal wall thickenings (Buellia ellip.). Pycnidia: common, laminal, hemispherical, dark brown to black, 0.2 - 0.3 mm diameter; in section: 50% immersed, globose, 350 µm diameter, brown in uppermost 50 µm, colourless elsewhere, multi-chambered (each chamber about 90 µm tall, 80 µm wide). Conidia: colourless, simple, narrowly ellipsoid to bacilliform, 5 - 6 x 1.5 µm. Chemistry: thallus K-, C-, KC-, P, UV; medulla K-, KC-, P, I-; lower surface K-, cilia K-.
Photobiont: green, Trebouxia-like; cells globose, 10 - 15 µm diameter; forming a continuous but rather irregular layer 70 - 120 µm thick.

Asci sometimes have a rather obscure central region that stains more weakly in KI, and they have been described as Lecanora type, but material that I have seen differs from typical Lecanora type asci. This central region is occasionally bounded by two narrow, parallel bands that stain more strongly than the rest of the apex (the overall appearance is then like a Porpidia tube embedded in an apex that is mostly KI+ blue).

This is a variable species, and some collections tend towards **A. crinalis** or **A. setifera**. However, I have not seen any material that can be referred unambiguously to either of those species. In some collections parts of some lobes are quite narrow, but I have not seen any material in which lobes were uniformly less than 0.6 mm wide almost everywhere, as is said to occur in **A. crinalis**.

Young apothecia, which are often the only apothecia present, always have a smooth thalline margin. However, in
older apothecia the thalline margin displays a continuum from smooth, through slightly crenulate, strongly crenulate, with elongate extensions of thalline tissue, to with elongate extensions of thalline tissue bearing a few cilia (a maximum of 5 cilia were observed on one apothecium). I can not see any discontinuity which might correspond to a gap between Anaptychia ciliaris and A. setifera. Ascospores sizes in even the most extreme of these apothecia correspond to those cited in the key for A. ciliaris; none exceeded 35 x 20 µm, which is much smaller than values reported in the literature for A. setifera. (However, I do not know whether the values reported for A. setifera are reliable.) There is no apparent correlation between lobe width and the degree of ornamentation of the thalline exciple.

A revision of this group, including ample material from SE Europe and neighbouring regions, is desirable to clarify the delimitation of species.

Widespread and common throughout Greece. Recorded from sea level to nearly 2500 m, but commonest between 400 m and 1800 m. Usually on bark, and recorded from at least 23 different species. Although it shows no strong host preference, it is particularly abundant on Abies cephalonica. There are also a few records from rock, soil, wood, and (once) overgrowing Lobaria pulmonaria. Host to the lichenicolous fungi Catillaria mediterranea and Stigmidium hageneia (one record each).

Throughout Europe, except for arctic regions. Also Macaronesia, Asia (widespread outside tropical regions), Africa (much of northern Africa except for desert regions, though reports for Ethiopia may refer to A. ethiopica; perhaps S. Africa). Reports for N. America said to be erroneous; those for S. America are in need of confirmation.

Anaptychia crinalis (Schleich. ex Schaer.) Vězda ex Nowak (1993) in Kochman et al., Fl. Polska 128. (A 1977 combination by Vězda was not validly published); Borrera crinalis Schleich. ex Schaer. (1840), Lich. Helve Spic. 488. (Nomen nudum by Schleicher in 1815. For a full discussion of the publication history of this name and its basionym, see Pištút, 1999.); Anaptychia ciliaris f. crinalis (Schleicher ex Schaer.) Rabenh.; Anaptychia ciliaris var. crinalis (Schleicher ex Schaer.) Rabenh.


Scattered in the southern half of Greece: Crete, Evia, Peloponnesus, but not recorded from the smaller islands. On bark at altitudes 445 - 1400 m. More than half of records are from conifers (Abies cephalonica, Pinus halepensis), but also reported once from each of Populus tremula, Quercus coccifera and Quercus ilex.

Scattered throughout much of central and southern Europe. Also Macaronesia (Madeira), western Asia (Turkey, Iran, Ural Mts, Georgia), N. Africa (Tunisia), N. America (fairly widespread in eastern half).

Anaptychia runcinata (With.) J. R. Laundon (1984)


Descriptions: Ahti et al. (2002); Clauzade & Roux (1985) as Anaptychia fusca; Smith et al. (2009).

Islands of the Aegean; also reported once for the coast of Attica. On coastal siliceous rock, at altitudes to 700 m. A report from an upland site on Tinos (Sikina) may refer to some other species.

Throughout Europe wherever there are coastal siliceous rocks. Also Macaronesia, the Mediterranean coast of Asia (Turkey), N. Africa (Morocco, Tunisia). Reports for elsewhere in Asia (Pakistan, Mongolia, China) are in need of confirmation, and an old report for N. America (Indiana) is certainly incorrect.

Anaptychia setifera Mereschk. ex Räsänen (1931)


For the synonymy with A kaspica I am following Nimis (1993: 70). However, the protologue of A. kaspica says ascospores 34 - 40 µm long, which does not fit the concept of A. setifera in the key above. Kurokawa (1962: 15) implied that the name Hagenia angustata de Not. (1846) is synonymous with A. kaspica. If all these suggested synonymies are correct, and if A. setifera really is a good taxon independent of A. ciliaris, then its correct name is A. angustata (de Not.) ined.


Mountains of Epiros, on bark at altitudes 500 - 900 m. The only phorophyte explicitly reported was Quercus pubescens.

Nimis (1993) suggests that A. setifera may be synonymous with A. crinalis, but for the moment I have followed North American authors, who distinguish them.

Widespread in SE Europe, from Romania to Greece. Also Macaronesia (Canary Is), Asia (widespread as far east as Mongolia), N. America (widespread, but absent from S. and W. USA).
Anema Nyl. ex Forssell (1885)


Literature: The genus is poorly known, and not often recorded. The best starting point is Moreno & Egea (1992b). It can be supplemented with the rather scanty additional information in: Clauzade & Roux (1985), Henssen & Jørgensen (1990), Nash et al. (2002), and Roux (2007). Ahti et al. (2007) is good for the species that also occur in northern Europe.

About 9 species worldwide, about 8 in Europe. The few Greek reports are all from the islands.

11 Thallus with distinct lobes, umbilicate squamulose or subfruticose.

22 Thallus subfruticose, lobes distinctly erect. (*A. suffruticosum*)

2 Thallus not subfruticose, lobes adpressed.

33 Lobes not branched. (*A. notarisii*)

3 Lobes radiating, dichotomously branched. *A. nummularium*

1 Thallus without lobes or indistinctly lobed.

22 Thallus of erect squamules.

33 Squamules 0.3 - 0.5 mm diameter, densely aggregated in cushions about 4 mm diameter. Surface bluish pruinose. Ascomata 1 per squamule. *A. nodulosum*

3 Squamules 6 - 8 mm diameter, isolated. Surface granular, deeply furrowed. Ascomata 5 - 7 per squamule. (*A. moedlingense*)

2 Thallus of adpressed squamules.

33 Squamules 0.2 - 1 mm diameter, densely aggregated. *A. prodigulum*

3 Squamules mostly more than 1 mm diameter, not aggregated into groups.

44 Upper surface with dense blueish pruina. *A. decipiens*

4 Upper surface usually not pruinose.

55 Squamules to 2 mm diameter. If present in Greece then probably restricted to high altitudes. (*A. tumidulum*)

5 Squamules 3 - 6 mm diameter. Not restricted to high altitudes. *A. nummularium*

Anema decipiens (A. Massal.) Forssell (1885)

Beitr. Gloeolich. 92; *Omphalaria decipiens* A. Massal. (1855), Symm. lich. nov. 61-62.

Descriptions: Jørgensen, in Ahti et al. (2007) is best. See also: Clauzade & Roux (1985); Roux (2007).

Crete, and perhaps also Santorini. On limestone at altitudes from sea level to 1100 m.

Throughout much of Europe, to about 61° N. Also Asia (scattered from Iran to Japan). Reports for N. Africa are incorrect according to Nimis (1993).

Anema nodulosum (Nyl.) Forssell (1885)


Description: Moreno & Egea (1992b).

Islands of Iraklia and Santorini, on rock at altitudes 2 - 250 m. The Greek reports are all slightly tentative.

Central and southern Europe. Also Asia (Iran), N. Africa (Morocco, Algeria), N. America (BC).

Anema nummularium (Dufour ex Durieu & Mont.) Nyl. ex Forssell (1885)

Beitr. Gloeolich. 94; *Collema nummularium* Dufour ex Durieu & Mont. (1846) in Durieu, Expl. Sci. Algérie 200-202; *Gonohymenia nummularia* (Dufour ex Durieu & Mont.) Henssen.

There is disagreement in the literature about whether *A. notarisii* is a distinct taxon or merely an extreme morph of *A. nummularium*.

Descriptions: Jørgensen, in Ahti et al. (2007) is best. See also: Clauzade & Roux (1985); Roux (2007).

Islands of the southern Aegean, including Crete. On calcareous rock at altitudes 0 - 300 m.

Widely distributed, but scattered, throughout Europe, except for the high arctic and strongly continental regions of eastern Europe, but absent from British Is. Also western Asia (Iran, Tajikistan), N. Africa (Morocco, Algeria).

Anema prodigulum (Nyl.) Henssen (1990)


Descriptions: Nash et al. (2002) is best. See also: Clauzade & Roux (1985); Nash et al. (2002); Roux (2007).

Crete, and perhaps Paros. On calcareous rock at altitude of about 50 m.
Scattered in central and southern Europe (Czech Republic, France, Greece, Slovakia, Spain). Also N. Africa (Morocco), N. America (Arizona).

**Anisomeridium (Müll. Arg.) M. Choisy (1928)**


Literature: Between them, Clauzade & Roux (1985) and Smith et al. (2009) cover the European species.

About 100 species, many of which are not lichenised. About 80 species are discussed in the lichenological literature. The genus is better represented in warm to tropical regions than in Europe. In Europe there are 7 species that are clearly or ± lichenised; they usually occur on bark. All but two of them are distinctly northern and unlikely to occur in Greece, where the genus is very rare.

11 Perithecia 0.3 - 0.4 mm diameter; wall 50 - 100 µm thick in upper part. Ascospores 12 - 16 µm long, 1-septate.

**A. biforme**

1 Perithecia 0.15 - 0.25 mm diameter; wall 30 - 50 µm thick in upper part. Ascospores 14 - 20 µm long, 1 - 3 -septate.

(A. polypori)

Anisomeridium biforme (Schae.) R. C. Harris (1978)

The basionym is usually ascribed to Borrer in: Hooker & Sowerby, English Botany, Suppl. 1, tab. 2617. 1831. However, in 1826 Schaerer clearly indicated that he had obtained the name from an unpublished manuscript of Turner and Borrer. Schaerer discussed the species again, in Lich. Helv. Spic. 7: 341. 1836, and there explicitly cited Borrer's discussion in English Botany. Although in 1831 Borrer did not cite Schaerer, there can be little doubt that the names V. biformis Schaer. (1826) and V. biformis Borrer (1831) denote the same species, and it seems best to regard the names as homotypic. Otherwise, V. biformis Borrer (1831) is an illegitimate later homonym, and the nomenclatural situation becomes complicated.

Description: Clauzade & Roux (1985, 1989); Nash et al. (2002); Smith et al. (2009). Naxos, on bark at 500 m.

Quite common in Europe, though in the south restricted to humid sites. Also Macaronesia, Asia (Russia, India, China), Malesia (PNG), Africa (Tunisia, perhaps Socotra and S. Africa), N. America (widespread, mainly in moist temperate regions), perhaps Caribbean (Bahamas), C. America (CR), perhaps S. America (Argentina, Uruguay, Brazil, Paraguay), Australasia (widespread in humid parts), Pacific (Fiji).

**Anthracocarpon Breuss (1996)**


Literature: The best starting point is Prieto et al. (2010).

A segregate from Catapyrenium s. lat., characterised by its carbonised perithecial wall. It has three species, only one of which occurs in Europe.

**Anthracocarpon virescens** (Zahlbr.) Breuss (1996)


Islands of Iraklia, Paros and Corfu, on rock and soil at altitudes 20 - 180 m. Circum-Mediterranean. In Europe, restricted to the south of the continent, from Portugal to Greece; not present north of the Alps or Pyrenees. Also western Asia (Turkey), N. Africa (Tunisia).

**Arctomia Th. Fr. (1860)**

Lich. Arct. 287. Type: A delicatula Th. Fr., the only species originally included. Family: Arctomiaceae.

Literature: The only Greek species is treated in all the standard floras, usually as Collema fasciculare.

Arctomia has about eleven described species, though many of them have a very restricted distribution. Three species occur in Europe, but two of them are northern and only one is likely to occur in Greece.
Arctomia fascicularis (L.) Otálora & Wedin (2013)

Lichenologist 45(3): 302; Lichen fascicularis L. (1767), Mant. Pl. 133; Collema fasciculare (L.) F. H. Wigg.; Gabura fascicularis (L.) P. M. Jørg.

This species was long placed in Collema, but it belongs in Arctomiaceae, not Collemataceae. Whether or not it should be placed in the genus Arctomia itself is debated, and the answer depends on both taxonomic and nomenclatural considerations. Jørgensen (2014) combined the epithet into Gabura, and explained why, but I prefer not to follow that view until the taxonomic and nomenclatural situation is clearer.

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009), all as Collema fasciculare.

Scattered, on the mainland, On bark at altitudes 400 - 1400 m. Reported from Abies, Fagus, Olea and Platanus.

Most of Europe except for the far north. Also Macaronesia, central and eastern Asia (no further west than Mongolia and southern Siberia), Malasia (New Guinea), Africa (widespread outside the humid tropics), N. America (scattered in USA), Caribbean (Haiti), C. America (Mexico), S. America (Bolivia, Brazil, Chile), Australasia (SE Australia, both islands of NZ), the Pacific (New Caledonia).

Arthonia Ach. (1806)


Literature: There is no adequate treatment of this genus in southern Europe, and the standard Floras such as Clauzade & Roux (1985) and Smith et al. (2009) are of limited assistance. Western Mediterranean species with muriform ascospores are treated in Grube & Giralt (1996).

As presently delimited the genus is heterogeneous, so a detailed description would not be appropriate. Thallus crustose, usually thin, without vegetative propagules. Apothecia flat to convex, rounded, irregular or elongated, small to medium sized. Disc: brown to black. Exicle: absent or very poorly developed. Asci broadly clavate to subglobose, KI+ blue in a small point near the apex. Ascospores colourless, septate or muriform, ellipsoid to ovoid, sometimes with one cell distinctly enlarged. Photobiont: chlorococcoid, Trentepohlia or absent; never cyanobacteria.

A large genus of several hundred species, not all lichenised, best represented in tropical regions. In Europe, it is best represented in oceanic areas. Most species are corticolous or lichenicolous, though some occur on rock. Many species have been reported for Greece, but often on the basis of only one or two collections, and the status of many reports is uncertain.

Arthonia as delimited here is polyphyletic, but the phylogeny of Arthoniaceae has not yet been worked out in full and I prefer not to take up some of the recent segregates until the nomenclature has stabilised.

I can not prepare an adequate account of this genus. It is not often encountered in the Peloponnese, so I can not compensate from my own collections for the inadequacies of the literature.

The species A. palmicola Ach., A. pinastri Anzi, A. rechingeri (J. Steiner) ined., and A. wagneriana (Szatala) ined., all of which are reported for Greece, are not included in the keys. A number of other species that might occur in Greece are not included either. One difficulty is that my keys to groups 3 and 4 depend on the reaction of apothecial pigments with K, but this information is often omitted from many descriptions, even those in modern Floras such as Nash et al. (2007).

Key to Arthonia main groups

11 Ascospores muriform or submuriform. Group 1.
1 Ascospores septate, without longitudinal septa.
22 Parasitic on other lichens. Group 2.
2 Not parasitic.
33 Ascospores strictly 1-septate. Group 3
3 Ascospores 2- or more septate. Group 4.

Key to Arthonia group 1: ascospores muriform or submuriform

11 Ascospores submuriform, transverse segments with 0 - 1 longitudinal septa. Ascospores 12 - 18 µm long. A. albolupulverea
1 Ascospores muriform, transverse segments with 1 - 3 longitudinal septa. Ascospores usually more than 18 µm long.
22 Hymenium & hypothecium pale brownish.
33 Ascospores 25 - 37 x 12 - 15 µm. Ascii KI-, Hyphae of thallus I+ blue. (A. spectabilis)
3 Ascospores 17 - 24 x 7 - 9.5 µm. Ascii with a KI+ blue ring. Hyphae of thallus I- or I+ yellowish. A. ruana
2 Hymenium & hypothecium ±colourless or pale yellow.
33 Lichen forming; thallus fairly thick and distinct. Ascospores 26 - 30 x 10 - 13 µm. (A. taediosoides)
3 Not lichen forming; thallus absent or inconspicuous.
44 Ascospores 18 - 22 x 10 - 12 µm; transverse segments with 3 - 4 longitudinal septa. (A. beccariana)
4 Ascospores 23 - 30 x 10 - 20 µm; transverse segments with 1 - 3 longitudinal septa. (A. sanguinea) Note 1.

(1) A. sanguinea is primarily a species of North and Central America. It is said to be present in Europe (Cyprus), but I have not found the original report and can not evaluate it. I am rather sceptical that this species occurs in Europe, but I retain it in the key for the present.

**Key to Arthonia group 2**: ascospores septate; parasitic.

11 Many ascospores 2 or more septate.

2222 On thallus of Pertusaria. (A. pantherina)
222 On thallus of Fuscospanaria sampaiana. (A. sampaianae)
22 On thallus or (less commonly) apothecia of Physcia aipolia or P. stellaris. (A. destruens)
2 On apothecia (less commonly thallus) of species of Lecanoraceae.

33 Asci arranged in compact black ascomata. On Lecanora.

444 On Lecanora muralis. (A. protoparmeliopseos)
44 On Lecanora rupicola. **A. varians**
4 On Lecanora carpinea. (A. subfuscicola)
3 Asci often intermixed with those of the host. On Lecidella. (A. intexta) Greek reports incorrect.

1 Ascospores strictly 1-septate.

22 Ascii with 4 ascospores.

33 On Diploicia canescens. (A. diploiciae)
3 On other lichens. (A. oligospora)
2 Ascii with (4) 8 ascospores.

33 Hypothecium pale (colourless, pale red or very pale brown).

44 Ascospores 16 - 21 x 9 - 11 µm.

55 On species of Diplotomma. **A. rubescens**
5 On Aspicilia contorta subsp. hoffmanniana (A. anatolica)
4 Ascospores not exceeding 15 µm long.

55 Hypothecium pale red. Ascospores 12 - 15 x 6 - 7 µm, slightly constricted at septum. On black-fruited species of Caloplaca. **A. nideri**
5 Hypothecium colourless to very pale brown. Ascospores 3 - 6 µm wide, constricted at septum or not.
66 Apothecia with small brown hairs. If present in Greece, probably restricted to distinctly maritime sites. (A. coronata)
6 Apothecia without hairs.

7777 On thallus of Phaeophyscia species. **A. phaeophysciae**
777 On apothecia of species in the Lecanora dispersa group. **A. apotheciorum**
77 On apothecia and thallus of Caloplaca and Xanthoria. **A. molendoi**
7 On species of Peltigeraceae or Lobariaceae. (A. pelvetii)
3 Hypothecium dark, at least in places.

44 Ascospores without a halo.

5 Epithecium brown or red-brown, K+ greenish or K+ dull red. Not on Cladonia.

666 On Diplotomma species. **A. punctella**
66 On Rinodina species on calcareous rock. (A. rinodinicola)
6 On Physcia species. **A. epiphyscia**
4 Ascospores with a halo.

55 On species of Xanthoparmelia. (A. xanthoparmeliarum)
5 On other hosts.

66 Hymenium and ascospore halo I+ reddish. Not on species of Acarospora. (A. almquistii)
6 Hymenium and ascospore halo I-. On species of Acarospora. (A. aysenae)
**Key to Arthonia group 3:** ascospores 1-septate; non-parasitic.

11 Apothecial sections (especially epithecium and/or hypothecium) K+ purple, violet or magenta at least in places (Notes 1 and 2).

22 On rock. Ascospores 9 - 15 µm long. **A. calcicola**

2 On bark or wood. Ascospore length various.

33 Ascospores 7 - 11 µm long. (A. spadicea)

3 Most ascospores more than 11 µm long.

44 Thallus chalk white. **A. galactites**

4 Thallus not chalk white, often indistinct.

55 Apothecia flat, 45 - 70 µm tall. **A. didyma**

5 Apothecia convex, 85 - 140 µm tall. (A. vinosa)

1 Apothecial sections K+ greenish or yellowish, or K-, but nowhere K+ purple, violet or magenta (Note 1).

22 Apothecia elongated. Photobiont Trentepohlia or absent. On bark.

33 Photobiont Trentepohlia. Ascospores with one end ±pointed.

44 Apothecia pruinose. **A. caesiella**

4 Apothecia not pruinose. **A. dispersa**

3 Photobiont absent. Ascospores with rounded ends. (A. excipienda)

2 Apothecia ±rounded (may be slightly elongate in some species). Photobiont Trentepohlia, chlorococcoid (not Trentepohlia) or absent. On various substrates.

33 Paraphyses, especially towards apices, distinctly horizontally oriented. Ascospores 12 - 15 - 2.5 - 5 µm, with one cell distinctly broader than other. Hymenium K+ blue. Usually on bark or overgrowing bryophytes, rarely on shaded siliceous rock. **A. muscigena**

3 Paraphyses ±vertically oriented throughout. Other characters and substrate various.

44 On bark, wood, soil or decaying bryophytes. Note 3.

55 Apex of paraphyses with brown pigment cap. Apothecia 0.05 - 0.3 mm diameter, convex. Ascospores 17 - 22 µm long. **A. ligniaria**

5 Apex of paraphyses without brown pigment cap. Other characters various.

66 Apothecia 0.1 - 0.15 mm diameter. Hypothecium pale. (A. tenellula)

6 Apothecia 0.3 - 0.7 mm diameter. Hypothecium dark. **A. patellulata**

4 On rock, usually calcareous.

55 Photobiont Trentepohlia. Apothecia thinly white pruinose. **A. meridionalis**

5 Photobiont chlorococcoid (not Trebouxia). Apothecia not pruinose. **A. lapidicola**

(1) The +colour may dissolve, and/or the reaction may be transient.
(2) Apothecial sections may also be K+ greenish or yellowish elsewhere.
(3) (A. exilis) belongs in this branch, but I have insufficient information to key it out fully.

**Key to Arthonia group 4:** ascospores 2- or more- septate; non-parasitic. *A. pinastri* and *A. wagneriana* belong in this group, but I do not have enough information to include them in the keys.

11 Apothecial sections (especially epithecium and/or hypothecium) K+ purple, violet or magenta at least in places (Notes 1 and 2).

22 Apothecia mostly irregularly rounded. Ascospores 20 - 28 x 7 - 9.5 µm. **A. cinnabarina**

2 Apothecia elongate or star shaped. Ascospores 14 - 19 x 4.5 - 7 µm. (A. fallax)

1 Apothecial sections K+ greenish or yellowish, or K-, but nowhere K+ purple, violet or magenta (Note 1).

22 Cells of ascospores distinctly unequal in size.

33 Ascospores 26 - 36 µm long. (A. ilicina)

3 Most ascospores less than 26 µm long.

44 Hypothecium pigmented.

55 Thallus granular. (A. arthonioides)

5 Thallus continuous. **A. melanophthalma**

4 Hypothecium colourless or almost. (A. astroidestera), (A. cinereopruinosa), (A. sexlocularis), (A. stellaris) Greek report tentative, (A. zwackhii)

2 Cells approximately equal in size.

33 Hypothecium distinctly pigmented.

44 On calcareous rock. **A cretacea**
4 On various substrates, but not calcareous rock. (A. byssacea)
3 Hypothecium colourless or pale.
44 On bark. Thallus C+ red or C-.
55 Apothecia white pruinose. Thallus and apothecia C+ red. A. pruinata
5 Apothecia not pruinose. Thallus and apothecia C-.
66 Photobiont Trentepohlia. Thallus delimited by a black line or not.
77 Thallus distinct. Mature ascospores strictly 3-septate, 13 - 23 x 5 - 7 \( \mu m \). Apothecia 40 - 60 \( \mu m \) tall, rounded to elongate. A. punctiformis
4 On rock. Thallus C+ red. (A. endlicheri)

(1) The +colour may dissolve, and/or the reaction may be transient.
(2) Apothecial sections may also be K+ greenish or yellowish elsewhere.

Arthonia albopulverea Nyl. (1853)
Thallus: crustose, very thin but continuous, white to pale grey, sometimes delimited by a dark grey to black prothallus 0.1 mm wide. Apothecia: subimmersed in substrate, irregularly rounded to elongate (sometimes very elongated when following natural grain of substrate), 0.5 - 5 x 0.1 - 0.3 mm, not pruinose. Disc: black. Exciple: absent (but epithecium continues round sides of apothecia). Thalline margin: absent. Epithecium: green-black to ±black, green-black in K. Hymenium: 35 - 50 \( \mu m \) tall, colourless, 1- or I+ faintly blue in places, KI+ blue. Hypothecium: 10 - 20 (70) \( \mu m \), colourless to very pale brown. Asci: subglobose to broadly clavate, 23 - 55 x 18 - 23 \( \mu m \); in KI with a faint blue arc at the top above a more strongly staining blue dot. Ascospores: colourless, submuriform, with (3) 4 - 5 (6) transverse septa, 0 - 1 longitudinal septa in each transverse segment, 8 per ascus, ovoid, 15 - 18 (23) x 5.5 - 9 \( \mu m \), reacting I-. Chemistry: thallus K-, C-, KC- in spot tests. Photobiont: absent.

The submuriform ascospores and conspicuous, non-lichenised thallus are distinctive.

Scattered, in the southern half of Greece, in humid sites close to the sea, at altitudes 0 - 100 m. Usually on bark, sometimes on wood. Recorded from bark of Juniperus oxycedrus subsp. macrocarpa, Olea europaea, Pistacia lentiscus, and Vitis aeginae-astus.

Southern Europe, from Spain to Cyprus. Also Macaronesia (Azores), Africa (widespread in N. Africa, also Socotra), N. America (California), C. America (Mexico).

Arthonia apotheciorum (A. Massal.) Almq. (1880)

The name Arthonia clemens has often been misapplied to this lichen, but A. clemens (Tul.) Th. Fr. is a parasitic species that is probably restricted to Rhizoplaca.

Description: Smith et al. (2009).

Islands of Iraklia and Santorini, and Sterea Ellada on the mainland, at altitudes 80 - 1400 m. Reported from Lecanora dispersa and Lecanora argardhiana. These reports are consistent with the ecology of this species, which is thought to be restricted to the Lecanora dispersa group.

There are scattered records from most regions of Europe. Also Asia (Turkey, Israel, Iran), N. Africa (Morocco, Algeria), N. America. Its precise distribution is unclear owing to confusion with other species.

Arthonia caesiella Nyl. (1853)
Botaniska Notiser 1853: 161.

Description: Clauzade & Roux (1985).

Kalimnos in the Dodecanese, on bark of Ceratonia siliqua at 300 m.

Spain, France and Greece. Also N Africa (Tunisia)

Arthonia calcicola Nyl. (1853)
Botaniska Notiser 1853: 162; Allarthonia calcicola (Nyl.) Redinger.

Description: Clauzade & Roux (1985).
Crete and the island of Kos in the Dodecanese (though some of the reports are said to be tentative), on calcareous rock at 0 - 600 m.

Southern Europe and the southern part of Central Europe. Also western Asia (Israel, Iran). A report for Sri Lanka seems doubtful to me.

**Arthonia cinnabarina** (DC.) Wallr. (1831)


Descriptions: Clauzade & Roux (1985) as *Arthonia tumidula*; Nash et al. (2007); Smith et al. (2009).

Corfu and Ikaria, on bark (*Ficus carica* and unspecified) close to sea level.

Cosmopolitan in temperate to warm areas that are not too dry. Widespread in Europe as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (southern USA), Caribbean (Bahamas, Guadeloupe, PR), C. America (Mexico, CR, El Salvador, Guatemala), S. America (widespread), Australasia (widespread in warm, humid parts), Pacific (Easter Is, Hawaii, New Caledonia, W. Samoa).

**Arthonia cretacea** Zahlbr. (1919)


Description: Clauzade & Roux (1985).

Islands of the southern Aegean, on calcareous rock at altitudes 40 - 275 m.

Sicily, Croatia and Greece. Also Macaronesia (Flores in Azores).

**Arthonia didyma** Körb. (1853)


Description: Clauzade & Roux (1985); Smith et al. (2009).

Reported for a single locality in Epiros. Altitude and substrate were not stated.

Widely distributed in Europe, to as far north as southern Scandinavia. Rare south of the Alps and probably confined to the mountains. Also Asia (Russia), N. America (New Brunswick, NE USA).

**Arthonia dispersa** (Schrad.) Dufour (1818)


A rather uncommon species, known from scattered localities usually not very far from the sea. On bark at altitudes 0 - 400 m. Reported from *Pinus maritima, Pistacia* sp., *Platanus orientalis* and *Quercus* sp.

Throughout Europe except for arctic regions. Also Macaronesia, Asia (widespread), N Africa (Morocco, Tunisia), N. America (widespread from northern USA to Alaska), perhaps S. America (Chile), Australasia (eastern Australia, NZN). Reports for southern Africa are incorrect.

**Arthonia epiphyscia** Nyl. (1875)

Flora 58: 361-362.

Description: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

Eastern Crete, at 200 m on *Physcia scopulorum*.

Widely distributed in Europe. Also Macaronesia, Asia (Turkey, Tajikistan, Russia), Africa (Morocco, S. Africa), N. America (western Canada, western USA), C. America (Mexico), S. America (Argentina, Bolivia, Chile, Peru), Australasia (NZN, NZS), Antarctica (subantarctic islands, perhaps elsewhere).

**Arthonia exilis** auct. graec.

There is a single report for Macedonia. The name *Arthonia exilis* has been used in many senses, and the identity of Greek material cited under this name must await further study.

**Arthonia galactites** (DC.) Dufour (1818)


Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

An uncommon species, known from scattered localities not very far from the sea. On bark at altitudes 0 - 400 m. Reported from *Ailanthus glandulosa* and *Pistacia lentiscus*.

Basically a circum-Mediterranean/Macaronesian species, though recorded as far north as the Netherlands. Absent
from the British Is and the Nordic countries. Also Macaronesia, western Asia (Turkey, Israel), N. Africa (Morocco, Algeria, Tunisia).

**Arthonia intexta** Almq. (1880)

Although accepted by Abbott (2009), largely because Triebel (1989) accepted it as a Greek species, this species has not been correctly reported for Greece. Reports refer to *Arthonia varians*. The confusion goes back a long way. Steiner (1893) reported *Arthonia glaucomaria* (= *Arthonia varians*) from Attica, parasitic on *Lecanora sordida* (= *L. rupicola*) and *Lecanora sulphurata* (= *L. rupicola* subsp. *sulphurata*), the expected hosts for *Arthonia glaucomaria*. However, in Steiner (1898) he cited these same reports under *Celidium glaucomarium* var. *intextum* (= *Arthonia intexta*). Steiner's later publication is the one that subsequent authors, including Triebel, have accepted, obviously without referring back to the 1893 publication or studying Steiner's collections. However, *Arthonia intexta* is thought to be restricted to species of *Lecidella*, which does not match Steiner's original report in 1893. Steiner's reports must be assumed to refer to *A. varians*.

**Arthonia lapidicola** (Taylor) Branth & Rostrup (1869)


There has been some confusion concerning the application of this name; see Fryday (2004b). As a result, Abbott (2009) treated it a synonym of *A. muscigena*, and also listed *Arthonia fusca* (A. Massal.) Hepp as an independent species, whereas it is probably a synonym of *A. lapidicola*.

Thallus: crustose, very pale brown, thin and continuous to slightly thicker and cracked, not well delimited. Apothecia: immersed to subsessile, flat to moderately convex, 0.25 - 0.5 mm diameter, not pruinose. Disc: black. Exciple: ± absent. Epithecium: brown in most places, pale blue-green in a few places, K-, N-. Hymenium: 70 µm tall, colourless in upper part, very pale green-brown in lower part. Hypothecium: 70 µm tall, dark brown. Paraphyses: anastomosed, slightly capitate, with a slight internal pigment cap, apex 3 µm wide; the tips of a few paraphyses departing from the vertical (but not extending horizontally). Ascospores: colourless, 8 per ascus, thinly 1-septate when mature, irregularly ellipsoid to slightly tadpole shaped, sometimes slightly constricted at septum, 12.5 - 15 x 5 - 7 µm. Photobiont: chlorococcoid (not Trebouxia or Trentepohlia).

Scattered rather thinly throughout Greece. On rock, usually calcareous, though my single collection was from sandstone that did not appear to be calcareous. There is an old report, as *Arthonia vagans* var. *koerberi*, overgrowing (or parasitic on) *Caloplaca variabilis*, but that may be an incorrect determination.

Throughout Europe. Also Macaronesia (Canary Is, Madeira), Asia (widespread outside tropical regions), North Africa (Tunisia), North America (widespread), South America (Peru), Australasia (NZS), and Antarctica (Signy Is).

**Arthonia ligniaria** Hellb. (1884)


Description: Smith et al. (2009).

Aegean island of Ikaria, on bark.

Scattered in cool and temperate parts of Europe (British Is, Netherlands, Germany, Estonia, Sweden). The Greek report is the only one that I have seen for south of the Alps.

**Arthonia mediella** Nyl. (1859)

Not correctly reported for Greece. A Peloponnesian collection that was tentatively referred to this species in Abbott (2009) belongs to *A. punctiformis*.

**Arthonia melanophthalma** Dufour ex Nyl. (1854)


Description: Clauzade & Roux (1985).

Scattered localities not very far from the sea. On bark of a wide range of non-coniferous trees and shrubs at altitudes 0 - 400 m.

Strictly circum-Mediterranean. In Europe known only from Spain, Corsica (old report), Italy, Greece and Cyprus. Also western Asia (Israel), N. Africa (Morocco, Algeria, Tunisia).

**Arthonia meridionalis** Zahlbr. (1914)


Islands of the southern Aegean, including Crete. On calcareous rock at altitudes 0 - 400 m.
Southern Europe, from Portugal to Cyprus, though there is a recent, disjunct, report for England. Also western Asia (Turkey), N. Africa (Morocco).

**Arthonia molendoi** (Heufl. ex Arnold) R. Sant. (1986)


Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2007); Smith et al. (2009).

Sterea Ellada, and the islands of Crete and Amorgos, at altitudes 600 - 1400 m on species of *Caloplaca*. Reported from *C. aurantia* and from one of the black-fruited species of the genus.

Widely distributed in Europe. Also Macaronesia, Asia (widespread), N. America (western half, from Alaska to California), S. America (southern Chile, Bolivia), Australasia (NZS), Antarctica (widespread). However, some reports may be incorrect owing to confusion with other species. Reports from members of *Physciaceae* may be unreliable.

**Arthonia muscigena** Th. Fr. (1865)


Abbott (2009) included *Arthonia lapidicola* within *A. muscigena*, but that view is not followed here.

Recently transferred to *Bryostigma*, as *B. muscigenum* (Th. Fr.) Frisch & G. Thor. However, the delimitation of *Bryostigma* is not yet very clear, and several other species presently placed in *Arthonia* may belong there. For that reason, I prefer not to take up *Bryostigma* yet.

Thallus: crustose, green-grey, continuous to coarsely granular, not well delimited. Apothecia: sessile, 0.15 - 0.2 mm diameter, convex, not pruinose, without an exciple. Disc: black. Epithecium: dark brown; in K remaining brown or developing a slight green-black tinge. Hymenium: 40 µm tall, pale brown, KI+ blue. Hypothecium: dark brown.

Paraphyses: sometimes terminating in a conventional, slightly capitulate apex, but in many cases extending horizontally for a considerable distance through the epithecium. Ascii: subglobose, 35 x 23 µm, with a distinct ocular chamber visible even in water, with a distinct KI+ blue apical bulge. Ascospores: colourless, 1-septate, 8 per ascus, 12 - 15 x 4 - 5 µm, tadpole or hourglass shaped, without a perispore. Photobiont: chlorococcoid (not Trebouxia or Trentepohlia).

The horizontal extensions of the paraphyses in the epithecium are distinctive, and the author's Peloponnese collection is clearly close to *A. muscigena*. However, the ascospores are larger than the 8 - 14 x 2.5 - 4 µm usually reported for that species. It is not clear to me whether this collection represents an extreme in the range of variation of *A. muscigena*, or whether it is one of the taxa for which I have little information, or even an undescribed species. For a published description of *A. muscigena* see Smith et al. (2009).

Very scattered, at altitudes 0 - 600 m, but never far from the sea. On bark of *Nerium oleander*, *Pistacia lentiscus* and *Quercus pubescens*.

Widely distributed in Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (Ural Mts.), N. Africa (Morocco), N. America (Alaska), C. America (Guatemala), S. America (Chile).

**Arthonia nideri** (J. Steiner) Clauzade, Diederich & Cl. Roux (1989)


Description: Apart from the protologue, the only other description that I have seen is the brief one in Clauzade, Diederich & Roux (1989). The status of this species is not clear to me, and I wonder whether it may be merely a morph of *Arthonia molendoi*. Mountains of central Greece, at altitudes of about 1400 - 1900 m on black-fruited species of *Caloplaca*. Not recorded for Greece since 1898.

Until recently, known only from the localities cited in the protologue. However, recently reported for Ukraine and Asia (Iran).

**Arthonia palmicola** Ach. (1814)

*Syn. Meth. Lich. 5.*

Description: See the protologue or Nylander (1876b).

Crete, on bark of *Lycium*.

In Europe, known only from a small island off the southern coast of Crete. Also Africa (Tunisia, Egypt, S. Africa), perhaps S. America (Argentina, Chile). It was described from Egypt, so the Greek report seems plausible.

Apart from distribution records, I have not seen any discussion of this species in the literature since the 19th century. Its status is not clear to me.

**Arthonia patellulata** Nyl. (1853)

Arthonia phaeophysciae Grube & Matzer (1997)

Biblioth. Lichenol. 68: 10.

Descriptions: Nash et al. (2007); Smith et al. (2009).

Known from a single site in Epiros, on Phaeophyscia ciliata and P. orbicularis at an altitude of 620 m.

Widespread in central and northern Europe, but absent from arctic regions; rare in southern Europe. Also Asia (Turkey), N. America (widespread in the western half), C. America (Mexico), S. America (Chile).

Arthonia pinastri Anzi (1862)


Descriptions: Nash et al. (2007) is best, but see also Clauzade & Roux (1985).

Eastern Crete (unlocalised). No further information available at present.

In the more oceanic parts of the Mediterranean: Spain, France, Italy, Yugoslavia and Greece; also Asia (Turkey), N. Africa (Morocco). Also N. America (California, Florida, perhaps elsewhere), C. America (Mexico).

Arthonia pruinata (Pers.) Steud. ex A. L. Sm. (1911)


Recently transferred to Pachnolepia, on the basis of molecular evidence. However, the genus Pachnolepia is monospecific, and lichenologists have described too many monospecific genera (Arcadia, 2009). Mainly for that reason, I am reluctant to take up Pachnolepia, at least until the generic divisions within Arthoniaceae have stabilised.

Descriptions: Clauzade & Roux (1985) as Arthonia impolita; Nash et al. (2007); Smith et al. (2009).

Islands of Amorgos, Corfu and Kos, on bark at altitudes 20 - 260 m.

Widely distributed in Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (southern Siberia), N. Africa (Morocco), N. America (widespread, but avoiding the continental interior), C. America (Mexico).

Arthonia punctella Nyl. (1859)


Descriptions: Clauzade, Diederich & Roux (1989); Smith et al. (2009).

Skyros, parasitic on Diplotomma hedinii at altitudes around 350 m.

Southern and south-central Europe, and western Europe to as far north as Sweden. Also Macaronesia, western Asia (Turkey).

Arthonia punctiformis Ach. (1808)


Thallus: crustose, very pale grey, very thin, not conspicuous, not well delimited; in section: 40 µm thick, poorly structured, without distinct cortex, ±colourless. Apothecia: usually rounded and 0.3 - 0.5 mm diameter, sometimes irregular or elongate, ±flat to slightly convex, not pruinose. Disc: black. Exciple: absent. Epitheium: grey to dark brown, becoming green-grey in K. Hymenium: 25 - 35 µm tall, pale brown. Hypothecium: 25 - 35 µm, colourless to pale brown. Paraphyses: 1 µm wide at base, 2.5 - 3 µm at apex, not or scarcely capitlate, apical cell with an internal crescent-shaped pigment cap. Asci: subglobose, 30 - 35 µm tall (of which 12 µm is stipe), 17 µm wide. Ascospores: colourless, 3-septate (when mature), 8 per ascus, 13 - 17 x (3) 4 - 6 µm, regularly ovoid (one end broader than other, but without a distinctly enlarged terminal cell). Chemistry: thallus C-, K-, KC- in spot tests. Photobiont: absent.

Could be confused with A. radiata, but that species is lichenised with Trentepohlia.

Very scattered, with no clear pattern. On bark at altitudes 0 - 1390 m.

Widely distributed in Europe, extending well into Scandinavia, but absent from truly arctic environments. Also Macaronesia, Asia (Russia, Japan), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread).

Arthonia radiata (Pers.) Ach. (1808)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered throughout Greece, but apparently much commoner in the north. On bark of several species of non-
Coniferous trees and shrubs at altitudes 0 - 1100 m.
Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), C. America (Mexico), S. America (Colombia, perhaps elsewhere). Australasia (SE Australia, NZN, NZS), Pacific (Hawaii, Ogasawara Shoto).

**Arthonia rechingeri** (J. Steiner) ined., non Zahlbr. (1911)
The combination into *Arthonia* has not been made, and can not be made because of the earlier *Arthonia rechingeri* Zahlbr. (1911). However, until Steiner's taxon is better understood it would be premature to publish a nomen novum.
Description: Only the protologue.
Corfu, on 'bark' of *Opuntia ficus-indica*, approximately at sea level. Known only from the type collection.
Steiner described this species in *Arthothelium*, a genus usually used for species with muriform ascospores. However, his protologue states that the ascospores are 5-septate. His description is not adequate for me to include it in the keys. I have not found any discussion of this species elsewhere in the literature.

**Arthonia ruana** A. Massal. (1852)
Description: Clauzade & Roux (1985); Smith et al (2009), both as *Arthothelium ruanum*.
Eastern Crete. No altitude or substrate was stated.
Throughout Europe, as far north as southern Scandinavia. Also Asia (widespread), N. America (eastern Canada, scattered in USA mainly in the east), Pacific (New Caledonia).

**Arthonia rubescens** (Arnold ex Zopf) Clauzade, Diederich & Cl. Roux (1989)
Description: Clauzade, Diederich & Roux (1989).
Known from a single locality on the island of Chios, where it was parasitic on *Diplotomma hedinii* at an altitude of 300 m.
Otherwise apparently only known from the type collection, in the Austrian Tirol.

**Arthonia varians** (Davies) Nyl. (1861)
Thallus: absent; hyphae below the hymenium appear to belong to the parasite, not the host, but no structured thallus is formed. Apothecia: entirely immersed in apothecia of host, black, initially forming small spots 0.15 - 0.35 mm diameter, later extending or coalescing and sometimes filling entire apothecium of host, to 0.75 mm diameter; without an exciple. Epithecium: dark brown, becoming green-black in K. Hymenium: 80 µm tall, pale brown, pigment obscuring fine features. Hypothecium: hyphae below hymenium form what could be described as a (poorly structured) hypothecium. Ascii: 25 - 35 x 13 - 15 µm, broadly clavate. Ascospores: colourless, 1 - 2 (3) - septate, 8 per ascus, 13 - 16 x 4 - 6.5 µm, usually ±narrowly ellipsoid, occasionally with slightly pointed ends. Photobiont: absent.
The combination of host species, immarginate apothecia immersed in the apothecia of the host, and 1- 2 -septate ascospores make this species easy to recognise.
Fairly widely distributed in the southern half of the country, but not yet recorded for the northern half. At altitudes 20 - 2150 m, in apothecia of *Lecanora rupicola*. Recorded from subsp. *rupicola* and subsp. *sulphurata*.
Widely distributed in Europe. Also Macaronesia, Asia (Turkey, Syria, Iran, Russia), N. Africa (Morocco, Algeria, Egypt), N. America (western Canada, western USA, perhaps elsewhere), C. America (Mexico), Australasia (NZS).

**Arthonia wagneriana** (Száta) ined.
*Allarthenia wagneriana* Szatala (1941), *Borbasia* 3: 97-98.
Description: See the protologue.
Known only from the type collection, which was on wood at high altitude on Mr. Olympos.

**Arthophacopsis** Hafellner (1998)
Literature: See the protologue.
The genus has only one species.

**Arthophacopsis parmeliarum** Hafellner (1998)


Description: See the protologue.

Epiros, on *Parmelia sulcata* at an altitude of 750 m.

Europe, mainly in the west, but also reported for Austria. Also Macaronesia (Canary Is), Asia (Russian far east), N. America (scattered in western half).

**Arthopyrenia** A. Massal. (1852)


Literature: There is no modern revision of the genus in Europe. Clauzade & Roux (1985), and Smith et al. (2009) are the best starting points. Nash et al. (2002) also has useful information. For the recently described *A. coppinsii* and *A. tuscanensis*, see Ravera (2006). Other European species are either poorly known or unlikely to occur in Greece.

About 120 species, most of which occur on bark and some of which are not lichenised. In Europe, more than 30 names are presently referred here, but many refer to poorly known taxa that may not be good species. There are few Greek records.

Some species in the key might be better placed in other genera.

11 Ascospores mostly 1-septate, only occasionally 3-septate when mature.

22 On calcareous rock. (*A. saxicola*)

2 On bark.

33 Involucrellum K+ green. (*A. analepta*), (*A. cinereopruinosa*)

3 Involucrellum remaining brown in K.

44 Ascospores 27 - 40 x 8 - 13 μm. (*A. antecellens*)

4 Ascospores no larger than 26 x 7 μm.

55 Pseudoparaphyses absent or gelatinised, but periphysoids present. Photobiont Trentepohlia or absent. (*A. coppinsii*), (*A. salicis*), (*A. tuscanensis*)

5 Pseudoparaphyses present. Photobiont absent.

66 Perithecia 100 - 230 μm diameter. Ascii 40 - 55 μm tall. *A. punctiformis*

6 Perithecia 200 - 500 μm diameter. Ascii 60 - 90 μm tall. *A. fraxini*

1 Ascospores soon becoming 3-septate. (*A. cerasi*), (*A. hyponta*)

**Arthopyrenia fraxini** A. Massal. (1852)


Descriptions: Clauzade & Roux (1989); Smith et al. (2009).

Crete, at 450 m. The substrate was not stated.

Fairly widely distributed in western, central and southern Europe; it reaches southern Scandinavia. Also Asia (Syria, Russia, India), N. America (Michigan).

**Arthopyrenia punctiformis** (Pers.) A. Massal. (1852)


*Arthopyrenia pluriseptata* is an obligate synonym of *Blastodesmia nitida*, but the name has often been misapplied. Steiner (1898) used the name when citing a specimen from the Peloponnese that he had previously reported as *Arthopyrenia persoonii*, a name which, when used correctly, is a synonym of *Arthopyrenia punctiformis* (although it too has sometimes been misapplied).

Descriptions: Clauzade & Roux (1985, 1989); Nash et al. (2002); Smith et al. (2009).

Scattered throughout Greece, from sea level to over 2000 m, on bark.

Present in most of Europe, except for arctic regions. Also Macaronesia, Asia (Turkey, Israel, Russia, perhaps Taiwan), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile; an old report for Brazil may be unreliable), Australasia (eastern Australia, NZ) Pacific (Hawaii). However, some reports may refer to other species.
Arthrosporum A. Massal. (1853)


Literature: Ekman (1996) discusses the delimitation of this monotypic genus. Arthrosporum has recently been merged with Toninia s. str. on the basis of molecular evidence, while Toninia s. lat. has been subdivided into five genera. However, it is sufficiently distinct from Toninia s. str. that I feel justified in maintaining the genus Arthrosporum, at least until further evidence becomes available.

Arthrosporum populorum A. Massal. (1853)
Mem. Lich. 128; Bacidia populorum (A. Massal.) Trevis.

Thallus: crustose, 1 cm diameter (in material seen)), pale grey, continuous, not smooth, thin (40 - 80 µm), without vegetative propagules. Cortex: true cortex absent, layer above photobiont cells 5 - 30 µm thick, colourless, without distinct structure, K-; sometimes with crystals that are partly soluble in K. Medulla: absent or poorly developed; photobiont cells often directly adjacent to bark. Apothecia: 0.3 - 0.35 mm diameter, sub sessile to sessile, flat to moderately convex, not pruinose. Disc: black. Thalline margin: absent. Exciple: dark brown to black, thin, becoming almost excluded; in section: 30 - 40 µm wide, mostly colourless, sometimes grey to black at upper part of outer edge, of radiating hyphae, lumina usually narrow and elongated, sometimes rounded in outermost part of exciple. Epithecium: grey to black, without crystals, K-, N+ purple-red. most pigment soluble in K and in N. Hymenium: 50 - 60 µm tall, colourless or with some epithelial pigment in upper part. Hypothecium: 40 µm tall, colourless. Paraphyses: 1 µm wide in lower part, occasionally branched, sometimes capitate, apical cell 1.5 - 4 µm wide. Asci: 50 - 60 x 15 - 17 µm, clavate, Bacidia type. Ascospores: colourless, 3-septate (when mature), narrowly ellipsoid to distinctly curved, 8 per ascus, 17 x 4.5 - 5.5 µm Chemistry: thallus UV- (or almost). Photobiont: green; cells 5 - 12 µm diameter, forming a ±continuous, irregular layer 35 - 60 µm thick.

Asci are said to have 8 - 16 ascospores, but in the material I have seen they had 8.

Easily recognised by the combination of dark apothecia, 3-septate, curved ascospores, grey epithelial pigment and the corticolous habit. Ascospores in species of Bacidia are generally narrower, and often longer and with more septa. Other species of Toninia s. lat. are never corticolous. Gyalecta has Trentepohlia as photobiont.

Scattered and not very common, always close to the sea, on bark at altitudes 0 - 280 m. Reported from Arbutus sp., Ceratonia siliqua, Phillyrea sp., Quercus cocciifera and Q. ilex.

Widely distributed in Europe, though absent from British Is. Also Macaronesia, Asia (Armenia, Russia), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread in cooler regions).

Aspicilia A. Massal. (1852)

Ric. Auton. Lich. Crost. 36. The name is conserved against several earlier names, though some are now treated as independent genera. Type: A. cinerea (L.) Körb. (conserved type). Family: Megasporaceae.

Literature: There is no monograph. Clauzade & Roux (1985), though not adequate, is probably the best starting point.

Thallus: crustose, well-developed in most species, smooth to areolate, usually some shade of white or grey, usually without marginal lobes. Apothecia: usually immersed in thallus. Disc: usually black. Exciple: usually poorly developed. Thalline margin poorly developed in most species. Epithecium: green, K- (some pigment dissolves), N+ bright blue-green (Aspicilia green) pigment present in most species; sometimes a brown pigment, K- (not dissolving), N- also present. Hymenium: colourless at least in lower part; if Aspicilia green pigment present in epithecium commonly also present in upper part of hymenium. Hypothecium: colourless. Paraphyses: branched and anastomosed but usually only sparingly so, moniliform, often with visible septa throughout. Asci: KI- or almost, often absent or immature. Ascospores: colourless, simple, ellipsoid, small to medium sized (generally between 10 and 30 µm long), often absent or immature. Chemistry: variable; some species with norstictic acid and/or stictic acid in medulla. Photobiont: green.

Aspicilia and the closely related genera Circinaria and Lobothallia are usually easily recognised by the combination of simple ascospores, Aspicilia green pigment, and moniliform paraphyses. Separation of the three genera is more difficult, because they were defined from molecular evidence. not on morphological grounds. Lobothallia usually has a more robust and well developed thallus and smaller ascospores that the other two; unlike them, it usually also has a well developed algal layer below the apothecia. Circinaria usually has 4-spored asci, whereas the other two usually have 8-spored asci. However, there are exceptions to these statements.

Many species in Aspicilia are very variable, and, as usual in such a situation, this has resulted in a proliferation of names, many of which are of doubtful value, and a confused taxonomy. Little modern monographic work has been done to sort out the mess, so Aspicilia remains a difficult genus. The number of good species is uncertain: estimates range
from 200 to 400. Most species occur on rock in a wide range of climates, a few occur on soil in arid areas or rarely on other substrates. The genus seems to be particularly well represented in warm, dry regions of Asia, but those regions are not well known lichenologically.

A. caesiopruinosa (H. Magn.) J. W Thomson, A. crusii Klem., A. hartliana (J. Steiner) Hue and A. trachytica (A. Massal.) Arnold are reported for Greece, but are not included in the key as I have insufficient information. All of them need a modern description from type material.

111 Ascospores usually not developed. Thallus greenish to brownish with prominent white pseudocyphellae (an important character). Apothecia rare, with black disc and (in section) Aspicilia green pigment. Hymenium 75 - 125 µm tall. Conidia straight or slightly curved, 6 - 9 x 1.3 µm. All reactions negative. On sun-exposed calcareous rock. (A. albosparsa) Note 1.

11 Ascospores more than 15 µm long.

22 Isidia, blastidia or soredia present.

33 Ascospores 22 - 27 x 10 - 15 µm. A. grisea

3 Ascospores 14 - 25 x 8 - 10 µm. (A. simoensis)

2 Isidia, blastidia and soredia absent.

33 Most asci with more than 4 ascospores (usually 8, sometimes 6) (Note 2). On calcareous or siliceous rock.

444 Medulla K+ yellow > blood-red (abundant norstictic acid) (Note 3), P+ yellow to orange (reaction sometimes faint). On siliceous rock

555 Ascospores 12 - 18 x 9 - 11 µm. Paraphyses moniliform, terminal few cells globose or subglobose. A. cinerea

55 Ascospores 17.5 - 24.5 x 10 - 14 µm. Paraphyses not moniliform, terminal few cells elongated. (A. prestensis)

5 Ascospores 20 - 30 x 11 - 15 µm.

66 Conidia 6 - 8 µm long. Areoles white-grey, grey or copper-brown, sometimes multi-coloured. A. cupreoglauc

6 Conidia 7 - 12 µm long. Areoles uniformly white to pale grey. A. intermutans

44 Medulla K+ yellow > slightly reddish (stictic acid; norstictic acid absent or present only in small amounts) (Note 3), P+ orange. On siliceous rock. If present in Greece, probably restricted to high altitudes. (A. laevata)

4 Medulla K- (Note 3), P-. On calcareous or siliceous rock.

55 On calcareous rock. Thallus white. Probably restricted to high altitude.

66 Apothecia pruinose; thalline margin raised, fairly well developed. A. candida

6 Apothecia not pruinose; thalline margin poorly developed. (A. verruculosa)

5 On siliceous rock. Thallus some shade of grey. Not restricted to high altitude.

66 Ascospores 8.5 - 12 µm wide (and 13 - 22 µm long). (A. calcitrapa) Note 4.

6 Most ascospores at least 14 µm wide.

77 Thallus pale (white-grey or pale grey). Ascospores 22 - 35 x 14 - 18 µm. On periodically submerged or very humid rocks. (A. aquatica)

7 Thallus not pale (blue-grey, brown-grey or dark grey). Ascospores 14 - 30 x 15 - 18 µm. On nutrient-enriched siliceous rock, Not aquatic. Circinaria caesiocinerea

3 Most asci with 4 ascospores. (A few asci may have 6 and, rarely, more.) See Note 2. Usually on calcareous rock.

444 Thallus 1 - 3 mm thick, verrucose areolate, sand coloured, grey, green-grey or brown-grey. A. desertorum

44 Thallus well developed but usually less than 1 mm thick, areolate, cracked-areolate or continuous, usually chalk white, grey-white or grey.

55 Thallus continuous or ±fissured around apothecia, chalk-white to grey-white. Medulla K-. A. subfarinosa

5 Thallus areolate. See Circinaria

4 Thallus immersed, except at apothecia where it forms a strongly white pruinose thalline margin that is distinctly raised above level of disc. A. coronata

1 Ascospores 10 - 15 µm long. On non-calcareous or weakly calcareous rock. Strictly montane. (If on calcareous rock, or not montane, see Lobothallia)

22 Conidia 13 - 24 µm long. Thallus pale white-grey to dark brown-grey. A. polychroma

2 Conidia 5.5 - 8 µm long. Thallus grey-white. (A. brucei)

(1) Perhaps common in Greece. See Senkardesler & Calba (2011) for a full description, and a discussion of some similar species.
(2) In species with moderately large ascospores, as here, cut a fairly thick section to count ascospores. In a normal thin section asci may be cut and may lose ascospores.

(3) It is best to test the reaction with K test on a thin section under the transmission microscope. Spot tests are often misleading in this genus.

(4) A. zonata, doubtfully reported for Greece, would key out here. Its conidia are 7 - 8 µm long; those of A. calcitrapa are 8 - 12 µm long.


There are a few reports for northern Greece, on rock at altitudes 1860 - 2170 m. This is a poorly known taxon, and it is not clear to me whether it is a good species.

Elsewhere known only from Sweden and Canada.

Aspicilia candida (Anzi) Hue (1910)

Description: Claudiae & Roux (1985).

Known from a single site in northern Epiros, where it occurred on calcareous rock at an altitude of 2100 m.

Widespread in Central Europe, but reported as far north as Greenland and as far south as the mountains of Sicily. Also Asia (Turkey, Iran, Russia, Tajikistan), N. America (cold regions).

Aspicilia cinerea (L.) Körb. (1855)

Thallus: crustose, pale grey, warted-areolate, to several cm diameter, 300 - 500 µm thick. Cortex: 25 - 35 µm thick (including epicortex if present), pale grey-brown in upper half, colourless in lower half, sometimes overlain by a colourless, structureless epicortex 5 - 7 µm thick; cortex K- but outermost part of epicortex K+ red (norstictic acid). Medulla: white. Apothecia: abundant, immersed in thallus, usually rounded, sometimes angular by compression, concave to flat, 0.4 - 0.8 mm diameter, not pruinose. Disc: black. Exciple: poorly developed, not visible externally; in section: 15 - 20 µm wide but scarcely distinct from hymenium. Epithecium: green to brown, K- (green pigment dissolving in K), N+ bright green. Hymenium: 80 - 95 µm tall, colourless or with epithelial pigment in upper part. Hypothecium: 80 - 120 µm tall, colourless. Paraphyses: sparingly branched and anastomosed (many paraphyses simple), with visible septa throughout, 1 µm wide at base, 3 µm at apex, moniliform. Ascii: 60 - 70 x 20 - 33 µm, clavate. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 16 x 8 µm (but very few mature ascospores seen). Pycnidia: often present, appearing externally as black dots, 0.1 mm wide; in section: 100% immersed, 200 µm tall, 150 µm wide, brown near apex but colourless elsewhere. Conidia: 13 - 18 x 1 µm. Chemistry: medulla K+ red (norstictic acid), C-, P+ yellow-orange, I-; thallus C-, UV-. Photobiont: green, not present below apothecia; cells globose, 8 - 13 µm diameter. Photobiont layer: there is a continuous, regular layer 40 - 60 µm thick, but isolated clumps of algal cells are often present below it.

The description is based on material that definitely belongs to A. cinerea, not to the recently described A. prestensis.

Quite widely distributed, especially in the northern half of Greece, but absent from most of the smaller islands. On siliceous rock at altitudes 0 - 2170 m, but commonest below 1200 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread outside subtropical regions), C. America (Mexico), S. America (Argentina, Brazil), Australasia (Australia, NZS), perhaps Antarctic (Kerguelen Is - determination not certain).

Aspicilia coronata (A. Massal.) de Lesd. (1906)

Thallus: crustose, to 2.5 cm diameter, immersed except in a zone around each apothecium (where it forms, in effect, a thalline margin), white pruinose. Apothecia: concave, 0.55 - 0.8 mm diameter Disc: black, white pruinose. Exciple: not visible externally; in section: poorly developed, 15 µm wide, scarcely differentiated from hymenium. Thalline margin: white pruinose, distinctly raised above level of disc; in section: 100 - 125 µm wide, with a cellular cortex 50 - 60 µm wide. Epithecium: green, K-, N+ blue-green. Hymenium: 150 µm tall, colourless in lower part, sometimes with green pigment in upper part, mostly KI+ blue but lower part KI+ purple. Hypothecium: 40 µm tall, colourless, KI+ blue. Paraphyses: anastomosed, 1 µm wide at base, 3 - 6 µm at apex, moniliform, often with visible septa throughout. Ascii: 100 - 110 µm, narrowly clavate, KI-. Ascospores: colourless, simple, ellipsoid, 4 per ascus, 25 x 15 µm. Chemistry: thallus K-, KC- (in spot tests at thalline exciple). Photobiont: green, cells globose, 10 - 12 µm diameter.
The combination of an immersed thallus and 4-spored asci is distinctive among Greek species of the genus. Widely distributed in Greece, but never very far inland. On calcareous rock at altitudes 0 - 1400 m. The reported altitudes give the impression of two distinct populations: a lowland one at 0 - 500 m, and an upland one above 1000 m, but there are too few records to be sure that this distinction is real.

Most reports are from south of the Alps, but present in central Europe and Sweden. Absent from British Is and most of the Nordic Countries. Also Asia (Iran, Japan), N. Africa (Egypt).

**Aspicilia cupreoglauca** de Lesd. (1910)


Thallus: crustose, areolate, pale grey, brown-grey or brown (usually with a brown tinge in at least some places), sometimes with white pruina especially at margins of areoles, to several cm diameter, sometimes with a zoned margin that may be paler than interior of thallus, usually not very thick (180 - 225 \(\mu\)m). Areoles: 0.3 - 1 mm wide, angular. Cortex: 40 - 50 \(\mu\)m tall, colourless, mostly with long hyphae parallel to surface, but distinctly cellular near apothecia, usually K+ red (norstictic acid, but concentration lower than in medulla). Apothecia: immersed, 0.2 - 0.7 mm diameter, flat or slightly concave. Disc: black, sometimes white pruinose. Exciple: poorly developed; in section: colourless, 15 - 20 \(\mu\)m wide. Thalline margin: ±present, but not sharply differentiated from rest of thallus. Epithecium: green, sometimes with a brown tinge, K- (green pigment mostly dissolving). Hymenium: 110 - 200 \(\mu\)m tall, colourless or with some epiphytic pigment in upper part, KI+ blue. Hypothecium: 30 - 100 \(\mu\)m tall, colourless. Paraphyses: often simple, sometimes sparingly branched and anastomosed, with visible septa throughout, 1 \(\mu\)m wide at base, 3 - 5 \(\mu\)m at apex, moniliform. Asci: 100 - 135 x 24 - 29 \(\mu\)m, cylindrical to slightly clavate, apex KI-, wall weakly and rather diffusely KI+ blue. Ascospores: colourless, simple, subglobose to ellipsoid, 8 per ascus, 20 - 33 x 12 - 22 \(\mu\)m. Pycnidia: fairly common, visible externally as a slight depression that is paler than adjacent thallus; in section: globose to ±cup-shaped (with a flat, broad top), 100% immersed, 80 - 120 x 90 - 120 \(\mu\)m, brown in a layer at surface, colourless elsewhere. Conidia: colourless, straight, 6 - 8 (9) x ¼ - 1 \(\mu\)m. Chemistry: in spot tests medulla K+ red (abundant norstictic acid), C-, P+ yellow (reaction often faint). Photobiont: green, not present below apothecia; cells globose, 9 - 13 \(\mu\)m diameter. Photobiont layer: continuous, 60 - 150 \(\mu\)m thick, regular or not (some collections have a very irregular upper margin, some have large isolated clumps of algal cells below main layer).

Not easy to separate from *A. intermutans*. All my collections have a brownish tinge to the thallus (at least in the herbarium), and are not pure white or pure grey. Conida, where seen, are generally consistent with this determination, though there is sometimes some ambiguity.

Throughout Greece, though scarce in inland districts. On siliceous rock at altitudes 0 - 1750 m. The lichenicolous fungi *Endococcus verrucosus* and *Rosellinula haplopora* have been recorded from this lichen. South of the Alps or just north of them (France, Bulgaria). Also Macaronesia, Asia (scattered to as far east as Mongolia).

**Aspicilia desertorum** "(Kremp.) Mereschk." (1911)


**Aspicilia grisea** Arnold (1891)


**Aspicilia esculenta** auct. graec.; **Aspicilia sphaerothallina** (J. Steiner) Szatala; **Lecanora esculenta** auct. graec.; **Lecanora sphaerothallina** (J. Steiner) J. Steiner.

Unfortunately, Krempellhuber's name is not legitimate, as he included, via his \(\beta\) (= var.) *esculenta*, the name *Lichen esculentus* Pall. The first step in clarifying the nomenclature will be to typify Krempellhuber's name (Article 7.5).

Description: Wasser & Nevo (2005) provide the only readily available description, but it is brief.

Scattered, with no clear pattern, on calcareous rock or serpentine at altitudes 800 - 2600 m. In Europe, a rather rare species known from the Iberian Peninsula, Greece, Russia and Ukraine. Commoner elsewhere. Macaronesia, Asia (widespread), N. America (widespread in western USA), C. America (Mexico).
Western Crete at an altitude of 1100 m. The substrate was not reported. Fairly widely distributed in Europe north of the Alps and Pyrenees, but the Greek report seems to be the only one from further south. Also western Asia (Turkey, northern Urals), N. America (Maine, Michigan).

**Aspicilia hartliana** (J. Steiner) Hue (1910)


Description: There is no modern description, and the application of the name is rather uncertain.

Very scattered in northern Greece, on calcareous rock at altitudes 1250 - 2650 m.

In Europe, known only from Greece and Northern (Yugoslav) Macedonia. Also central Asia (Kazakhstan, Tajikistan, Mongolia, NW China).

**Aspicilia intermutans** (Nyl.) Arnold (1887)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

The relation between *A. intermutans* and *A. cupreoglauca* is not clear. All Pelopponesian collections cited by Abbott (2009) under *A. intermutans* have been re-examined by me and referred to *A. cupreoglauca*, though in some cases only tentatively. Note that Sipman & Raus (1999, 2002) tended to use the name *A. intermutans* by default for most siliceous collections of *Aspicilia*.

Throughout Greece. On siliceous rock at altitudes 0 - 1400 m. The lichenicolous lichens and fungi *Caloplaca inconnexa*, *Endococcus verrucosus*, *Immersaria athroocarpa* and *Ingvariella bispora* have been recorded from this host. *Dactylospora rimulicola* has been reported from a collection that was tentatively referred to this species. Reports of *Endococcus rugulosus* from this are probably incorrect.

Widely distributed south of the Alps. Present north of the Alps, but does not reach Scandinavia. Also Macaronesia (Tenerife), Asia (Turkey, Syria, Iran, southern Siberia), N. Africa (Morocco, Algeria, Tunisia).

**Aspicilia polychroma** Anzi (1860)


Description: Clauzade & Roux (1985).

Widespread on the islands of the Aegean (including Crete) and adjacent coasts of the mainland, but scarce elsewhere. On siliceous rock (including serpentine) at altitudes 5 - 1400 m, but scarce above 1000 m.

Scattered in southern and central Europe; very rare further north. Also Asia (fairly widespread as far east as Mongolia), N. Africa (Morocco), perhaps N. America (Alaska, Canada).

**Aspicilia subfarinosa** (J. Steiner) Senkard. & Sohrabi (2011)


Descriptions: Şenkardeşler & Sohrabi (2011); Sipman (2007a) as *A. substerilis*.

Southern half of Greece, never very far from the sea. Usually on calcareous rock, sometimes on schist, at altitudes 140 - 1100 m. The lichenicolous lichen *Caloplaca inconnexa* has been reported from this lichen.

Mediterranean coast of Europe, from France to Greece. Also western Asia from Turkey to Iran.

**Aspicilia trachytica** (A. Massal.) Arnold (1887)


Description: No modern description found. See the protologue, or Massalongo (1856d), or Hue (1910b).

Scattered, with no clear pattern. Not reported for any of the Aegean islands, but present on Corfu. On siliceous rock at altitudes 100m to montane levels.

Southern Europe from Iberian Peninsula to Greece, with a disjunct report for Slovakia. Also Macaronesia (Canary Is), Asia (Iran, Mongolia), N. Africa (Morocco, Algeria).
**Bacidia De Not. (1846)**


Literature: The best starting point is Llop (2007a). Ekman (1996), and Smith et al. (2009) are also helpful. Earlier works are apt to be misleading, and are best avoided. Unfortunately, the key in Llop (2007a) does not include the common *B. thyrrenica*, and its use will lead to confusion.

Thallus: crustose, very variable but never very thick and usually some shade of white, grey or green. Vegetative propagules: present in some species. Apothecia: small to medium sized, colourless, brownish or greenish, in some species poorly developed and not well differentiated from hymenium. Hymenium: colourless, though sometimes with some epiphytic pigment in upper part. Hypothecium: colourless or pale in most species. Paraphyses: simple, never capitate, but in some species broadening gradually towards apex. Asci: rather small, narrowly clavate to clavate, apex with a KI+ blue plug with a narrow central KI- region which does not penetrate the uppermost part of the plug (Bacidia type). Ascospores: colourless, several to many times longer than wide, multi-septate, 8 per ascus. Chemistry: most reactions of medulla and thallus negative. Photobiont: green, trebouxioid.

The KI+ blue region of the ascus apex stains more intensely blue in a narrow zone close to the KI- central region; this distinguishes Bacidia type asci from Biatora type which lack this zone of more intense staining. In practice, this narrow zone is difficult to observe in most collections. In the species descriptions for this genus I have described as "Bacidia type" all asci where observations indicated "Biatora or Bacidia" type.

The circumscription of *Bacidia* has been narrowed since the time of Zahlbruckner, but it remains heterogeneous. In its present sense it contains about 300 species. They occur on all substrates, but few are found on hard, exposed rock. Collections of *Bacidia* are often quite difficult to determine, and several new species have been recognised in Mediterranean regions in recent years; as a result many old reports are probably unreliable. Although many species have been recorded, *Bacidia* does not form a prominent part of the Greek lichen biota.

The keys do not include *B. acerinoides*, for which I have insufficient information. They also assume that apothecia are present. In regions where the lichens are better known than in Greece, several species of *Bacidia* commonly occur sterile. Some of them probably occur in Greece too, but in our present state of knowledge it is not practical to write a good key to sterile crustose lichens.

**Key to Bacidia main groups**

11 Hypothecium dark (brown-orange, orange-brown, red-brown, dark brown or red-black), at least in part. Group 1.
1 Hypothecium pale (colourless, yellow, pale brown or pale red-orange).
22 Upper part of hymenium green, blue-green or green-grey, usually N+ red to purple, sometimes with a precipitate of blue crystals. Group 2.
2 Upper part of hymenium colourless, yellow, orange, brown or dirty purplish, N reaction variable.
3 Ascospores 10 or more times as long as wide. Group 4.
44 Exciple and/or upper part of hymenium with crystals (Note 1). Group 3.
4 Exciple and upper part of hymenium without crystals (though a crystalline pruina may overlie the hymenium). Group 5.
3 Ascospores less than 10 times as long as wide. Group 5.

(1) Crystals may be abundant and easily observed, or fewer and easy to overlook in a thin section. In case of doubt, repeat with a much thicker section.

**Key to Bacidia group 1: hypothecium dark.**

11 Epithecium some shade of green, N+ red, purple or violet, sometimes with precipitation of blue granules.
22 Most ascospores more than 20 µm long, 3 - 7 -septate, ends often blunt. See *Toniopsis*
2 Most ascospores less than 20 µm long, mostly 3-septate, ends rounded or pointed.
33 On calcareous rock. Asci Bacidia type. Ascospores 11 - 20 x 2.5 - 4.5 µm. **B. coprodes**
3 On shaded siliceous rock. Asci Porpidia type. Ascospores 11 - 17 x 3 - 4.5 µm. See (Aquacidia trachona)
1 Epithecium colourless, orange-brown or brown, N reaction various.
22 Ascospores 15 - 25 x 2 - 2.5 µm, usually 3-septate, ends usually blunt. On bark. See **Bellicidia incompta**
2 Ascospores more than 35 \( \mu m \) long, 3 - 14 -septate, ends pointed.
33 Terricolous or overgrowing bryophytes or plant debris on calcareous substrates. Ascospores 36 - 60 x 2 - 2.5 \( \mu m \), 3 - 7 -septate. (B. herbarum)
3 On bark. Ascospores 50 - 70 x 3 - 4 \( \mu m \), 7 - 14 -septate. (B. polychroa)

**Key to Bacidia group 2:** hypothecium pale; epithecium green,

11 Terricolous or overgrowing bryophytes or plant debris on calcareous substrates, rarely directly on calcareous rock. Ascospores 25 - 50 x 1.5 - 2 \( \mu m \), 3 - 7 -septate. (B. viridescens)
1 On bark (or occasionally wood), or overgrowing bryophytes on bark.
222 Ascospores 45 - 80 x 2 - 3 \( \mu m \), 7 - 16 -septate. Exciple with many small granular inclusions, soluble in K. B. absistens
22 Ascospores 30 - 50 x 3 \( \mu m \), 3 - 7 -septate, Exciple without granular inclusions. B. friesiana
2 Most ascospores less than 30 \( \mu m \) long.
33 Outer part of exciple dark purple-brown, K+ intensifying purple. Ascospores 20 - 30 x 2 - 2.5 \( \mu m \), 3 - 7 -septate, ends usually blunt. See Scutula circumspecta
3 Outer part of exciple not very dark. Ascospores usually 3-septate, ends various.
44 Apothecia 0.5 - 1.5 mm diameter. Ascospores 17 - 26 x 1.5 - 2.5 \( \mu m \), sometimes slightly curved. (B. beckhausii)
4 Apothecia 0.2 - 0.5 mm diameter. Ascospores 12 - 19 x 2.5 - 3 \( \mu m \), straight. B. igniarii

**Key to Bacidia group 3:** hypothecium pale; epithecium not green; ascospore aspect ratio >10; apothecia with crystals.

This group has caused much confusion, mainly because two common Mediterranean species, B. parathalassica and B. thyrrenica, were described only recently. A further difficulty is that the common species appear to be rather variable, most characters overlap, and it is not easy to construct a key that works.

Two kinds of crystals occur in this group. One kind is soluble in K but not in N, the other is soluble in N but not in K. Published description imply that each species has just one kind of crystal and that it occurs in well-defined locations, but some collections have a few, occasionally more than a few, crystals of the "wrong" kind or in the "wrong" place. It may be necessary to weigh all the evidence before making a determination.

11 Ascospores 55 - 95 \( \mu m \) long. Upper part of hymenium, and outer part of exciple, with small crystals that are soluble in K but not in N. Crystals usually not present in medulla of exciple. Thallus continuous or tending to become warted or granular. B. rosella
1 Ascospores shorter, at least on average, and almost always less than 70 \( \mu m \) long. If substantially overlapping with range for B. rosella, then other characters different.
22 Thallus granular or granular-isidiate. Ascospores 40 - 65 x 2 - 3.5 \( \mu m \), 5 - 10 -septate.
33 Thallus granular-isidiate. Cortex of thallus, sometimes also upper part of hymenium, with crystals soluble in K but not in N. Exciple usually without crystals. B. rubella
3 Thallus granular, but not isidiate. Cortex and hymenium without crystals. Exciple with many small crystals soluble in N but not in K. (B. iberica)
2 Thallus smooth to warted, but not granular. Ascospores various.
33 Upper part of hymenium, and outer part of exciple, with small crystals soluble in K but not in N. Medulla of exciple usually without crystals (Note 1). Ascospores 40 - 55 x 2 - 3 \( \mu m \). In Mediterranean vegetation (but not strictly coastal). B. thyrrenica
3 Upper part of hymenium usually without crystals (Note 2). Outer part of exciple without crystals. Medulla of exciple with crystals, usually large or forming ±large groups, soluble in N but not in K. Ascospores and habitat various.
44 Ascospores 45 - 70 \( \mu m \) long. Thallus continuous or cracked, but not warted. Crystals in exciple not abundant, colourless. Probably restricted to submediterranean habitats. B. fraxinea
4 Ascospores 30 - 50 \( \mu m \) long. Thallus often warted. Crystals in exciple abundant, slightly yellowish. In coastal Mediterranean habitats. B. parathalassica

(1) There may be a few clusters of crystals in medulla of exciple that are soluble in N but not in K.
(2) Occasional collections of B. parathalassica may have crystals in the upper part of the hymenium, sometimes quite a lot of them. They are soluble in K but not in N.
Key to Bacidia group 4: hypothecium pale; epithecium not green; ascospore aspect ratio > 10; apothecia without crystals.

11 Disc of apothecia ±black, not pruinose. Ascospores 21 - 40 x 2 - 3 µm, curved or S-shaped. Apothecia 0.2 - 0.5 mm diameter. Exciple red-brown in inner part, darker in outer part, K+ intensifying purplish. On bark. See Bibbya vermifera

1 Not as above. On various substrates.

22 Most ascospores more than 2.5 µm wide; septation various, some species with more than 7 septa. Apothecia not pale: at least partly brown-yellow or ±orange to red-brown to black. On bark.

33 Upper part of hymenium dirty purplish, K+ pure green, N+ pure purple (often with a precipitate of blue crystals). Exciple with minute (less than 1 µm) crystals. Ascospores 45 - 80 x 2 - 3 µm, 7 - 16 -septate. B. absistens

3 Upper part of hymenium colourless, yellow, orange or brown; K and N reactions not jointly as above. Exciple with or without minute crystals. Ascospores various.

44 Thallus entirely consisting of isidiate granules.

55 Granules often brownish or grey on their upper surface. Apothecia pink-brown to black. Cortex without crystals. In section, at least upper part of exciple and part of hymenium ±red-brown, K+ purplish. Ascospores 60 - 75 x 2.3 - 3 µm, 9 - 16 -septate. (B. biatorina)

5 Granules never dark coloured on their upper surface. Apothecia pale to dark red-brown, never black. Cortex with crystals. In section, exciple ±yellowish to pale orange throughout, K+ intensifying but not K+ purplish. Ascospores 40 - 70 x 2.5 - 3 µm. 3 - 7 -septate. B. rubella

4 Thallus not granular or isidiate.


66 Epithelial pigment forming ±distinct grey-brown caps over apices of paraphyses. Ascospores 36 - 67 x 3 - 4.5 µm, 5 - 14 -septate, sometimes slightly curved or S-shaped. (B. heterochroa)

6 Most epithelial pigment dissolved in the gelatinous matrix or as irregular granules between apices of paraphyses. Ascospores 34 - 70 x 2.5 - 4 µm, 7 - 16 -septate, straight. B. laurocerasi

5 Exciple yellow or red-yellow, K+ mauve. Epithecium colourless to brown-orange. Disc brown-orange to purple-brown, often darkening with age. Ascospores 50 - 70 x 3 - 4 µm, 7 - 14 -septate. (B. polychroa)

2 Most ascospores less than 2.5 µm wide, 3 - 7 -septate. Apothecia pale or dark. On various substrates.

333 On calcareous soil or decaying vegetation thereon. Ascospores 35 - 60 x 2 - 2.5 µm. (B. herbarum)

33 Usually on bark.

44 Outer part of exciple yellow-brown. Ascospores 35 - 55 x 1.5 - 2 µm. B. arceutina

4 Outer part of exciple ±colourless. 28 - 40 x 1.5 - 2 µm. B. punica

3 On shaded parts (crevices and overhangs) of siliceous rocks by the sea. Ascospores 25 - 45 x 1.5 - 2.5 µm. Hypothecium pale red-orange in upper part, colourless in lower part. (B. sipmanii)

Key to Bacidia group 5: hypothecium pale; epithecium not green; ascospore aspect ratio < 10.

11 On bark or overgrowing bryophytes on bark.

22 Ascospores 1 - 3 -septate, 20 - 23 x 4 - 6 µm. B. crozalsiana

2 Ascospores 5 - 6 -septate, 20 - 2 x 4 - 5 µm. See Scutula effusa

1 On rock or soil, or overgrowing bryophytes on rock or soil. Ascospores usually 3-septate.

22 Ascospores 12 - 18 x 4 - 4.5 µm. On calcareous rock. (B. fuscoviridis)

2 Ascospores 16 - 30 x 5 - 6 µm. Usually overgrowing bryophytes, sometimes directly on rock. See (Bilimbia microcarpa)

Bacidia absistens (Nyl.) Arnold (1871)
Descriptions: Llop (2007a); Smith et al. (2009).
Very scattered, with no clear pattern but never very far from the sea. On bark at altitudes 25 - 250 m. Reported from Cupressus sempervirens and Platanus orientalis.
Widespread in the western half of Europe and in Macaronisia. Very rare in eastern Europe. Also Asia (Turkey), western N. America (from BC. to California).
Bacidia acerinoides J. Steiner (1918)


Description: See the protologue. Dr. E. Llop (pers. comm.) suggests that it may belong in *Scoliciosporum*, but the ascospores are rather long for species of that genus (reported as 40 - 64 x 4 - 4.5 µm ). If a *Bacidia*, it seems close to *B. absistens* or *B. friesiana* but the ascospores are rather broad for those species. The number of septa was not reported. There is no mention of inclusions in the exciple, but Steiner may not have used polarising light. Application of the name will remain uncertain until the type is studied.

Rhodes, on bark of *Styrax officinalis* at an altitude of 780 m.

Only Portugal and Greece.

Bacidia arceutina (Ach.) Th. Fr. (1865)

*Bot. Notiser* 1865: 187 (and in *Lichenes Scandinaviae rariores et critici exsiccati*, Fasc 3. no. 66. It is unclear which was published first.; *Lecidea luteola* γ L. (= var.) arceutina Ach. (1803), Methodus 61; *Bacidia effusa* auct. graec.; *Catillaria minuta* Lettau, nom. superfl.

Descriptions: Ekman (1996); Llop (2007a); Smith et al. (2009).

Scattered, usually fairly close to the sea, at altitudes 0 - 770 m. On bark or calcareous rock.

Widely distributed in Europe, to as far north as southern Scandinavia. Also Macaronesia (widespread), Asia (widespread), N. America (southern Canada, cooler parts of USA). Reports for C. America and S. America are probably incorrect.

Bacidia coprodes (Körb. ex Arnold) Lettau (1912)

*Hedwigia* 52(3-4): 132; *Bilimbia coprodes* Körb. ex Arnold (1858), *Flora* 41: 503; *Bacidia trachona* auct.; *Bilimbia trachona* auct.


Scattered, in the northern half of Greece, with no clear pattern. On calcareous rock at altitudes 0 - 2150 m.

The distribution of *B. coprodes* is not well known, as it was long lost in the synonymy of *B. trachona*. However, it appears to be widely distributed in Europe (map in Llop & Ekman, 2007). Also N. America (Ontario, eastern half of USA), Antarctica (subantarctic islands).

Bacidia crozalsiana (H. Olivier) Zahlbr. (1926)


Description: Clauzade & Roux (1985).

Naxos, on bark at an altitude of 200 m.

Only France, Italy and Greece.

Bacidia fraxinea Lönnr. (1858)

*Flora* 41: 612-613; *Bacidia fillax* (Körb.) Lettau.

Description: Llop (2007a).

Scattered in the northern half of Greece, on bark at altitudes 0 - 770 m. All reports with an indication of substrate are from *Platanus orientalis*.

Throughout Europe, except perhaps for arctic regions. Also western Asia (Turkey, Iran, Ural Mts of Russia).

Bacidia friesiana (Hepp) Körb. (1860)

*Parerga Lichenol.* 133 (and by Anzi, *Cat. Lich. Sondr.* 70. It is not known which was published first.); *Biatora friesiana* Hepp (1857), *Flecht. Eur.* no. 288.

Descriptions: Ekman (1996); Llop (2007a); Smith et al. (2009).

Corfu and Peloponnesse, never very far from the sea. On bark at altitudes 100 - 1200 m. The only phorophyte explicitly reported was *Abies cephalonica*.

Widely distributed in Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Russia, Bhutan, perhaps China), Africa (S. Africa), N. America (Oregon).

Bacidia igniarii (Nyl.) Oxner (1968)


Descriptions: Ekman (1996); Llop (2007a); Smith et al. (2009).

Rhodes, at an altitude of 200 m. The substrate was not reported.

Throughout Europe, but nowhere common. Also Asia (widespread in Russia), N. Africa (Morocco, Algeria), N. America (widespread in Canada, also present in Minnesota).
Bacidia laurocerasi (Delise ex Duby) Zahlbr. (1926)
Cat. Lich. Univ. 4: 213; Patellaria laurocerasi (as "lauro-cerasi") Delise ex Duby (1830), Bot. Gall. 2: 653; Bacidia endoleuca (Nyl.) Kickx.

Descriptions: Ekman (1996); Llop (2007a); Smith et al. (2009).

Amorgos, Corfu and Rhodes, on bark at altitudes 0 - 650 m. Reported from Olea europaea, Quercus coccifera and Q. macrolepis.

Throughout Europe, to as far north as southern Scandinavia. Commonest in regions with a maritime climate, but occurs elsewhere, even in Russia. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, perhaps S. Africa; also St Helena), N. America (eastern half; perhaps elsewhere), perhaps Caribbean (Bahamas), perhaps C. America (Mexico - old report), S. America (Chile, Brazil, Colombia), Australasia (Victoria, perhaps elsewhere in Australia; both islands of NZ). Many reports, especially older ones, may refer to other species.

Bacidia parathalassica Llop & Gómez-Bolea (1999)
Mycotaxon 72: 80-81.

Thallus: crustose, forming large patches to several cm diameter when well developed (but often encountered as small thalli with just a few apothecia), green-grey, sometimes with a brown tinge, not pruinose, usually continuous or cracked, occasionally poorly developed and discontinuous, often warted, usually rather thin (to about 100 µm). Cortex: 20 - 25 µm thick, colourless, basically formed of hyphae parallel to surface, but sometimes developing a weak cellular texture in lower part, often with crystals. Medulla: white. Apothecia: abundant, sessile, flat when young, often convex later, (0.3) 0.4 - 0.7 (1.0) mm diameter, sometimes with a little white pruina on exciple when young. Disc: pale orange, pink-orange or pink-brown. Exciple: pale pink-brown or pink-orange, paler than disc, sometimes becoming excluded; in section: 75 µm wide, colourless in outer part, inner part sometimes pale yellow, upper part (level with or a little below hymenium) of radiating hyphae that develop elongated lumina, 1 - 3 times as long as broad, in outermost part; lowest part of exciple (well below hymenium) formed entirely of anastomosed hyphae; crystals abundant in inner part, absent from outermost part, large (to 10 µm diameter), colourless to pale yellow, soluble in N but not in K. Epithectum: colourless, K-. Hymenium: 65 - 80 µm tall, colourless, usually without crystals, upper part sometimes with a few crystals, rarely with many. Hypothecium: 80 - 130 µm tall, upper one third differentiated into a poorly developed subhymenium, mostly colourless, sometimes pale yellow in lowest third, lowest part of clearly visible, anastomosed hyphae. Paraphyses: simple, 1 µm wide at base, to 1.5 µm at apex, not capitate. Asci: 38 - 40 x 10 µm, narrowly clavate, Bacidia type. Ascospores: colourless, 4 - 6 (8) -septate, acicular, (30) 33 - 55 (63) x 2 - 3 µm, usually straight, often with one end pointed and the other slightly rounded. Chemistry: medulla I-; thallus C-, K-, KC-, P-, UV+ faintly dull green or orangeish. Photobiont: green, cells globose, 6 - 9 µm diameter. Photobiont layer: 30 - 55 µm thick, usually continuous.

Well characterised by the abundant crystals in the inner part of the exciple and the strongly coastal ecology. B. thyrrenica probably could occur at coastal sites (though I have not seen it there), but has a different pattern of crystals in the apothecia.

Widely distributed on the coasts of the islands and the mainland, and probably much more common than the records to date suggest. On bark at altitudes 0 - 400 m. Reported from a wide range of phorophytes, with no clear preference.

Southern Europe, from Portugal to Greece. Also Asia (Turkey), N. Africa (Morocco).

Bacidia punica Llop (2010)

Description: See the protologue.

Crete, Naxos, Rhodes and Thessaly. Most reports were unlocalised and no substrate was specified. The report for Rhodes was from bark of Laurus nobilis at an altitude of about 300 m.

Widely distributed in southern Europe. Not reported from other continents.

Bacidia rosella (Pers.) De Not. (1846)

The Peloponnesian collections that Abbott (2009) cited under this name all belong to B. parathalassica or B. thyrrenica, but B. rosella is present in the Peloponnes. It is likely that many other Greek reports are also incorrect: most of them pre-date the description of B. parathalassica and B. thyrrenica.

Thallus: crustose, green-grey or grey-green, not pruinose, continuous or cracked, smooth or warty, sometimes becoming rather granular, forming patches to a few cm diameter, about 100 µm thick where not warty, to 300 m at warts. Cortex: 15 - 20 µm thick, mostly colourless, sometimes pale brown in upper part, appearing cellular (formed of vertical hyphae with broad lumina, but individual hyphae usually not discernible), with abundant, small crystals soluble in K. Medulla: white. Apothecia: sessile, flat when young, often becoming convex later, 0.3 - 0.85 mm diameter, usually slightly white pruinose. Disc: pale orange to pink-orange. Exciple: pale orange, paler than disc, sometimes
becoming excluded in very mature apothecia; in section: 60 - 75 µm wide, mostly colourless to very pale yellow, but pale brown to brown in a narrow layer at surface, K-, N-, brown pigment soluble in K but not in N, formed of anastomosed hyphae in inner part, some of anastomoses reducing outward and outer part of radiating hyphae, lumina generally not well developed, sometimes present in outer part, long and narrow except in outermost cell layer where they may be rounded; small crystals abundant, usually confined to outermost part, soluble in K but not in N. Epithecium: pale brown to brown, pigment in the form of minute granules 1 µm wide or less, K-, N-, granules soluble in K but not in N; crystals as for hymenium. Hymenium: 120 µm tall, colourless, upper part with many small crystals soluble in K but not in N. Hypothecium: to 170 µm tall, colourless or with faint yellow tinge. Paraphyses: simple, 1 µm wide at base. Ascii: 80 - 100 x 11 - 13 µm, ±cylindrical, Bacidia type. Ascospores: colourless, 9 - 17-septate, acicular, 52 - 85 x 3 - 4 (4.5) µm, 8 per ascus. Chemistry: medulla I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 15 µm diameter. Photobiont layer: continuous, ±regular, 30 - 50 µm thick.

Easily separated from other species of this group by its much longer ascospores.

Throughout Greece in localities that are not very far from the coast. My collections were on bark of Quercus spp. at altitudes 700 - 1120 m. The reported altitude range for the other Greek records, all of which are from bark, suggests that some of them refer to B. parathalassica or B. thyrenica.

Reported from much of Europe to as far north as southern Scandinavia, but reports for southern Europe are difficult to evaluate, owing to confusion with B. parathalassica and B. thyrenica. Also Macaronesia, Asia (Turkey, Russia, Japan), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America are incorrect and refer to B. rosellizans, so reports for C. America and S. America may also be incorrect.

**Bacidia rubella** (Hoffm.) A. Massal. (1852)


**Thallus:** pale green, to several cm diameter, of isidiate granules. Isidia: ±globose, 0.06 - 0.1 mm diameter, scattered or forming a ±continuous crust. Cortex: present, 5 - 7 µm thick, colourless, without distinct structure, K-, with abundant crystals soluble in K. Medulla: absent; interior of granules occupied by photobiont cells. Apothecia: sessile, ±flat, 0.4 - 0.8 mm diameter, not pruinose; in section: entirely without crystals. Disc: brown-pink to pink-brown, sometimes darkening in old apothecia. Exciple: brown-pink, often slightly paler than disc, becoming almost excluded; in section: 60 - 80 µm wide, colourless to pale orange-brown, of branched hyphae on an overall radiating trend, narrow elongated lumina often visible in outer part, K-, pigment only slightly soluble in K. Epithecium: very pale orange-brown, K-, pigment slightly soluble in K. Hymenium: 100 µm tall, colourless, KI+ blue. Hypothecium: 200 µm tall, colourless, of randomly oriented hyphae that are more densely packed in upper 50 µm. Paraphyses: simple, 1 µm wide in lower part, 1 - 2 µm at apex, not capitate or moniliform. Ascii: 60 - 70 x 12 - 13 µm, narrowly clavate, Bacidia type. Ascospores: colourless, usually 5 - 6-septate when mature, 51 - 65 x 2.5 - 3 µm, one end distinctly more rounded than the other, 8 per ascus. Chemistry: thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 9 - 13 µm diameter.

Material that I have seen had no crystals in apothecial sections, but the exciple is said sometimes to have radiating streaks of small crystals.

Easily distinguished from other *Bacidia* species with a pinkish disc by the entirely granular-isidiate thallus. *B. rosellizans* can develop some granular patches, but its thallus is never entirely granular-isidiate; it also has abundant crystals in the apothecia.

Scattered throughout Greece. (The Peloponnesian collection cited by Abbott (2009) was a very granular specimen of *B. rosellizans*, but *B. rubella* is present in the Peloponnese.) Usually on ±basic bark, but reported once from wood. At altitudes 0 - 1400 m, on a wide range of phorophytes with no clear preference.

Widely distributed in Europe, as far north as the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, S. Africa, Madagascar), N. America (widespread), perhaps C. America (CR, an old report for Mexico), S. America (widespread), perhaps Pacific (Hawaii, New Caledonia). Many reports are old and probably unreliable.

**Bacidia thyrenica** Llop (2007)


**Thallus:** crustose, pale grey to green-grey, not pruinose, usually smooth, sometimes very slightly warted, continuous or sometimes of slightly separated rounded areoles, forming small patches to a few cm diameter, thin (110 - 140 µm). Cortex: 15 - 25 µm thick, usually colourless, formed of a network of hyphae, with abundant small crystals most of which are soluble in K. Medulla: white. Apothecia: sessile, flat, sometimes becoming convex later, 0.4 - 1.4 mm diameter, sometimes slightly white pruinose when young, pruina persisting longer on exciple than on disc. Disc: pink-brown to orange-brown. Exciple: white to pale orange-brown or pale pink-brown, sometimes becoming excluded; in section: 60 - 80 µm wide, colourless in inner part, pale brown or pale yellow-brown in outer part, pigment K-, basically formed of
radiating hyphae, though with some anastomoses. Hyphae sometimes with long narrow lumina, lumina sometimes more rounded in outer 1 (2) cell layers; crystals: always present, small, arrangement very variable. Epithecium: colourless to brown, K-, crystals as for hymenium. Hymenium: 55 - 80 µm tall, colourless, upper part with many small crystals, most of which are soluble in K, not in N. Subhymenium: sometimes present, not well developed, to 20 µm tall. Hypothecium: 100 - 150 µm tall, mostly colourless, upper part sometimes pale grey or pale yellow-brown. Paraphyses: simple, 1 µm wide at base, 1 - 2 µm at apex, not capitulate. Ascii: 55 - 60 x 9 - 13 µm, broadening upwards, Bacidia type. Ascospores: colourless, 5 - 8 -septate, acicular, usually straight, (33) 36 - 52 x 2 - 3 µm. Chemistry: medulla I-; thallus K-, C-, KC-, P-, UV+ pale orange. Photobiont: green; cells globose or subglobose, 10 - 13 µm diameter, forming a regular, usually continuous layer 30 - 45 µm thick.

For separation from B. paratalassica see under that species. There is so much overlap in the characters of B. paratalassica and B. thyrrenica that they might be better regarded as two subspecies of the same species.

Widely distributed in Greece near the sea, though not strictly coastal. On bark, at altitudes below 400 m. There is a single report from an altitude of 1000 m, in Crete, but confusion with B. rosella seems possible. Recorded from a wide range of phorophytes, with no clear preference.

Mediterranean Europe, from the Balearic Is to Greece. Also Macaronesia (Tenerife), western Asia (Turkey).

**Bacidina Vězda (1991)**


Literature: The best introduction is Ekman (1996), which covers the North American corticolous species, many of which also occur in Europe. Most other European species are treated in Clauzade & Roux (1985) and/or Smith et al. (2009) under Bacidia. Information on the genus in the Iberian Peninsula, much of which is relevant to Greece, may be found in Llop (2002, 2007a) and Llop & Hladun (2000).

This segregate from Bacidia s. lat. has about 45 species, of which about 21 have been reported for Europe. There are few Greek records, and only one species, *B. phacodes,* is moderately common.

11 Upper part of hymenium green to blue-green, N+ red to purple. (B. egenula)
1 Upper part of hymenium colourless, yellow, orange, brown or dirty purplish, N reaction variable. (If hymenium with a blue or green tinge, then not N+ red to purple.)
22 Hypothecium dark red-brown. (B. arnoldiana)
2 Hypothecium colourless, yellow or pale brown.
33 Many ascospores more than 45 µm long. On bark. **B. assulata**
3 Few or no ascospores more than 45 µm long. On various substrates.
44 On leaves. (B. apiahica)
4 On other substrates.
55 Thallus finely granular-sorediate, with discrete granules 20 - 50 µm diameter.
66 Apothecia pale to dark pink or red-brown. Edge of upper exciple pink-brown, K+ purplish. (B. caligans)
6 Apothecia white or pale. Edge of upper exciple colourless, K-. **B. delicata**
5 Thallus smooth, warted or granular-warted (with granules more than 60 µm diameter), but not finely granular-sorediate.
66 On bark or wood. **B. phacodes**
6 On siliceous rocks in streams or lake margins. **B. inundata**

*Bacidina assulata* (Körb.) S. Ekman (1996)  

Descriptions: Ekman (1996); Llop (2007a). The description in Clauzade & Roux (1985) as *Bacidia assulata* is not really adequate, and descriptions in British Floras may refer to a different taxon.

Western Crete and northern Epiros at altitudes 500 - 740 m. The only phorophyte explicitly reported was *Pistacia* sp. Crete is at the limit of the range of this species, and the report dates from 1943, so it may be unreliable.

Mainly in middle latitudes of Europe, though there are a few records from southern Scandinavia and from Mediterranean regions; the latter include Sardinia and Cyprus. Also Asia (Russia), N. America (New York, Oklahoma).

*Bacidina delicata* (Larbal. ex Leight.) V. Wirth & Vězda (1994)  
Descriptions: Llop (2007a); Smith et al. (2009) as Bacidia delicata.
Cretan, at about 600 m. The substrate was not reported. Cretan is at the limit of the range of this species, but the record is a modern one by experienced lichenologists, so is probably reliable.
Mainly in from middle latitudes of Europe, though it reaches southern Scandinavia and there are a few records from southern Europe. Also Macaronesia (Azores), Asia (southern Siberia, Bangladesh, HK, Taiwan), N. America (scattered in eastern USA).

**Bacidina inundata** (Fr.) Vězda (1991)
Descriptions: Llop (2007a); Smith (2009) as Bacidia inundata.
Mt. Olympus, on inundated calcareous rock at about 1000 m. Not recorded since 1959. This species usually occurs on siliceous rock in streams, but flowing water could leach calcium ions from a substrate. Abbott (2009) accepted the report.
Widely distributed in central and northern (but not arctic) Europe. There are only a few records for the south of the continent. Also Macaronesia (Azores, Gomera), Asia (widespread), N. America (SE Canada, widespread in USA). A report for S. America (Brazil) seems doubtful to me.

**Bacidina phacodes** (Körb.) Vězda (1991)
*Folia Geobot. Phytotax. 25(4): 432; Bacidia phacodes Körb. (1860), Parerga Lichenol. 130-131; Bacidia albescens (Stizenb.) Bausch.
Descriptions: Llop (2007a); Smith et al. (2009) as Bacidia phacodes.
Scattered, with no clear pattern, although most reports are from fairly close to the sea. On bark, or overgrowing bryophytes on bark, at altitudes 80 - 700 m. Reported from *Olea europaea* and *Platanus orientalis*.
Widespread in temperate and warm parts of Europe. Also Macaronesia (Canary Is), Asia (widespread), Africa (Morocco, Algeria, S. Africa), Australasia (NZN). Reports for N. America are erroneous according to Ekman (1996), and reports for S. America (Brazil, Paraguay) seem doubtful to me.

**Bactrospora** A. Massal. (1852)
Literature: Egea & Torrente (1993a) is the standard monograph.
About 32 species. Six occur in Europe, but only one is known for Greece. Fairly easily separated from other crustose genera with *Trentepohlia* by the very long, multi-septate ascospores and the branched paraphyses. The tendency of the ascospores to fragment is characteristic of the genus, but in the only Greek species this tendency is not very pronounced.

11 Ascospores 2 - 3 µm wide, not constricted at centre, soon fragmenting in asci into segments with one, or only a few, cells. On bark. (B. dryina)
1 Ascospores 3 - 4 µm wide, sometimes slightly constricted at centre, not usually fragmenting in ascus, sometimes fragmenting outside asci into multicellular segments. On bark or rock.
22 Ascospores 60 - 95 µm long, up to 17-septate. On bark. **B. patellarioides** s. lat.
3 Conidia 8 - 13 µm long. Exciple 50 - 80 µm wide at top, 60 - 160 (250) µm at base, prominent, persistent. Apothecia 0.3 - 1.2 mm diameter, flat or slightly convex. Exciple prominent, persistent. Subhymenium colourless. **B. patellarioides var. patellarioides**
3 Conidia 13 - 17 µm long. Exciple 20 - 50 µm wide at top, up to 80 µm at base, sometimes becoming excluded. Apothecia 0.3 - 0.6 mm diameter, flat to distinctly convex. Subhymenium pale brown to dark brown. **B. patellarioides var. convexa**
2 Ascospores 35 - 60 µm long, 3 - 9 -septate. On rock. (B. thyrsodes)

**Bactrospora patellarioides** (Nyl.) Almq. (1869) var. patellarioides
Thallus: crustose, white to pale grey, sometimes with a slight brown or green tinge, continuous or slightly cracked, forming small patches to 1.5 cm diameter; superficial and usually distinct but rather thin, 70 - 110 µm. Cortex: true cortex absent; layer above photobiont 50 - 70 µm thick, colourless, without distinct structure, K-, hyphae interwoven
with abundant crystals. Medulla: absent; photobiont layer directly overlies substrate. Apothecia: sessile, usually ± flat, sometimes slightly concave or slightly convex, 0.3 - 0.9 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, sometimes slightly shiny, prominent, persistent; in section: 50 - 100 µm wide in upper part, about 50% wider in lower part, dark brown to black, sometimes with a slight red or purple tinge, not closed below, formed of interwoven hyphae with clearly visible lumina, which sometimes result in an obscurely cellular texture; K and N reactions of pigment as for epithecium. Epithecium: orange-brown to dark brown, K- or developing a slight green tinge, N-, pigment not soluble in K or N. Hymenium: 95 - 130 (175) µm tall, colourless. Hypothecium: 75 - 125 µm tall, colourless; a very pale brown subhymenium is sometimes developed (dimensions included in those for hymenium and hypothecium). Paraphyses: branched, especially in upper part, 1.5 µm wide at base, 3 µm at apex, not or scarcely capitate. Asci: 75 - 110 x 8 - 12 µm, cylindrical, KI+ blue in a small patch at the top, this patch has a K- central region; wall of ascus K- or almost so. Ascospores: colourless, 8 - 20 -septate but septa often difficult to count, 8 per ascus, 50 - 125 x 2 - 4 µm, usually straight but sometimes slightly curved, not fragmenting within ascus but sometimes fragmenting after release. Pycnidia: often present, appearing externally as black dots 0.1 mm diameter; in section: immersed, cup shaped (with flat top), 160 µm tall, 180 µm wide at the top, mostly colourless but sometimes with patches of brown pigment in upper part. Conidia: colourless, 9 - 14 x about ¾ µm, usually curved. Chemistry: thallus K-, C-, KC-, P-, I-, UV-. Photobiont: Trentepohlia; cells globose, 8 - 12 µm diameter, chloroplast often forming a crescent shape on one side of the cell. Photobiont layer: continuous but rather irregular, 15 - 40 µm thick.

The combination of Trentepohlia photobiont and very long, multi-septate ascospores easily separates the genus from others.

On bark in humid coastal localities, usually at altitudes below 200 m but recorded up to 480 m. Recorded from a wide range of trees and shrubs, but with a mild preference for Juniperus (33% of records).

Widely distributed in southern Europe, but not present north of the Alps. Also Macaronesia, Asia (Israel, Japan; an old report for India is probably incorrect), N. Africa (Morocco, Algeria, Tunisia, Libya), western N. America (Alaska, BC, California).

Bactrospora patellarioides var. convexa (de Lesd.) Egea & Torrente (1993)

Similar to var. patellarioides, but with longer conidia (not seen) and a narrower exciple. The apothecia tend to be smaller and may become convex.

Corfu and Alonisos, on bark of a wide range of phorophytes, and once on wood of Olea europaea, at altitudes 20 - 280 m.

Southern Europe from Spain to Greece. Also N. Africa (Morocco), N. America (California).

Baeomyces Pers. (1794)
Ann. Bot. Usteri 7: 19 as 'Boeomyces', but on page 155 as 'Baeomyces'. Sanctioned by Fries, Syst. Mycol. I, page xxiii of the introduction. Type: B. byssoides (L.) P. Gaertn., B. Mey. & Scherb. (= B. rufus), selected by Clements & Shear, Gen. Fung. 320. 1931. (That was not a species discussed by Persoon, but it was treated by Wiggers within Tubercularia, a genus that Persoon cited.) Family: Baeomycetaceae.

Literature: The only species likely to occur in Greece is treated in Smith et al. (2009). All the European species are treated by Clauzade & Roux (1985).

Baeomyces has between 8 and 15 species, depending on the status of some poorly known ones. Three species are present in Europe. They occur on acidic soil or, less commonly, decaying vegetation. Only a single species is likely to occur in Greece.

Baeomyces rufus (Huds.) Rebent. (1804)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Known from three sites in northern Greece, close to the border with Bulgaria, at altitudes 1200 - 1400 m. Reported from bark of Picea (probably decaying bark close to the base of the tree, though that was not stated), and directly on granite rock.

Throughout cold and temperate Europe, but much rarer in the south, where it is confined to the mountains. Also Macaronesia, Asia (widespread), N. America (widespread in cooler parts), C. America (CR, El Salvador, Guatemala, Mexico), S. America (Argentina, Colombia, Venezuela).
**Bagliettoa A. Massal. (1853)**

Mem. Lichenogr. 146-147. Type: *B. limborioides* A. Massal., the only species originally included. Family: Verrucariaceae.

Literature: The best starting points are Halda (2003) and Krzewicka (2012). Gueidan et al. (2009) and Yuzon et al. (2014) discusses phylogeny. The latter provides a key to species, on which the key below is based.

Bagliettoa is a group of about 12 crustose species segregated from Verrucaria. Species delimitation in the genus is not settled, and many reports are probably unreliable. About 10 species occur in Europe. They have an endolithic or poorly developed, thallus and occur on calcareous rock. The genus is well-defined phylogenetically, but is not easily recognised on purely morphological grounds, though some species have a distinctive radially cracked involucrellum. Because of the difficulty of delimiting the genus morphologically, no generic description is provided. Species of Bagliettoa are common on limestone in Greece, except in the mountains and the far north.

As with Verrucaria, there seems to be great variability in ascospore dimensions, and different authors may quote very different ranges. The key does not include the entire ranges that may be found in the literature. It is best to use other characters to determine collections, and note ascospore dimensions only to exclude an obviously incorrect determination.

111 Thallus with purple, pink or red tint (red crystals in cortex).
   22 Involucrellum present, with fine but distinct radial cracks. *B. cazzae*
   2 Involucrellum absent or without distinct radial cracks. *B. marmorea*

11 Thallus dark green, blue-green or blue-grey. Green pigment present in upper part of cortex (visible in compound microscope if thallus sectioned). *B. parmigerella*
   1 Thallus grey, white or ochre. Green pigment present or not in upper part of cortex.
   22 Involucrellum absent. *B. calciseda*
   2 Involucrellum present, with fine radial cracks.
   33 Involucrellum narrower than exciple.
      44 Upper part of cortex with green pigment. Ascospores 18 - 28 x 10 - 15 μm (Note 1). *B. parmigerella*
      4 Upper part of cortex without green pigment. Ascospores 18 - 28 x 8 - 13 μm. *B. baldensis*
      3 Involucrellum as large as or larger than exciple.
      44 Involucrellum protruding well above level of thallus, large, 0.3 - 0.4 mm diameter. Thallus sometimes with an ochre tinge. Ascospores 18 - 28 x 12 - 15 μm. *B. limborioides*
      4 Involucrellum not or only slightly protruding, small, 0.15 - 0.3 mm diameter. Thallus without an ochre tinge.
      55 Exciple colourless throughout (except when dead). Ascospores 13 - 22 x 8 - 11 μm. *B. steineri*
      5 Exciple brown to black, at least in some parts in mature perithecia.
       66 Ascospores 12 - 15 x 5 - 6 μm. Exciple 0.1 - 0.2 mm wide. (B. quarnerica)
       6 Ascospores 13 - 20 x 7 - 12 μm. Exciple 0.2 - 0.3 mm wide. *B. parmigerella* s. lat.

(1) The cited range is from Halda (2003). Smith et al. (2009) give a range of 14 - 21 x 6 - 8 μm.

**Bagliettoa baldensis (A. Massal.) Vězda (1981)**

Bestimmungsch. Eur. Flecht. 2: 363; Verrucaria baldensis A. Massal. (1852), Ric. Auton. Lich. Crost. 173-174; Bagliettoa sphinctrina (Dufour) Körb.; Verrucaria calciseda f. alocyza Arnold; Verrucaria calciseda f. insculptoides J. Steiner; Verrucaria calciseda f. sphinctrina (Dufour) Arnold; Verrucaria cazzae var. graeca Servít; Verrucaria dalmatica Servít; Verrucaria parmigerara var. alocyza (Arnold) J. Steiner (as "alociza"); Verrucaria parmigerara var. calcivoroides (J. Steiner) Szatala; Verrucaria parmigerara f. kierkienis Servít; Verrucaria parmigerara f. subconcentrica J. Steiner; Verrucaria pinguis f. dealbata J. Steiner; Verrucaria sphinctrina (Dufour) Mull. Arg., nom. illeg.; Verrucaria steineri f. geographica Servít; Verrucaria steineri var. lactea Servít; Verrucaria steineri f. suborbicularis Servít; Verrucaria subconcentrica (J. Steiner) Servít; Verrucaria subconcentrica var. saxivora Servít.

Some infra-specific names cited above may be synonyms of *B. parmigerara* or *B. steineri*, but their types have not been re-studied since those two species were segregated from *B. baldensis* by Yuzon et al. (2014).

Thallus: crustose, to several cm diameter, immersed or thinly superficial, inconspicuous, white, 130 - 260 μm thick. Cortex: 25 - 50 μm thick, colourless, without distinct structure even in K, K-. Medulla: white, not delimited from photobiont-bearing layer. Perithecia: 0.2 - 0.25 mm diameter, black, 100% immersed in pits in substrate; in section: 400 μm tall x 300 μm wide, subglobose to slightly pyriform. Exciple: colourless, 25 - 40 μm wide, formed of hyphae parallel to boundary of peritheciurn. Involucrellum: present, usually with 2 - 6 radial cracks, at top of perithecium only, 250 μm diameter, 15 - 25 μm thick, slightly arched, not or only slightly separating from perithecium. Paraphyses: disappearing early. Periphyses: abundant in upper part of perithecia, 2 μm wide at base, 2 - 4 μm at tips, often with
Verrucaria marmorea (Clemente) Ach. nom. superfl.; Verrucaria marmoreus in Gueidan et al., Bagliettoa marmorea (Scop.) Gueidan & Cl. Roux (2007) (Morocco, Algeria, perhaps elsewhere), perhaps N. America, perhaps S. America (Argentina, Chile).

Krzewicka (2012).

Massal. ex Arnold; Mem. Lichenogr. 147; Bagliettoa limborioides A. Massal. (1853)

225 - 250 µm immersed in pits in substrate, black, 0.2 - 0.25 mm diameter; in section: pyriform to conical or even almost rectangular, pseudocortex: 60 - 75 µm thick, mostly colourless but with some red crystals, without distinct structure. Perithecia: immersed in pits in substrate, black, 0.2 - 0.25 mm diameter; in section: pyriform to conical or even almost rectangular, 225 - 250 µm tall x 175 - 300 µm wide. Exciple: brown throughout. Involucrellum: present, radially cracked, 125 µm diameter, restricted to top of perithecium. Paraphyses: disappearing early. Paraphyses: present. Photobiont: green. I have seen only immature asci without ascospores. The scarcity of ascospores has been noted by other authors.

The combination of a radially cracked involucrellum and the immersed or thinly superficial white thallus. However, not all perithecia have a cracked involucrellum, and scanty collections may be difficult to separate from B. marmorea.

The record of Abbott (2009) for the Peloponnese was based on a scanty collection that is more likely to belong to B. marmorea.

Throughout Greece, but commonest in sites not very far from the sea. On calcareous rock at altitudes 0 - 1800 m, but 70% of reports are from below 400 m.

Throughout Europe to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (Ontario, scattered in USA), perhaps C. America, Australasia (widespread). An old report for S. America seems doubtful to me.


Bagliettoa cazzae (Zahlbr.) Vézda & Poelt (1981)

Thallus: immersed, to a few cm diameter, most parts with red-purple tinge. Cortex: true cortex absent; pseudocortex: 60 - 75 µm thick, mostly colourless but with some red crystals, without distinct structure. Perithecia: immersed in pits in substrate, black, 0.2 - 0.25 mm diameter; in section: pyriform to conical or even almost rectangular, 225 - 250 µm tall x 175 - 300 µm wide. Exciple: brown throughout. Involucrellum: present, radially cracked, 125 µm diameter, restricted to top of perithecium. Paraphyses: disappearing early. Paraphyses: present. Photobiont: green. I have seen only immature asci without ascospores. The scarcity of ascospores has been noted by other authors.

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Throughout Europe to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (Ontario, scattered in USA), perhaps C. America, Australasia (widespread). An old report for S. America seems doubtful to me.
Thallus: crustose, immersed or almost, usually with pink, pink-purple or reddish patches, especially near perithecia, occasionally entirely white. Prothallus: sometimes present, black, 0.05 - 0.15 mm wide. Cortex: 25 ± mm thick, at least half occupied by large clusters of pinkish crystals. Perithecia: immersed in pits in substrate, black, 0.15 - 0.5 mm diameter; in section: globose, 300 - 500 µm diameter, wall colourless. Involucrellum: often absent; if present: 150 - 350 µm diameter, not separating from perithecium, not radially cracked. Paraphyses: disappearing early. Periphyses: present. Ascospores: colourless, simple, usually ellipsoid, 17 - 27 x 10 - 13 µm. Photobiont: green.

The pink crystals in the cortex are distinctive. However scanty collections may lack pink areas, and could then be confused with *B. baldensis*.

Throughout much of Greece, though perhaps absent from the NE quadrant of the country. On calcareous rock at all altitudes.

Southern and central Europe. Absent from British Is and the Nordic Countries. Also Asia (widespread as far east as Tajikistan), N. Africa (Morocco, Algeria), perhaps N. America (southern USA).

**Bagliettoa parmigera (J. Steiner) Vězda & Poelt (1981)**


Thallus: immersed, inconspicuous, scarcely distinguishable from the white substrate, to a few cm diameter; adjacent thalli often merging with a black zone 0.03 - 0.1 mm wide at border. Cortex: colourless. Perithecia: immersed in pits in substrate, black, 0.15 - 0.2 mm diameter; in section: pyriform, 300 µm tall x 250 µm wide. Exciple: brown, at least in upper part of some perithecia. Involucrellum: present, radially cracked, 350 µm diameter, wider than exciple, not protruding much above level of thallus, upper surface ± flat. Paraphyses: disappearing early. Periphysoids: present. Ascospores: colourless, simple, ellipsoid, 13 - 20 x 7 - 12 µm, 8 per ascus. Photobiont: green; cells globose, 9 - 10 µm diameter.

Scattered throughout Greece, but always close to the sea. On calcareous rock at altitudes 50 - 1200 m. The lichenicolous lichen *Toninia verrucariae* has been reported once from this host.

Mainly southern Europe, but present in central Europe and probably reaching as far north as southern Scandinavia. Also western Asia (Turkey, Israel), North Africa (Morocco).

**Bagliettoa parmigerella (Zahlbr.) Vězda & Poelt (1981)**

Bestimmungschl. Eur. Flecht. 2: 363; *Verrucaria parmigerella* Zahlbr. (1919), *Öst. Bot. Z.* 68: 64-65; *Verrucaria bagliettoaeformis* var. erumpens Servít; *Verrucaria baldensis* var. rechingeri Servít; *Verrucaria hiascens* var. spermogonifera Hepp; *Verrucaria pinguis* J. Steiner, nom. illeg.; *Verrucaria pinguis* f. alocizoides J. Steiner; *Verrucaria sphinctrinella* Zschacke; *Verrucaria sphinctrinella* var. alocizoides (J. Steiner) Servít; *Verrucaria sphinctrinella* f. circumarata (Servít) Servít; *Verrucaria sphinctrinella* var. expallida Servít; *Verrucaria sphinctrinella* f. spermogonifera (Arnold) Servít.


Scattered throughout Greece; commonest in the islands, but always close to the sea. On calcareous rock at altitudes 0 - 1000 m.

Southern and central Europe, with scattered reports from further north to Finland. Also Asia (Turkey, Lebanon, Israel; also a disjunct but probably reliable report for Yunnan), N. Africa (Morocco).

**Bagliettoa steineri (Kušan) Vězda (1981)**


Description: Halda (2003).

Islands of Amorgos, Chios and Corfu. On limestone at altitudes 150 - 900 m.

Scattered in southern and central Europe, probably reaching as far north a southern Scandinavia. Also western Asia (Turkey), North Africa (Morocco). I am sceptical of a very disjunct report for Taiwan.

**Bellemerea Haffellner & Cl. Roux (1984)**


Literature: There is no monograph, but Clauzade & Roux (1985), and Smith et al. (2009) are adequate starting points. Galloway (2007a), and Nash et al. (2007) also have useful information.

At least 8 species, of which 6 have been reported for Europe. They generally occur in northern or alpine regions,
and Greece is at the southern end of the range for the genus.


1 Thallus K-, P-. Algal layer continuous below hypothecium. Ascospores 7 - 16 x 4 - 9 µm. Disc brown-black when dry. **B. cinereorufescens**

**Bellemerea cinereorufescens** (Ach.) Clauzade & Cl. Roux (1984)

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

Recently reliably reported for Epiros, on serpentine at an altitude of 2150 m. There is also a 19th century report for Mt. Helmos in the Peloponnese, in Steiner (1894d), on what appears to have been an inclusion of hard siliceous rock (?) chert) within limestone at high altitude, probably over 2000 m. The report was not accepted by Abbott (2009), as Steiner stated that the thallus reacted K+ yellow, C-, whereas the expected reaction in this species is K-, C-. However, spot tests with K can be difficult to interpret, and Steiner's report is not impossible.

Widespread in northern and central Europe, though absent from British Is. Present, but scarce, south of the Alps. Also cool to cold regions of Asia (Turkey, Russia, Mongolia), N. America (widespread, mainly in the west). A report for HK seems doubtful to me.

**Bellicidia Kistenich et al. (2018)**


Literature: Kistenich et al. (2018)

The genus was erected recently for a single species formerly placed in *Bacidia*, but which is clearly not close to the type species of that genus.

**Bellicidia incompta** (Borrer) Kistenich et al. (2018)


Descriptions: Llop (2007a); Smith et al. (2009), both as *Bacidia incompta*.

Stereas Ellada and Rhodes, on bark at altitudes 200 - 1500 m. Reported from *Abies* and *Pyrus amygdaliformis*.

Widely distributed in Europe as far north as southern Scandinavia, but nowhere common. Also Macaronesia, Asia (Russia, Tajikistan), perhaps N. Africa (Tunisia), perhaps S. America (Colombia), perhaps Australasia (Queensland), perhaps Pacific (Hawaii). Its status in N. America is disputed.

**Biatora Fr. (1817)**


Literature: Printzen & Otte (2005) give a key to all European species. The key below is based on it.

About 54 species, of which about 35 occur in Europe. They are northern species, often with rather specialised habitat requirements, and often rather rare. Greece is outside the expected range of most of them.

The key does not include *B. athoa*.

11 Soredia present. (B. chrysantha), (B. efflorescens), (B. pontica)

1 Soredia absent.

22 Apothecia grey, grey-black, green-black or khaki. (B. globulosa), (B. mendax), (B. ocelliformis)

2 Apothecia without grey or blue tinge; white, pale beige, orange-brown, red-brown or dark brown.

33 Ascospores mostly 3-septate. **B. epirotica**

3 Ascospores mostly simple or 1-septate.

44 Thallus granular, often with a green tinge. Exciple colourless or ±uniformly pale brown. (B. sphaeroides) and (B. vernalis). Greek reports of both species doubtful.

4 Thallus not granular, white-grey or poorly developed. Exciple various.

55 Ascospores 1-septate, 8 - 10 x 2 - 3 µm. Pycnidia sessile or on short stalks, white pruinose. On wood or dry bark. Exciple with conglutinate radiating hyphae. (B. veteranorum)
5 Ascospores 0 (1) -septate, 8 - 15 x 3 - 5 µm. Pycnidia not as above. On bryophytes or decaying vegetation in upland localities. Exciple colourless in outer part, pale brown in inner part. (B. subduplex)

Biatora athoa Räsänen (1944)


Description: See the protologue. According to Printzen (1995) the species is near _Lecanora symmicta_.

Known only from the type collection on the Athos peninsula, on bark at an altitude of about 400 m.

Biatora epirotica Printzen & T. Sprib. (2011)

_Phytotaxa_ 18: 22.

Description: See the protologue.

_Epiros_, on bark of _Abies borisii-regis_ at altitudes 300 - 780 m.

Known only from Greece and Turkey.

Biatoropsis Räsänen (1934)


This genus of lichenicolous basidiomycetes has four species, but three were described only recently and are not well known.

Biatoropsis usnearum Räsänen (1934)


Descriptions: Diederich (1996); Nash et al. (2004).

There is only a single, unlocalised report for Greece. No host or altitude information was published.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread, but not N. Africa or S. Africa), N. America (widespread), Caribbean (PR), C. America (Mexico, CR), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

Bibbya J. H. Willis (1956)


Literature: Most species are discussed in Timdal (1991), under _Toninia_. For the circumscription of the genus see Kistenich et al. (2018).

_Bibbya_ contains 10 species, most of which were formerly placed in _Toninia_, plus one from _Bacidia_. There are 4 species in Europe.

11 Thallus crustose. On bark. _B. vermifera_

1 Thallus squamulose. On soil or rock.

22 Thallus not pruinose. Ascospores 20 - 42 µm long, 1 - 7 -septate. (B. ruginosa)

2 Thallus with at least some pruina. Ascospores 12 - 20 µm long, usually 3-septate. _B. lutosas_

Bibbya lutosas (Ach.) Kistenich, Timdal, Bendiksky & S. Ekman (2018)

_Taxon_ 67(5): 891; _Lecidea lutosas_ Ach. (1810), _Lichenogr._ Universalis 182; _Toninia lutosas_ (Ach.) Timdal.

Descriptions: Nash et al. (2002); Nimis & Martellos (2004); Timdal (1991), all as _Toninia lutosas_.

_Crete_, on calcareous rock at altitudes around 250 m.

Southern and south-central Europe. Also Asia (Israel, southern Siberia, Inner Mongolia), Africa (Algeria, Tunisia, Namibia, S. Africa), N. America (Arizona, Colorado, New Mexico), C. America (Mexico).

Bibbya vermifera (Nyl.) Kistenich et al. (2018)

_Taxon_ 67(5): 892; _Lecidea vermifera_ Nyl. (1853), _Bot. Notiser_ 1853: 98; _Bacidia vermifera_ (Nyl.) Th. Fr.

Thallus: crustose, inconspicuous. _Apothecia_: subsessile, flat at first, becoming slightly convex later, 0.2 - 0.5 mm diameter, not pruinose. Disc: black. _Thalline margin_: absent. Exciple: black, becoming almost excluded; in section: 35 - 45 µm wide, red-brown in inner part, black in outer part, K reaction as for epithecium. _Epithecium_: black to red-black, K+ intensifying purplish. _Hymenium_: 40 µm tall, colourless. _Hypothecium_: 150 µm tall, colourless, formed of two fairly distinct layers. _Paraphyses_: simple, not capitate. _Ascospores_: colourless, curved to sigmoid, one end pointed, the other rounded, 22 - 29 x 2 µm. _Pycnidia_: visible externally as black dots, 0.05 mm diameter, immersed in thallus: in
section: red-brown. Conidia: of two types; first type: colourless, narrowly ellipsoid, 3 - 4 x 1 µm; second type (less common): bacilliform, straight, 7 - 9 x about ½ µm. Photobiont: green.

The combination of curved to sigmoid ascii, red-black apothecial pigment, and two types of conidia, is very distinctive. This species can not be confused with any other.

Northern Peloponnesse, on bark of Abies cephalonica at an altitude of 1400 m.

Most reports are from central Europe, though there are scattered reports from further north into Scandinavia. South of the Alps it is very rare, though it is reliably reported for Salamanca in Spain. Also Asia (Siberia, Mongolia), N. America (southern Canada, cooler parts of USA).

**Bilimbia De Not. (1846)**


Literature: The most convenient source for southern European species is Nimis & Martellos (2004), which treats them under *Myxobilimbia*.

About 13 species, some poorly known, of which 5 occur in Europe. They usually occur on soil or over bryophytes or decaying vegetation. They generally require a cool or cold climate, so in southern Europe are almost restricted to the mountains, though *B. sabuletorum* can occur at lower altitudes.

11 Thallus crustose or minutely squamulose. Ascospores (0) 2 - 3 -septate, 14 - 20 µm long. *B. lobulata*
1 Thallus crustose. Ascospores 3 - 12 -septate, 18 - 40 µm long.
22 Ascospores mostly 3-septate. Epithecium brown to red-brown. (B. microcarpa)
2 Ascospores 6 - 11 -septate. Epithecium various.
33 Disk dark brown to black. Epithecium green to black-green. Ascospores 9 - 11 -septate. (B. accedens)
3 Disc pale coloured to brown, not very dark. Epithecium colourless to brown. Ascospores 5 - 9 -septate. *B. sabuletorum*

**Bilimbia lobulata (Sommerf.) Hafellner & Coppins (2004)**

Thallus: small-squamulose, to 3 cm diam. Squamules: green, often white-cottony at the margins, not pruinose, to 0.3 mm diameter, rounded to slightly incised, usually adpressed, sometimes slightly warty. Hypothallus: sometimes visible, black. Vegetative propagules: absent. Cortex: 10 - 40 µm, mostly colourless, sometimes pale brown in outermost 5 µm, outer part (and sometimes entire cortex) structureless, inner part of randomly oriented hyphae with broad lumina; all parts K-. Medulla: poorly developed, white, of loosely interwoven hyphae. Apothecia: convex, 0.5 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Excie: excluded early; in section: brown, of radiating hyphae. Epithecium: colourless, to green-black, green-brown or brown-black, the amount of pigment varying greatly, K-. Hymenium: 70 - 120 µm, colourless to pale brown. Hypothecium: red-brown, K+ slightly purplish. Paraphyses: 1 µm wide in lower part, to 2.5 µm at apex, not capitulate, sometimes branched, very coherent. Asci: 65 x 15 µm, K+ blue in a rather thin layer at the top, and sometimes for a considerable distance down the sides. Ascospores: colourless, usually 3-septate when mature, 8 per ascus, 15 - 20 x 6 - 7 µm, ends ±rounded though often with one end slightly more pointed than the other. Chemistry: medulla K-. Photobiont: green, cells globose, 10 - 15 µm diameter, often aggregated into large clumps and so forming a slightly irregular and slightly discontinuous layer.

The thallus could, at first glance, be confused with some members of *Pannariaceae*, but the green algal photobiont and the 3-septate ascospores clearly distinguish it microscopically.

Very scattered, in the mountains of the mainland and larger islands. On calcareous soil at altitudes above 1000 m.

Almost throughout Europe, though south of the Alps it is restricted to the mountains. Also Macaronesia (CVI), Asia (widespread to as far east as Mongolia), N. Africa (Morocco), N. America (widespread), Australasia (SE Australia, NZS), Antarctica (subantarctic islands, Antarctic Peninsula).

**Bilimbia sabuletorum* (Schreb.) Arnold (1869)**


There is disagreement about whether *B. accedens* is a distinct species or merely a morph of *B. sabuletorum*, but the key treats it as distinct.


Scattered, with no clear pattern. Overgrowing bryophytes on calcareous rock, apparently sometimes directly on
calcareous rock, at all altitudes but commoner above 1000 m.

Almost throughout Europe. Also Macaronesia, Asia (Turkey, Russia, India, China), Africa (Morocco, Algeria, S. Africa), N. America (widespread in cool to temperate regions), perhaps S. America (Argentina), Australasia (NSW, NZS), Antarctica (subantarctic islands, Antarctic Peninsula).

Blastodesmia A. Massal. (1852)


The only species retained in the genus today is not lichenised, but is often treated in the lichenological literature.

Blastodesmia nitida A. Massal. (1852)


Description: Clauzade & Roux (1985).

Scattered in the northern half of Greece, at altitudes of 750 - 1200 m on bark of Fraxinus ornus.

B. nitida is a species of ± southern Europe (Spain, Italy, Yugoslavia, Bulgaria and Greece). Reports for further north may be incorrect. I have not seen any reports for other continents.

Blennothallia Trevis. (1853)


Literature: Carvalho (2012), and Degelius (1974) between them discuss the Greek species, under Collema.

Blennothallia is a segregate from Collema s. lat. It was delimited on molecular grounds, and is not well characterised morphologically. There are four species, of which two occur in Europe. Both are present in Greece.

11 Ascospores submuriform, 15 - 20 x 8.5 µm. B. furfureola

1 Ascospores usually 3-septate, rarely submuriform, 26 - 34 x 13 - 15 µm. B. crispa s. lat.

22 Thallus distinctly foliose, to several cm diameter. B. crispa var. crispa

2 Thallus almost crustose, to 0.5 cm diameter. B. crispa var. metzleri

Blennothallia crispa (Huds.) Otálora, P. M. Jørg. & Wedin (2013) var. crispa

Fungal Diversity 64(1): 282; Lichen crispus Huds. (1762), Fl. Angl. 447; Collema cheileum (Ach.) Ach.; Collema cheileum γ C. (= var.) graniforme (Hoffm.) Ach.; Collema cheileum var. hyporrhizum Nyl.; Collema conchilobum (Flot.) Körb.; Collema crispum (Huds.) F. H. Wigg.; Collema crispum var. crenulatum (Hoffm.) Duby; Collema furvum f. conchilobum (Flot.) Müll. Arg.; Collema furvum var. conchilobum (Flot.) Zahlbr.; Collema subcheilum Harm.; Collema sublimosum J. Steiner.

Descriptions: Ahit et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009), all as Collema crispum.

Fairly common throughout Greece. On calcareous rock or soil, rarely overgrowing bryophytes on soil. At altitudes 0 - 2200 m, but commonest below 1000 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside the tropics), N. America (widespread), Caribbean (PR), C. America (Mexico), S. America (Chile), Australasia (NZN).

Blennothallia crispa var. metzleri (Arnold) Cl. Roux (2014)

Cat. Lich. Fr. 149, nom. inval.; Collema cheileum β (= var.) metzleri Arnold (1861), Flora 44: 258; Collema cheileum var. lividofuscum (Flörke) Zahlbr.; Collema cheileum f. monocarpum (Dufour ex Schaer.) Leight.; Collema crispum var. metzleri (Arnold) Degel.; Collema metzleri (Arnold) J. Steiner.

Description: Carvalho (2012); Clauzade & Roux (1985), both as Collema crispum var. metzleri.

Scattered throughout Greece. Less common that var. crispum (or perhaps overlooked). On calcareous rock at altitudes 0 - 1200 m.

Essentially a species of southern Europe; there are only a few, scattered records from north of the Alps. Also western Asia (Turkey, Syria, Tajikistan), perhaps N. Africa (Algeria), N. America (California).

Blennothallia furfureola (Müll. Arg.) Otálora, P. M. Jørg. & Wedin (2013)

Description: Degelius (1974), as *Collema furfureolum*. Peloponnesse, on calcareous rocky ground at an altitude of 610 m. In Europe, only Italy, Croatia and Greece. Also south and east Asia (India, China, Japan, Vietnam). This is an implausible distribution, and merits further investigation.

**Botryolepraria Canals et al. (1997)**


Literature: The best place to start is the original description in Canals et al. (1997).

The genus has two species, only one of which occurs in Europe.

**Botryolepraria lesdainii** (Hue) Canals et al. (1997)

*Lichenologist* 29(4): 340; *Crocynia lesdainii* Hue (1924), *Lepraria aeruginosa* sensu Sm. (1810), non (Weis) Sm. Descriptions: Canals et al. (1997); Nash et al. (2007); Smith et al. (2009).

Scattered in the southern half of Greece, though not reported for Peloponnese. Modern reports are from rock and soil at altitudes between 17 and 800 m. Older reports include one from bark and at altitudes to well over 2000 m, but they may not be reliable.

The range of *B. lesdainii* is difficult to assess, owing to the unreliability of many older reports and the lack of attention paid to sterile crusts, but it is probably distributed throughout Europe, except perhaps for arctic regions. It requires shade, so may be less common in southern Europe than elsewhere. Also Macaronesia, Asia (widespread), N. America (widespread), Caribbean (Cuba), S. America (Bolivia, Peru), Australasia (Tasmania).

**Brianaria S. Ekman & M. Svensson (2014)**


A genus of four species, formerly placed in *Micarea* but not closely related to that genus. All occur in Europe, but only one is likely to occur in Greece.

**Brianaria bauschiana** (Körb.) S. Ekman & M. Svensson (2014)


Descriptions: Coppins (1983a); Smith et al. (2009), both as *Micarea bauschiana*. Known from a single site in western Crete, on rock at an altitude of 200 m. Widely distributed in temperate Europe to as far north as southern Scandinavia, but rare south of the Alps. Also Macaronesia (Azores, Canary Is), N. America (temperate eastern parts). A report for HK seems doubtful to me.

**Brodoa Goward (1986)**

*Bryologist* 89: 220. Type: *B. oroarctica* (Krog) Goward. Family: *Parmeliaceae*.

Literature: Thell & Moberg (2011) discuss all species.

Three species, all present in Europe, two reported for Greece. They have a distinctly arctic-alpine distribution. Greece is at the limit of their range, and they are known only from high mountains in the extreme north of the country.

11 Medulla KC-. Many secondary lobes present in central parts. **B. intestiniformis**

1 Medulla KC+ red. Secondary lobes few or absent.
22 Thallus adpressed, Medulla P+ orange everywhere. (B. atrofusca)
2 Thallus loosely adpressed to ascending. Medulla P+ orange near lobe tips, but elsewhere P-. **B. oroarctica**

**Brodoa intestiniformis** (Vill.) Goward (1986)


Description: Clauzade & Roux (1985) as *Hypogymnia intestiniformis*; Clauzade & Roux (1989); Smith et al. (2009). Rare, in the far north of Greece on calcareous or siliceous rock at altitudes 1800 - 2100 m. Widespread in central and northern Europe. South of the Alps it is rare and confined to the highest mountains.
Also western and central Asia (Turkey, Russia, Kazakhstan, Mongolia). Reports for N. America are incorrect.

**Brodoa oroarctica** (Krog) Goward (1986)


Description: Nash et al. (2002); Thell & Moberg (2011).

Known from a single mountain in northern Macedonia, on granite rock at altitudes 1750 - 1800 m.

Far northern Europe. The Greek report appears to be the only European one from south of Sweden, and confirmation is desirable. Also Asia (Russia, Mongolia), N. America (widespread).

**Bryobilimbia** Fryday, Printzen & S. Ekman (2014)


Literature: Fryday et al. (2014). As I have seen only one species, see the description of *B. hypnorum* below.

A genus of 6 species in cool and temperate regions, 4 of which are European. The two Greek species are easily recognised by the blue granules in the hymenium. The genus is rare in Greece.

1 Apothecia dark brown to black. Exciple often persistent. Ascospores often thinly 1 (3) -septate, finely warted, 4.5 - 6 (7) µm wide. On bryophytes and plant debris on calcareous rock or calcareous soil. **B. hypnorum**

1 Apothecia pale brown to dark brown. Exciple usually soon excluded. Ascospores simple, without ornamentation. 3 - 4.5 (5) µm wide. On bryophytes over acidic rock or bark. **B. sanguineoatra**

**Bryobilimbia hypnorum** (Lib.) Fryday, Printzen & S. Ekman (2014)


Thallus: crustose, grey, superficial but thin, to 3 cm diameter. Cortex: true cortex apparently absent; outermost part of thallus 15 - 25 µm thick, colourless to very pale brown, without distinct structure. Apothecia: 0.4 - 0.8 mm diameter, sessile, flat, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, becoming almost excluded; in section: 75 µm wide, mosty very dark brown and opaque (structure not visible), sometimes colourless to blue-green in outermost 10 µm. Epitheicum: pale grey, grey pigment K-, N-; epithecium also with dark blue granules. Hymenium: 50 - 65 µm, colourless to pale brown, with dark blue granules. Granules: 1.5 - 3 µm diameter, K+ dull grey-green, N-. Hypothecium: 220 µm tall, mostly very dark brown and opaque, paler brown in uppermost 35 µm, K-, N-, a little pigment dissolving in N but not in K. Paraphyses: simple, 1 µm wide at base, 2 µm at apex, not capitate or moniliform. Asc: 42 x 12 µm, narrowly clavate, Porpidia type. Ascospores: colourless, usually simple, sometimes 1-septate with thin septum, ellipsoid, 14 x 7 µm. Chemistry: thallus K-, C-, KC-, P, UV-. Photobiont: green, cells globose, 10 - 15 µm diameter, forming a rather irregular layer 30 - 50 µm thick.

Very scattered, with no clear pattern, at altitudes 300 m and above. Usually overgrowing bryophytes on calcareous rock and soil, but there is a modern, and probably reliable, report from limestone.

Widely distributed in Europe. Also Macaronesia, Asia (Turkey, Syria, Russia, Mongolia), N. Africa (Morocco), N. America (fairly widely distributed from Alaska to cooler parts of USA), Australasia (scattered in Australia), Antarctica (Signy Is).

**Bryobilimbia sanguineoatra** (Wulf.) Fryday, Printzen & S. Ekman (2014)


Description: The status in Greece of this species is not clear, as the epithet *sanguineoatra* has often been misapplied. The discussion of *Lecidea sanguineoatra* auct., non (Wulf.) Ach. in Purvis et al. (1992) might refer to the taxon reported from Greece. There are no modern reports; the two published records date from 1935 and 1940.

Kefallonia and Macedonia, at altitudes 700 - 1100 m. The only substrate explicitly reported was bark of *Abies cephalonica*.

Central and southern Europe. Also Macaronesia, Asia (Japan), N. Africa (Algeria, Tunisia), N. America (Colorado, perhaps elsewhere in USA).

**Bryoria** Brodo & D. Hawksw. (1977)

*Op. Bot.* 42: 78-81. It is a nomen novum for *Setaria* Ach. ex Michx. (1803) a name which, although legitimate, is not available for use because *Setaria* P. Beauv. (1812), the name of a genus of grasses, has been conserved against it. Type:
**B. trichodes** (Michx.) Brodo & D. Hawksw. Family: Parmeliaceae.

Literature: The genus has been regarded as difficult, mainly because species concepts were too narrow. With the recent reduction to synonymy of many names, the Greek species, at least, are now straightforward. Smith et al. (2009) is a reasonable starting point, but uses the old, narrow species concepts in the fuscescens group.

Easily recognised by the fruticose habit and the dark-coloured branches that are round in cross-section. *Alectoria* and *Usnea* are paler in colour. *Evernia* and *Ramalina* usually have branches that are flattened, and are also paler in colour.

About 42 species, of which 13 occur in Europe. Most are rather northern, and in southern Europe are restricted to the mountains.

Spot tests are difficult, as the dark colour of the thallus tends to mask any positive reaction. Pretreatment with K clears the cortex, so that medullary reactions can be seen more easily. Spot tests are best done on branch tips, which often contain the highest concentrations of lichen substances.

1 Thallus ± erect. Lateral spinules usually present and sometimes abundant. Medulla P- or P+ red.

22 Apical branches paler than basal branches. Medulla K-, C-, KC-, P- or P+ red.

33 Soralia present, with tufts of spinules, arising from pseudocyphellae. Medulla and soralia P-. (B. smithii)

3 Soralia absent. Medulla P+ red. (B. bicolor) Greek report needs confirmation.

2 Apical branches ± same colour as basal branches. Medulla P+ red.

33 Medulla K+ yellow, C+ pink. KC+ red, P+ red. **B. nadvornikiana**

3 Medulla K+, C+, KC+, P+ red. **B. furcellata**

1 Thallus pendent or prostrate. Lateral spinules absent or few. Medulla or soralia (not always both) P+. **B. fuscescens**

**Bryoria furcellata** (Fr.) Brodo & D. Hawksw. (1977)


Description: Purvis et al. (2009).

Known from a single site in Macedonia, near the Bulgarian border, on *Pinus sylvestris* at an altitude of 1550 m.

Northern and central Europe; not present in Mediterranean regions. Also Macaronesia, Asia (widespread), North America (widespread), C. America (Mexico, perhaps elsewhere), S. America (Colombia), Pacific (Hawaii).

**Bryoria fuscescens** (Gyeln.) Brodo & D. Hawksw. (1977)


Thallus: fruticose, to 15 cm long. Branches: pendent, without lateral spinules, usually ± rounded, to 0.5 mm diameter, brown. Pseudocyphellae: absent. Soralia: present, pale green to brown; some tuberculate and others developing in longitudinal fissures in thallus. Cortex: of periclinal hyphae; sometimes spiralling slightly around branch. Chemistry: medulla K-, KC-, P-; cortex possibly K- (a faintly yellowish pigment is mobilised, but unclear whether this is the original cortical pigment going into solution or a + yellow reaction due to atranorin), KC-, P-; soralia K-, KC-, P+ red. Photobiont: green.

Throughout Greece, though uncommon on the islands. Reported at altitudes from 150 m to the tree limit, though commonest above 800 m. Usually on bark of conifers (*Abies*, *Pinus* and *Picea* spp.) or *Fagus*. Less commonly on rock or wood.

Widespread; absent only from regions with an arctic or true Mediterranean climate. Also Macaronesia, Asia (widespread), Africa (widespread in uplands with ± temperate climate), N. America (widespread). Reports for S. America (Argentina, Chile, Falkland Is), Pacific (Hawaii) and Antarctica (widespread) may need confirmation.

**Bryoria nadvornikiana** (Gyeln.) Brodo & D. Hawksw. (1977)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Macedonia, on bark of *Picea abies* and *Pinus silvestris* at altitudes 1300 - 1550 m.

Northern and central Europe, rare in the mountains of the south. Also Asia (widespread), E. Africa (Kenya, Tanzania, Uganda), North America (widespread), perhaps Pacific (Hawaii).
Buella De Not. (1846)

*Giorn. Bot Ital.* ann. 2, 1(1): 195-196. The name is conserved against *Gassicurtia* Fée, though that is now usually treated as an independent genus. Type: *B. disciformis* (Fr.) Mudd (conserved type). Family: *Caliciaceae*.

Literature: The best starting point for saxicolous species is Scheidegger (1993). Information on other species is scattered, but useful sources are Ahit et al. (2002), Clauzade & Roux (1985), Giralt et al. (2000), Smith et al. (2009).

Thallus: crustose, usually some shade of white, grey or brown. Soralia: present in a few species. Cortex: usually present but often poorly structured. Medulla: white, small to medium sized (exceeding 1 mm diameter in only a few species), submersed to sessile, flat or convex, without a thalline margin. Disc black. Exciple: black; in section: usually some shade of brown, dark and almost opaque in some species. Epithecium: brown, K+ reactions various. Paraphyses: about 1 µm wide at base, simple, often capitate, apical cell often with internal brown pigment. Asci: ±Bacidia type. Ascospores: brown, 1-septate in most species, ellipsoid, 8 per ascus, small to medium sized (mostly in range 10 - 25 µm long), without wall thickenings (Buella type) in most species. Chemistry: various. Photobiont: green, trebouxioid.

*Buella* s. lat. contains several hundred species, of which over 80 are present in Europe. They occur on all substrates except leaves. Several segregates have been recognised in recent years, but European lichenologists have been slow to adopt them. *Buella* s. lat. in southern Europe is not at all well known, and it is not clear where many of the species would best be placed if the new segregates were accepted. Mainly for that reason, I take a conservative view of *Buella* here, and only segregate *Amandinea* and *Diplotomma*. Numerous species have been reported for Greece, but the genus is not prominent in the Greek lichen biota.

Some species with immersed apothecia could be confused with *Rhizocarpon*. The two genera have different ascus types, but an easier way to separate them is by paraphyses: simple in *Buella* and distinctly anastomosed in *Rhizocarpon*.

Some keys refer to ascospore types. *Buella* type ascospores have a wall that is uniformly rather thin. *Callispora* type ascospores have a thin wall that is thickened near the septum and near the mid point between septum and tips. *Physconia* type ascospores have a thicker wall that, at intermediate stages of development, is further thickened near the septum.

*B. olympica* Müll. Arg. and *B. samothrakiana* Szatala are not included in the keys, as I have insufficient information.

**Key to Buella main groups**

11 Ascospores 3-septate or submuriform. Group 1.

1 Ascospores 1-septate, or apothecia absent.
   2222 On other lichens. Group 2.
       222 On bryophytes, soil or decaying vegetation on the ground. Group 3.
   22 On bark or wood. Group 4
   2 On rock (usually siliceous).
   33 Apothecia immersed to sessile. Hymenium without oil droplets. Exciple absent or present; if present then excipular pigments K-, N- or N+ red. Group 5
   3 Apothecia sessile, constricted at the base. Hymenium with or without oil droplets. Exciple present; excipular pigments K- or K+, N- or N+ intensifying purple plus a diffusing brown-red solution. Group 6.

**Key to Buella group 1 1: ascospores 3-septate or submuriform**

*B. cedricola* and *B. lecanorae* may belong in *Diplotomma* (as D. cedricola and D. renobalesii) but as I have not seen material of either species, and both are rather poorly known, I treat them here for the present.

11 Vegetative propagules present. On bark or wood.
   22 Thallus white to pale brown-grey, with soralia. **B. griseovirens**
   2 Thallus brown, with blastidia. (B. subericola)
       1 Vegetative propagules absent. On various substrates.
   222 Lichenicicolous on Lecanora albescens. (B. lecanorae)
       22 Terricolous, or overgrowing mosses or lichens on the ground. **B. geophila**
   2 On bark or wood; occasionally lichenicicolous on species on bark or wood (but not on Lecanora albescens).
   33 Thallus K+ yellow > red (norstictic acid). (B cedricola)
   3 Thallus K-, K+ yellow or K+ orange (norstictic acid absent). **B. triseptata**
Key to Buellia group 2: ascospores 1-septate; lichenicolous.

11 Thallus areolate or squamulose, clearly visible.
   222 On Dimelaena oreina. Ascospores 12 - 16 x 6.5 - 7.5 µm. (B. imshaugii)
22 On Buellia tesserata. Ascospores 10 x 5 - 7 µm. **B. epifimbriata**
2 On other hosts.
   33 Thallus brown to grey-brown, obscurely squamulose. Ascospores 12 - 14 x 7 - 8 µm. **B. badia**
3 Thallus white, areolate. Ascospores 11 - 15 x 5 - 8 µm. **B. excelsa**
1 Thallus not visible. See **Karschia**

Key to Buellia group 3: ascospores 1-septate; terricolous (or similar).

11 Thallus with a lobed margin. **B. patouillardii**
1 Margin not lobed.
   22 Thallus C+ red. (B. thiopholiza)
2 Thallus C-.
   33 Thallus K+ yellow. **B. insignis**
3 Thallus K-.
   44 Thallus well developed, fairly thick. **B. epigaea**
4 Thallus poorly developed or very thin. (B. almeriensis)

Key to Buellia group 4: ascospores 1-septate; corticolous

11 Hymenium with numerous oil droplets (Note 1). Exciple usually persistent. Thallus said to be K+ yellow (reaction may be faint) (Note 2). Ascospores 17 - 26 x 7 - 10 µm. **B. disciformis**
1 Hymenium without oil droplets. Other characters various.
22 Ascospores 22 - 25 µm long. Thallus granular. Apothecia 0.2 - 0.3 (0.4) mm diameter, soon becoming convex. (B. hyperbolica)
22 Ascospores 6 - 10 (12) µm long. Thallus not granular. Apothecia 0.2 - 0.3 (0.5) mm diameter, sometimes convex. **B. schaereri**
2 Ascospores 12 - 21 µm long. Thallus not granular. Usually some apothecia more than 0.3 mm diameter (except sometimes in Amandinea punctata), flat or convex.
   33 Thallus KC+ orange, UV+ orange; in section C+ orange. Norstictic acid absent. Ascospores (12) 17 - 20 x 7 - 9 µm. Probably restricted to the uplands (above 1000 m). **B. chloroleuca**
3 Thallus KC-, UV-; in section C-. Norstictic acid present or absent. Ascospore size various. Not restricted to the uplands,
   44 Exciple well developed, 80 - 125 µm wide. Ascospores Physconia type when young, then Buellia type when mature. Norstictic acid often present. Ascospores 11 - 18 x 6 - 9 µm. **B. erubescens**
4 Exciple not exceeding 80 µm wide. Other characters various.
   55 Ascospores Buellia type (without wall thickenings) or Physconia type (thickened only at septum). All reactions negative. Exciple to 80 µm wide. See **Amandinea** key.
5 Ascospores Callispora type (median and lateral wall thickenings) when young, then tending towards Buellia type when mature but always retaining some features of Callispora type. Norstictic acid (K+ red, with crystals) present or absent. Exciple poorly developed, to 60 µm wide.
   66 Ascospores 17.5 - 21 x 7.5 - 9 µm. Norstictic acid often present. **B. iberica**
6 Ascospores 14 - 17 x 5.5 - 7 µm. Norstictic acid absent. (B. mediterranea)

(1) Oil droplets may be almost confined to lowermost part of hymenium and uppermost part of hypothecium.
(2) My single collection of B. disciformis reacts K-, even in thin section.

Key to Buellia group 5: ascospores 1-septate; saxicolous; apothecia immersed.

22 Medulla faintly I+ blue. Apothecia 0.4 - 0.6 mm diameter. Ascospores 12.5 - 14 x 6.5 - 7.5 µm. (B. caldesiana)
2 Medulla I-. Apothecia 0.2 - 0.5 mm diameter. Ascospores 13 - 19 x 6.5 - 10 µm. **B. ocellata**
1 Thallus C- or C+ red. Hypothecium colourless or brown. Ascospores constricted at septum or not. Thallus various.

222 Thallus or medulla K+ yellow > red (norstictic acid)

3 Many ascospores more than 15 μm long (12 - 18 x 6 - 10 μm). Ascospores slightly constricted at septum, finely ornamented. Thallus usually greyish or brownish, less commonly ±white. **B. aethalea**

3 Ascospores not exceeding 15 μm long. Ascospores constricted at septum or not, ornamented or not. Thallus white, grey or brown.

44 Medulla I+ violet. Thallus whitish. Ascospores 9 - 15 x 4.5 - 6.5 μm, not constricted at septum, finely ornamented. **B. spuria**

4 Medulla I-. Other characters various

555 Thallus chalky, well developed; continuous, cracked or slightly areolate. Ascospores not constricted at septum. **B. maritima**

5 Thallus white to grey, but not chalky, generally not very well developed. Ascospores slightly constricted at septum. **B. abstracta**

5 Thallus brown, not chalky. Ascospores not constricted at septum.

66 Thallus areolate, dark brown, often glossy. Ascospores 9 - 12 x 5 - 7 μm. (B. tyroldensis)

6 Thallus cracked, pale brown, matt. Ascospores 10 - 12 x 7 - 8 μm. **B. atrocinerea**

22 Thallus or medulla K+ yellow or orange (norstictic acid absent).

33 Thallus white or grey, without a brown tinge. Medulla I+ violet or I-.

44 Medulla I+ violet. Prothallus absent or poorly developed. Apothecia usually more than 0.3 mm diameter.

55 Medulla K+ yellow > orange (stictic acid; atranorin may also be present). **B. spuria**

5 Medulla I-, K+ weakly yellow (atranorin only; stictic acid absent). **B. subsquamosa**

4 Medulla I-. K+ weakly yellow (atranorin). Black prothallus usually present at margin of thallus. Apothecia 0.15 - 0.3 mm diameter. **B. stellulata**

3 Thallus brown, or at least with a brown tinge. Medulla I-.

44 Thallus obscurely squamulose. Apothecia 0.3 - 0.7 mm diameter. **B. badia**

4 Thallus crustose. Apothecia 0.2 - 0.3 mm diameter. **B. atrocinerea**

22 Thallus K- or thallus not visible.

33 Thallus becoming squamulose. Ascospores 9.5 - 11 x 5 - 9 μm. Apothecia ± flat. (B. griseosquamulata)

3 Thallus not becoming squamulose. Ascospores and apothecia various.

44 Ascospores 6.5 - 8.5 μm wide. See **Amandinea** key.

4 Ascospores to 6 (6.5) μm wide.

55 Apothecia 0.3 - 0.5 mm diameter. Black prothallus present. Thallus superficial, white, areolate. Ascospores 9 - 11 x 5 - 6 μm. **B. tesserata**

5 Medulla I+ blue. (B. leptocline), (B. saxorum), (B. sardiniensis)

5 Apothecia 0.2 - 0.35 mm diameter. Prothallus absent. Thallus sometimes poorly developed, sometimes parasitic.

66 On calcareous rock. Ascospores 10 - 12.5 x 5.5 - 6.5 μm. **B. caloplacivora**

6 On siliceous rock. Ascospores 11 - 13.5 x 4.5 - 5.5 μm. **B. abstracta**

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**Key to Buellia group 6:** ascospores 1-septate; saxicolous; apothecia sessile.

11 Ascospore wall thickened at septum and, independently, on side between septum and tips (but not thickened at tips).

**B. leptoclineoides**

1 Ascospore wall of uniform thickness, or thickened only at septum.

22 Exciple colourless in inner part, red-black in outer part. Hypothecium pale, I+ blue. Ascospores 12 - 15 x 7.5 - 9 μm. **B. vilis**

2 Exciple different. Hypothecium dark, or if pale then I-. Ascospores various.

33 Soredia present. (B. sorediosa)

3 Soredia absent.

44 Exciple of intricate, narrow, randomly oriented hyphae.

55 Medulla I+ blue. (B. leptocline), (B. saxorum), (B. sardiniensis)

5 Medulla I-.

66 On gypsum. (B. almeriensis)

6 On siliceous rock. **B. subdisciformis**

4 Exciple cellular or of broad hyphae.

55 Thallus C+ orange. (B. concinna)

5 Thallus C-.
Buellia abstracta (Nyl.) H. Olivier (1903)

The name Buellia sequax has commonly been misapplied to this species, but when used correctly it denotes the species here called Buellia excelsa.

Descriptions: Nash et al. (2007); Scheidegger (1993); Smith et al. (2009), all as Buellia sequax.

Thallus: crustose, poorly developed, inconspicuous, almost immersed, to 2.5 cm diameter. Prothallus: absent. Apothecia: 0.2 - 0.25 mm diameter, ±flat, sub sessile, not constricted at base, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, becoming almost excluded; in section: 20 - 40 µm wide, mostly dark brown to black, opaque, immermost 5 - 10 µm sometimes brown, not opaque. K-, pigment not soluble in K. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 60 - 70 µm tall, colourless to pale brown, without oil droplets. K+ blue. Hypothecium: 100 µm tall in centre of apothecia, thinning towards margins, mostly dark brown, opaque, uppermost part sometimes brown, not opaque. Paraphyses: simple, 1.5 µm wide at base, capitate, apical cell 3 - 4 µm diameter with brown pigment. Asci: 50 x 10 - 12 µm, narrowly clavate, ±Lecanora type. Ascospores: brown, 1-septate, narrowly ellipsoid, sometimes slightly constricted at septum, 10 - 12 x 5 µm, 8 per ascus. Photobiont: green; cells globose, 7 - 10 µm diameter.

Islands of the Aegean, including Crete. On siliceous rock at altitudes 5 - 300 m. Reports from calcareous rock may reapply to B. caloplacavira.

Basically a species of warm temperate Europe. Present in British Is, but absent from Baltic States, Nordic Countries and most of the eastern half of Europe. Also Macaronies, Asia (Turkey, HK), Africa (Morocco, S. Africa), N. America (western USA), C. America (Mexico).

Buellia aethalea (Ach.) Th. Fr. (1874)
Lichenogr. Scand. 604; Gyalecta aethalea Ach. (1810), Lichenogr. Universalis 669-670; Buellia sorrorides Erichsen; Melanaspicilia aethalea (Ach.) Vain.

Descriptions: Ahti et al. (2002); Nash et al. (2007); Smith et al. (2009).

Very scattered, with no clear pattern. On siliceous rock at altitudes 50 - 2150 m.

Subcosmopolitan. Throughout Europe. Also Macaronies, Asia (widespread), Africa (Morocco, S. Africa; Ascension Is, St Helena), N. America (widespread but scattered), perhaps C. America (Mexico), S. America (Argentina, Bolivia, Brazil, Colombia), Australasia (widespread in Australia; NZS), Pacific (Marquesas), Antarctica.

Buellia atrocinerea (Nyl.) Scheid. (1993)
Lichenologist 25(4): 345; Lecanora atrocinerea Nyl. (1872), Flora 55: 428; Rinodina atrocinerea (Nyl.) Boistel.

Description: Scheidegger (1993).

Northern Peloponnesse, at an altitude of 700 m. The substrate was not reported.

Southern Europe, from Portugal and southern France to Greece. Also N. Africa (Morocco).

Buellia badia (Fr.) A. Massal. (1853)
Mem. Lich. 124; Lecidea badia Fr. (1825), Syst. Orb. Veg, 1; 287; Diploicia badia (Fr.) A. Massal.

Thallus: when well developed obscurely squamulose, of rounded to irregular squamules 0.5 - 1 mm diameter, brown, not pruinose, 150 - 220 µm thick, when free-living forming small patches to about 8 mm diameter; thallus much reduced when parasitic and sometimes entirely absent. Cortex: 15 - 35 µm thick, orange-brown in outermost 5 - 10 µm, colourless or almost in lower part, with a rather obscure cellular structure, K-; sometimes overlain by a colourless epiciphaler layer about 5 µm thick. Medulla: white. Apothecia: 0.2 - 0.7 mm diameter, flat to convex, sessile, not pruinose. Thalline margin: absent. Disc: black, matt. Exciple: black, usually matt, sometimes slightly shiny when young, sometimes becoming excluded; in section: 20 - 40 µm wide, dark brown, almost opaque, of radiating hypheae that develop broad lumina, K-, pigment not soluble in K. Epithecium: brown to dark brown, K- pigment not soluble in K. Hymenium: 60 - 70 µm tall, colourless. Hypothecium: 100 - 150 µm tall, pale brown to dark brown. Paraphyses: 1 - 1.5 µm wide at base, simple, clavate, sometimes with visible septa in upper part, not moniliform, often capitate, apex 2.5 - 5 µm wide, apical cell with internal brown pigment. Asci: 45 - 50 x 11 - 15 µm, ±cylindrical to slightly clavate, apex K+ blue, Bacidia type. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, 11 - 14 x 7 - 7.5 µm. Chemistry: medulla K+ red (norstictic acid) but reaction very patchy; thallus K-, UV-.

Photobiont: green, cells globose, 8 - 16 µm diameter.
Photobiont layer: 50 - 70 µm thick, ±continuous, usually fairly regular but photobiont cells sometimes arranged in vertical columns.

An easily recognised species, provided that at least some thallus is present.

Scattered, with no clear pattern, at altitudes 25 - 1250 m. Parasitic (about half of records) or directly on siliceous rock. Reported from Acaulospora scotica, Lecanora muralis subsp. bolcana, Neofuscelia sp., and Squamarina cartilaginea.

Throughout Europe. Also Macaronesia, Asia (widespread outside warm, moist areas), Africa (Morocco, Algeria, Kenya, Zimbabwe), N. America (cool and temperate parts), C. America (Mexico), perhaps S. America (Argentina), Australasia (widespread but scattered in Australia; NZS).

**Buellia caloplacivora Llimona & Egea (1984)**


**Description:** See the protologue,

Islands of the southern Aegean, on calcareous rock at altitudes 0 - 290 m.

Southern Europe, from Spain to Greece. Also Macaronesia (Canary Is).

**Buellia chloroleuca Körb. (1860)**

* Parerga Lichenol. 191; Tetramelas chloroleucus (Körb.) A. Nordin.

Thallus: crustose, thin, pale grey, to 2 cm diameter, without vegetative propagules. Apothecia: immersed to subsessile, flat to convex, 0.2-0.55 mm diam, not pruinose. Thalline margin: absent. Disc: black. Exciele: black; in section 55 - 70 µm wide, K-. Epithecium: K-. Ascospores: brown, 1-septate, ellipsoid, (12) 16 - 20 x (6) 7.5 - 10 µm, Buellia type. Chemistry: thallus K-, KC+ persistent orange, UV+ orange (or sometimes with a green tinge).

Fairsly easily separable from similar species by the KC+ orange reaction of the thallus and the absence of nostriotic acid.

Typical material is fairly easily recognised by the rather large ascospores and the KC+ orange reaction. The common *Amandinea punctata* has smaller ascospores and is KC-.

Some Peloponnesian collections that appear to belong here have ascospores considerably smaller than the usual lower limit of 17 µm reported in the literature. If the KC reaction is not checked they would key out as *Amandinea punctata*.

Cretan and Peloponnese, on bark of Abies cephalonica and wood of Cupressus sempervirens and Pinus nigra at altitudes 1340 - 1500 m.

Mainly northern and central Europe, rare in the south. Also Asia (Turkey, Russia), N. America (widespread in cooler parts).

**Buellia disciformis (Fr.) Mudd (1861)**

* Man. Brit. Lich. 216: Lecidea parasema var. disciformis Fr. (1826), Nov. Sched. Crit. page 9, no. 215 and 216. (Lecidea disciformis Fr. (1823) is a nomen nudum.); Buellia disciformis f. microspora (Vain.) de Lesd.; Hafellia disciformis (Fr.) Marbach & H. Mayrhofer; Lecidea disciformis (Fr.) Nyl.

Fries introduced the basionym in a very untidy way, and although the name is validly published it is not clear to me whether it is legitimate. Even if legitimate, the correct name for this species may be *Buellia tersa* (Ach.) ined. Conservation may be required to maintain current usage.

Thallus: crustose, pale grey, not pruinose, cracked, 2 cm diameter, 150 - 220 µm thick, without vegetative propagules. Cortex: 15 - 30 µm thick, colourless to very pale brown, obscurely cellular (probably formed of vertical hyphae with broad, rounded lumina), K-. Medulla: white. Apothecia: submersed to subsessile, flat, 0.3 - 1.2 mm diameter, not pruinose. Thalline margin: absent. Disc: black. Exciele: black, thin but persistent; in section: 30 - 50 ± colourless or pale brown in upper part, darkening downwards to very dark brown, K- pigment not soluble in K. Hypothecium: brown to brown, K-, pigment not soluble in K. Hymenium: 100 - 130 µm tall, not well delimited from hypothecium, colourless, with abundant oil droplets in lowermost part (and in uppermost part of hypothecium), sometimes some also present in upper parts, KI+ blue. Hypothecium: to 400 µm thick, colourless or pale brown in upper part, darkening downwards to very dark brown, K- pigment not soluble in K. Paraphyses: 1 µm wide at base, simple, sometimes capitate, apex 2.5 - 3.5 microns, apical cell with internal brown pigment cap. Asci: 80 x 15 microns, narrowly clavate, apex KI+ blue (? Bacidia type). Ascospores: brown, 1-septate, ellipsoid, sometimes slightly curved, 8 per ascus, 17 - 25 x 7 - 9 µm, wall often distinctly paler at apices than at sides, ±Buellia type, rarely tending towards Callispora type when over-mature. Chemistry: medulla K-, 1-; thallus K-, UV- (or almost). Photobiont: green, cells ±globose, 9 - 13 µm diameter, forming a continuous, regular layer 45 - 75 µm thick.

My only Greek collection agrees well with published descriptions of *B. disciformis*, except that the thallus reacts K-, not K+ yellow (atranorin). Further collection are needed to determine whether this is typical of Greek material.

The combination of large apothecia and a hymenium with oil droplets is fairly distinctive among corticolous species of *Buellia*. 
Scattered rather thinly, perhaps throughout Greece, at altitudes 400 - 1500 m. On bark, and reported from Abies sp., Acer monspessulanum, Fagus sp. and Quercus sp.

Throughout Europe, except in regions with true Mediterranean climate. Also Macaronesia, Asia (widespread), perhaps Malesia (Java - old report), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico - old report), S. America (apparently widespread, though some reports old), Australasia (eastern Australia, NZS), Pacific (Hawaii, Marquesas, New Caledonia, Tahiti).

**Buellia dispersa** (A. Massal.) A. Massal. (1856)
Descriptions: Nash et al. (2007); Scheidegger (1993); Wasser & Nevo (2005).

Islands of the Aegean and adjacent coasts of the mainland. On siliceous rock close to sea level. Mainly southern Europe, from Portugal to European Turkey, but present in Austria and Switzerland, and there is a disjunct report for Finland. Also Macaronesia, Asia (Turkey, Israel, Iran), Africa (scattered outside humid tropics), N. America (southern Canada, western USA), C. America (Mexico), perhaps S. America (Chile - old report).

**Buellia epifimbriata** Sipman (2002)
Description: See the protologue.
Islands of the southern Aegean, on Buellia tesserata (=B. fimbriata) at altitudes 70 - 200 m. B. epifimbriata is known only from Greece.

**Buellia epigea** (Pers.) Tuck. (1866)

Crete, at an altitude of 900 m. The substrate was not reported. Widespread in Europe (though absent from British Is), but not common. In southern Europe restricted to the uplands. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (scattered in cool parts), perhaps S. America (Argentina), perhaps Australasia (Australia).

**Buellia erubescens** Arnold (1875)
Verh. k. k. zool.-bot. Ges. Wien 25: 493; Buellia disciformis var. saprophila (Ach.) Jatta; Buellia zahlbruckneri J. Steiner
Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2007; Smith et al. (2009).
Scattered, mainly in northern Greece. Not common. On bark (Juniperus oxycedrus, Pinus nigra, Quercus frainetto), or on wood, at altitudes 700 - 1300 m. Throughout Europe, but in the south confined to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico). Reports for S. America (Argentina, Brazil) are in need of confirmation.

**Buellia excelsa** (Leight.) A. L. Sm. (1911)
Monogr. Brit. Lich. 2: 174; Lecidea excelsa Leight. (1875), Grevillea 4(30): 78; Buellia caloplacivora Llimona & Egea
The correct name is B. sequax (Nyl.) Zahlbr, since the epithet sequax has priority over excelsa by a few months. However, the name B. sequax has been misapplied in the past, and I am reluctant to take it up, since doing so may cause confusion. It might be best to formally reject the name Lecidea sequax Nyl.
Descriptions: Smith et al. (2009); Scheidegger (1993)
Known from two sites on Chios, on sandstone and on weakly calcareous rock, at altitudes 100 - 500 m. Western Europe to as far north as Scotland and Denmark, and Mediterranean coasts from France to Greece. Also Macaronesia, Asia (Turkey), N. America (western USA), C. America (Mexico), South America (Brazil, Chile, Paraguay, Uruguay), Pacific (Hawaii). Reports for the Americas may refer to a different species.

**Buellia geophila** (Flörke ex Sommerf.) Lyne (1937)
Meddel. Grønl. 118(8): 177, 181; Lecidea geophila Flörke ex Sommerf. (1826), Suppl. Fl. Lapp. 158; Buellia triphragmia (Nyl.) Arnold; Diplotomma triphragmium (Nyl.) Szatala.
Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nordin (2000b).
Scattered, with no clear pattern, at altitudes 400 - 900 m. On bark of Juniperus oxycedrus or Quercus coccifera, or on wood of Juniperus oxycedrus. The epithet suggests a terricolous species, although according to Moberg, in Ahti et al. (2002), it is occasionally corticolous. In Greece it would be expected to occur at montane levels, and the Greek
reports may refer to a different taxon. Greek reports were all as *B. triphragmia*, but according to both Nordin (2000b) and Ahti et al. (2002) that name is a synonym of *B. geophila*. Something does not seem quite right here.

Widespread in Europe from the Alps northwards, but very rare in the south. Also Asia (widespread), N. Africa (Morocco, perhaps elsewhere), N. America (northern USA northwards). Old reports for S. America and the Pacific seem doubtful to me.

*Buellia griseovirens* (Turner & Borrer ex Sm.) Almb. (1952)


Thallus: crustose, white to very pale brown-grey, not pruinose, thin (50 - 80 µm), continuous, to a few cm diameter. Soralia: white to blue-grey, delimited, usually ±circular but sometimes elongated along grain of substrate, 0.3 - 0.6 mm diameter, initially slightly excavate, later flat but slightly raised. Cortex: colourless. Medulla: poorly developed. Apothecia: subsessile, flat, 0.5 - 0.9 mm diameter, not pruinose. Thalline margin: absent. Disc: black. Exciple: black, 0.07 - 0.1 mm wide, persistent; in section: 70 - 90 µm wide, very dark brown to almost black, continuous with hypothecium, nearly opaque, K-. Epithecium: colourless to dark brown, K-. Hymenium: 130 µm tall, colourless, without oil droplets. Hypothecium: 100 µm tall, brown in uppermost 20 - 40 µm, dark brown in lower part, K-. Paraphyses: 1.5 µm wide, simple, not moniliform, usually slightly capitate, apex 2 - 3 µm, usually with internal crescent of brown pigment, sometimes with visible septa in upper part. Asci: 75 x 20 µm, clavate. Ascospores: brown, 3-septate to submuriform, 8 per ascus, 23 - 26 x 12 - 17 µm. Chemistry: soralia C+ faintly orange, K+ yellow > red, P+ yellow to orange; thallus C-, K+ yellow > red (norstictic acid), P+ yellow. Photobiont: green, cells globose, 8 - 16 µm diameter, forming a continuous, regular layer 50 - 60 µm thick.

The description of the paraphyses above refers to what appear to be the "normal" paraphyses of the lichen. In the material studied, what appears to be a second set of paraphyses is also present. These are variously oriented (not just vertical), 2 - 4 µm wide, anastomosed, and bearing many colourless spheres 2 - 4 µm diameter (? oil storage cells). The host apothecium does not appear to be harmed in any way. They may belong to a parasymbiont. Additional collections are needed to determine their status.

*Phlyctis argena* has similar K and P reactions, but its soralia never have a blue tinge and it almost always lacks apothecia.

Very scattered, with no clear pattern. On bark or wood, usually of conifers, at altitudes 700 - 1400 m.

Throughout Europe except for the high arctic, though in the south restricted to the uplands. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Tunisia), N. America (widespread but scattered), perhaps S. America (Chile), Australasia (both islands of NZ).

*Buellia iberica* Giralt (2000)


Description: See the protologue.

Chios and Samothraki, on bark at altitudes 575 - 800 m. The only phorophyte explicitly reported was *Quercus pubescens*.

Only southern Europe (Andorra, Portugal, Spain, Greece).

*Buellia insignis* Körb. (1855)

*Syst. Lich. Germ.* 230-231; *Tetramelas insignis* (Körb.) Kalb

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Macedonia, at an altitude of 1300 m, on bark of *Juniperus oxycedrus*. Although this species is usually terricolous (at least in northern Europe), according to Ahti et al. (2002) it is occasionally corticolous.

Arctic and subarctic mountains of the Pyrenees, Alps and Caucasus. Reliably reported from south of the Alps from a few montane localities in Italy and Greece. Also Asia (widespread), N. America (a few scattered localities), Australasia (NZS). I am sceptical of a report for Caribbean (Guadeloupe).

*Buellia leptoclinoides* (Nyl.) J. Steiner (1907)


Islands of the Aegean, on siliceous rock at altitudes 5 - 450 m.

Southern Europe and the Atlantic margin to as far north as British Is. Absent from northern Europe and parts of eastern Europe with a continental climate. Also Macaronesia (Canary Is), Africa (widespread in N. Africa and mid Atlantic islands).
Buellia maritima (A. Massal.) Bagl. (1856)
in Massalongo, Sched. Crit. 150; Catolechia maritima A. Massal. (1855), Symm. lich. nov. 51-52; Buellia subalbula auct. mult.
Thallus: crustose, white, rather chalky, not pruinose, forming small circular patches 1 - 4 mm diameter when rock smooth, often extending along cracks in rock otherwise, continuous to almost areolate, 150 - 170 µm. Areoles: contiguous, no hypothallus visible between them. Prothallus: prominent, black, 0.1 - 0.7 mm wide. Cortex: 25 - 35 µm thick, colourless, without distinct structure, K- (usually no norstictic acid in cortex). Medulla: white. Apothecia: submersed to subsessile, flat, 0.3 - 0.5 mm diameter, not pruinose. Thalline margin: absent. Disc: black. Exciple: thin, (0.02 - 0.04 mm) but persistent; in section: 30 µm wide, dark brown, opaque. Epitheciun: dark brown, K-, pigment between paraphyses dissolves but internal pigment in apical cell not soluble in K, N+ reddish. Hymenium: 50 - 80 µm tall, colourless, upper part sometimes with some epitecial pigment. Hypothallus: 80 - 130 µm, colourless in upper part, brown below. Paraphyses: 1 µm wide at base, simple, usually capitiate, apical cell 2.5 - 5 µm wide with internal brown pigment. Asci: 50 x 14 µm, narrowly clavate, apex KI+ blue. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, 11 - 13 x 7 µm. Chemistry: medulla K+ yellow > red (abundant norstictic acid), I-; thallus C- appearing K+ yellow > red in spot tests but this is just intense medulla reaction showing through, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: 30 - 80 µm thick, slightly irregular (cells tending to form clumps), sometimes discontinuous.
The small white rosettes, bounded by a black prothallus are distinctive.
Scattered, but usually near the coast. A 19th Century report for inland Greece (Kalambaka) may be incorrect. On siliceous rock at altitudes 0 - 300 m.
Only Italy and Greece in Europe. Also Macaronesia (Tenerife), Asia (Israel, Bahrain Yemen, S Korea), perhaps Africa (Angola, St. Helena), N. America (California), C. America (Mexico), Australasia (SE Australia). Many reports from outside Europe are of B. subalbula, which may be a different species.

Buellia ocellata (Flot.) Körb. (1855)
Syst. Lich. Germ. 224; Lecidea petraea var. ocellata Flot. (1828), Flora 11(2): 691; Buellia verruculosa auct. mult., non (Sm.) Mudd.
Descriptions: Ahti et al. (2002); Clauzade & Roux (1985) as Buellia verruculosa; Smith et al. (2009).
The green tinge to the thallus is unique among Buellia species so far recorded for Greece, and this species is unlikely to be confused with any other.
Northern Peloponnese, on siliceous rock at altitudes above 1100 m. A rather rare species, known in Greece only from a single recent collection and a single one from the 19th century.
Widespread except for parts of eastern Europe with distinctly continental climate. In southern Europe restricted to the mountains. Also Macaronesia, Asia (Turkey, Russia, India, perhaps Thailand), N. America (California, Maine), Australasia (SE Australia), NZS.

Buellia olympica Müll. Arg. (1879)
Description: The only descriptions that I have seen are the protologue and Steiner (1898: 160), neither of which provide enough detail for modern purposes. The protologue states “habitat ad saxa granitica montis Olympi”. Unfortunately, the collector was not stated, and it is not clear to me who might have collected from Mt. Olympus at this early date. Müller does not explicitly mention Greece, and he may mean the Bithynian (Turkish) Mt. Olympus.

Widespread except for parts of eastern Europe with distinctly continental climate. In southern Europe restricted to the mountains. Also Macaronesia, Asia (Turkey, Russia, India, perhaps Thailand), N. America (California, Maine), Australasia (SE Australia), NZS.

Buellia patouillardii (Hue) Zahlbr. (1931)
Cat. Lich. Univ. 3: 387; Lecidea patouillardii Hue (1897), Catalogue raisonné 149 as patouillardii; Buellia zoharyi Galun ex Poelt & Sulzer.
Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Wasser & Nevo (2005), all as B. zoharyi.
Crete, at an altitude of 150 m. The substrate was not reported.
Basically a circum-Mediterranean/Macaronesian taxon. Southern Europe: Spain, Italy, Greece, Cyprus. Also Macaronesia (Lanzarote), Asia (Israel; also just outside the Med in Iran), N. Africa (Morocco, Egypt).

**Buellia samothrakiana** Szatala (1943)  

Description: See the protologue. Unfortunately, it does not provide enough detail for modern purposes. The name was lectotypified by Şenkardeşler et al. (2014: 141), and a modern description needs to be prepared from the type.  
Island of Samothraki, on siliceous rock. The altitude was not reported.  
Known only from the type collection.

**Buellia schaereri** De Not. (1846)  

Thallus: crustose, very thin (about 50 µm), inconspicuous. Apothecia: sessile, ±flat, 0.25 mm diameter, not pruinose. Thalline margin: absent. Disc: black. Exciple: black, about 0.03 mm wide, ±persistent; in section: 50 - 60 µm wide, brown to red-brown, of radiating hyphae with lumina broadening in outer part, K-, pigment not soluble in K. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 50 µm tall, colourless to pale brown, without oil droplets, KI+ blue. Hypothecium: 70 µm tall, red-brown, K-, pigment not soluble in K. Asci: 35 - 40 x 10 µm, clavate.  
Ascospores: pale brown to brown, 1-septate, ellipsoid, 8 per ascus, 9 - 11 x 5 µm. Photobiont: green; cells globose, 7 - 10 µm diameter.  
Ascospore widths cited in the literature are in the range (2.5) 3 - 4 (4.5) µm, but in the single collection I have seen most ascospores were nearly 5 µm wide.  
Fairly easily recognised by the combination of ascospores that are small (for _Buellia_), small apothecia, and the corticolous habit. Externally could be confused with _Catillaria nigroclavata_ or some morphs of _Amandinea punctata_, but easily separated from those species by its ascospores.  
Scattered, mainly in the southern half of Greece. Not common. On bark at altitudes 300 - 1000 m. Reported from _Acer_ sp., _Pinus brutia_ and _Quercus frainetto_.  
Widespread as far north as the tree limit. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Socotra, perhaps Sao Tome), N. America (widespread in eastern half), C. America (Mexico), S. America (Argentina, Brazil, Colombia), perhaps Australasia (NSW).

**Buellia spuria** (Schaer.) Anzi (1860)  
_Cat. Lich. Sondr._ 87 and by Körber in _Parerga Lichenol._ 183. It is not known which was published first.; _Lecidea spuria_ Schaer. (1828), _Lich. Helv. Spic._ 127.  
Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).  
Chios and Evia, on siliceous rock at altitude 5 - 300 m.  
Mostly central and southern Europe. Present in British Is, but its status in the Nordic Countries has been disputed; not reported for Baltic States. Also Macaronesia, Asia (Turkey, China, Taiwan), Africa (scattered), N. America (widespread, mainly in USA), Caribbean (Cuba), C. America (Mexico), S. America (widespread south of the tropics), Australasia (widespread), Pacific (Hawaii).

**Buellia stellulata** (Taylor) Mudd (1861)  
Descriptions: Ahti et al. (2002); Nash et al. (2007); Smith et al. (2009).  
The Peloponnesian collection cited in Abbott (2009) belongs to _B. maritima_, a species which Abbott, following Scheidegger (1993), regarded as synonymous with _B. stellulata_.  
Islands of the Aegean, including Crete, never very far from the sea. On siliceous rock at altitudes 0 - 300 m. Some reports may refer to _B. maritima_.  
Subcosmopolitan in cool to warm temperate regions, but absent from humid tropics and regions with a strongly continental climate. Widespread in Europe, except for the most continental eastern parts. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (warmer parts of USA), C. America (Mexico, perhaps CR), S. America (widespread), Australasia (widespread), Pacific (widespread), perhaps Antarctica (St Paul Is - old report).

**Buellia subdisciformis** (Leight.) Jatta (1900)  
Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).  
Common on the islands of the Aegean, including Crete. On siliceous rock at altitudes 0 - 830 m, but commonest
below 400 m.
Warmer temperate Europe, as far north as British Is. Absent from Nordic Countries, Baltic States and those parts of eastern Europe with a continental climate. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), perhaps N. America, C. America (Mexico), S. America (Brazil), perhaps Australasia (old report for NSW), Pacific (New Caledonia). I am sceptical of all the Southern Hemisphere reports.

**Buellia subsquamosa** J. Steiner (1907)


According to Scheidegger (1993) this species is present in Greece, on rock. No further details were given.

Mainly southern Europe (Portugal, Spain, Italy, Greece), though also present in southern France and Austria (Tirol). There are no reports for other continents.

**Buellia tesserata** Körb. (1860)

*Parerga Lichenol.* 189; *Buellia fimbriata* (Tuck.) Sheard.

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2007).
Scheidegger (1993) considered that *B. tesserata* was known only from the Norwegian type collection, but he had a concern that the type had been labelled with an incorrect locality. *B. tesserata* is now considered to be the correct name for *B. fimbriata*, a Mediterranean species.
 Islands of the southern Aegean. On siliceous rock at altitudes 10 - 450 m, but most reports are from below 200 m.

Mediterranean and Atlantic Europe, though absent from British Is; almost absent from interior of Europe. Also Macaronesia (warmer parts), Asia (Turkey, Bahrain), Africa (Morocco, Algeria; Ascension Is, St Helena), N. America (Arizona, California, perhaps Oklahoma), C. America (Mexico).

**Buellia triseptata** A. Nordin (1999)

*Bryologist* 102(2): 260-262.
Thallus: crustose, sometimes wide-spreading, to several cm diameter, but more commonly as very small, inconspicuous patches, white to very pale brown-grey, not pruinose, sometimes slightly warted, immersed to thinly superficial (80 - 100 µm); thallus absent when parasitic. Cortex: 20 - 30 µm tall, colourless, not well structured but an irregular network of hyphae sometimes visible, K- Medulla: poorly developed. Apothecia: sessile, flat to convex, 0.2 - 0.75 mm diameter, not pruinose. Thalline margin: absent. Disc: black. Proper exciple: black, thin, sometimes becoming excluded; in section: 50 µm wide, red-brown in inner part, dark brown in outer part, of radiating hyphae that develop broad lumina in outer part. Epitheci um: brown to dark brown, K-, pigment not (or incompletely) soluble in K. Hymenium: 120 µm tall, pale brown to dark brown. Paraphyses: 1 µm wide, simple, capitate, apex to 4 µm with internal brown pigment. Asci: 50 - 75 x 15 µm, clavate, ±Bacidia type. Ascospores: brown, 3-septate, 8 per ascus, 16 - 20 x 5 - 7.5 µm, sometimes slightly curved, ornamentation sometimes visible. Chemistry: thallus K- C-, but spot tests often difficult to interpret because thallus thin. Photobiont: green, cells globose to slightly ellipsoid, 7 - 10 µm diameter. Photobiont layer: 60 - 80 µm thick, sometimes discontinuous.
Parasitic specimens are difficult to separate with certainty from species of *Diplotomma*.

Northern Peloponnese, On bark and wood of conifers at altitudes 1200 - 1400 m. Once apparently parasitic on a species of *Pertusaria* in the same environment (though the parasitic specimen might belong in *Diplotomma*).

Southern Europe, from Portugal and southern France to Greece. Also Asia (Turkey), N. America (western USA), C. America (Mexico).

**Buellia vilis** Th. Fr. (1867)


Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2007).

If a perhaps anomalous report for Sterea Ellada, at high altitude on limestone, is discounted, then this species is scattered in localities close to the sea, and occurs on siliceous rock at altitudes 350 - 700 m. However, there are no modern, confirmed reports of this species, and its status in Greece is not entirely clear.

Widespread in central and northern Europe, but very rare south of the Alps. Also Asia (Russia), N. America (widespread in cold parts of western half), continental Antarctica.

**Calicium Pers.** (1794)


Literature: There is no worldwide or even European monograph, but the standard floras all cover the few species
that occur in Greece. Ahti et al. (1999), Muñiz & Hladun (2011), Smith et al (2009) are all helpful; Clauzade & Roux (1985) is merely adequate. There is a key to all European species in Tibell (1999).

Thallus: crustose, immersed to moderately well developed. Ascomata: stalked, mazaediate, often with a distinct pruina. Ascospores: brown, 1-septate, often with surface ornamentation, forming a black mass.

About 35 species, about 21 of which occur in Europe. Most occur on bark or wood in undisturbed forests in cool or temperate regions. These ecological requirements are not easily met in Greece, and the genus is almost restricted to the few remaining patches of undisturbed montane forest, where it is uncommon.

Species of Calicium are difficult to work with. They are rare in Greece, so it is hard to acquire adequate material for study. They are fragile, and must be curated with care if they are not to disintegrate in the herbarium. The stalk and head are brittle, which makes it almost impossible to cut good thin sections (without a microtome), but squash preparations are not adequate for observing fine details.

11 Pruina on ascomata yellow. (C. adspersum)
1 Pruina absent or not yellow.

22 Stalk of apothecia short, less than twice as long as diameter of head. Thallus often well developed.
33 Thallus green to yellow-green, often well developed, finely granular. Asci clavate. On rock. (C. corynellum)
3 Thallus grey to green, well developed, irregularly granular to verrucose. Asci cylindrical. On wood. (C. montanum)

2 Stalk long, at least twice as long as diameter of head (Note 1). Thallus well developed or not.
33 Stalk and exciple in section or squash I+ dark blue to blackish. Ascomata usually with a distinct white pruina on lower surface of head. Ascospores only becoming septate at a late stage, generally non-septate while in the ascus. (C. lenticulare) Greek report doubtful.
3 Stalk and exciple in section or squash I-, or only a colourless surface layer of the stalk I+ slightly red-blue. Pruina various, or absent. Ascospores 1-septate from an early stage.
44 Mature asci clavate. Thallus distinctly green or yellow-green. C. viride
4 Mature asci cylindrical. Thallus variously coloured, or inapparent; grey-green in some species but not distinctly green or yellow-green.
5 Lower side of head with brown pruina. Ascospores 8 - 10 x 3.5 - 4.5 µm. Thallus poorly developed. C. salicinum
5 Lower side of head without brown pruina. Ascospores various. Thallus various.
66 Thallus thick, grey, with granular surface, K+ yellow-red, C-. Ascospores 9 - 11 x 4 - 5 µm. C. quercinum
6 Thallus immersed or thinly superficial. Ascospores various.
77 Ascomata without pruina. Asci 49 - 60 µm long. Ascospores 13 - 15 µm long. Apothecia black or dark brown. C. abietinum
7 Ascomata usually with white pruina (sometimes faint), at least along edge of exciple. Asci 35 - 41 µm long. Ascospores 9 - 13 µm long. Apothecia black. C. glaucellum

(1) At least in C. glaucellum, stalk length is very variable, and I have seen material in which stalks are short enough to cause confusion. In case of difficulty, note that C. glaucellum always has a poorly developed thallus.

Calicium abietinum Pers. (1797)
Tent. Disp. Meth. Fung. 59; Calicium abietinum f. denigratum auct. graec., non (Vain.) Zahlbr.; Calicium abietinum var. minutum (Körb.) Keissl.

Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Muñiz & Hladun (2011); Nash et al. (2004); Smith et al. (2009).

Northern Greece and perhaps the island of Samos, on bark of Pinus or on wood at altitudes of 600 - 1200 m.

Subcosmopolitan in cool and temperate regions. Widespread in Europe as far north as southern Scandinavia, but uncommon south of the Alps. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Kenya), N. America (widespread), C. America (Guatemala), S. America (Chile, Colombia, Paraguay, Venezuela), Australasia (widespread).

Calicium glaucellum Ach. (1803)
Methodus 97; Calicium abietinum var. glaucellum (Ach.) Vain.

Thallus: crustose, immersed or inconspicuous. Head: black, 0.2 - 0.3 mm diameter, sometimes slightly white pruinose on upper surface, especially of exciple. Stalk: black, 0.25 - 1 x 0.05 - 1 mm, reacting I- in squash. Asci: cylindrical, 40 - 53 x 4 µm. Ascospores: brown and 1-septate when mature (colourless and often simple when young), 10 - 13 x 4.5 - 5 (7) µm, ellipsoid, uniseriate in ascus, surface ornamented.

The white pruina, especially on the upper surface of the exciple, is distinctive among Greek species. Calicium
Calicium salicinum Pers. (1794)

The nomenclature requires clarification. Persoon included in synonymy three earlier names, Mucor lichenoides L., Trichia lenticularis Hoffm. and "Embolus" (error for Elvela) sepulchralis Batsch. The first has been formally rejected, but the other two are legitimate. Unless Persoon's name can be shown to have been sanctioned, which I have not been able to do, conservation may be required. The name Mucor sphaerocephalus L. (1753), not cited by Persoon, may be another earlier synonym, but it has been formally rejected.

Thallus: poorly developed. Stalk: black, 0.8 - 1.3 x 0.15 mm. Head: 0.3 - 0.35 mm diameter, 0.2 mm tall, black, brown pruinose on side, also on upper surface in immature apothecia. Asci: 42 - 50 x 4 µm. Ascospores: pale brown, 1-septate, 8 - 10 x 3.5 - 4 µm, usually ±ellipsoid but sometimes slightly asymmetric or irregular, uniseriate, with ornamentation.

The brown pruina on the margin of the head is distinctive.

Scattered thinly throughout Greece at altitudes of 600 - 1500 m on bark or, less commonly, wood. Reported from bark of Abies cephalonica, Juniperus drupacea, Quercus pubescens and wood of Prunus pseudoarmeniaca.

Throughout Europe, except for treeless arctic regions, but uncommon south of the Alps. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Algeria, Malawi, widespread in E. Africa), N. America (widespread), Caribbean (DR, PR), C. America (CR, Guatemala, Mexico, Nicaragua), S. America (widespread), Australasia (widespread).

Calicium viride Pers. (1794)

The only species is discussed in all the standard Floras, under Collema. Collema is a recent segregate from Collema s. lat., for a single species.
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So cotra), N. America (Alaska, Alberta, BC, perhaps elsewhere).

**Caloplaca Th. Fr. (1860)**

Lich. Arct. 118. It is a nomen novum for *Callopisma* de Not., nom. illeg. (later homonym of a generic name of vascular plants). It is conserved against *Pyrenodesmia* A. Massal. (1853) and *Xanthocarpia* A. Massal. & de Not. (1853), though they are now usually regarded as independent genera. Type: *C. cerina* (Hedw.) Th. Fr., listed in Appendix of ICN.

Family: Teloschistaceae.

As circumscribed here, *Caloplaca* includes the crustose members of *Teloschistaceae*. Thus delimited, it is artificial and heterogeneous. It is being subdivided, and the subdivision is an improvement, but many species that do not belong in the now more narrowly delimited *Caloplaca* s. str. have not yet been placed elsewhere. Because the new divisions are not closely linked to morphology, or to other readily observable characters, I can not reliably make the necessary re-dispositions myself. Also, the new genera are themselves sometimes unstable. Those difficulties make it inconvenient to use the new genera in this Flora.

A practical solution is to indicate the new generic names, for those who wish to use them, but not to arrange the Flora according to them. That makes it possible to show the latest taxonomic ideas without disrupting the organisation of the Flora every time someone publishes a new phylogenetic hypothesis. These alternative generic names are shown here in parentheses for all cases for which they have been published: for example *Caloplaca* (*Pyrenodesmia*) *variabilis* means the species treated here as *Caloplaca variabilis*, which some recent authors would treat as *Pyrenodesmia variabilis*. When the taxonomy of a new genus appears to have stabilised, information for it will be extracted from this section and placed under the new generic name.

Literature: It is very difficult to get a good overview of this group in southern Europe. The last attempt at a European summary was in Clauzade & Roux (1985), but it is based on western species rather than those of SE Europe, it is far from perfect even for western Europe, and many new taxa have been described since then. Galloway (2007a), Nash et al. (2007) and Smith et al. (2009) contain extensive discussions of *Caloplaca*, and are sometimes useful, but were not written with SE Europe in mind and must be used with care in Greece. There have been several publications dealing with small groups, but some of them have a northern European bias; these too should be used with circumspection in Greece. They include: Arup (2006a) for the citrina group; Arup (2009) for the holocarpa group; Arup & Ákélius (2009) for taxa related to *C. herbidella*; Gaya (2009) for the saxicola group; Giralt, Nimis & Poelt (1992) for the florubescens group; Muggia, Grube & Tretiach (2008) for the endolithic, black-fruited species; Navarro-Rosínés & Hladun (1996) for the lactea group; Seichting (1999) for species with bluish and greenish soredia; Šoun et al. (2011) for the cerina group; van den Boom & Rico (2006), who provide a key to the idisiate and granular isidiate species occurring in western Europe; Vondrák, Říha et al. (2009) for the citrina group in the Black Sea region; Vondrák, Šoun et al. (2008), who provide a key to saxicolous members of the cerina group; and Wunder (1974) who monographed the black-fruited taxa, though not very satisfactorily.

*Caloplaca* is a large, and troublesome, group. Many species are poorly understood, many species are difficult to separate (in part, because they are poorly understood), there are probably still several undescribed species in Europe, and the taxonomy has usually been developed in northern and western Europe and is sometimes unsatisfactory when applied to Greek collections. I have many Greek collections that I can not determine, and the present treatment of the genus must be regarded as provisional.

Because of the difficulties, it is even more important in this group than in most to work only with well-developed material in good condition. Poorly developed, damaged or immature collections commonly display ambiguous characters and are often impossible to key out reliably.

The genus as circumscribed here is too heterogeneous for a description to be useful. Most, but not all, species have some part that is coloured orange, yellow or red and that reacts K+ purple. The genus is cosmopolitan, though probably poorly represented in the humid tropics, and occurs on all substrates, except leaves. The group shows some overall preference for warm, dry, conditions, and some tendency to avoid strongly acidic or nutrient-poor substrates. It is very well represented in Mediterranean regions of Europe.

*Caloplaca* in the sense used here is a large assemblage of about 800 species, of which about 270 occur in Europe. It contains the majority of the species in *Teloschistaceae*. About 125 species are present in Greece, but the genus can not be said to be well understood here.

Many new species have been described in recent years, and that can make it difficult to evaluate old reports; some of them almost certainly refer to the new species. Some of the authors own collections, originally reported under a different name, belong to species that were not described when the original determination was made.

*C. biatorina* var. *puisilloides* J. Steiner, *C. festivella* (Nyl.) Kieff, *C. hymetti* J. Steiner, *C. sororicida* M. Steiner & Poelt, and *C. transascpica* (Nyl.) Zahlbr. are reported for Greece but are not included in the keys as I have insufficient
information.

Key to Caloplaca main groups

11 Apothecia black, dark brown or brown, without any yellow, orange or red tinge even when young. Epithecium K+ violet, K+ red-brown or K-; never K+ red or purple (parietin absent). Thallus not yellow, orange or red.
22 On rock. Group 1A.
2 On bark or wood. Group 1B.
1 Apothecia yellow, orange, or red (rarely becoming ±black when old); or apothecia absent. Epithecium K+ red or purple (parietin). Thallus variously coloured; yellow, orange or red in many species.
22 Vegetative propagules present.
33 Soredia absent, or if present derived from disintegration of granular isidia. Primary vegetative propagules corticate (Note 1). Group 2.
3 Soredia present, not derived from disintegration of granular isidia. Corticate vegetative propagules present or absent.
44 Soredia some shade of yellow, orange or red, K+ purple. Group 3A.
4 Soredia differently coloured, K- in most species, rarely K+ violet or purple. Group 3B.
2 Vegetative propagules absent.
33 Thallus, and thalline margin if present, orange, yellow or green-yellow, at least in places; orange part K+ purple.
44 Thallus with a lobed margin.
66 Ascospores not polarilocular (usually simple or 1-septate). Group 5A.
55 Ascospores polarilocular, rhomboid or lemon shaped, at least when mature. Group 5B.
5 Ascospores polarilocular, remaining ellipsoid. Group 5C.
4 Thallus without a lobed margin.
55 Ascospores not polarilocular (usually simple or 1-septate). Group 6.
5 Ascospore polarilocular
   66 Ascospore septum thin, remaining less than 3 μm wide. (Note 2) On rock (nearly always calcareous), or on calcareous soil at high altitudes. Group 7.
6 Ascospore septum at least 3 μm wide in mature ascospores. (Note 2) On various substrates.
   7777 Parasitic, at least when young, on lichens on rock. Group 8A
7777 On bark. Thallus green-orange, green-yellow (Note 3) or golden yellow. Pycnidia usually present in marginal parts of thallus. Group 8B
77 On calcareous rock. (Note 4). Group 8C
7 On siliceous rock. Group 8D
3 Thallus, and thalline margin if present, white, grey, green-grey, (rarely brown or yellow-green), or inapparent; K- (or rarely K+ yellow). Note 5.
44 Apothecia sessile, with prominent, broad, persistent, grey thalline margin. Group 4.
4 Not as above. A thalline margin may be present in young apothecia, but it becomes excluded or does not remain prominent.
55 Ascospore septum thin, remaining less than 3 μm wide. (Note 3) Group 9.
5 Ascospore septum at least 3 μm wide in mature ascospores. (Note 3)
   6666 Parasitic, at least when young, on lichens on rock. Group 10A
6666 On bryophytes or on decaying vegetation on the ground. Not in Mediterranean or sub-Mediterranean climatic zones. Group 10B
666 On bark or wood. Group 10C
66 On calcareous rock or (occasionally) calcareous soil. (Note 5). Group 10D
6 On siliceous rock or (occasionally) non-calcareous soil. Group 10E

(1) Isidia, blastidia and schizidia are corticate, soredia are not. However, the distinction is not always easy to apply in practice. Small, rounded blastidia, schizidia and other corticate protuberances may superficially resemble soredia. If a specimen with small, rounded propagules does not key out in one branch, try the other branch.
(2) Unfortunately, this dichotomy is not sharp. If a specimen with septum width near the cutoff value does not key out in one branch, try the other branch.
(3) The green tinge is not apparent in some forms of artificial light, so use natural light or a daylight bulb. The green tinge is easily overlooked in small thalli.
(4) Some parasitic species are not obviously so. If a specimen fails to key out here, try the key to Group 8A.
(5) If the thallus is inapparent and the apothecia have an orange exciple, it is advisable confirm in section that the margin lacks algae, i.e. that there is no orange thalline margin. Lichens with an orange thalline margin do not
belong in this branch.

Key to Caloplaca group 1A: without orange pigments, on rock.

Species concepts in this group have not been worked out satisfactorily. The characters that have been used to separate species are often imprecise and difficult to apply with confidence to individual specimens, and the lichens themselves are variable. The key in Clauzade & Roux (1985), which uses the presence or absence of crystals in the hymenium, is misleading, as this character is now thought to be variable. The present discussion should be regarded as provisional.

C. hymetti belongs in this group, but is not included in the key, as I have insufficient information.

11 Ascospores simple. On non-calcareous rock. (C. demissa)
1 Ascospores polarilocular. On calcareous or non-calcareous rock.
222 Thallus with blastidia or schizidia. Surface of thallus with ±spherical, white pruinose outgrowths about 0.2 mm diameter (Note 1). (C. albopustulata)
22 Thallus with soredia.
33 Thallus endolithic, often forming bowl-shaped depressions in the substrate. (C. (Pyrenodesmia) erodens)
3 Thallus epilithic, well developed. Soredia arising on margins of areoles, erupting from lower surface, sometimes eventually spreading over entire upper surface. (C. (Pyrenodesmia) concreticola)
2 Thallus without vegetative propagules
33 Thallus clearly superficial, smooth, cracked or areolate. Sedifolia grey pigment present in apothecial sections (Note 2). Apothecia not immersed in pits in substrate. On calcareous or siliceous rock.
44 Thallus forming roundish spots to 1 cm diameter, thin. Apothecia usually less than 0.5 mm diameter. 55 Hymenium with oil drops. Not restricted to maritime sites. (C. (Pyrenodesmia) microstepposa)
5 Hymenium without oil drops. Always within a few km of the sea. (C. micromarina)
4 Thallus usually larger, sometimes thick, usually distinctly areolate. Apothecia sometimes more than 0.5 mm diameter.
55 Apothecia immersed to subimmersed. Thallus thick.
66 Areoles flat, tightly arranged. Hypothecium with vertical rows of small, round cells. Not restricted to arid sites. C. (Pyrenodesmia) chalybaea
6 Areoles not flat, often convex. Hypothecium without vertical rows of small round cells. Restricted to arid sites. C. circumalbata. Three varieties are sometimes recognised.
77 Thallus very thick, usually more than 0.3 mm. Apothecia ±immersed. C. circumalbata var. circumalbata
7 Thallus to 0.3 mm thick. Apothecia ±sessile.
88 Thallus with distinct areoles. Apothecia with a white margin. Caloplaca circumalbata var. candida
8 Thallus cracked but distinct areoles not well developed. Apothecia without a white margin. (C. circumalbata var. bicolor)
5 Apothecia ±sessile, at least when mature. Thallus thin to ±thick.
66 Margin of apothecia and sometimes also disc white pruinose. Thallus colour variable, often brown to grey to dark grey (Note 3). On calcareous rock. C. (Pyrenodesmia) variabilis
6 Apothecia not pruinose. Thallus grey. Often on siliceous rock.
77 Hypothecium red-brown. C. diphyodes
7 Hypothecium colourless. Some morphs of C. neotaurica
3 Thallus ±immersed in substrate (Note 4). Sedifolia grey pigment present or absent in apothecial sections. Apothecia immersed in substrate or not. On calcareous rock.
44 Hypothecium distinctly cellular. Paraphyses not moniliform, not capitate. Apothecia 0.8 - 1.0 mm diameter, sessile. Apothecial sections without Sedifolia grey pigment (which is confined to pycnidia and outer, black part of prothallus). Epithecium grey-brown, K+ red-brown. (C. (Pyrenodesmia) badioreagens)
4 Hypothecium not cellular (occasionally obscurely cellular in lower part). Paraphyses often moniliform or capitate, sometimes distinctly so. Apothecia 0.3 - 0.55 (0.8) mm diameter, immersed in shallow pits in substrate to subsessile. Apothecial sections with Sedifolia grey pigment in epithecium and outer part of exciple. Epithecium and outer part of proper exciple K+ violet (Note 2).
5 Thalline margin absent or poorly developed. Apothecia sometimes immersed in shallow pits in substrate.
66 Exciple thick, persistent. Disc often pruinose. Ascospore septum 2 - 5 µm wide. Prothallus, if present,
black. Hymenium without extracellular oil drops. **C. albopruinosa**

6 Exciple thin, sometimes becoming excluded. Disc rarely pruinose. Ascospores septum 1 - 3 µm wide. Prothallus, if present, white or black. Hymenium with numerous extracellular oil drops. **C. (Pyrenodesmia) alociza**

(1) The spherical outgrowths of C. albopustulata, which occur on the surface of areoles, are distinct from the fine granulation (to 0.05 mm diameter) that may occur above and adjacent to emergent apothecia in species like C. chalybeia.

(2) Sedifolia grey may be present only in low concentration, and may occur together with a brown pigment that is K-.

The epithecium may be grey or brown, depending on the proportions of the pigments, and the faint K+ violet reaction may be obscured by the brown pigment. The K+ violet reaction is sometimes more distinct in the outer part of the exciple. The N+ violet and fleeting C+ violet reactions of Sedifolia grey are no clearer.

(3) Caution. The dark thallus of C. variabilis may be covered by a white pruina in places, and so may appear pale. I have seen material of C. chalybea in which the pale thallus had absorbed iron oxide and appeared rather dark and rusty.

(4) A very thin, rather granular, white or pale grey-white, superficial thallus may be present, scarcely distinguishable from the granular crystals of the rock. It is too thin to have distinct cracks or areolation, and does not have a smooth surface.

(5) This may be the taxon that Frolov et al. (2016) call Caloplaca erodens "non-sorediate".

**Key to Caloplaca group 1B:** Without orange pigments; on bark or wood.

11 Thallus usually brown, sometimes pale grey or green-grey, well developed. Granular blastidia 0.05 - 0.15 mm diameter abundant. Soralia absent. Epithecium K-. **C. fuscoblastidia**

1 Thallus white to grey, usually thin. Blastidia absent. Soralia present or absent. Epithecium K+ violet or K-

22 Disc pale brown to brown, never very dark. Soralia often present, green to grey-green, initially excavate, sometimes convex later. Epithecium K-. Ascospores 10 - 13 µm long. **C. obscurella**

2 Disc dark brown to black. Soralia absent. Epithecium with Sedifolia grey pigment, K+ violet if enough pigment present, otherwise K-. Many ascospores more than 13 µm long.

33 Thallus grey. Thalline margin present, at least on lower surface of apothecia. **C. (Parvoplaca) servitiana**

3 Thallus white. Thalline margin absent. **C. oleicola**

**Key to Caloplaca group 2:** Some part K+ purple; isidia or similar present.

11 Thallus yellow or orange.

22 Isidia branched to coralloid. On bark. **C. (Blastenia) coralliza**

2 Isidia ±granular, in some species easily eroding and becoming somewhat sorediate. Not on bark.

33 Thallus with marginal lobes.

44 Thallus with whitish pruina. Central part with scale-like schizidia. Ascospores simple. On calcareous rock or soil or overgrowing bryophytes. **C. (Gyalolechia) subbracteata**


3 Thallus not placodioid; ±entirely subsquamulose or crustose.

444 Thallus orange. Apothecia small, not exceeding 0.4 mm diameter. On calcareous rock

55 Thallus areolate. **C. (Flavoplaca) coronata**

5 Thallus mainly of scattered granules. **C. lithophila**

44 Thallus distinctly yellow. Ascospores 9 - 16 x 4.5 - 7.5 µm.

55 Thallus with ±distinct white or pale prothallus. Blastidia eventually covering most of thallus. (C. thamnoblastia)

5 Prothallus absent.

66 Blastidia confined to central part of thallus, not giving rise to soralia. Margin of thallus with short lobes. Margin of apothecia without blastidia. Typically on inland, sun exposed, base rich, siliceous rock, less commonly on limestone or at coastal localities. **C. (Flavoplaca) arces**

6 Blastidia sometimes extending over entire thallus surface, sometimes giving rise to soralia. Marginal lobes absent or very poorly developed. Margin of apothecia sometimes covered with blastidia. Typically on coastal calcareous rock, less commonly on siliceous rock, bark or soil, less commonly at inland localities. **C. (Flavoplaca) limonia**
4 Thallus pale yellow, brown-orange or olive-orange. Asci sometimes with fewer than 8 ascospores. Ascospores 16 - 20 x 10 - 13 μm when mature. (C. (Gyalolechia) xanthostigmaidea) Greek report needs confirmation.

1 Thallus grey.

222 Thallus with lobules. Apothecia with orange to dark red disc and prominent, grey thalline margin. On coastal siliceous rock. **C. thracopontica**

22 Thallus with isidia that soon become sorediate. On nutrient-enriched bark. (C. virescens)

2 Thallus with isidia, blastidia or granules that do not become sorediate. On various substrates.

33 With branched to coralloid isidia. Apothecia present or absent. On bark or wood.

44 Isidia usually brown to orange, rarely grey, 55 - 90 μm wide. Apothecia usually absent. On bark. **C. (Blastenia) coralliza**

4 Isidia usually grey, less commonly with an orange tinge, 75 - 115 μm wide. Apothecia nearly always present. On bark or wood. **C. herbidella**

3 Isidia, blastidia or granules various, but not usually distinctly branched to coralloid. Apothecia usually present. On various substrates.

44 Apothecia with a continuous thalline margin. Note 2.

55 Isidia elongate. On rock. (C. squamuloisidiata)

5 Isidia, blastidia or granules globose or irregular; if ±elongate then not on rock. On bark or rock.

66 On bark.

77 Disc brown. Thallus brown, with globose to flattened blastidia. **C. fuscoblastidiata**

7 Disc yellow or orange.

88 Thallus endophloedeal. Probably restricted to the uplands. **C. (Parvoplaca) nigroblastidiata**

8 Thallus not endophloedeal. At all altitudes.

99 Thallus grey, thin to thick, almost entirely granular. At all altitudes. **C. monacensis**

9 Thallus grey to yellow-grey, thin, not granular. Blastidia grey or grey-yellow. **C. (Athallia) baltistanica**

6 On rock.

77 Disc yellow. Thallus granular-areolate. On siliceous or, less commonly, calcareous rock. **C. chlorina**

7 Disc orange or brown. Thallus various. On sun-exposed, calcareous rock.

88 Blastidia mostly on margins of areoles. **C. emilli**

8 Blastidia covering most of areoles. **C. (Flavoplaca) gelleverjae**

4 Thalline margin absent, or granular and discontinuous.

55 Disc usually rust red when mature (sometime orange when young, occasionally dark brown when mature).

On bark or wood.

66 Isidia cylindrical to branched. Thallus K- or K+ purple. On bark or wood. **C. herbidella**

6 Isidia granular, not branched. Thallus K-. On wood. **C. (Blastenia) furfuracea**

5 Disc yellow to brown. On non-calcareous rock. **C. xerica**

(1) C. bilewskii de Lesd. also keys out here, but is a poorly known taxon whose status needs clarification. It is not reported for Greece.

(2) In C. gelieverjae the thalline margin is restricted to the lower surface of young apothecia.

**Key to Caloplaca group 3A:** Some part K+ purple; yellow, soralia present, soralia orange or red.

11 Thallus with marginal lobes (which may be poorly developed), sometimes distinctly radiating (forming well-delimited circular patches), or thallus of distinct squamules. On rock or Bryophytes on rock.

222 Thallus entirely leprose, bright yellow. **C. (Leproplaca) xantholyta**

22 Thallus of ±umbilicate squamules, **C. (Flavoplaca) arcisproxima**

2 Thallus not as above.

33 Soralia mainly lip-shaped, on short lobes or along margins of areoles. Usually on exposed, calcareous rock. **C. (Calogaya) decipiens**

3 Soralia crater-like, punctiform or irregular. Usually in shaded sites.

44 Thallus ±rosette-forming.

55 Thallus yellow-orange. Marginal lobes (0.1) 0.2 - 0.4 (0.6) mm broad. Soralia usually lemon yellow, less commonly orange-yellow, 0.2 - 0.5 (0.7) mm diameter. Apothecia orange, 0.2 - 0.4 (0.8) mm diameter. Paraphyses anastomosed, 3.5 - 5 μm wide at apex. Ascospores sometimes irregular and with 3 locules, 13 - 18.5 x 5 - 7 μm. **C. (Leproplaca) cirrochroa**
5 Thallus orange-red. Marginal lobes 0.1 - 0.2 (0.4) mm broad. Soralia orange-red, 0.1 - 0.3 (0.5) mm diameter. Apothecia orange-red, 0.1 - 0.3 (0.4) mm diameter. Paraphyses not anastomosed, 4 - 9.5 μm wide at apex. Ascospores polarilocular (with 2 locules), 11.5 - 13.5 x 6 - 8 μm. (C. (Leproplaca) proteus)

4 Thallus normally a thin crust, areolate or not. (C. (Leproplaca) obliterans)

1 Thallus without marginal lobes, not distinctly radiating, not (or only obscurely) squamulose. On various substrates.

22222 Thallus inconspicuous, immersed in bark. Soralia punctiform, not becoming confluent, yellow-grey, yellow, dark yellow, brown-orange or green-orange. Apothecia absent. (C. lucifuga)

222 Thallus entirely leprose. Apothecia absent. Usually on calcareous rock or overgrowing bryophytes on calcareous rock.

33 Thallus grey-yellow, brown-yellow or orange-brown. On calcareous rock. C. (Leproplaca) chrysodeta

3 Thallus bright yellow. C. (Leproplaca) xantholyta

222 Thallus forming a very thin crust, pale yellow to grey. Delimited, bright yellow breaking through cortex, almost crater-like. Apothecia sometimes present. On bark. C. (Solitaria) chrysophthalma

2 Not as above. Usually on rock.


3 Thallus and soralia yellow to orange. Prothallus usually absent. Soralia and thallus various. Thallus various. Apothecia present or absent. On various substrates.

44 Soralia ± delimited (though old thalli may be entirely sorediate), developing mainly from margins of areoles. C. (Flavoplaca) limonia

4 Soralia not delimited, thallus often entirely sorediate.

55 Areoles large, 0.5 - 1.1 mm wide, 130 - 260 μm thick. Old thalli usually entirely sorediate. Usually on concrete. C. (Flavoplaca) austrocitrina

5 Areoles generally smaller, to 180 μm thick. Thallus usually not entirely sorediate. On various substrates.

66 On siliceous coastal cliffs, to about 20 m above sea level.

77 Blastidia developing over much of upper surface of areoles (not just at margins). At least some soralia developing from cracked blastidia or after blastidia have eroded. (C. (Flavoplaca) confusa)

7 Blastidia, if present, mainly at margins of areoles. Soralia marginal and ± labriform, not developing from blastidia. C. (Flavoplaca) nigromarina

6 On other substrates.

77 Soralia covering 10 - 50 (100) % of thallus, mainly marginal, usually brighter or paler yellow than thallus. Areoles usually flat or with slightly lifted margin. Apothecia to 0.6 (0.8) mm diameter. Thalline margin usually not sorediate. On bark or calcareous rock. C. (Flavoplaca) flavocitrina

7 Soralia covering (5) 25 - 100 % of thallus, usually same colour as thallus. Areoles flat to convex. Apothecia to 1.0 (1.5) mm diameter. Thalline margin often sorediate. Usually on rock, sometimes terricolous or on bryophytes, rarely on wood. C. (Flavoplaca) citrina

(1) C. leproscens of Christensen (1994c) would key out here. It has not been formally described and is not reported for Greece.

Key to Caloplaca group 3B: Apothecia K+ purple (or absent), soralia present, not yellow, orange or red.

11 On bark or (rarely) wood or decaying plant remains.

22 Disc brown, K-. C. obscurella

2 Disc yellow, orange or red, K+ purple.

33 Soralia remaining discrete, grey to pale-yellow-green, distinctly concave, K-. C. ulcersosa

3 Soralia becoming confluent, or if discrete then not distinctly concave.

44 Soralia pale green-yellow, usually K+ pale pink or purple (test in squash). C. (Scythoria) phlogina

4 Soralia grey or green-grey, K-. C. substerilis

55 Soralia small, usually extended in one direction (rarely rounded), to 0.2 mm long, formed in tiny cracks in the bark or on margins and lower surface of thallus squamules. Thallus immersed or partly of diffuse, tiny squamules. C. substerilis

5 Not as above.
66 Thalline margin persistent. (C. turkuensis) Greek report needs confirmation.
6 Thalline margin becoming excluded. (C. virescens)

1 On calcareous or at least base rich rock.
22 Thallus ± well developed, with marginal lobes (which may be obscure). C. teicholyta
2 Thallus poorly developed, grey, thin, without marginal lobes. C. albolutecescens

Key to Caloplaca group 4: Some part K+ purple, without vegetative propagules, with prominent grey thalline margin.

11 Disc some shade of orange or yellow, without a red tinge.
22 Thallus areolate, not smooth, covered in minute (0.01 mm diameter) spherical isidioid outgrowths that are easily overlooked. C. chlorina
2 Thallus without isidioid outgrowths.
3333 Paraphyses distinctly broadening towards apices. C. furax
333 On bryophytes or decaying vegetation.
44 Thalline margin brownish. Thallus thick, well developed, areolate to subsquamulose. (C. congrediens)
4 Thalline margin ± grey. Thallus usually thin, not very well developed, often inconspicuous.
55 Disc pale green-yellow to dark green-yellow. C. cerina var. stillicidiorum
5 Disc orange. C. cerina var. muscorum
33 On bark or wood
44 On calcareous rock. Paraphyses distinctly broadening towards apices. C. areolata
4 On siliceous rock. Paraphyses not broadening at apices. On siliceous rock. C. viridirufa

Key to Caloplaca group 5A: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin lobed, ascospores not polarilocular.

11 Ascospores 0 (1) -septate. Not restricted to the uplands.
22 Ascospores with pointed ends, 17 - 24 x 7 - 8 µm. Overgrowing mosses on calcareous soil. C. (Gyalolechia) klementii
2 Ascospores with rounded ends, to 20 µm long and to 6 µm wide. On rock, soil or bryophytes.
33 Ascospores 7 - 16 µm long, ellipsoid or ovoid, ± regular in shape, not strongly elongated. Usually on soil or overgrowing terricolous bryophytes; rarely on rock. C. (Gyalolechia) fulgens
3 Ascospores 12 - 20 µm long, distinctly elongated, oblong with rounded ends or rather irregularly shaped, sometimes slightly narrower in central part than at the ends (hourglass-shaped), sometimes with one end broader than the other (tadpole-shaped or more regular and almost clavate). Usually on calcareous rock; occasionally on calcareous soil or bryophytes thereon. Note 1. C. (Gyalolechia) fulgida
1 Ascospores 1 (3) -septate. Restricted to the uplands.
22 Thallus egg-yellow, distinctly pruinose at centre. C. (Gyalolechia) pruinosa
2 Thallus orange, not pruinose. C. (Variospora) australis

(1) Ascospores in C. fulgida are very variable. For specimens that are not growing directly on limestone, it is advisable to examine many ascospores to exclude C. fulgens with certainty.

Key to Caloplaca group 5B: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin lobed, mature ascospores polarilocular, lemon-shaped.
11 Marginal lobes flat, closely adpressed. Thallus often appearing zoned in colour. On limestone. **C. (Variospora) aurantia**

11 Marginal lobes slightly convex, loosely adpressed. Thallus yellow-orange to brown-orange, not pruinose. On siliceous rock not far from (to a couple of kilometres) the sea. **C. (Variospora) aegaea**

1 Marginal lobes closely adpressed, at least some distinctly convex. Thallus orange, pruinose or not. On calcareous or siliceous rock.


2 Lobe ends palmately rounded, matt, orange, sometimes with white pruinose patches. Most paraphyses not branched. On calcareous rock, maritime or not. **C. (Variospora) flavescens**

**Key to Caloplaca group 5C:** Some part K+ purple, without vegetative propagules, without prominent grey thalline margin, thallus orange, margin lobed, mature ascospores polarilocular, ellipsoid.

Published information for some species in the difficult complexes around **C. aurea** and **C. saxicola** is scanty and often contradictory. Some Greek reports may be unreliable.

The key does not include **C. biatorina** var. **pusilloides**, as I have insufficient information..

11 Marginal lobes distinct and well-developed.

22 White or white-yellow pseudocyphellae present in central parts of thallus (absent at lobe tips). On non-calcareous rock. (C. (Elenkimiana) gloriae)

2 Pseudocyphellae absent. On various substrates.

33 Ascospore septa to 2 µm wide. On soil in fissures and cracks of calcareous rocks, at high altitude. **C. aurea**

3 Many ascospores with septa at least 3 µm wide. On various substrates.

44 Thallus with abundant pruina, sometimes tinged pink as a result.

55 Ascospores 5.5 - 7 µm wide, aspect ratio 1.6 - 2.2.

66 Disc orange, brown or red. (C. (Calogaya) pusilla)

6 Disc yellow or yellow-orange. (C. (Variospora) erythrina)

5 Ascospores 4 - 5 µm wide, aspect ratio 2.3 - 3.2. (C. arnoldii subsp. clauzadeana)

4 Thallus with little or no pruina, without a pink tinge.

55 Marginal lobes strongly convex.

66 Lower cortex present. See **Xanthoria**.

6 Lower cortex absent. (C. (Variospora) thallincola) Greek report doubtful.

5 Marginal lobes flat or moderately convex.

66 Ascospores narrowly ellipsoid; length/width typically 3 or more. On limestone. **C. tenuata**

6 Ascospores broadly ellipsoid; length/width typically less than 2.5

77 Thallus red-orange or orange-red, usually forming ±regular rosettes

88 Aspect ratio of most ascospores less than 2. At alpine levels.

99 Thallus usually whitish and decaying in central parts. Ascospores 5 - 6.5 µm wide. (C. (Calogaya) arnoldiiconfusa)

9 Thallus not whitish and decaying in central parts. Ascospores 6.5 - 8 µm wide, aspect ratio 1.4 - 2. **C. (Calogaya) biatorina**

8 Aspect ratio of more ascospores 2 or more. Not restricted to alpine levels.


Usually on calcareous rock. **C. (Calogaya) arnoldii subsp. arnoldii**

9 Thallus without pruina. Marginal lobes rarely forked. Central areoles flat. Usually on siliceous rock. **C. (Calogaya) arnoldii subsp. oblitterata**

7 Thallus orange, brown-orange or yellow-orange, without a red tinge, rosette-forming or not.

88 Apothecia brown, not pruinose. On siliceous rock. (C. (Gyalolechia) ehrenbergii)

8 Apothecia orange or brown-orange, pruinose or not. On various substrates.

99 Marginal lobes weakly adpressed. Apothecia not pruinose. On siliceous rock not far from the sea. **C. (Variospora) aegaea**

9 Marginal lobes strongly adpressed. Apothecia pruinose or not. On various substrates.

AA Ascospores 7 - 9 µm wide, septum 3 - 6 µm broad. Non-isidiate morph of **C. granulosa**

A Ascospores 4 - 7 µm wide, septum 2.5 - 4.5 µm broad.

BB Cortex with epinecral layer and parietin crystals on the surface making thallus appear rugose. Marginal lobes often reduced. Apothecia 0.2 - 2.5 mm diameter, often grouped in clusters that cover thallus. **C. (Calogaya) saxicola**
B Cortex without epinecral layer or superficial crystals; if pruina present then thallus not appearing rugose. Marginal lobes well developed. Apothecia rarely exceeding 1.2 mm diameter, not in clusters.

CC Thallus not forming well-delimited rosettes. On siliceous rock. **C. (Calogaya) arnoldii** subsp. oblitterata


DD Thallus to 8 mm diameter. Marginal lobes much branched and overlapping. Areoles 0.3 - 0.9 mm wide. Lower part of medulla with abundant crystals. On surfaces exposed to water from rain. (C. pseudofulgensia)

D Thallus to 3.5 mm diameter. Marginal lobes sometimes branched, but not overlapping. Areoles 0.2 - 0.5 mm wide. Medulla without crystals. On surfaces protected from direct rainwater run off. (C. (Calogaya) arnoldii subsp. nana)

1 Marginal lobes present but not well developed.

22 On bark or wood. Thallus generally only clearly visible when young, later obscured by apothecia.

33 Asci 16-spored. Ascospore septum 2 - 3.5 µm broad. (C. (Calogaya) persica)

2 On rock, or parasitic on lichens on rock. Thallus generally visible throughout.

33 On non-marine marine rock, or if on marine rock then not as above. Parasitic or not. See keys to Groups 8C and 8D, especially **C. inconnexa**, **C. lithophila**, **C. necator**, **C. (Flavoplaca) polycarpa** and **C. (Calogaya) saxicola**

**Key to Caloplaca group 6:** Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin not lobed, mature ascospores not polarilocular.

11 Thallus ± even, thin, sometimes slightly areolate. Ascospores 3 -septate. **C. (Xanthocarpia) ochracea**

11 Thallus areolate or verrucose areolate.

22 Ascospores 0 (1) -septate.

33 Ascospores 12 - 16 x 3 - 5 µm, constricted at the waist. (C. poeltii)

3 Ascospores 9 - 13 x 4 - 7 µm, ellipsoid, not constricted at the waist. **C. bracteata**

2 Ascospores 1 (3) -septate. On soil.

33 Ascospores pyriform, with one end distinctly larger than the other. Very rare outside Macaronesia. (C. (Gyalolechia) canariensis)

3 Ascospores ellipsoid, sometimes slightly constricted at septum. (C. (Gyalolechia) desertorum) (Two forms are sometimes recognised, differing slightly in ascospore size.)

1 Thallus granular or inapparent. Ascospores 1 (3) -septate. Ends of ascospores rounded. Overgrowing bryophytes in upland regions. **C. (Calogaya) schistidii**

**Key to Caloplaca group 7:** Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin not lobed, mature ascospores polarilocular, septum narrow.

11 Ascospores 9 - 12 µm long. Thallus yellow. Apothecia 0.3 - 1 mm diameter, initially immersed but eventually becoming sessile. Disc red-brown. Ascospores 4 - 6 µm wide, septum 1 - 2.5 µm broad. On calcareous rock. **C. adriatica**

1 Ascospores 12 - 23 µm long.

22 Disc orange to brown-orange. Septum to 2 µm long. Apothecia 0.5 - 1.5 (2) mm diameter. On soil in fissures and cracks of calcareous rocks, at high altitude. **C. aurea**

2 Disc egg-yellow to orange. Septum 1.5 - 3.5 µm long. Apothecia various. On various substrates.

33 Thallus squamulose or squamulose-areolate. Hymenium 80 - 120 µm tall. Apothecia 0.3 - 0.5 (0.6) mm diameter. On calcareous rock. **C. (Xanthocarpia) interfulgens**

3 Thallus crustose or crustose-areolate, sometimes poorly developed. Hymenium 60 - 90 µm tall. Apothecia various. On various substrates.

44 At least some ascospores markedly swollen around septum. Lumina of mature ascospores shaped like those of
Physcia species (ascospore wall thickening at septum and apex). Exciple approximately same colour as disc. On calcareous rock.

55 Thallus fairly well developed, distinctly areolate. Prothallus absent. Apothecia 0.4 - 1 (1.5) mm diameter, often densely crowded and irregular. C. (Variospora) glomerata

5 Thallus thin, smooth, continuous, developing a crack only around apothecia. White prothallus sometimes present. Apothecia 0.3 - 0.4 mm diameter, sparse to abundant but never crowded. C. (Variospora) latzelii

4 Ascospores not swollen around septum, not Physcia type. Exciple distinctly paler than disc. On various substrates.

55 On soil containing gypsum. Apothecia 0.5 - 1 (1.3) mm diameter. (C. (Xanthocarpia) epigaea)

5 On rock.

66 Margin of thallus diffuse, often surrounded by white prothallus. Thallus ± well developed. Apothecia 0.4 - 0.7 mm diameter. Probably restricted to ± damp microhabitats. C. (Xanthocarpia) crenulatella

Key to Caloplaca group 8A: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin not lobed, ascospores polarilocular, septum broad, parasitic on saxicolous lichens

1111 On Rinodina alba on siliceous rock. Apothecia to 1 mm diameter. (C. rinodinae-albae)

111 On Clauzadea immersa. Thallus ± immersed. Apothecia 0.2 - 1 mm diameter. Alpine localities. C. nubigena

11 On Verrucaria species on calcareous (or at least base rich) rock. (Perhaps on other species of endolithic calcareous lichens.)

22 Thallus poorly developed, endolithic or of a few scattered yellow-orange patches. Apothecia 0.2 - 0.4 (0.7) mm diameter, usually in small groups. C. (Flavoplaca) oasis

2 Thallus usually ± well developed, superficial, orange. Apothecia 0.2 - 0.3 mm diameter. C. (Flavoplaca) polycarpa

1 On other species.

222 Thallus inconspicuous, not granular. On lichens on siliceous rock. (C. (Rufoplaca) subpallida)

22 Thallus of granules that are not lobed. On Aspicilia polychroma at alpine levels. (C. insularis) Greek reports doubtful.

2 Thallus of granules that are usually at least weakly lobed. Usually on Aspicilia or Acarospora. Not restricted to alpine levels. C. inconnexa s. lat.

33 On lichens on calcareous rocks, usually species of Aspicilia or Acarospora. C. inconnexa var. inconnexa

3 On Aspicilia species on siliceous rock. C. inconnexa var. nesodes (Athallia nesodes)

Key to Caloplaca group 8B: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin not lobed, ascospores polarilocular, septum broad, on bark

11 Ascospores (12) 15 - 18 x 6 - 10 (11) µm (Note 1), septum 5 - 9 µm. Oil-bearing paraphyses absent. Apex of paraphyses 3 - 4 µm wide. Thallus yellow-green to white, continuous. C. (Gyalolechia) flavorubescens s. lat. Note 2.

22 Apothecia 0.5 - 1.5 mm diameter (Note 1). Exciple visible, thalline margin not visible (or not clearly), margin moderately thick. C. (Gyalolechia) flavorubescens v. flavorubescens

2 Apothecia 0.5 - 3 mm diameter (Note 1). Both exciple and thalline margin visible, margin thick to very thick. C. (Gyalolechia) flavorubescens v. quercina

1 Ascospores 10 - 13 x 5 - 7.5 µm, septum 3.5 - 6 µm. Paraphyses with large cells containing oil, distinct from normal paraphyses, sometimes present (Note 3). Apex of paraphyses 3 - 6 µm wide. Thallus golden yellow, very thin, continuous to ± areolate. C. (Athallia) alnetorum. Note 2.

(1) Dimensions are from Roux (2007). In all my collections ascospore dimensions were towards the lower end of the range. Collections with no ascospores more than 15 µm long, no apothecia more than 1 mm diameter, and the green tinge of the thallus not well developed, should be checked against C. pyracea.

(2) Roux (2007) states that the hypothecium in C. flavorubescens has numerous oil droplets and is not transparent in section, whereas that in C. alnetorum lacks oil droplets and is transparent. In Greek material of C. flavorubescens seen by me, the hypothecium is not transparent, but it was not clear that oil droplets were present. Unfortunately, Roux does not state the dimensions of the oil droplets.

(3) For a description of oil cells see C. aegatica below.
Key to Caloplaca group 8C:

Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. Thallus orange, margin not lobed, ascospores polarilocular, septum broad, on calcareous rock.

11 Disc yellow or orange, without a red tinge (Note 1).

2222 Ascospores swollen at septum. Wall of mature ascospores thickened at apices. Lumina of mature ascospores resembling those of Physcia (wall thickened at septum and apices) (Note 2).

33 Thallus fairly well developed, distinctly areolate. Prothallus absent. Apothecia 0.4 - 1 (1.5) mm diameter, often densely crowded and irregular. C. (Variopora) glomerata

3 Thallus thin, smooth, continuous, developing a crack only around apothecia. White prothallus sometimes present. Apothecia 0.3 - 0.4 mm diameter, sparse to abundant but not crowded. C. (Variopora) latzelii

2222 Ascospores not swollen at septum. Wall of some ascospores thickened everywhere, more than 1 µm thick. Lumina of ascospores very variable, but some resembling an hour-glass; never Physcia type. C. (Flavoplaca) calcitrata

22 Ascospores not swollen at septum. Septum very broad. Lumina small, at ends of ascospore, connected by a long and rather broad central channel which may have irregular swellings. Mature ascospores sometimes appearing 3-septate. Thallus very thin; predominantly orange with white patches or predominantly white with orange patches. C. (Xanthocarpia) ochracea

2 Ascospores not as above; normal polarilocular type, not swollen at septum. On calcareous or siliceous rock.

33 Thallus green-orange or green-yellow (green tinge best seen in natural light or with a daylight bulb). C. (Gyalolechia) flavovirescens

33 Thallus with a yellow tinge (yellow or orange-yellow). See Note 3.

44 Thallus with parietin crystals on surface, and thus appearing rugose (but not obviously pruinose). Apothecia to 1 mm diameter, usually abundant and crowded in centre of thallus. C. (Calogaya) saxicola

4 Thallus not pruinose or rugose, or if pruinose then with smaller apothecia. Apothecia various.

55 Thallus very poorly developed, almost immersed. Apothecia 0.3 - 0.7 mm diameter. C. (Athallia) holocarpa

5 Thallus usually distinct, though sometimes thin. Apothecia various.

66 Apothecia mostly 0.2 - 0.4 mm diameter. Ascospore septum 2.5 - 4.5 µm wide. Thallus superficial but thin and rather poorly developed. Not restricted to maritime sites. C. (Flavoplaca) oasis

6 Apothecia mostly 0.3 - 0.6 mm diameter. Ascospore septum 3 - 6 µm wide. Thallus often well developed. Maritime (i.e. never very far from the sea). C. (Flavoplaca) calcitrata

3 Thallus without a yellow tinge (pale orange, orange or brown-orange). See Note 3.

44 On marine rock directly affected by seawater or salt spray. Apothecia sessile. Thallus orange.

55 Apothecia darker than thallus. Disc and excipule often of different colours. Apex of paraphyses swollen, 3 - 5 µm wide, with 2 - 3 distinct, globose cells. Ascospores 12 - 14 x 6 - 8 µm. C. (Flavoplaca) marina Greek reports doubtful.

5 Apothecia ± same colour as thallus. Disc and excipule the same colour. Apex of paraphyses not swollen, 1 - 2 µm wide. Ascospores 10 - 12 x 4 - 6 µm. C. (Flavoplaca) ora

4 On calcareous rock, not restricted to marine localities.

55 Apothecia 0.15 - 0.3 mm diameter. Thallus of scattered, orange, corticate granules. C. lithophila

5 Many mature apothecia exceeding 0.3 mm diameter. Thallus areolate or of large granules.

66 Black hypothallus prominently visible between areoles or at margins of areoles. Areoles generally well-developed, not resembling granules. Thallus often wide-spreading. Not parasitic even when young. C. dalmatica

6 Black hypothallus present or absent. Areoles often poorly developed and few or rather inconspicuous, sometimes resembling large granules. Thallus usually forming small patches, to 1 cm diameter. Parasitic when young, and sometimes closely associated with an Aspicilia species when mature. C. inconnexa var. inconnexa

1 Disc with a red tinge: red, rust red, red-brown or red-orange (Note 1).

22 Thallus pink or orange-pink. Usually montane. C. coccinea

2 Thallus without a pink tinge. Not confined to upland regions.

33 Apothecia 0.1 - 0.3 mm diameter. Disc dark orange to orange-red. Excipule orange, paler than disc. C. lithophila. Note 1.

3 Mature apothecia 0.2 - 1.3 mm diameter, rust red-brown to scarlet.

44 Thallus very yellow. (C. subochracea v. luteococcinea). Greek report is provisional.

4 Thallus not very yellow. C. (Blastenia) subochracea v. subochracea
(1) This couplet may be ambiguous if the disk is very dark orange, but I have not found a better couplet. In case of difficulty, consult both branches.

(2) The swelling around the septum develops early. Unfortunately, apical wall thickenings and the unusually shaped lumina may only be observable in mature ascospores.

(3) This couplet is not very satisfactory, as some collections are ambiguous and some species are variable. In case of difficulty try both branches.

**Key to Caloplaca group 8D:** Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus orange, margin not lobed, ascospores polariilocular, septum broad, on siliceous rock.

11 Disc yellow or orange, without a red tinge (Note 1).
   22 Thallus orange, without a yellow tinge. On marine rock directly affected by seawater or salt spray. Apothecia sessile.
      33 Apothecia darker than thallus. Disc and exciple often of different colours. Apex of paraphyses swollen, 3 - 5 µm wide, with 2 - 3 distinct, globose cells. Ascospores 12 - 14 x 6 - 8 µm. (C. (Flavoplaca) marina) Greek reports doubtful.
      3 Apothecia same colour as thallus. Disc and exciple the same colour. Apex of paraphyses not swollen, 1 - 2 µm wide.

2 Thallus with a yellow tinge (yellow or orange-yellow). Not confined to marine sites.
   33 Thallus with parietin crystals on surface, and thus appearing rugose (but not obviously pruinose). Apothecia to 1 mm diameter, usually abundant and crowded in centre of thallus. C. (Calogaya) saxicola
   3 Thallus not pruinose or rugose, or if pruinose then with smaller apothecia. Apothecia various.
      44 Thallus covered with coarse granules. Strictly maritime. C. (Flavoplaca) communis
      4 Thallus not covered with coarse granules. Not restricted to maritime sites. C. (Athallia) vitellinula

1 Disc with a red tinge: red, rust red, red-brown or red-orange (Note 1).
   22 Apothecia ± immersed. Ascospores 9 - 11 µm long. C. rubelliana
   2 Apothecia not immersed. Ascospores 10 - 13 µm long. C. irrubescens

(1) This couplet may be ambiguous if the disk is very dark orange, but I have not found a better couplet. In case of difficulty, consult both branches.

**Key to Caloplaca group 9:** Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus not orange, septum narrow.

Some species in this group were poorly understood before the publication of Navarro-Rosinés & Hladun (1996). Reports of C. lactea and C. marmorata from before 1996 may be unreliable.

111 Terricolous, or overgrowing bryophytes or plant debris.
   22 Ascospores 15 - 20 x 8 - 20 µm.
      33 On mosses of genus Grimmia on siliceous substrates. (C. fulvolutea)
      3 On bryophytes and plant debris on calcareous, or at least base-rick, substrates. C. (Bryoplaca) sinapisperma
   2 Ascospores 10 - 13 x 6 - 7.5 µm. C. (Athallia) saxifragarum

11 On bark. C. (Cerothallia) luteoalba
   1 On rock or parasitic on lichens on rock.
      22 Disc with a reddish tinge (rust red, orange-red or dark red-brown).
         33 Parasitic. Ascospores 11 - 13 µm long. Usually alpine. C. epithallina
         3 Not parasitic. Most ascospores more than 13 µm long. Not restricted to high altitudes.
            44 On calcareous rock. Apothecia 0.2 - 0.5 (0.8) mm diameter. C. (Xanthocarpia) marmorata
            4 On siliceous rock. Apothecia 0.3 - 1.5 mm diameter. C. ligustica
      2 Disc without a reddish tinge (orange, yellow-orange or brown-orange). Note 1.
         33 Apothecia 0.6 - 2.0 mm diameter. Disc orange to brown-orange. Ascospores 16 - 23 µm long, septum, 1 - 2 µm wide. C. (Xanthocarpia) ferrarii
         3 Apothecia 0.2 - 0.7 (0.8) mm diameter. Disc orange, yellow-orange or brown-yellow. Ascospore length various, septum 1 - 3.5 µm wide. Note 2.
            44 Disc dark or dull orange. Apothecia 0.3 - 0.7 mm diameter. Ascospores 13 - 17 µm long. Usually on siliceous rock, sometimes on calcareous rock. C. (Rufoplaca) arenaria
            4 Disc orange, yellow-orange or brown-yellow. Apothecia only rarely exceeding 0.5 mm diameter. Ascospores 13
- 23 µm long. On calcareous rock.
55 Apothecia 0.1 - 0.3 mm diameter. Ascospores 11 - 16 x 6 - 8.5 µm. Disc waxy orange, yellow-orange or brown-yellow. Thallus usually endolithic; sometimes thinly superficial and white. **C. lactea**

5 Apothecia 0.2 - 0.5 (0.8) mm diameter. Most ascospores more than 15 µm long. Disc various.

66 Disc orange, orange-red or grey-red. Exciple uniformly hyphal. Paraphyses much branched in upper part. Ascospores (12) 13.5 - 19 (21) x (5) 5.5 - 7 (8) µm, septum 2 - 3 µm wide. **C. (Xanthocarpia) marmorata**
6 Disc yellow or brown-yellow. Exciple cellular in outermost part. Paraphyses simple, strongly capitate when mature. Ascospores 16 - 21 (25) x (5) 5.5 - 7 µm, septum 1 - 2 (2.5) µm wide. **C. lacteoides**

1 (1) Judging from the scanty and inconsistent information in the literature, C. lactea and C. lacteoides in this branch may sometimes be parasitic. The other species are probably never parasitic.

2 Caloplaca crenulatella, keyed in Group 10, may occasionally appear to key out here. However, careful examination usually reveals some trace of a coloured thallus.

**Key to Caloplaca group 10A**: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus not orange, septum broad. parasitic. 1 Thallus not visible, contained within host thallus. On Aspicilia. (C. interna) Greek reports tentative. 11 Disc yellow, orange or brown-orange; without a red tinge, not becoming blackish.

2 Thallus clearly visible, areolate to squamulose-areolate. 22 Thallus yellow, orange or brown-orange; without a red tinge. 33 Thallus subsquamulose. **C. pellodella**
3 Thallus crustose.
4 Disc with a brown tinge. Perhaps restricted to Aspicilia. 55 Thallus squamate to areolate, with irregular short marginal lobes. Vegetative propagules absent. **C. furax**
5 Thallus continuous to weakly areolate, without marginal lobes. Vegetative propagules often present, as dark grey pustules or lobules on thallus surface. **C. xerica**
4 Disc dark orange. Perhaps restricted to Verrucaria. **C. (Flavoplaca) oasis**
2 Disc red-orange to rust red. Ascospores 13 - 18 µm long, septum 3 - 8 µm wide. **C. fuscoatroides**

**Key to Caloplaca group 10B**: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus not orange, septum broad, on bryophytes or decaying vegetation. 11 Disc yellow, orange or brown-orange; without a red tinge. 22 Apothecia with thick, brownish thalline margin. Thallus well developed, areolate to subsquamulose. (C. congrediens)
2 Thalline margin absent, or grey, thin and becoming excluded. Thallus well developed or not. Restricted to high altitude (above tree line). 33 Ascospores 14 - 17 x 7 - 9 µm. Disc yellow or yellow-orange (said to become green-yellow, dark green or even blackish later). **C. (Parvoplaca) tiroliensis**
3 Ascospores 10 - 13 x 6 - 7.5 µm. Disc bright orange, dull yellow-orange or pale brown-orange. **C. (Athallia) saxifragarum**
1 Disc dark rust red. At alpine levels. **C. (Blastenia) ammiospila**

**Key to Caloplaca group 10C**: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus not orange, septum broad, on bark or wood. 11 Disc yellow, orange or brown-orange; without a red tinge, not becoming blackish.
22 Apothecia with thick, brownish thalline margin. Thallus well developed, areolate to subsquamulose. (C. congrediens)
2 Thalline margin absent, or grey, thin and becoming excluded. Thallus well developed or not. Restricted to high altitude (above tree line). 33 Ascospores 14 - 17 x 7 - 9 µm. Disc yellow or yellow-orange (said to become green-yellow, dark green or even blackish later). **C. (Parvoplaca) tiroliensis**
3 Ascospores 10 - 13 x 6 - 7.5 µm. Disc bright orange, dull yellow-orange or pale brown-orange. **C. (Athallia) saxifragarum**
1 Disc dark rust red. At alpine levels. **C. (Blastenia) ammiospila**

**Key to Caloplaca group 10C**: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. thallus not orange, septum broad, on bark or wood.
subhymenium, if present) more than 50 \( \mu \text{m} \) tall. Thallus from a few mm to many cm diameter.

55 Ascospores (12) 15 - 18 x 6 - 10 \( \mu \text{m} \). Shade forms of **C. (Gyalolechia) flavorubescens**

5 Ascospores 10 - 15 \( \mu \text{m} \) long.

66 Some paraphyses with some cells swollen and containing oil (Note 2). Thallus clearly visible, ±continuous, grey without any yellow or orange. Pycnidia nearly always absent. Apothecia 0.3 - 2 mm diameter. Thalline margin grey, fairly distinct (except sometimes in very mature apothecia). Exciple persistent. Probably restricted to strictly mediterranean vegetation in humid localities not far from the coast. **C. aegatica** (If not in strictly mediterranean vegetation, consider C. alnetorum.)

6 Paraphyses without oil cells. Thallus visible or not; if visible, continuous or not, ±grey but sometimes with a yellow or orange tinge. Pycnidia nearly always absent. Apothecia 0.3 - 1 mm diameter, margin thin to ±broad. Thalline margin visible or not. Exciple persistent or not. Not confined to strictly mediterranean vegetation or to coastal localities.

77 Thalline margin distinct, 50 - 80 \( \mu \text{m} \) wide, yellow-grey to pale grey; lower part with distinct cortex to 20 \( \mu \text{m} \) thick. Disc orange to dark orange. **C. (Athallia) pyracea**

7 Thalline margin usually not apparent, 0 - 50 \( \mu \text{m} \) wide; cortex absent or poorly developed, 0 - 10 \( \mu \text{m} \) thick. Disc yellow to orange.

88 Ascospores narrowly ellipsoid, 4 - 6 \( \mu \text{m} \) wide; aspect ratio often more than 2. **C. (Athallia) skii**

8 Ascospores ellipsoid, 6 - 8 \( \mu \text{m} \) wide; aspect ratio usually less than 2. Only rarely corticolous (usually saxicolous). **C. (Athallia) holocarpa**

11 Disc red-brown or yellow-brown to almost black, often pruinose. Apothecia 0.4 - 1 mm diameter, margin not convoluted but sometimes deformed by compression. Ascospores thick-walled (for Caloplaca). Note 3. **C. (Huneckia) pollini**

1 Disc rust red or orange-red, not pruinose. Apothecia diameter various, margin convoluted or not. Ascospores not thick walled.

22 Exciple bright orange, distinctly paler than disc, not becoming excluded; or exciple yellow-orange or orange-yellow. See **C. aegatica** and **C. (Athallia) pyracea** earlier in key.

2 Exciple rust-red, sometimes tinged orange.

33 Apothecia 0.5 - 2 mm diameter, usually remaining flat. Thallus usually fairly well developed, though never very thick. Disc and exciple usually without any orange tinge. Exciple persistent, sometimes strongly convoluted in older apothecia. Paraphyses simple or almost so. Forming patches to several cm diameter on bark or, less commonly, wood. Note 4. **C. (Blastenia) ferruginea**

3 Apothecia 0.2 - 0.5 mm diameter, sometimes becoming slightly convex. Thallus very thin and poorly developed to ±well developed. Disc and exciple sometimes with an orange tinge. Exciple sometimes becoming excluded in older apothecia, not or not strongly convoluted. Paraphyses distinctly branched in uppermost part. A pioneer species most commonly encountered as small patches, a few mm diameter, on twigs. Note 4. **C. (Blastenia) hungarica**

(1) This couplet is not as easy as it seems. Overlapping asci in C. cerinelloides can be mistaken for asci with more than 8 ascospores, asci in C. cerinella can lose ascospores because of damage while sectioning, and immature asci can cause confusion. In case of doubt, section more than one apothecium.

(2) The swollen cells in oil paraphyses are distinctive, at least when mature. Oil cells are irregular or elongated, unlike the ±globose upper cells in normal moniliform paraphyses, and they may not be confined to the upper part of the paraphyses. Oil cells are larger than normal apical cells (and at first glance may even be mistaken for immature or deformed ascospores). Oil cells generally have a slight greenish colour, whereas normal apical cells are colourless. However, oil cells may be scarce, so it is essential to study ample material.

(3) Published information on the ecology of C. pollini is contradictory, but it appears to be restricted to truly Mediterranean regions, and perhaps to sites close to the sea. In Spain, a common substrate is Juniperus phoenicea.

(4) Some publications claim that C. ferruginea and C. hungarica differ in thallus colour (said to be paler in C. hungarica), and width of ascospore septum (said to be narrower in C. hungarica). However, I have found much overlap in these characters. C. hungarica is also said to have an exciple that reacts faintly I+ blue whereas C. ferruginea reacts I-, but I have not been able to observe a really convincing I+ reaction in the former.
**Key to Caloplaca group 10D**: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. Thallus not orange, septum broad, on calcareous rock.

11 Disc yellow, orange or brown-orange; without a red tinge, not becoming blackish.
22 Thallus, or at least hypothallus, clearly visible.
   33 Thallus chalk white, cracked to areolate. On maritime calcareous rock. **C. veneris**
33 Thallus sand coloured in centre, grey to dark grey at margin. Apothecia with thalline margin. (C. erythrina var. pulvinata)
3 Thallus whiteish or yellow-green. Apothecia without thalline margin. **C. (Gyalolechia) flavovirescens**

**Key to Caloplaca group 10E**: Some part K+ purple, without vegetative propagules, without prominent grey thalline margin. Thallus not orange, septum broad, on siliceous rock.

11 Disc yellow, orange or brown-orange; without a red tinge, not becoming blackish.
22 Thallus, if present, of dark grey to black convex areoles, often on a black hypothallus. **C. atroflava** s. lat.
44 Apothecia yellow-orange to brown-orange. Aquatic, or at least close to water. **C. atroflava var. submersa**
4 Apothecia orange. Not aquatic. **C. atroflava** var. **atroflava**

3 Thallus continuous or weakly areolate.

44 Surface of thallus, at least in older parts, distinctly warded and irregular on a scale of about 0.1 mm, generally darker where warded. Disc and exciple both with a brown tinge. **C. xerica**

4 Surface not warded. Disc and exciple without a brown tinge. **C. neotaurica**

2 Thallus and hypothallus absent, indistinct or poorly developed.

33 Ascospore septum ± narrow, to 3.5 μm wide. Not associated with nutrient enrichment. **C. (Rufoplaca) arenaria**

3 Ascospores septum 3 - 6 μm wide. On slightly nutrient-enriched rock **C. (Athallia) holocarpa**

1 Disc with a red tinge (red, orange-red, brown-red or rust red), later becoming blackish in some species.

22 Thallus with marginal lobes. On siliceous rock.

33 Thallus grey. Marginal lobes poorly developed. **C. fuscoatroides**

3 Thallus yellow-green. Marginal lobes well developed.

44 Apothecia brown-red or dull red. **C. (Usnochroma) carphinea**

4 Apothecia bright red. **C. (Usnochroma) scoriophila**

2 Thallus without marginal lobes.

33 Thallus chalky, white, well developed and well delimited. On soil or on base-rich siliceous rock. **C. aetnensis**

3 Thallus not chalky, white or grey, or inapparent.

44 Cortex of exciple very dark grey-brown or very dark violet-brown to carbon black. Apothecia eventually becoming black or blackish. Thallus superficial, distinctly areolate. Hymenium 50 - 75 μm tall. Exciple 5 - 10 μm thick, K+ violet. **C. conversa**

4 Cortex of exciple not very dark in colour. Other characters various.

55 Apothecia 0.2 - 0.4 mm diameter, usually becoming blackish. Exciple thin but persistent. Thallus K+ violet (test in section). Usually on nutrient-enriched rock. **C. (Rufoplaca) scotoplaca**

5 Apothecia 0.3 - 1.5 mm diameter, becoming blackish or not. Exciple ± thick, persistent or not. Thallus K+ or K-. Not restricted to nutrient-enriched rock.

66 Thallus dark (dark grey, brown or black). Dark prothallus or hypothallus commonly present.

77 Apothecia C-. Dark hypothallus often present. **C. atroflava**

7 Apothecia C+ purple. Hypothallus absent but dark prothallus may be present. **C. neotaurica**

6 Thallus pale grey. Prothallus present or absent.

77 Thallus bordered by distinct black prothallus. Thallus cracked to areolate. On hard rock affected by salt-spray from the sea. **C. limitosa**

7 Prothallus, if present, weakly developed. Thallus morphology various. Not confined to marine rocks.

88 Thallus squamulose or squamulose-areolate. **C. fuscoatroides**

8 Thallus smooth, continuous to ±cracked. **C. (Blastenia) cremularia**

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**Caloplaca adriatica (Zahlbr.) Servit (1931)**


Description: Clauzade & Roux (1985).

Cret and Evia, on calcareous rock at about 1100 m.

Mediterranean parts of Europe, and Bulgaria. Also N. Africa (Morocco).

**Caloplaca (Variospora) aegaeae** *Sipman* (2002)

in Sipman & Raus, **Wilddenowia** 32: 366-367; **Variospora aegaeae** (Sipman) Arup, Frödén & Söchting.

Thallus: crustose, orange, not pruinose, central part of ±hemispherical areoles 0.4 - 1 mm diameter, marginal part lobed. Marginal lobes: loosely adpressed, convex, rather irregular and sometimes overlapping, 250 - 350 μm thick. Cortex: 50 - 80 μm thick, colourless in lower part, orange in outer 15 μm, rather weakly cellular; in K upper part diffusing a red-purple pigment into solution and then becoming pale red. Lower cortex: present in outermost 0.3 mm of the marginal lobes, contiguous with and having same structure as upper cortex, without rhizines or other outgrowths. Medulla: white. Apothecia: sessile, flat to slightly convex, not pruinose, 0.3 - 0.5 mm diameter. Disc: dark orange. Thalline margin: present, prominent in young apothecia, in older apothecia almost confined to lower surface; in section: 130 μm wide, of which cortex 20 μm. Exciple: orange, paler than disc, persistent; in section: 25 - 100 μm wide, orange at surface, colourless in inner part; inner part of ±radiating hypheae, outer part of more randomly oriented hypheae with elongated or irregularly rounded lumina. Epithecium: orange, K+ purple, diffusing a red-purple pigment into solution. Hymenium: 70 μm tall, colourless. Hypothecium: 90 μm tall, colourless. Paraphyses: 2 μm wide at base, 2.5 μm at apex, sometimes slightly moniliform, sometimes branched in upper part. Ascii: 60 x 17 μm, cylindrical or narrowly
clavate. Ascospores: colourless, polarilocular, ellipsoid at first, later rhomboid, 11 - 14 x 6 - 8 µm, septum 3 - 5 µm, 8 per ascus. Pycnidia: dark orange, darker than thallus, 0.1 mm diameter; in section: 100% immersed, single chambered, ellipsoid, 300 µm tall, 200 µm wide, colourless. Conidia: colourless, bacilliform, 3 x 0.5 µm. Chemistry: thallus K+ purple. Photobiont: green, cells globose, 10 - 12 µm diameter, forming distinct clumps. Photobiont layer: 30 - 100 µm thick, ±continuous but irregular.

Could be confused with *C. flavescens*, but that is restricted to limestone. *C. thallincola* (doubtfully reported for Greece) has long, narrow marginal lobes that are much more regular than those of *C. aegaea*, and is strictly marine (i.e. it only occurs on rocks at the sea shore).

Coastlines of the Aegean and adjacent mainland, on siliceous rock at altitudes of 0 - 220 m. It is maritime, rather than strictly marine, and may occur some distance inland.

Southern Spain, Italy, Greece, and Russia (Caucasus). Also Macaronesia (Canary Is).

**Caloplaca aegatica** *Giralt, Nimis & Poelt* (1992)


Thallus: crustose, grey, moderately thick, cracked, to about 2 cm diameter. Prothallus: absent. Cortex: 15 - 25 µm thick, mostly colourless, sometimes pale brown in outermost 5 µm, structure obscure in many places, but in others formed of hyphae oriented predo,minantly (but not exclusively) horizontally. Medulla: poorly developed. Apothecia: subimmersed when young, later sessile, flat, not pruinose, 0.3 - 0.6 mm diameter. Disc: orange. Thalline margin: grey, thin, becoming excluded. Exciple: pale orange, paler than disc, persistent; in section: not very well developed, 20 µm wide, hyphal; outermost part K+ red, pigment diffusing into solution and forming minute crystals. Epithecium: orange-brown, K+ red, pigment diffusing into solution and forming minute crystals. Hymenium: 75 - 95 µm tall, colourless. Hypothecium: 75 µ - 80 µ m tall (including poorly differentiated subhymenium), colourless. Paraphyses: sometimes branched in upper part; a few paraphyses in upper third of hymenium with oil cells. Oil cells: ±globose to elongate, sometimes with pointed ends, 7 - 12 x 5 µm, often with slight greenish tinge contrasting with colourless hymenium. Immature oil cells can be recognised by the slight swelling of a paraphysis combined with the greenish tinge. Asci: 50 x 15 µm, ±clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 10.5 - 13 x 5 - 6 µm, septum 5.5 - 7 µm, 8 per ascus. Pycnidia: common in marginal parts of thallus, forming orange dots 0.05 mm diameter; in section: 50% immersed, 170 µm tall, 160 µm wide at the rather flat base, 110 µm wide at surface, mostly colourless, wall orange in some places in upper half of pycnidium. Conidia: colourless, narrowly ellipsoid to bacilliform, 2 - 2.5 x 0.7 µm. Photobiont: green, cells globose, 8 - 15 µm diameter, forming a discontinuous layer 60 - 80 µm thick.

Provided that the oil cells are observed, this species could only be confused with *C. alnetorum*, but that usually has a yellow thallus (at least in places), smaller apothecia, and usually occurs above the level of true Mediterranean vegetation. If oil cells are overlooked, it could be confused with *C. pyracea*.

Southern half of Greece, never very far from the sea. On bark in strictly Mediterranean vegetation. Reliably reported from altitudes 0 - 400 m, and there are other reports up to 900 m. Reported from *Ficus carica*, *Pinus brutia*, and *Pistacia lentiscus*.

A circum-Mediterranean/Macaronesian species. Southern Europe, from Portugal to Greece and Cyprus. Also Macaronesia (Madeira, Canary Is), western Asia (Syria), N. Africa (Morocco, Tunisia).

**Caloplaca aenensis** *de Lesd.* (1935)


*C. aenensis* is reported here with some hesitation, as both my collections appear to intergrade into material that looks like typical *C. crenularia*. However, some has a definitely white, rather chalky, though sometimes rather thin thallus, which forms a prominent white thalline margin in younger apothecia, though it may become excluded later; these are not characters expected for *C. crenularia*. Because of the uncertainty, Abbott (2009) did not accept *C. aenensis* as a confirmed Greek species.

Thallus: crustose, white or very pale grey, sometimes rather chalky, usually fairly well developed (but less so than in *C. erythrocarpa*). Apothecia: abundant, flat, usually sessile (not ±immersed as in *C. erythrocarpa*), 0.25 - 0.6 mm diameter, not pruinose. Disc: rust red to very dark red-brown, matt. Thalline margin: present in young apothecia, becoming excluded. Exciple: orange to red, usually paler than disc, matt, smooth, persistent; in section: dark brown in outer part, colourless in inner part. Epithecium: orange-brown. Hymenium: 80 - 110 µm tall, colourless. Hypothecium: 90 µm tall, colourless. Paraphyses: moniliform. Ascospores: colourless, polarilocular, sometimes swollen at septum, 16 - 17 x 8 - 10 µm, septum 4 - 5 µm wide, 8 per ascus. Chemistry: apothecia K+ purple. Photobiont: green.

Closely related to *C. erythrocarpa*, but that occurs on calcareous rock. *Caloplaca teicholyta* is sorediate, usually only sparingly fertile, and occurs on calcareous substrates. *C. crenularia* has a much darker thallus (grey or brown-grey).

Southern Peloponnisos, on siliceous rock close to sea level.

Southern Europe from Spain to Greece. Also Macaronesia (Canary Is.), N. Africa (Morocco).
Caloplaca alboluteens (Nyl.) H. Olivier (1909)


Description: Claouzade & Roux (1985); Smith et al. (2009).

Islands of the southern Aegean, including Crete, on calcareous rock at altitudes 100 - 290 m.

Scattered, mainly in central Europe, but reaching southern Scandinavia and present south of the Alps. Also Macaronesia (Canary Is), western Asia (Turkey, Syria).

**Caloplaca albopruinosa (Arnold) H. Olivier (1909)**


Thallus: immersed or, less commonly, very thinly superficial, white to pale grey. Prothallus: said to be present sometimes. Vegetative propagules: absent. Apothecia: often immersed in pits in substrate, sometimes subsessile, usually ±flat, (0.1) 0.3 - 0.55 mm diameter Disc: black or very dark brown, often white or blue-white pruinos. Thalline margin: generally absent, sometimes very poorly developed on lower part of apothecium. Exciple: present, usually fairly prominent, persistent, black or very dark brown, sometimes covered with a white or blue-white pruina; in section: 40 - 50 µm wide, grey to dark brown in outer part, colourless in inner part, outer part K+ violet, mostly formed of radiating hyphae; hyphal tips expand near surface giving a thin cellular layer; without crystals. Epithecium: grey to brown, K+ violet; crystals absent or very few (except for overlying pruina). Hymenium: 50 - 90 µm tall, colourless in lower part, sometimes with epithelial pigments in upper part; crystals absent or very few. Hypothecium: colourless, 50 - 125 µm tall, without distinct structure, often not well differentiated from medulla; crystals absent. Paraphyses: 2 - 3 µm wide in lower part, to 5 µm at apex, often with distinct septa, usually moniliform in upper part though not strongly so, sometimes branched in upper part. Ascii: clavate to broadly clavate, 40 - 62 x 12 - 20 µm, Teloschistes type (with a bow-shaped, KI+ blue, cap). Ascospores: colourless, polarilocular, ellipsoid, 10 - 15 x (5) 7 - 8 µm, septum (2) 2.5 - 5 µm, 8 per ascus. Photobiont: green, patchily present below apothecia; cells globose or subglobose, to 12 µm diameter.

The endolithic thallus, absence of vegetative propagules, and a hypothecium that is not cellular easily separate this species from most the others in the group. However, separation from *C. alcicola* and endolithic forms of *C. variabilis* is sometimes problematic. Collections with weak species from most the others in the group. However, separation from *C. alcicola* and endolithic forms of *C. variabilis* is sometimes problematic. Collections with weak development of a thalline margin may be hard to separate from *C. variabilis*.

Almost throughout Greece, but rare in the north. On calcareous rock at all altitudes. There is a single report of it on *Clausidea immersa*, but it was probably merely overgrowing that species, not parasitic on it.

Widespread in southern Europe, but not ranging far north of the Alps. Also Asia (Turkey, Iran, Armenia, Kazakhstan, perhaps further east) N. Africa (Morocco, Algeria, Tunisia, Egypt). Some reports may be unreliable owing to confusion with other species.

Caloplaca (Athallia) alnotorum Giralt, Nims & Poelt (1992)


Thallus: crustose, to 2 cm diameter (in material seen), thin (70 - 90 µm), smooth or cracked, occasionally areolate, usually pale yellow to pale green-yellow, some parts sometimes with little or no yellow pigment and then appearing brownish, not pruinos, without vegetative propagules. Cortex: 20 - 25 µm thick, colourless to very pale brown, without distinct structure, K+ purple. Medulla: often absent, photobiont layer then directly overlying bark; to 25 µm thick when present. Apothecia: 0.25 - 0.35 mm diameter, subimmered to subsessile, concave to flat, not pruinose. Disc: orange. Thalline margin: present in young apothecia; in section: 70 µm wide. Exciple: present, persistent, yellow, paler than disc; in section: 15 - 25 µm wide, of hyphae ±parallel to paraphyses. Epithecium: with orange-brown, polarising granules; granules K+ purple-red, soluble in K. Hymenium: 70 µm tall, colourless. Hypothecium: 60 - 80 µm tall, colourless. Paraphyses: simple, 1 µm wide at base, 3 µm at apex, occasionally with oil cells. Ascospores: colourless, polarilocular, ±ellipsoid, 11 - 12 x 5 - 5.5 µm, septum 4 µm, 8 per ascus. Pycnidia: common near margin of thallus, orange, 0.07 mm diameter; in section: 50% immersed, single chambered, ±conical, base resting directly on bark, 110 µm tall, 150 µm wide, colourless except where over lain by cortex, walls often surrounded by photobiont layer. Conidia: colourless, bacilliform, 2 x 0.7 µm. Chemistry: thallus K+ purple, UV+ orange. Photobiont: green, cells globose, 8 - 10 µm diameter, forming a continuous, ±regular layer 30 - 50 µm thick.

For separation from *C. aegatica*, see under that species.
Caloplaca (Pyrenodesmia) alociza (A. Massal.) Lettau (1912)

_Hedwigia_ 52(3-4): 236; _Biatorina alociza_ A. Massal. (1855), Symm. Lich. Nov. 42-43; _Blastenia agardhiana_ f. _albomarginata_ (J. Steiner) Szatala, nom. inval.; _Blastenia agardhiana_ var. _albomarginata_ (J. Steiner) Servit; _Blastenia agardhiana_ var. _alociza_ (A. Massal.) Szatala (as "alociza"); _Caloplaca agardhiana_ f. _albomarginata_ (J. Steiner) J. Steiner; _Caloplaca agardhiana_ var. _alociza_ (A. Massal.) J. Steiner (as "alociza"); _Caloplaca intercedens_ var. _albomarginata_ J. Steiner; (? _Caloplaca variabilis_ var. _ecrustacea_ auct. graec.; _Pyrenodesmia alociza_ (A. Massal.) Arnold.

Thallus: crustose, immersed, to 2 cm diameter. Prothallus: 0.5 - 2 mm wide, often zoned, dark grey to black in outer part, ±white in inner part. Apothecia: 0.25 - 0.4 mm diameter, ±flat, often immersed in shallow pits in substrate, sometimes subsessile, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, thin, becoming almost excluded (said to become completely excluded sometimes); in section: 45 - 50 µm tall, colourless. Hymenium: 70 µm tall, colourless. Hypothecium: 120 µm tall, ±colourless. Paraphyses: sometimes branched in upper part, 1 µm wide at base, 3 µm at apex, not capitate, slightly moniliform. Ascospores: colourless, polarilocular, ellipsoid, 15 x 8 µm, septum 2.5 - 3 µm wide. Photobiont: green.

The combination of an immersed thallus and black apothecia that are often in shallow pits in the substrate excludes most other species. However, _C. alociza_ is not always easy to separate from _C. albopruinosa_, and some collections are difficult to place.

Throughout Greece. On calcareous rock at all altitudes.

Widespread in central and southern Europe, reaching southern Sweden. Also Asia (widespread in warm, dry regions as far east as Tajikistan), N. Africa (Morocco, Algeria, Tunisia, Egypt).

Caloplaca (Blastenia) ammiospila (Wahlenb. ex Ach.) H. Olivier (1909)


Known from a single site in Epiros, at an altitude of about 1100 m. The substrate was not reported.

Narrowly distributed from the high arctic to the Alps, but very rare south of the Alps. Also Asia (widespread), N. Africa (widespread), perhaps C. America (Mexico), Australasia (both islands of NZ), Antarctica (Antarctic Peninsula and nearby islands).

Caloplaca (Xanthocarpia) aquensis Houmeau & Cl. Roux (1984)


Crete and Sterea Ellada, on rock at altitudes 0 - 50 m.

Scattered in southern Europe and warmer parts of central Europe. Also Asia (Turkey), N. Africa (Morocco).

Caloplaca (Flavoplaca) arcis (Poelt & Vézda) Arup (2006)


Description: Smith et al. (2009).

Sykros, on serpentine rock at an altitude of 25 m.

Probably throughout Europe. Also Macaronesia, western Asia (Turkey).

Caloplaca (Flavoplaca) arcisproxima Vondrák, Říha, Arup & Soëchting (2009)


Description: See the protologue.

Chios and Crete, on siliceous rock at altitudes 5 - 230 m.

Only reported for France (including Corsica), Greece and Ukraine, but probably more widespread.

Caloplaca (Rufoplaca) arenaria (Pers.) Müll. Arg. (1862)

Caloplaca areolata (Zahlbr.) Clauzade (1968)

Description: Clauzade & Roux (1985) as Caloplaca spathulata.

Chios, on limestone at an altitude of 700 m.

Mainly southern Europe, from Portugal to Greece, though also reported for Hungary. Also western Asia (Turkey). A report for N. America (Vermont) is probably incorrect.

Caloplaca (Calogaya) arnoldii (Wedd.) Zahlbr. (1918) s. lat.


Descriptions: Gaya (2009) is best. The description under this name in Purvis et al. (1992) refers to a different taxon. Also described very briefly in Clauzade & Roux (1985), as C. saxicola subsp. arnoldii and C. saxicola subsp. biatorinoides.

Recently divided into four subspecies, but it is not known to which subspecies most Greek reports refer. Judging from the alpine ecology, some may even refer to the recently described Caloplaca arnoldii-confusa.

Mt. Olympus and islands of Chios and Samothraki, on calcareous rock at altitudes 200 to above 2000 m.

Most European reports are from middle latitudes. Absent from British Isles and very rare in Scandinavia. Rare in southern Europe. Also Macaronesia (Azores), Asia (Turkey, Bhutan, Nepal). A report for N. Africa (Egypt) is certainly incorrect, and may refer to C. biatorina.

Caloplaca (Calogaya) arnoldii subsp. oblitterata (Pers.) Gaya (2009)

Persoon's epithet is correct Latin; it is derived, ultimately, from the verb oblittero. In genera of feminine gender it must become oblitterata. There is no justification for using 'oblitterata'.

Descriptions: Gaya (2009); Wilk (2012).

Amorgos, Chios and Iraklia, on calcareous or siliceous rock at altitudes 175 - 500 m.

Throughout Europe. Also Macaronesia (Madeira), Asia (Tajikistan), Africa (Ascension Is), N America (western USA), S America (Colombia, perhaps Brazil), Australasia (Victoria, Western Australia).

Caloplaca atroflava (Turner) H. Olivier (1909) var. atroflava


European authors describe this species as having a dark grey thallus bordered by a prominent black hypothallus.
However, according to Wetmore in Nash et al. (2007), the prothallus may be present or absent. Eastern Peloponnesian and Evia. The record for Evia was from calcareous rock and probably refers to some other species. My Peloponnesian collection was from volcanic rock at an altitude of 30 m.

Widespread north of the Alps, rare in the south. Also western Asia (Turkey, Israel, Armenia), N. America (BC, western USA), C. America (Mexico).

Caloplaca atroflava var. submersa (Nyl.) H. Magn. (1944)


Description: There is no good, modern description, but Wade (1965) and Wirth et al. (2013a) may be helpful. Perhaps just an ecologically modified morph, without taxonomic significance.

Kalimnos, on schist at an altitude of 30 m.

Scattered, from southern Scandinavia to as far south as Calabria, and from western Ireland to Greece. I have not seen any reports from other continents.

Caloplaca (Variospora) aurantia (Pers.) Helbl. (1890)

Bih. K. Sv. Vet.-Akad. Handl. 16(3): 60; Lichen aurantius Pers. (1794), Annln Bot. (Usteri) 11: 14; Caloplaca aurantia var. callopisma (Ach.) J. Steiner; Caloplaca aurantia var. enissalae (Servit & Cretz.) Szatala; Caloplaca aurantia f. orientalis (J. Steiner) ined.; Caloplaca callopisma (Ach.) Th. Fr.; Caloplaca callopisma f. orientalis J. Steiner; Caloplaca symphasea (Ach.) Zhhbr. Gasparrinia aurantia (Pers.) Synd.; Gasparrinia aurantia var. intermedia (Zahlbr.) Szatala; Gasparrinia callopisma (Ach.) Synd.; Gasparrinia callopisma var. enissalae (Servit & Cretz.) Szatala; (?) Gasparrinia callopisma f. leucothalla (Malbr.) Szatala; Gasparrinia callopisma f. orientalis (J. Steiner) Szatala; Lecanora aurantia (Pers.) Hue; Physcia aurantia (Pers.) Arnold - Greek records cited as 'aurantica'; Placodium callopismum (Ach.) Mérat; Variospora aurantia (Pers.) Arup, Frödén & Sochting.

Thallus: crustose, forming neat rosettes to 3 cm diameter; central part areolate or squamulose-areolate, dark orange to brown-orange; marginal part prominently lobed, pale orange, sometimes with a yellow tinge; a distinct white-pruinose ring sometimes present between central and marginal parts. Marginal lobes: flat, usually not overlapping, 0.25 - 0.8 mm wide at base, 3 mm long, 250 - 320 µm thick. Cortex: present, 25 - 40 µm thick, colourless in inner part, orange in outer 10 - 15 µm, pigment in distinct granules, cellular, cells rounded or slightly elongate, 6 - 11 x 4 - 10 µm, elongate cells generally ± vertically oriented; K+ red-purple, usually diffusing a red-purple pigment into solution. Medulla white, to 180 µm thick in central parts of lobes, of loosely interwoven hyphae. Apothecia: abundant in central parts of thallus not present on marginal lobes, submersed when young, sessile when mature, flat, not pruinose, 0.3 - 0.75 (1.0) mm diameter. Disc: dark orange to dark orange-brown. Thalline margin: present, persistent but in mature apothecia confined to lower surface; in section: 60 - 90 µm wide, cortex 20 - 40 µm wide with orange pigment in outer half, colourless in inner half. Exciple: orange, paler than disc, smooth, persistent; in section: 25 - 40 µm wide, mostly colourless, dark brown-orange in a thin surface layer, ±hyphal, sometimes with a few cell-like lumina present in outermost part; reaction with K as for cortex. Epitheicum: orange-brown to dark brown-orange, K reaction as for cortex. Hymenium: 80 µm tall, colourless to very pale brown-orange, underlain by a ±colourless subhymenium to 100 µm tall. Hypothecium: 50 µm tall (excluding subhymenium), colourless, ±cellular or of hyphae with distinct broad lumina. Paraphyses: simple, 1 µm wide at base, 3 - 4 µm at apex, often moniliform. Asci: 60 - 62 x 20 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, soon becoming lemon shaped or rhomboid (very immature ones may be ±globose), 10 - 13 x 8 - 10 µm, septum 4 - 6 µm wide in mature ascospores (often less in immature ones), 8 per ascus. Pycnidia: often present on marginal lobes, dark orange, darker than thallus, 0.05 mm diameter; in section: 100% immersed, cup-shaped with flat top, 150 µm tall, 120 µm wide, colourless (except where overlain by cortex), sometimes 2-chambered. Conidia: colourless, bacilliform, 3 - 4 x 0.75 µm. Chemistry: orange parts K+ purple, C-, UV+ orange; medulla I-. Photobiont: green, cells globose, 9 - 12 µm, tending to cluster so that photobiont layer though ±continuous is rather open and irregular, 50 - 80 µm thick.

The very flattened marginal lobes are distinctive, and well-developed collections can not be confused with other species. Scanty material can sometimes be confused with C. flavesces, because that species often has some lobes which are only weakly convex, or even almost flat. A useful additional character is such cases is the colour of the marginal lobes, which are usually pale orange or yellow-orange in C. aurantia (much paler than central parts of thallus) but pure orange in C. flavesces (not differing much in colour from central part). In C. flavesces, apothecia are often present closer to the margin of the thallus than in C. aurantia.

Very common in southern Greece, scattered in the north. On calcareous rock at altitudes 0 - 1800 m, but scarce above 1000 m. A report from bark of Quercus (Riga-Karandinos, 2000), is unexpected but perhaps not impossible. The lichenicolous fungus Arthonia molendoi has been reported once from this species.

Most of Europe, except for the Nordic countries, but commonest in the south. Also Macaronesia (Azores), Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt, perhaps elsewhere), S. America (Argentina). Reports for N.
Caloplaca aurea (Schaer.) Th. Fr. (1871)


Mt. Olympus, on soil at altitudes 1800 m and above.

Most European reports are from middle latitudes. Absent from Nordic countries and British Is, very rare south of the Alps. Also western Asia (Syria), N. Africa (Morocco).

Caloplaca (Variospora) australis (Arnold) Zahlbr. (1889)

Thallus: crustose, orange, not pruinose, well developed, to 0.6 mm thick, with distinct, elongated, radiating marginal lobes. Marginal lobes: 4 x 0.3 - 1 mm, sometimes convex, sometimes slightly overlapping. Cortex: 40 - 70 µm thick, orange in upper half, colourless in lower half, distinctly cellular; cells isodiametric to elongated (aspect ratio 1 - 2), 5 - 12 µm wide; elongated cells without preferred orientation; K+ red, diffusing a red pigment into solution. Medulla: white, in section of very broad, rather densely packed hyphae. Apothecia: sessile, becoming sessile, concave to flat, 0.5 - 1 mm diameter, not pruinose. Disc: dark orange. Thalline margin: not apparent externally; in section: present on lower surface of apothecia. Exciple: orange; in section: 75 - 125 µm wide, orange in outer part, colourless in inner part, of very broad anastomosing hyphae with distinct elongated lumina. Epithectum: orange-brown; K+ purple-red, diffusing purple-red pigment into solution. Hymenium: 75 - 100 µm tall, colourless. Hypothecium: 150 - 175 µm tall, colourless. Paraphyses: simple, 2 µm wide at base, broadening gradually to 3 µm at apex, with visible septa, not capitate or moniliform. Ascospores: colourless, 1-septate (a few very mature ones with 4 locules and appearing 3-septate), 17.5 - 25 x 6 µm, septum 1 µm broad, ends rounded to pointed. Chemistry: thallus and apothecia K+ purple. Photobiont: green, cells globose, 9 - 12 µm diameter, tending to aggregate into large clumps so photobiont layer irregular, not entirely continuous, 60 - 160 µm thick.

Externally, could be confused with C. flavescens, but when examined microscopically there is no room for doubt.

Very scattered, on Crete and the mainland, at altitudes 1650 m and above, on calcareous rock. The lichenicolous fungus Muellerella pygmaea has been reported once from this lichen.

The core range of C. australis appears to be the Pyrenees, Alps, and mountains of the Balkans, but reported from elsewhere in the south and from Ukraine. Also Asia (Turkey), N. Africa (Morocco). A report for Macaronesia (Canary Is) is doubtful.

Caloplaca (Flavoplaca) austrocitrina Vondrák, Říha, Arup & Sochting (2009)

Description: See the protologue.

Very scattered in the southern half of Greece. On calcareous or at least base-rich rock at altitudes 0 - 240 m.

Central and southern Europe. Also Asia (Turkey), N. America (California), S. America (Argentina). Probably more widespread, but overlooked.

Caloplaca baltistanica Poelt & Hinteregger (1993)
Biblioth. Lichenol. 50: 82; Athallia baltistanica (Poelt & Hinteregger) Halici & Vondrák.

Description: Vondrák, Halici et al. (2016) as Athallia balsistanica.

Crete, on bark at an altitude of 1100 m.

The Greek report is the only one for Europe. Also Asia (Turkey, Pakistan).

Caloplaca (Calogaya) biatorina (A. Massal.) J. Steiner var. biatorina (1910)
Annls Mycol. 8: 239; Physcia elegans (= var.) biatorina A. Massal. (1852), Flora 35: 565-566; Calogaya biatorina (A. Massal.) Arup, Frödén & Sochting; Caloplaca nišeri J. Steiner.


Scattered, on Crete and the mainland. On calcareous rock. Reported from all altitudes, but reports from low altitude are probably unreliable; according to Gay (2009) this species is holarctic.

Widespread in southern and central Europe, to as far north as southern Scandinavia, though absent from British Is. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread in western USA), Australasian (NZS).
Caloplaca biatorina var. pusilloides J. Steiner (1910)

*Annls Mycol.* 8(2): 239; *Gasparrinia biatorina var. pusilloides* (J. Steiner) Szatala.

This poorly known taxon may prove to be a synonym of var. *biatorina*.

Mt. Olympus, on calcareous rock above 1800 m.

Only known from Greece and Iran.

Caloplaca bracteata (Hoffm.) Jatta (1900)

Syll. Lich. Ital. 236; *Psora bracteata* Hoffm. (1796), Deutschl. Fl. 2: 169; *Caloplaca bracteata* (Hoffm.) Jatta; *Fulgensia bracteata* (Hoffm.) Rääsinen; *Lecanora bracteata* (Hoffm.) Zahlbr.

Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004), both as *Fulgensia bracteata*.

Scattered, with no clear pattern, on calcareous soil at altitudes 150 - 2100 m. Abbott (2009) was sceptical of low altitude reports from Crete and Naxos, but a reliable recent reported for Attica at about 500 m (Hymettos) suggests that they may be correct. Perhaps the Greek taxon differs in some way from the arctic-alpine one.

Widespread from the Alps to the high arctic, rare south of the Alps. Also Asia (widespread), N. America (widespread), Australasia (scattered in Australia, NZS).


Thallus: crustose, usually areolate, sometimes almost continuous with a few cracks, usually pale orange to orange, sometimes yellow, to 1.5 cm diameter. Areoles sometimes scattered, sometimes radiating very slightly at margin. Apothecia: sub sessile to sessile, flat to slightly convex, 0.3 - 0.9 mm diameter, not pruinose. Disc: orange. Thalline margin: absent externally, sometimes obscurely present in section. Exciple: yellow-orange, pale orange or orange, sometimes slightly paler than disc, sometimes becoming excluded; in section: 50 µm wide, orange-brown at surface, colourless in inner part, outer part rather obscurely cellular (best seen in K) with cells 5 x 3 µm, inner part distinctly hyphal, but hyphae not parallel; pigmented part K+ red-purple, diffusing red-purple pigment into solution . Hymenium: 80-100 µm tall, colourless. Hypothecium: 150 µm tall, colourless, sometimes with oil droplets 0.5 - 2 µm diameter. Paraphyses: often moniliform, apex 2 - 5 µm wide. Ascospores: colourless, ±polarilocular, ellipsoid, rarely very slightly swollen at septum, (9) 12 - 16 x 5 - 7 µm, septum (when reasonably well defined) 3 - 7 µm wide, wall often distinctly thicker than usual for *Caloplaca*, but some Greek collections have only thin-walled ascospores, lumina always with rounded ends but otherwise very varied: ellipsoid (in which case ascospore appears simple), or hourglass shape, or forming 2 distinct lumina with the two internal ends usually pointed, 8 per ascus. Photobiont: green, of globose cells 12 - 19 µm diameter.

If enough ascospores are examined, this species can not be confused with any other, as the combination of thick-walled ascospores and hourglass-shaped lumina is diagnostic. However, care is required, as the distinctive ascospores are rare in some collections.

Peloponese, and islands of Alonisos and Chios, never very far from the coast, on limestone at altitudes 5 - 850 m.

A mainly circum-Mediterranean and Black Sea species, but reported for British Is. Also western Asia (Turkey), N. Africa (Morocco, Algeria).

Caloplaca (Usnochroma) carphinea (Fr.) Jatta (1900)


Description: Clauzade & Roux (1985).

Islands of the southern Aegean, including Crete. On siliceous rock at altitudes 50 - 250 m.

Southern Europe, extending to Bulgaria. Also Macaronesia (warmer parts), western Asia (Turkey, Israel), N. Africa (Morocco), South America (Chile).

Caloplaca cerina (Hedw.) Th. Fr. (1860) var. cerina


Thallus: crustose, usually grey to dark grey, less commonly pale grey or white-grey, forming small irregular patches 0.5 - 2 cm diameter, usually thin, 40 - 170 µm, obscurely areolate, only rarely thick enough to develop cracks or slight warfs. Prothallus and hypothallus: absent. Cortex: present but often irregularly developed, 8 - 25 µm thick, mostly colourless, sometimes very pale brown in outer 5 µm; when well developed sometimes ±cellular in inner part. Medulla: in section sometimes forming a distinct and recognisable layer, colourless, 15 - 20 µm thick. Apothecia: sessile, (0.25)
0.4 - 1.0 (1.4) mm diameter, usually ±flat, sometimes concave when young or slightly convex when old. Disc: usually orange or dark orange, sometimes yellow-brown or yellow-orange, never with a red tinge, rarely slightly pruinose. Thalline margin: present, smooth, persistent, sometimes abundantly white pruinose at apex, the coarse pruina then forming a distinct white ring; in section: (40) 80 - 180 µm thick, cortex thick cortex, well delimited from algal layer, usually colourless (sometimes pale brown in outermost 5 µm), 20 - 120 µm thick in water, sometimes swelling markedly in K, mostly of anastomosed hyphae embedded in a K-soluble gel. Exciple: usually not visible externally; in section: (0) 8 - 25 (40) µm wide, colourless in inner part, brown-orange or orange-brown at surface. Epithecium: brown-orange or orange-brown, diffusing a purple-red solution in K and afterwards colourless or with clusters of purple-red crystals. Hymenium: 50 - 100 µm tall, colourless, K+ blue. Hypothecium: 40 - 110 µm tall, colourless. Paraphyses: often branched in upper part, 1 - 1.5 µm wide at base, 3 - 5 µm at apex, sometimes slightly moniliform. Ascii: Teloschistes type. Ascospores: colourless, polarilocular, ellipsoidal or narrowly ellipsoidal, 10 - 17 x 5 - 8 µm, septum 4 - 8 µm, 8 per ascus. Pycnidia: almost invisible externally; in section: 100% immersed, 90 µm tall, 60 µm wide, top very pale grey, elsewhere colourless. Conidia: colourless, bacilliform, 3 x 0.5 µm. Chemistry: disc K+ purple. Photobiont: green, cells globose, 7 - 15 µm diameter, forming a sconiform but rather irregular layer.

The thallus is rather variable. Some collections with a warted thallus might belong to *C. monacensis*. However, they were all on bark that had a very irregular surface, and the warts may be a response to the irregularity. Until I have seen well-developed material of *C. monacensis* on smoother bark, for comparison, I prefer not to refer any collections to that species.

*C. cerina* can be confused with some morphs of *C. pyracea* that have a thalline margin. However, in *C. pyracea* the thalline margin is never very well developed. *C. pyracea* also possesses a well-developed exciple, whereas the exciple in *C. cerina* is narrow and usually not visible externally. *C. haematites* has smaller apothecia and the disc has a distinct red tinge.

My collections are heterogeneous. The morph most commonly encountered has a thalline margin that eventually becomes very thin, though it is never completely excluded. Another morph has a very thick, persistent thalline margin. What may be a third morph resembles the first one but has unusually small (0.25 - 0.5 mm diameter) apothecia.


I have seen only a single Greek collection. If it is representative, then var. *muscorum* differs from var. *cerina* in having more crowded, slightly larger apothecia, a disc which often has a slight red tinge, slightly longer ascospores, a granular thallus, and it occurs on a different substrate.

Very scattered, in the mountains. On bryophytes on soil at altitudes 900 - 1750 m.

Widespread in southern Europe and warmer parts of central Europe, but not reported for British Is or Nordic countries. Also Macaronesia, Asia (widespread), N. Africa (Morocco).

**Caloplaca cerina var. muscorum** (A. Massal.) Jatta (1900)


Sometimes regarded as a synonym of var. *stillicidiorum*, but the matter does not seem to have been settled definitively.


I have seen only a single Greek collection. If it is representative, then var. *muscorum* differs from var. *cerina* in having more crowded, slightly larger apothecia, a disc which often has a slight red tinge, slightly longer ascospores, a granular thallus, and it occurs on a different substrate.

Very scattered, in the mountains. On bryophytes on soil at altitudes 900 - 1750 m.

Widespread in southern Europe and warmer parts of central Europe, but not reported for British Is or Nordic countries. Also Macaronesia, Asia (widespread), N. Africa (Morocco).
Descriptions: Clauzade & Roux (1985) as Caloplaca stillicidionum; Nimis & Martellos (2004); Smith et al. (2009), the latter two as Caloplaca cerina var. chloroleuca.

Scattered, with no clear pattern. Overgrowing bryophytes on rock (and probably also bryophytes on soil) at altitudes 1200 - 1850 m.

Throughout central and northern Europe, much less common in the south and there confined to the mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps South America (Bolivia), perhaps Australasia (NSW).

Caloplaca (Athallia) cerinella (Nyl.) Flagay (1896)

Thallus: crustose, inconspicuous, immersed or very thinly superficial, yellow to pale orange when visible. Apothecia: sessile, flat, not pruinose, 0.1 - 0.25 mm diameter. Disc: orange. Thalline margin: sometimes weakly present, to 45 µm wide in section, cortex poorly developed. Exciple: yellow-orange to orange, often paler than disc, persistent but sometimes becoming very thin; in section: rather poorly developed, 15 - 20 µm wide, brown-orange in outer part, colourless in inner part; pigmented part K+ red, sometimes diffusing pigment into solution where it may form minute crystals. Epitheicum: brown-orange to orange-brown, K+ red, sometimes diffusing pigment into solution where it may form minute crystals. Hymenium: 55 - 75 µm tall, colourless. Hypothecium: 25 - 40 µm tall, colourless. Paraphyses: usually simple, occasionally branched in upper part, apex to 3.5 µm wide, sometimes ±moniliform. Asci: clavate to almost cylindrical, 40 - 52 x 10 - 20 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 - 12 x 5 - 5.5 (7) µm, septum 3 - 5 µm, 12 - 16 per ascus. Photobiont: green, cells globose, 10 - 16.5 µm diameter.

The very small apothecia prevent confusion with all except C. cerinelloides, but that has 8-spored asci.

Scattered, with no clear pattern. On nutrient-rich, or at least not strongly acidic bark at altitudes 100 - 950 m. I have observed the lichenicolous fungus Lichenodiplis lecanorae several times on this lichen.

Widespread in Europe to as far north as southern Scandinavia, but rather uncommon south of the Alps. Also Macaronesia, Asia (widespread), N. America (Morocco, Algeria, Ethiopia), perhaps S. America (Argentina), Australasia (NSW, Tasmania, NZS).

Caloplaca (Athallia) cerinelloides (Erichsen) Poelt (1993)

Thallus: crustose, immersed or superficial but very thin and inconspicuous, pale grey if visible, usually forming small patches just a few mm diameter, sometimes up to 1.5 cm across. Apothecia: subsessile to sessile, usually flat, not pruinose, 0.15 - 0.35 (0.4) mm diameter. Disc: orange to orange-yellow. Thalline margin: sometimes visible, thin, grey, tending to become excluded; in section usually present at least on lower surface of apothecia, 30 - 75 µm wide, cortex to 20 µm. Exciple: always present but sometimes hard to distinguish from thalline margin, yellow to orange, at least slightly paler than disc, sometimes becoming excluded; in section: 8 - 30 µm wide, of radiating hyphae, with elongated lumina in outer part. Epitheicum: orange to orange-brown, K+ mobilising a purple-red pigment into solution leaving epithecium colourless. Hymenium: 50 - 60 µm tall, colourless. Hypothecium: 10 - 50 µm tall, colourless, without distinct structure. Paraphyses: simple, 1 µm wide at base, 1.5 - 3 µm at apex, capitate or moniliform, with visible septa. Ascii: 47 - 50 x 12 - 14 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8.5 - 13 x 5 - 7.5 µm, septum 3 - 5 (6) µm, 8 per ascus. Photobiont: green (best seen below apothecia), cells globose, 10 - 15 µm diameter.

Could only be confused with C. cerinella, but that has 12 - 16-spored asci.

Widespread in the southern half of Greece, rare in the north, never very far from the sea. On ±nutrient-rich bark of a wide range of phorophytes, at altitudes 0 - 900 m, but usually below 400 m. It appears to be a pioneer species on bark, and distinctly more thermophilic than C. cerinella. The lichenicolous fungus Lichenodiplis lecanorae has been reported once from this host.

Widespread in Europe, just reaching southern Scandinavia. Also Macaronesia, Asia (widespread), N. America (BC, California), Australasia (NZS).

Caloplaca (Pyrenodesmia) chalybaea (Fr.) Müll. Arg. (1862)

Thallus: crustose, superficial but sometimes very thin, to several cm diameter, to 150 µm thick but generally less; specimens with thin thallus generally smooth or cracked, those with thicker thallus are areolate. Areoles: white, pale brown or pale grey, sometimes with white pruina, subrounded to subangular, 0.2 - 1.0 mm wide; surface below pruina
smooth to slightly warted. Prothallus: sometimes present, black, 0.05 - 0.1 mm wide. Vegetative propagules: absent. Cortex: 50 µm thick, colourless or very pale grey, without distinct structure, K-. Medulla: poorly developed. Apothecia: immersed to submersed in thallus (not in pits in substrate), 1 - 4 (most commonly 1) per areole, usually flat, rarely slightly convex, 0.3 - 0.5 (0.6) mm diameter, often distinctly white or blue-white pruinose on exciple, only occasionally slightly white pruinose on disc. Disc: black when dry, dark brown when wetted. Thalline margin: sometimes present, but becoming excluded, to 100 µm wide in section. Exiple: present, sometimes indistinct and poorly developed, especially in specimens with a well-developed thalline margin, 30 - 50 µm wide when well developed; outer part brown-grey, K+ violet (sedifolia grey), weakly cellular, often with many fine crystals; inner part colourless, hyphal, sometimes with crystals. Epithecium: brown to grey, K+ violet but reaction often faint, usually without crystals except for those associated with pruina. Hymenium: 45 - 125 µm tall, usually colourless but sometimes with epithelial pigment in upper part, KI+ blue, without crystals. Hypothecium: 50 - 150 µm tall, colourless, sometimes with abundant crystals in lower part (?rock debris), usually without distinct structure but occasionally with a weak cellular texture in lowest part. Paraphyses: sometimes branched in upper part, 1.5 µm wide at base, 2.5 - 5 µm at apex, usually at least slightly moniliform. Asci: broadly clavate, 48 - 52 x 25 - 27 µm, Teloschistes type. Ascospores: colourless, polarilocular, usually ellipsoid, occasionally slightly lemon-shaped, 12 - 17.5 x 7 - 10 µm, septom 2.5 - 5 µm, 8 per ascus. Pyecnidia: sometimes present near margin of thallus, appearing like black dots 0.04 - 0.07 mm diameter; in section: almost oblong, 180 µm tall, 220 µm wide, weakly divided into about 3 chambers, pale brown at top and on upper parts of sides, colourless elsewhere. Conidia: colourless, bacilliform, 2.5 - 3 x 1 µm. Chemistry: thallus K-, C-, KC-, P-, UV-. Photobiont: green; cells globose to subglobose, 8 - 17 x 8 - 12 µm diameter. Photobiont layer rather variable; in some collections forming a well-defined, continuous layer 80 - 100 µm thick, in others discontinuous, and made up of clusters of cells 25 - 40 µm diameter.

For separation from C. variabilis see under that species. "Typical" material of this species is easy to recognise, but some collections are ambiguous.

Almost throughout Greece, though not reported from many of the smaller islands. On calcareous rock at all altitudes. (I have one collection of what appears to be this species from siliceous rock.) The lichenicolous species Muellerella erratica and Placopyrenium fuscellum have each been reported once from this host.

Widespread in Europe, except for northern regions. Also Macaronesia, Asia (widespread in warm, dry regions as far east as Tajikistan), N. Africa (Morocco, Tunisia).

**Caloplaca chlorina (Flot.) H. Olivier (1909)**


Description: Smith et al. (2009)/

Scattered, mainly in the southern half of Greece, never very far from the sea. On rock, usually calcareous, at altitudes 10 - 2000 m.

Reported from most of Europe outside the arctic. Also Macaronesia, Asia (Turkey, Russia, Pakistan), N. America (widespread but scattered), perhaps C. America. However, as presently delimited the species may be heterogeneous. For example, it is not clear to me that collections from calcareous rock around the Mediterranean are conspecific with those from bark in Scandinavia.

**Caloplaca (Leprolaca) chrysodeta (Vain.) Dombr. (1970)**


The name does not appear to have ever been validly published.

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

There are scattered records from a few localities, all of which are fairly close to the sea. On limestone or on bryophytes at altitudes 400 - 1100 m.

Present in most of Europe outside the arctic. Also Macaronesia, Asia (widespread), N. America (widespread), perhaps S. America, Australasia (Norfolk Is, NZS).

**Caloplaca (Solitaria) chrysophalma Degel. (1944)**


Thallus: crustose, forming patches to a few cm diameter, white to orange, orange parts better developed and 120 - 130 µm thick. Soralia: frequent, orange, 0.25 - 0.4 mm diameter, initially ulcerose and surrounded by a slightly upturned thalline rim, sometimes coalescing later but thallus never entirely sorediate. Cortex: in orange parts of thallus 25 - 30 µm thick, colourless to pale brown, upper part of ±horizontal hyphae, lower part sometimes obscurely cellular, K+ red-purple. Chemistry: soralia and orange parts of thallus K+ purple. Photobiont: green, cells globose, 10 - 12 µm thick.
diameter, in orange parts of thallus forming a ± continuous but rather open layer (not all occupied by algal cells), 40 - 60 µm thick.

This lichen can not be confused with any other.

Peloponnesian and island of Samothraki, on bark of *Quercus pubescens*, sometimes overgrowing bryophytes on the bark, at altitudes 600 - 1280 m.

Commonest in mid latitudes of Europe, but present north to southern Scandinavia and south to the Mediterranean mountains, where it is rare. Also Macaronesia, Asia (widespread), N. America (widespread), Australasia (Tasmania, NZS).

**Caloplaca circumalbata** (Delile) Wunder (1974) var. circumalbata


The description is for *C. circumalbata* s. lat., as I have insufficient information to be able to distinguish the varieties.

Thallus: crustose, areolate, white to brown, to a few cm diameter, (100) 500 - 800 µm thick, without vegetative propagules. Areoles: 0.2 - 0.5 mm wide, angular, ± flat, surface usually irregular. Prothallus: occasionally present, black. Apothecia: common, slightly immersed in areoles to sessile, flat to slightly convex, 0.4 - 1.3 mm diameter, sometimes white pruinose. Disc: very dark brown to black. Thalline margin: present, smooth, persistent. Exciple: thin, black; in section K-. Epitheciun: pale brown to brown-K, pigment soluble in K. Hymenium: 65 - 125 µm tall, colourless or with some epithecial pigment in upper part, without crystals. Hypothecium: 100 µm tall, colourless to pale brown. Paraphyses: usually simple, 3 µm wide at apex, clavate, not capitate, sometimes slightly moniliform, with visible septa. Ascosporae: colourless, polarilocular, ellipsoid, 13 - 17 x 5 - 8 (11) µm, septum 1.5 - 4 µm, 8 per ascus.

Chemistry: medulla K-; thallus K-. Photobiont: green, present below apothecia.

Widespread in southern Greece, rare in the north. On limestone at altitudes at least 1200 m.

A circum-Mediterranean taxon. Most reports do not indicate which variety is involved, but the species as a whole is reported for southern Europe from Spain to Cyprus, western Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt). A 19th Century report for S. America (Uruguay) is almost certainly incorrect.

**Caloplaca circumalbata var. candida** (Stizenb.) Wunder (1974)


Description: I have not seen an adequate description of this taxon.

Scattered, mainly in the southern half of Greece. On calcareous rock at all altitudes, but rare above 1200 m. Southern Europe, from Spain to Greece. Also N. Africa (Algeria, Tunisia).

**Caloplaca (Leproplaca) cirrochroa** (Ach.) Th. Fr. (1871)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Very scattered in the northern half of Greece, on calcareous rock at altitudes of 500 m and above.

Widespread in Europe south of the arctic. Also Asia (widespread), N. Africa (Egypt), N. America (widespread), S. America (Argentina, Brazil, Galapagos Is), Australasia (eastern Australia).

**Caloplaca (Flavoplaca) citrina** (Hoffm.) Th. Fr. (1860)


The Peloponnesian collection of Abbott (2009) probably belongs to *C. flavocitrina*. Most Greek reports probably also refer to other species, especially *C. flavocitrina*. However, there are a few modern reports from northern Greece that may be reliable.

Descriptions: For *C. citrina* s. lat. see: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

Published reports are from all parts of Greece, from bark and rock, at altitudes of 0 - 2000 m. Some may refer to other species.

There are reports of *C. citrina* from most of the world outside the humid tropics. However, according to Vondrák, Říha et al. (2009), the range of *C. citrina* sensu stricto is much more restricted; the details are uncertain owing to confusion with other species.

**Caloplaca coccinea** (Müll. Arg.) Poelt (1975)

Caloplaca (Flavoplaca) communis Vondrák et al. (2009)


Description: see the protologue.

Amorgos, Crete and Iraklia, on rock at altitudes 0 - 300 m.

SE Europe, from Sardinia to Ukraine. Also western Asia (Turkey).

Caloplaca conversa (Kremp.) Jatta (1900)


Chios and western Crete, on siliceous rock at altitudes 5 - 500 m.

Widespread in southern and central Europe, but absent from British Is and Nordic countries. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (scattered in USA), C. America (Mexico).

Caloplaca (Blastenia) coralliza Arup & Ákelius (2009)


The correct name in *Caloplaca* appears to be *C. viperae* (Zahlbr.) H. Olivier; in *Blastenia* it is *B. viperae* Zahlbr.

Description: See the protologue.

One of the two Peloponnesian collections referred to *C. herbidella* by Abbott (2009) may belong here. It has a brown thallus and narrow isidia, 0.05 - 0.08 (0.1) mm wide, but it is also abundantly fertile and occurred on the bark of a conifer, *Abies cephalonica*. According to Arup & Ákelius (2009) the first two characters match *C. coralliza*, whereas the second two do not, and are more characteristic of *C. herbidella*. Because of the uncertainty, no description is provided.

Scattered, with no clear pattern, on bark, usually of conifers, at altitudes 550 m and above.

Much of Europe, but avoiding the far north and those parts of eastern Europe with a continental climate. Also western Asia (Syria), N. Africa (Tunisia).

Caloplaca (Flavoplaca) coronata (Kremp. ex Körb.) J. Steiner (1919)


Southern half of Greece, on limestone or base rich rock, at altitudes 20 - 1050 m.

Widespread to as far north as southern Scandinavia, though absent from British Is. Also Asia (Turkey, Syria, Siberia, perhaps China), N. Africa (Morocco). I am sceptical of a report for S. America (Brazil).

Caloplaca (Blastenia) crenularia (With.) J. R. Laundon (1984)

*Lichenologist* 16(3): 231; *Lichen crenularius* With. (1796), *Arr. Br. Pl. Ed.* 3, 4: 22 (as *crenulatus*, clearly an error as Withering had already discussed a *Lichen crenulatus*. The spelling was corrected in the index); *Blastenia crenularia* (With.) Arup, Søchting & Frödén; *Caloplaca caesiorufa* (Ach.) Flagey; *Caloplaca ferruginea* f. *saxicola* [author unknown]; *Caloplaca festiva* auct., non Zawacki; *Lecanora caesiorufa* (Ach.) Nyl.; *Placodium festivum* auct., non Hepp.

The epithet *festa* has often been misapplied to *C. crenularia*, but *Leccidea caesiorufa* var. *festiva* Ach. (1814) is an obligate synonym of *Caloplaca arenaria*.

The *crenularia* group on siliceous rock is in need of revision in Greece. As noted by Vondrák & Slaviková-Bayerová (2006), Greek material referred to *C. crenularia* is probably not conspecific with the taxon described by Withering. According to Purvis et al. (1992), *C. crenularia* in the British Isles occurs in "sheltered, preferably rather damp, situations". Greek collections that I have referred here tolerate more open and dryer habitats. In addition, most
descriptions of *C. crenularia* state that the disc does not turn blackish and that that exciple is ± the same colour as the disc. This fits some Greek collections, but there seems to be a continuum through to material with a disc that becomes unambiguously blackish and in which the exciple is distinctly paler than the disc.

I have referred material from coastal sites with a well-developed, continuous, marginal, black hypothallus to *C. limitosa* (although some collections that I have called *C. crenularia*, including those from coastal sites, have a discontinuous and poorly developed black, marginal hypothallus). Material with areoles that are distinctly subsquamulose or that have distinctly upturned margins has been referred to *C. fuscoatrooides*. All other material in this group without any trace of chalky thallus (or chalky thalline margin) and with apothecia that are unambiguously rust red (including those in which the apothecia becomes blackish later) has been assigned to *C. crenularia*. Material placed under that name may be heterogeneous.

Some collections that are close to *C. crenularia* but with discs that are orange, red-orange or orange-red, but not clearly rust red, may belong to *C. atroflava*, but I can not exclude the possibility that they are merely juvenile specimens of *C. crenularia*. Those collections are regarded as undetermined, and they are ignored in this Flora. Other collections close to *C. crenularia* have traces of a white, chalky Thalline margin, but the thallus itself is not chalky so I have not assigned them to *C. aetnensis*; those collections are also regarded as undetermined, and are ignored.

A problem when trying to understand this group is that siliceous rock is not a common substrate in Greece, so it is difficult to acquire many collections. In addition, a significant proportion of my material of this group was collected from lava on Methana. That rock has an extremely irregular surface, which makes it difficult to understand the morphology of the thallus.

The description here is based on a single, well-developed, ample, collection that fits the 'traditional' concept of *C. crenularia* reasonably well. It is not a 'hybrid' description. The ecological information, however, includes all the material that I have referred to *C. crenularia*.

Thallus: crustose, cracked to areolate, pale grey. Areoles: flat (without upturned margin). Prothallus: sometimes weakly present, black, discontinuous, inconspicuous. Apothecia: 0.4 - 1 mm diameter, sessile, flat, not pruinose. Disc: rust red, sometimes blackening a little in older apothecia. Thalline margin: not visible externally, but present in section on lower surface of apothecia; 90 µm wide, of which 20 µm is a weakly cellular cortex. Exciple: rust red, not blackening, usually paler than disc, persistent; in section: 50 - 80 µm wide, dark orange-brown in outermost 10 µm, colourless in inner part, pigmented part K+ red, diffusing a red pigment into solution. Epithecium: dark brown-orange, K+ red, diffusing a red pigment into solution. Hymenium: 70 µm tall, colourless. Hypothecium: to 120 µm tall, colourless; upper 80 µm forming a subhymenium. Paraphyses: occasionally branched in upper part, often slightly moniliform, not capititate. Asci: 55 x 23 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12 - 15 x 5.5 - 8 µm, septum 3.5 - 7.5 µm. Pycnidia: fairly common in patches on areoles, forming rust red to blackish dots 0.2 mm diameter, almost entirely immersed; in section: basically cup shaped, 250 µm tall x 200 µm wide, but expanding in a thin layer near top to 260 µm wide, orange-brown in a surface layer 40 µm thick, colourless elsewhere, without distinct wall. Conidia: colourless, bacilliform, 2 x 0.5 µm. Photobiont: green.

*C. aetnensis* differs in having a well developed and chalky white (not dark coloured) thallus. *C. limitosa*, as understood here, differs in having a well-developed, black, marginal prothallus. *C. fuscoatrooides*, as understood here, has areoles with distinctly upturned margins.

Throughout Greece. On siliceous rock at altitudes 0 - 2170 m, but rare above 1200 m. Reports from other substrates are probably incorrect.

Throughout Europe. Also Macaronesia (widespread, Asia (widespread, but not central Asia), Africa (widespread in N. Africa; also Ascension Is, St Helena). Reports for N. America are incorrect; those for Caribbean, S. America are probably also incorrect. However, until the crenularia group has been adequately revised, the status of many reports is unclear.

**Caloplaça (Xanthocarpia) crenulatella (Nyl.) H. Olivier (1909)**


I have collections that key out as this species from three sites. However, they are heterogeneous and cannot all correspond to *C. crenulatella* sensu stricto. All three collections have the following characteristics:

Thallus: crustose, inconspicuous or of a few scattered areoles, pale yellow (collections on lava) or yellow-orange to orange (collections on limestone). Cortex: (only examined in one of the collections from limestone), cellular, cells 5 - 6 µm diameter. Apothecia: sessile, flat, not pruinose (very slightly pruinose in one collection), not large (0.35 - 0.7 mm diameter in collections from lava, 0.25 - 0.55 mm in collections from limestone). Disc: orange to brown-orange. Thalline margin: variable, but never very prominent; sometimes absent; in one collection the uneven pattern of exclusion gave a slightly crenulate appearance to the apothecia. Exciple: orange or pale orange, paler than disc, persistent; in section 15 - 30 µm wide, surface-colourless in lower part, hyphae in upper part
developing distinct elongated lumina; pigmented part K+ red-purple (pigment diffusing into solution). Epithecium: brown-orange to orange-brown, K+ red-purple (pigment diffusing into solution). Hymenium: 70 µm tall (collections on lava) or 75 - 100 µm (collections on limestone), colourless. Hypothecium: 70 - 100 µm tall, colourless. Paraphyses: apex 2 - 4 µm wide (collections on lava) or 3.5 - 6 µm (collections on limestone), usually moniliform. Ascospores: colourless, polarilocular, narrowly ellipsoid, 13 - 20 x 4.5 - 7 µm (on lava) or 14 - 21 x 5 - 8 µm (on limestone), septum 1 - 3 µm wide, not swollen at septum, 8 per ascus. Photobiont: green, of globose cells.

For published descriptions of *C. crenulatella*, see: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, perhaps throughout Greece. On rock, usually but not always calcareous, at all altitudes.

In the protologue, Nylander cited this species *supra saxa calcarea circa Staveley* (Martinidae). That locality, in England, is in what was then the county of Westmorland. Wade (1965) states that this species occurs *On siliceous rocks ... Westmorland*, and he provides a description, so he had certainly seen what he considered to be this species. However, he does not make it clear whether he had studied the holotype in H-NYL. It is not clear (to me, at least) whether this is a species of calcareous rock that is erroneously reported from other substrates, or whether it is a species that generally prefers, but is not restricted to, calcareous rock. Three of the present author's collections referred to this name were from limestone, two were from volcanic rock.

Widespread in southern and central Europe, and present as far north as southern Scandinavia. Also Asia (Turkey, Iran, Russia, Mongolia), N. America (widespread), C. America (Mexico), Australasia (NZS).

**Caloplaca cretensis** (Zahlbr.) Wunder (1971)

Descriptions: Roux (2005), or see Zahlbruckner's fairly detailed protologue.

Scattered in localities close to the sea, on calcareous rock at altitudes 0 - 1200 m. Mediterranean Europe, from southern France to Greece. Also Asia (Turkey).

**Caloplaca (Variospora) dalmatica** (A. Massal.) H. Olivier (1909)
*Mém. Soc. Natn. Sci. Nat. Math. Cherbourg* 37: 30 & 112; *Callopisma dalmaticum* A. Massal. (1855), *Symm. Lich. Nov. 30-31. (Published in 1854 as a nomen nudum.); *Blastenia schaereri* (Arnold) Servité; (?)*Callopisma aurantiacum* auct. graec. (all these records are saxicolous); (?)*Caloplaca aurantiaca* auct. graec. (saxicolous records only); (?)*Caloplaca aurantiaca* var. *dalmatica* Zahlbr.; *Caloplaca aurantiaca* var. *diffracta* (A. Massal.) Lojka; *Caloplaca aurantiaca f. placida* (A. Massal.) J. Steiner; *Caloplaca aurantiaca var. placida* (A. Massal.) Dalla Torre & Sarnth.; *Caloplaca aurantiaca* var. *velana* (A. Massal.) Flagey; *Caloplaca dolomitica* (Hue) Zahlbr.; *Caloplaca placida* (A. Massal.) J. Steiner; *Caloplaca placida var. diffracta* (A. Massal.) J. Steiner; *Caloplaca placida var. velana* (A. Massal.) J. Steiner; *Caloplaca schaereri* (Arnold) Zahlbr.; *Caloplaca velana* (A. Massal.) Du Rietz; *Caloplaca velana var. schaereri* (Arnold) Clauzade & Cl. Roux; (?)*Leccanora aurantiaca* auct. graec. (saxicolous records only); *Placodium placidium var. diffractum* (A. Massal.) Szatala; *Placodium placidium var. velanum* (A. Massal.) Szatala.

*Caloplaca dolomitica* is regarded by some authors as distinct. For a modern description see Wilk (2012). However, the dalmatica complex is in need of revision, and for the moment I prefer not to try to make fine taxonomic distinctions. The epithet *dolomitica* has been combined into *Variospora* but *dalmatica* has not.

Thallus: crustose, areolate, orange or brown-orange, not pruinose, to 2.5 cm diameter. Areoles: subangular to angular, 0.5 - 1 mm wide. Hypothallus: black, visible between or at edge of many areoles, sometimes also present at margin of thallus. Apothecia: immersed at first, soon becoming subsessile or sessile, remaining flat or becoming convex, 0.2 - 0.7 mm diameter, not pruinose (but some collections with very rough brown disc which may suggest a brown pruina). Disc: orange to brown, usually smooth, occasionally very rough. Thalline margin: not visible externally; sometimes obscurely present in section, on lower surface of apothecia. Exciple: pale orange to dark orange or brown-orange, same colour as disc or slightly paler, smooth, usually persistent except in a few very convex apothecia; in section: 15 - 40 µm wide, orange-brown in outer part, colourless in inner part, formed of unoriented hyphae with distinct elongated lumina (lumina visible sometimes even in lower part of exciple), outermost part sometimes appearing weakly cellular especially in K; pigmented part K+ red-purple. Epithecium: orange-brown, K+ red-purple, often with abundant crystals. Hymenium: 50 - 75 µm tall, often with epithecial pigment in the upper part, colourless elsewhere. Hypothecium: 60 - 100 µm tall (of which half to two-thirds is a subhymenium), colourless. Paraphyses: apex 2.5 - 6 µm; apical cell not always the widest, moniliform. Asci: ± clavate, 45 x 13 - 16 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 9 - 13 x 5 - 10 µm, septum 3 - 5 µm wide, 8 per ascus; many collections lack mature ascospores. Photobiont: green, cells subglobose or globose, 10 - 16 µm diameter.

This taxon (or group of taxa) can be distinguished by the presence of a black hypothallus between, or at the margins of many of the areoles.

Collections that I have referred to *C. dalmatica* are variable and may be heterogeneous. Some have a distinct brown tinge to the thallus, and usually also to the apothecial disc, whereas in others the thallus and disc are unambiguously
Some collections have a well-delimited margin, often marked by a prothallus, whereas in others the margin is poorly defined.

Greek collections correspond fairly well to the concept of *C. dolomiticola* (Hue) Zahlbr (as *C. velana* var. *dolomiticola*) in Clauzade & Roux (1985: 251). None of them match any of their other infra-specific taxa.

Throughout Greece. On calcareous, or at least not strongly acidic rock at all altitudes. In one published report it was said to be parasitic on *Verrucaria marmorea*.

Throughout Europe to as far north as southern Scandinavia, though commonest in the south. Also Asia (widespread), Africa (widespread outside tropics; also Ascension Is, St Helena), perhaps N. America, perhaps Caribbean, perhaps C. America, perhaps S. America.

**Caloplaca Calogaya** decipiens (Arnold) Blomb. & Forssell (1880)

Enum. Pl. Scand. 4: 69; *Physcia decipiens* Arnold (1867), *Flora* 50: 562; *Calogaya decipiens* (Arnold) Arup, Frödén & Sochting; (?) *Caloplaca decipiens* var. *leprosa* Arnold.

Description: Gaya (2009) is best. Also: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

Thessaly, on rock at an altitude of about 200 m. Not recorded since 1898.

Throughout Europe, though uncommon in the south. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread in western half), perhaps C. America, Australasia (NZS).

**Caloplaca diffusa** Vondrák & Llimona (2011)


Description: See the protologue.

Eastern Peloponnese, on serpentine rock at low altitude.

The few reports to date suggest a species of southern Europe and the Atlantic margin to as far north as Wales. Also Asia (Turkey, Georgia).

**Caloplaca diphyodes** (Nyl.) Jatta (1900)


Description: Clauzade & Roux (1985) as *Caloplaca variabilis* subsp. *diphyodes*, but note that Clauzade & Roux's treatment of the black-fruited taxa of Caloplaca is not very satisfactory.

Mt. Olympus, on calcareous rock at altitudes 700 - 1250 m. Last reported in 1959, based on collections made in 1934.

Northern and central Europe; very rare south of the Alps. Also Asia (widespread as far east as Himalayas), Antarctica (though this may be a distinct taxon). Under the name *Caloplaca lecideina* it is reported for N. Africa (Morocco, Egypt), but these reports may refer to other species. Reports for N. America are incorrect.

**Caloplaca emilii** Vondrák et al. (2013)


Description: See the protologue.

Island of Poros, on limestone at an altitude of 200 m.

Central Europe, from France to Ukraine; also Greece. Not reported for other continents.

**Caloplaca epithallina** Lyne (1940)


Descriptions: Clauzade & Roux (1985); Nash et al. (2007).

Very scattered in the northern half of Greece. One of the two published records, that for Evia, parasitic on an *Aspicilia* sp., was considered doubtful by Abbott (2009). The other was from an altitude of 200 m; the substrate was not reported.

Northern and central Europe, very rare in the south. Also Macaronesia, Asia (widespread), N. America (widespread in western half), C. America (Mexico).

**Caloplaca erythrocarpa** (Pers.) Zwackh (1862)


The epithet *lallavei* has often been applied to this species, but the protologue for *Lecidea lallavei* Clemente (1807), especially the adjective *tartarea*, fits *C. teicholyta* better than *C. erythrocarpa*. Clemente's name does not appear to have been typified.

Thallus: crustose, usually forming ± circular patches to about 3.5 cm diameter, white, sometimes slightly chalky but
not pruinose, fairly thick, to 0.6 mm; central part of subrounded areoles 0.4 - 0.5 mm wide, usually with an apothecium in each areole, marginal part usually of subangular areoles 0.5 - 1 mm wide, less commonly smooth to lightly cracked. Areoles usually flat, occasionally slightly convex. Prothallus: often present, grey-black to black, usually inconspicuous and intermittent, 0.05 - 0.1 mm wide, but occasionally prominent, ±continuous and up to 0.4 mm wide. Cortex: 30 - 50 µm thick, grey to brown, structure obscured by abundant small crystals. Medulla: white, chalky; in section without obvious structure. 

Apothecia: abundant, confined to central part of thallus, rounded but sometimes becoming angular by compression, (0.25) 0.4 - 0.7 (0.8) mm diameter, immersed to subimmersed, rarely becoming subsessile, usually ±flat, not pruinose. Disc: dark red or rust red, sometimes blackening. Thalline margin: variable; prominent in some specimens, absent or confined to lower surface of apothecia in others. Exciple: rust red (occasionally orange in shade specimens), paler than disc, persistent; in section: 70 - 80 µm wide, orange in outermost 25 µm, colourless in inner part, outer part with weak cellular structure; pigmented part K+ red, diffusing a red pigment into solution. Epithecium: orange or orange-brown, K+ red, diffusing a red pigment into solution. Hymenium: 60 - 100 µm tall, colourless. Hypothecium: 50 - 75 µm tall, colourless. Paraphyses: sometimes branched in upper part, sometimes slightly moniliform, not capitate. Asci: 65 x 15 - 16 µm, narrowly clavate, ±Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12 - 16 (18) x 6 - 8 (10) µm, septum (3) 5 - 8 µm, 8 per ascus. Pycnidia: common in marginal parts of thallus, forming dark grey to black dots 0.05 - 0.07 mm diameter; in section: 100% immersed, hemispherical to pyriform, 150 -250 µm tall, 140 - 160 µm wide, pale brown to grey in surface layer 15 - 25 µm thick, colourless elsewhere, without prominent wall. Conidia: colourless, narrowly ellipsoid to almost bacciliform, 2.5 - 3 x 0.5 - 1 µm. Chemistry: apothecia K+ purple; thallus K-. Photobiont: green, cells globose, 12 - 15 µm diameter, often occurring in clumps and forming a discontinuous layer 50 - 100 µm thick.

After sectioning one pycnidium, I also observed numerous conidia that were bifusiform, 4 x 0.5 µm, in addition to the normal ones. It was not clear whether they belonged to the Caloplaca.

Collections with abundant apothecia but few or no mature asci are common. These apothecia are over-mature, not immature, as staining with KI reveals remains of the apical apparatus of discharged asci.

This distinctive and beautiful species can not be confused with any other. C. arenaria (with which it has sometimes been synonymised) has ascospores with a narrower septum, a less well developed thallus, and occurs on siliceous rock. C. teicholyta has soredia.

Very common in the southern half of Greece, rare in the north and there perhaps restricted to sites with a ±maritime climate (i.e. not far inland). Usually on limestone, but sometimes on other kinds of rock that are not strongly acidic. A report from bark is certainly incorrect. At altitudes 0 - 1300 m.

Throughout southern Europe. Present north of the Alps, reaching Estonia but not British Is. Also Macaronesia, Asia (widespread to as far east as NW China), N. Africa (Morocco, Tunisia, Egypt). A report for S. America (Tierra del Fuego) seems very doubtful to me.

Caloplaca (Xanthocarpia) ferrariai (Bagl.) Jatta (1900)


Rare and scattered in the southern half of Greece, on calcareous rock at altitudes of 50 - 300 m.

Basically circum-Mediterranean. Widespread in southern Europe, plus a few reports from C. Europe (Czech Republic, Ukraine). Also western Asia (Turkey, Syria, Iraq, Israel), N. Africa (Morocco).

Caloplaca (Blastenia) ferruginea (Huds.) Th. Fr. (1860)

Lich. arct. 123; Lichen ferrugineus Huds. (1762), Fl. Angl. 444; Blastenia ferruginea (Huds.) A. Massal.; Blastenia ferruginea Körb. (= var.) genuina Huds. (Harms.) Szatala; (?) Blastenia ferruginea f. lignicola (Harms.) Szatala; (?) Blastenia ferruginea f. microcarpon (Anzi) Szatala (as microcarpa); Caloplaca ferruginea α (= var.) genuina Th. Fr., nom. inval.; (?) Caloplaca ferruginea f. microcarpon (Anzi) Szatala (as microcarpa); Caloplaca festiva f. cinerofusca (F. H. Wigg.) J. Steiner; Caloplaca festiva var. cinerofusca (F. H. Wigg.) Szatala; Caloplaca festiva f. obliterata (Körb.) Szatala; Placodium ferrugineum var. genuinum (Räs., nom. inval.

For a discussion of the epithet aurantiaca, see under Caloplaca flavobescens. Some Greek records of Caloplaca aurantiaca might refer to C. ferruginea.

The name Caloplaca ferruginea has been used in a broad sense, and Greek collections may not belong to C. ferruginea s. str.

Thallus: crustose, pale grey, forming patches to 4 cm diameter, superficial and fairly well developed but thin (90 - 150 µm thick), slightly cracked, rarely becoming slightly areolate or slightly warted. Cortex: 15 - 35 µm thick, colourless, K-, without distinct structure. Medulla: 0 - 40 µm thick (algal layer sometimes directly overlying bark). Apothecia: usually abundant, sessile, flat, 0.35 x 0.5 - 1.4 mm diameter, not pruinose. Disc: rust red or dull red.
Thalline margin: absent. Excie: ±same colour as disc, or very slightly paler, persistent, sometimes becoming very irregular in old apothecia; in section: 60 - 120 μm wide, orange-brown in outer 10 - 25 μm, colourless in inner part, formed of distinctly anastomosed hyphae, never developing a true cellular texture even in outermost part, all parts reacting I-, pigmented part K+ red (pigment diffusing into solution), N-. Epithecium: orange-brown, K+ red (pigment diffusing into solution), N-. Hymenium: 70 - 120 μm tall, colourless, without oil droplets, I+ blue. Subhymenium: 30 - 80 μm tall, colourless or very pale brown-yellow, variable and not always sharply delimited from hypothecium, without oil droplets, I+ blue. Hypothecium: 50 - 90 μm tall, colourless, I-. Paraphyses: simple, not capitate, 1.5 - 2 μm wide in lower part, 2.5 - 3 μm in upper part, sometimes slightly moniliform. Asci: 45 x 14 μm, narrowly clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12 - 17 x 6 - 9 μm, septum 4 - 8 μm, 8 per ascus. Chemistry: hypothecium K+ purple; thallus K-, C-, KC-, UV-. Photobiont: green, cells globose, 8 - 10 μm diameter, often in clusters, forming a discontinuous but usually irregular layer 25 - 75 μm thick.

The I reactions of apothecial section were observed using Lugol's iodine alone (no pre-treatment with K).

The large, flat, rust-red discs with a ±concolourous, persistent and sometimes strongly convoluted margin ensure that this species, when well developed, cannot be confused with any other. C. hungarica is a much smaller species, the apothecia are sometimes convex, and the exciple sometimes becomes excluded. Collections in which the apothecia seem unusually orange should be checked against C. agatica and even C. flavorubescens. Those species always have some paraphyses that are branched in upper part, and sometimes have abundant oil droplets in the subhymenium, whereas C. ferruginea has simple paraphyses and lacks oil droplets.

Throughout Greece, at all altitudes where there are suitable substrates Usually on bark, and recorded from a wide range of trees and shrubs; less commonly on wood, the only phorophyte definitely recorded being Abies cephalonica. Reports from rock probably refer to other species. C. ferruginea s. lat is present throughout Europe. Also Macaronesia (widespread), Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), perhaps Caribbean (Bahamas), C. America (Mexico), S. America (Argentina, Chile, perhaps elsewhere), Australasia, (widespread), Pacific (Hawaii, New Caledonia).

**Lichen Flora of Greece**

Caloplaca festivella (Nyl.) Kieff. (1895)


Description: See Nylander's protologue. This species is not included in the keys as the protologue is inadequate. Known from a single site in eastern Macedonia, from serpentine at an altitude of 2170 m.

Rare and scattered in the mountains of Europe, from Sweden to Calabria and Greece. Also India (Madhya Pradesh).

**Caloplaca (Variospora) flavescens** (Huds.) J. R. Laundon (1984)

*Lichenologist* 16(1): 53; *Lichen flavescens* Huds. (1762), Fl. Angl. 445; *Caloplaca aurantia f. centrifuga* (A. Massal.) J. Steiner; *Caloplaca aurantia f. centroleuca* (A. Massal.) J. Steiner; (?) *Caloplaca aurantia var. dalmatica* Zahlbr.; *Caloplaca aurantia f. heppiana* (Müll. Arg.) Poelt, nom. inval.; *Caloplaca callopis* f. centroleuca (A. Massal.) J. Steiner; *Caloplaca heppiana* (Müll. Arg.) Zahlbr.; *Caloplaca murorum f. centrifuga* (A. Massal.) J. Steiner; *Gasparinia aurantia f. centrifuga* (A. Massal.) Szatala; *Gasparinia aurantia f. centroleuca* (A. Massal.) Szatala; (?) *Gasparinia aurantia var. dalmatica* (Zahlbr.) Szatala; *Lecanora heppiana* (Müll. Arg.) Hue; *Placodium murorum var. centroleucum* (A. Massal.) Hepp; *Variospora flavescens* (Huds.) Arup, Frödén & Sochting.

It is not clear to me whether the various 'centroleuca' names belong under *Caloplaca aurantia* or *Caloplaca flavescens*. The epithet suggests the former species, but for the moment I follow Nimis (1993) and place them here.

Thallus: crustose, orange, sometimes brown-orange in central parts, usually not pruinose, rarely with slight white pruina, areolate in centre, lobed at margin, usually forming small rosettes to about 3 cm diameter, to 700 μm thick in central parts. Marginal lobes: adpressed, usually not overlapping, usually slightly to moderately convex, only occasionally ±flat, matt, 1.5 - 2.5 x 0.3 - 1 mm, 270 - 370 μm thick. Cortex: 40 - 60 μm thick, brown-orange in outer 10 - 20 μm, colourless in lower part, lower part with distinct hyphae, upper part obscurely cellular, pigmented part K+ purple-red, diffusing a red pigment into solution; pigment present as abundant granules. Medulla: white. Lower cortex: absent. Apothecia: usually abundant in central part of thallus, not present within about 2 mm of margin, sessile, flat, not pruinose, 0.45 - 0.75 mm diameter. Disc: orange to dark orange. Thalline margin: present but generally confined to lower surface of apothecia, persistent; in section: 100 - 200 μm wide, cortex 20 - 30 μm. Exciple: orange to orange-yellow, paler than disc, thin but usually distinct, 0.05 mm wide, persistent; in section: 70 - 90 μm wide, colourless except for outermost 10 - 15 μm which is brown-orange, mostly formed of anastomosing hyphae, but hyphae broaden in outermost 25 μm giving a weakly cellular appearance; K reaction of pigmented part as for epithecium. Epithecium: dark orange-brown, K+ red, diffusing a red pigment into solution. Hymenium: 70 μm tall, colourless, underlain by colourless subhymenium to 100 μm tall. Hypothecium: 60 μm tall, colourless. Paraphyses: simple, 1.5 μm wide at base, 3 μm at apex, sometimes slightly moniliform. Asci: 62 x 17 μm, zycolindrical to narrowly clavate, Teloschistes type. Ascospores: colourless, polarilocular, usually lemon-shaped or rhomboid, sometimes almost globose, 11 - 14 (17) x 6 -
10 μm, septum 3 - 5 μm, 8 per ascus. Pycnidia: often present on marginal lobes, forming small bumps, dark orange (darker than thallus), 0.05 - 0.1 mm diameter; in section: 70% immersed, ±globose though with rather flat top, 220 μm tall, 200 μm wide, colourless except where over lain by cortex, rather weakly 2-chambered. Conidia: colourless, bacilliform, 3 x 0.5 μm. Chemistry: orange parts K+ purple, C-, P-, UV+ orange; medulla K-, C-, KC-, P-, I-. Photobiont: green, cells globose, 8 - 13 μm diameter, often forming clumps; photobiont layer 90 - 130 μm thick, often slightly discontinuous because of gaps between clumps; in some places prominent bundles of hyphae extend upwards from medulla through these gaps.

For separation from C. aurantia, see under that species.

Throughout Greece. On calcareous rock at all altitudes.

Most of Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Israel, Russia as far east as southern Siberia), N. Africa (Morocco, Algeria, Tunisia, Egypt). Reports for N. America are incorrect, and an old report for S. America (Brazil) is very doubtful.

Caloplaca (Flavopla ca) flavocitrina (Nyl.) H. Olivier (1909)

My single collection was cited as C. citrina in Abbott (2009), though with some doubt. Although the material is scanty it has the non-sorediate thalline margin characteristic of C. flavocitrina.

Thallus: crustose, areolate, without marginal lobes. Areoles 0.3 - 0.5 (0.7) mm wide, brown-orange where not sorediate. Soralia: abundant, pale yellow, not delimited and often covering large areas of the thallus almost completely. Apothecia: present but not abundant, sessile, slightly concave to flat, 0.45 - 0.55 mm diam, not pruinose. Disc: brown-orange. Thalline margin: present, pale yellow, sometimes abraded but not sorediate; in section: 50 μm wide, brown-orange in outer 20 μm. Exciple: present, thin, orange; in section: 25 μm wide, colourless in inner part, brown-orange at surface, hyphal. Epithecium: brown-orange, K+ red-purple. Hymenium: 50 μm tall, colourless. Hypothecium: 125 μm tall, colourless, without distinct structure. Paraphyses: 1 μm wide at base, 2 μm at apex. Ascospores: colourless, ellipsoid, polarilocular, with thin wall (not dichroa type), 11 x 5 μm. Chemistry: thallus, soralia and apothecia all K+ purple. Photobiont: green, cells globose, 8 - 17 μm diameter.

The soralia are true soralia, and lack a cortex.

Scattered in the southern half of Greece, at sites within a few km of the sea. On bark, wood and calcareous rock, at altitudes 0 - 1000 m, but usually below 400 m.

Probably throughout Europe. Also Macaronesia, Asia (Turkey, Georgia, India), "Africa" (St Helena, Ascension Is), N. America (scattered), perhaps Australasia (scattered in Australia), Pacific (Hawaii).

Caloplaca (Gyalolechia) flavorubescens (Huds.) J. R. Laundon var. flavorubescens (1976)
Lichenologist 8(2): 147; Lichen flavorubescens Huds. (1762), Fl. Angl. 443; (?) Caloplaca aurantiaca auct. graec. (corticolous records); Caloplaca salicina (J. F. Gmel.) Szatala; (?) Caloplaca salicina f. lignicola (Nyl.) Szatala; Caloplaca suberythrella (Nyl.) Clauzade & Rondon; Gyalolechia flavorubescens (Huds.) Sochting, Frödén & Arup; (?) Lecanora aurantiaca auct. graec. (corticolous).

The epithet aurantiacus has been used in many senses, and the confusion goes back to the beginning. In the protologue for Lichen aurantiacus, Lightfoot (1777: 810) described a species growing upon the bark of oaks, and other trees, and sometimes upon rocks. The thallus when it grown on bark, is whitish ash colour'd, when on rocks darker ash-coloured. The apothecia are of an orange colour, with margins of the same colour. This description does not really match any of the lichens to which the name appears to have been applied in Greece. Lightfoot wondered whether it might be the same as Lichen flavorubescens Huds., but that species is not saxicolous. Abbott (2009) cited saxicolous Greek records under Caloplaca dalmatica, though some might refer to C. flavoirescens, and corticolous ones under C. flavorubescens, though some might refer to C. ferruginea. Laundon (1976: 148) lectotypified the name Lichen aurantiacus Lightf. on a Dillenian specimen that belongs to Caloplaca ferruginea (s. lat.).

Thallus: crustose, to several cm diameter when well developed, but often found as small patches just a few mm across, usually thin but to 400 μm thick when well developed, continuous or slightly cracked, green-yellow or green-orange when well developed, sometimes pale orange, pale yellow or almost grey, not pruinose. Prothallus: absent. Cortex: 40 - 100 μm thick, K+ red. Medulla: white, of loosely interwoven hyphae. Apothecia: nearly always present, subsessile to sessile, generally flat but sometimes becoming convex, (0.2) 0.3 - 1.5 mm diameter, not pruinose. Disc: orange. Thalline margin: sometimes absent, sometimes visible in section on lower surface of apothecia, occasionally just visible externally as a grey or pale yellow ring; in section: 60 - 100 μm wide, with algal cells in a neat, regular band 15 - 25 μm wide; cortex brown-orange near the surface, colourless elsewhere. Exciple: orange, pale orange or yellow, usually at least slightly paler than disc, persistent; in section: 15 - 80 μm wide, orange-brown at surface, colourless in inner part, hyphal; pigmented part K+ red. Epithecium: orange-brown to brown-orange, K+ red. Hymenium: 60 - 100 μm tall, colourless. Hypothecium: 45 - 100 μm tall (including subhymenium), colourless, not transparent, oil droplets
Caloplaca (Gyalolechia) flavorubescens var. quercina (Flagey) Giralt, Nimis & Poelt (1992)

In my collections, var. quercina differs from var. flavorubescens merely in having a more prominent and persistent thalline margin. However, there seems to be a continuum linking the two varieties and it is not clear to me whether var. quercina merits formal taxonomic recognition. Var. quercina is said to differ also in the upper limit of the diameter attained by apothecia, but I have not observed that.

The cortex of the thalline margin consists of a loose structure of anastomosing hyphae in a K-soluble gel. Pycnidia: usually absent, but abundant when present, dark brown-orange, convex, 0.15 mm diameter, forming in well-developed thalli a continuous, irregular layer 125 µm thick.

For more details of anatomy of the thalline margin, which is basically the same in both varieties, see under var. quercina.

Collections with a well-developed green tinge can not be confused with other species. However, the green tinge is sometimes poorly developed, and then collections with small apothecia and small ascospores could be confused with some morphs of C. pyracea. However, C. flavorubescens always has a continuous thallus, whereas C. pyracea rarely does. The presence of even a single pycnidium is sufficient, for practical purposes, to exclude C. pyracea. For the separation from var. quercina, see under that variety.

Throughout Greece, but commoner in the southern half of the country. On bark of a very wide range of host trees and shrubs. Encountered once on wood of Abies cephalonica by the present author. Sipman & Raus (2002) report it once for calcareous rock (though confusion with C. flavovirescens seems possible in that case). At all altitudes where there are suitable substrates.

Most of Europe except for arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Socotra, perhaps Madagascar), N. America (widespread), perhaps S. America (Argentina, Paraguay), Australasia (widespread), Pacific (Hawaii, New Caledonia, Tahiti), Antarctica (subantarctic Macquarie Is).
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009), all as *Fulgensia fulgida*.

Probably throughout Greece, but not very common. On calcareous soil or rock, less commonly overgrowing bryophytes on calcareous substrates, at altitudes 0 - 2100 m. Some reports may refer to *C. fulgida*.

Widespread to as far north as southern Scandinavia, but commonest in warm regions. Also Macaronesia, Asia (widespread in warm dry regions), Africa (throughout N. Africa; also Somalia), northern N. America (widespread), C. America (Mexico), Australasia (Tasmania, both islands of NZ).

**Caloplaca (Gyalolechia) fulgida** (Nyl.) Zahlbr. (1907)

*Hedwigia* 47: 64 and in *Öst. bot. Z.* 57(2) 72. It is not known which was published first; *Placodium fulgidum* Nyl. (1865), *Flora* 48: 212; (?) *Caloplaca fulgens* var. farinosa Sambo; (?) *Caloplaca subfulgens* var. greeca Servit; *Fulgensia fulgida* (Nyl.) Szatala; (?) *Fulgensia fulgens* var. farinosa (Sambo) Szatala; *Gyalolechia fulgida* (Nyl.) Sochting, Frödin & Arup.

Thallus: crustose, with distinct marginal lobes, sometimes slightly warted in central part, to 5 cm diameter, yellow in marginal part, yellow to orange in centre, white to pale yellow pruinose especially at margins, 200 - 350 µm thick, without vegetative propagules. Marginal lobes: 0.8 - 2.5 x (0.3) 0.5 - 1 mm, flat to convex, usually not overlapping. Cortex: 30 - 40 µm thick, mostly orange, at tips of marginal lobes extending about 0.4 mm along the lower surface; structure obscure because of pruina; K+ red. Medulla: white; in section: of broad, loosely interwoven hyphae; at margins of the thallus hyphae oriented predominantly along the axis of lobes. Apothecia: usually present, sessile, flat to slightly convex, not pruinose, (0.4) 0.5 - 1.3 (1.65) mm diameter. Disc: dark brown-orange, dark red or brown. Thalline margin: often present in young apothecia, thin, usually soon excluded. Exciple: orange, orange-brown or red-brown, paler than disc, usually smooth, persistent but sometimes becoming very thin; in section: 60 - 80 µm wide, orange-brown in outer 10 - 20 µm, colourless in inner part, formed of broad hyphae on a radiating pattern but with distinct lumina and appearing cellular; lumina usually elongated but sometimes ±isodiametric. Epithecium: orange to orange-brown, K+ red, pigment diffusing into solution and there forming minute crystals. Hymenium: 50 - 85 µm tall, colourless. Subhymenium: 50 - 90 (125) µm tall, colourless to very pale grey or very pale yellow, with abundant oil droplets at least in lower half; oil droplets 1 - 5 µm diameter. Hypothecium: 25 - 150 µm tall, colourless, with abundant oil droplets 1 - 5 µm diameter. Paraphyses: simple, 1.5 µm wide at base, 3 µm at apex, often with visible septa in upper part, sometimes slightly capitare or moniliform. Asci: Teloschistes type. Ascospores: colourless, simple, oblong with rounded ends, or slightly hourglass-shaped, or tadpole shaped, never regularly ellipsoid, ends rounded, 12 - 18 x 4 - 6 µm, 8 per ascus. Photobiont: green, cells globose, 10 - 15 µm diameter, forming a ±continuous layer 25 - 40 µm thick.

Easily confused with *C. fulgens*; ascospores must be examined carefully to separate the two species.

Throughout Greece, though less common in the northern half. Al altitudes 0 - 1600 m, on calcareous or base rock, less commonly on calcareous soil, occasionally overgrowing bryophytes on calcareous substrates.

Widespread in southern Europe, but ranging no further north than Provence, Croatia and Bulgaria. Also western Asia (widespread as far east as Iran), N. Africa (Morocco, Tunisia).

**Caloplaca furax** Egea & Llimona (1983)

*Collectanea bot.* 14: 266.

Description: There is a brief description in Wetmore (1996).

Chios, on sandstone at an altitude of 480 m.

Scattered in southern Europe, and the southernmost parts of central Europe. Also western Asia (Turkey).

**Caloplaca furfuracea** H. Magn. (1944)


Thallus: crustose, white to grey. Isidia: scarce to abundant, rather soft, usually granular, sometimes proliferating slightly but not cylindrical or clearly branched, 0.1 - 0.3 mm diameter. Soralia: absent. Apothecia: frequent, sessile, flat when young, sometimes convex later, rounded when young, sometimes ±crenulate later (0.3) 0.5 - 1.6 mm diameter, not pruinose. Disc: usually rust red, sometimes dark orange. Thalline margin: absent. Exciple: rust red, often slightly paler than disc, sometimes becoming connective and/or almost excluded when old; in section: 80 µm wide, orange-brown to dark orange-brown in outer part, paler orange-brown in inner part, of radiating hyphae that broaden outwards. Epithecium: dark orange-brown. Hymenium: 100 µm tall, colourless. Hypothecium: 125 µm tall, colourless, upper half sometimes forming a subhymenium that is not continuous with exciple. Ascospores: colourless, polarilocular, ellipsoid, 11 - 14 x 7.5 - 8 µm, septum 4 - 5 µm, 8 per ascus. Chemistry: isidia K- (even in section). Photobiont: green, cells globose, 7 - 15 µm diameter.

Crete and Peloponnesse. On bark and wood of *Abies cephalonica* and *Cupressus sempervirens*, and on bark of *Quercus coccifera*, at altitudes 700 - 1400 m.

Widespread in Europe, but scattered. Also Asia (Turkey, Kazakhstan), N. America (widespread in western half).
Thallus: crustose, green-grey to brown-green when fresh, fading to brown in herbarium, 85 - 100 μm thick. Blastidia: abundant, 0.06 - 0.1 mm diameter, globose to slightly flattened. Soralia: absent. Cortex: present, 18 μm thick. Medulla: not well differentiated. Apothecia: sessile, 0.3 - 0.5 mm diameter, flat at first, becoming convex later, not pruinose. Disc: dark brown to black. Thalline margin: absent, even in section. Exciple: brown, becoming almost excluded; in section: of radiating hyphae with broad lumina, but often appearing cellular. Epithecium: brown to green-brown, K- Hypothecium: 60 μm tall, colourless. Hymenium: 50 μm tall, colourless. Paraphyses: apical cell not pigmented. Ascospores: colourless, ellipsoid to elliptical, 12 - 16 x 5.5 - 10 μm, septum 5 μm wide, 8 per ascus. Conidia: colourless, 3 - 1 μm. Chemistry: thallus K-. Photobiont: green, in a rather irregular layer.

This species can not be confused with any other.

Western Peloponnese, on bark of Pinus pinea in a coastal site at an altitude of 10 m. The site was completely destroyed by fire in 2007. Only Portugal, southern Spain and Greece.


Thallus: crustose, grey, areolate. Areoles: 0.3 - 1.5 mm diameter, 120 μm thick at margins, 200 μm at centre. Prothallus: sometimes present, brown-orange, to 0.5 mm wide. Isidia: abundant over most of surface of areoles, very small, 0.01 mm diameter, almost black, much darker than thallus. Soralia: absent. Cortex: 15 - 50 μm thick, mostly colourless, sometimes pale brown in outer 5 - 10 μm, cellular; cells subrounded, 4 - 6 μm diameter; outer part faintly K+ violet. Apothecia: submersed to subsessile, slightly concave to flat, 0.4 - 0.5 mm diameter, not pruinose. Disc: brown-orange. Thalline margin: present, persistent, 50 - 90 μm wide in section; cortex: present, colourless, 18 - 25 μm wide. Exciple: present, orange, paler than disc; in section: 20 μm wide, colourless except at surface, which has same pigment as epithecium, cellular; cells +-isodiametric near surface, but in inner part lumina distinctly elongated. Epithecium: orange-brown, diffusing a reddish pigment in K, and afterwards colourless to pale red. Hymenium: 60 μm tall, colourless, KI+ blue. Hypothecium: 130 μm tall, colourless. Paraphyses: 1 μm wide at base, broadening to 3 - 4 μm at apex, sometimes slightly capitulate, rarely moniliform. Asci: 45 - 52 x 15 - 17 μm, Teloschistes type. Ascospores: colourless, ellipsoid, occasionally slightly swollen at septum when mature, 12.5 - 15 x 7.5 - 9 μm, septum 5 - 6 μm, 8 per ascus. Pycnidia: fairly common near margin of thallus, appearing as black dots 0.1 mm diameter; in section: 100% immersed, slightly pyriform, 150 μm tall, 120 μm wide, wall mostly colourless. Conidia: colourless, 3 x 1 μm, narrowly ellipsoid to bacilliform. Photobiont: green; cells globose, 10 - 15 μm diameter, forming a continuous layer 50 - 80 μm thick.

The minute, blackish blastidia on a grey, areolate thallus are diagnostic.

Northern Peloponnese and southern Sterea Ellada, on limestone at altitudes 10 - 700 m. The Peloponnesian collection was from a site with much nutrient enrichment, as there was a large pen for sheep and goats nearby. Only Greece and Ukraine.

Caloplaca (Variospora) glomerata Arup (1990)

Thallus: crustose, orange, areolate, not pruinose, without vegetative propagules. Prothallus: absent. Apothecia: abundant, crowded and irregular, subsessile, flat to slightly convex, 0.4 - 1.2 mm diameter, not pruinose. Disc: orange. Thalline margin: absent. Exciple: orange, slightly paler than disc, persistent but becoming very thin. Epithecium:
orange, K+ purple. Hymenium: 80 µm tall, colourless. Hypothecium: 100 µm tall, colourless. Ascospores: colourless, polarilocular, ellipsoid to slightly rhomboid, often swollen at septum, 15 - 17 x 7 -7.5 µm, septum 3.5 µm wide, 8 per ascus. Photobiont: green.

According to the protologue, mature ascospores may develop distinctive "Physcia type" lumina. Those were not observed in my single, rather scanty collection.

Specimens with well-developed ascospores are not likely to be confused with any other species, except perhaps Caloplaca latzelli, but that has a smoother, non-areolate thallus. In the absence of mature ascospores, C. glomerata could be confused with some morphs of C. dalmatica, though C. dalmatica usually has a conspicuous black hypothallus.

Peloponnese and Chios, on limestone at altitudes 880 - 2030 m. One of the two collections cited by Abbott (2009) does not belong to this species, though its correct placement is uncertain.

C. glomerata is not well known; there are scattered reports from Sweden to Calabria. Also Asia (Turkey, northern Ural Mts), N. Africa (Morocco). The pattern is hard to interpret.

Caloplaca (Flavoplaca) granulosa (Müll. Arg.) J. Steiner (1894)


A morph lacking isidia has been called var. sardonia, but I doubt that it has any taxonomic significance. It has not been reported for Greece.

Santorini and Mt. Olympus, on calcareous rock at altitudes 300 - 1000 m.

Widespread in southern and central Europe, absent from Scotland and Nordic countries. Also Asia (Russia, Tajikistan, Japan), Africa (Algeria, Tunisia, S. Africa), perhaps N. America, perhaps S. America (Argentina), Australasia (Victoria), perhaps Pacific (Island).

Caloplaca grimmiae (Nyl.) H. Olivier (1909)


Thallus: immersed in host, not visible externally. Apothecia: subsessile, flat to ±convex, 0.25 - 0.5 mm diameter, not pruinose. Disc: brown-red. Exciple: not visible externally; in section: 40 µm wide, colourless in inner part, orange-brown in a thin layer at surface, K-. Thalline margin: dark grey, ±persistent but becoming thin or reflexed. Epithecium: orange-brown, in K diffusing a purple-red pigment into solution, afterwards appearing pale red. Hymenium: 55 µm tall, colourless, K+ blue. Hypothecium: 40 µm tall, colourless. Paraphyses: often branched in upper part, 1.5 µm wide at base, 3 µm at apex, usually slightly moniliform or capitiate. Asci: 33 - 40 x 12 - 15 µm, rather variable in shape, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12.5 x 7 µm, septum 2.5 - 3 µm, 8 per ascus. Chemistry: disc K+ purple. Photobiont: green; cells subglobose 7 x 5 µm.

This species can not be confused with any other.

Scattered, with no clear pattern; uncommon but not rare. Parasitic on Candelariella vitellina at altitudes 0 - 2150 m, but usually below 800 m. Reports from rock may be incorrect, or may have overlooked the parasitic habit.

Widespread in Europe to as far north as southern Scandinavia, though absent from British Is. Also Macaronesia, Asia (widely spread), N. America (mainly western half).

Caloplaca haematites (Chaub.) Zwackh (1862)

Flora 45: 487; Lecanora haematites Chaub. (1821) in Saint-Amans, Fl. Agen. 492; Callopus haematites (Chaub.) A. Massal.; Caloplaca cerina var. haematites (Chaub.) H. Olivier; Lecanora cerina var. haematites (Chaub.) Nyl.; Placodium haematites (Chaub.) Anzi.

Thallus: crustose, usually forming small patches a few mm wide, sometimes extending to larger areas a few cm across, grey to dark grey, usually thin (about 100 µm), occasionally thick enough to display some cracks or areolation. Cortex: to 25 µm thick when well developed, colourless, K+ violet. Apothecia: sub sessile when young, sessile when mature, usually ± flat, less commonly slightly concave or slightly convex, 0.2 - 0.5 mm diameter, usually without pruina, occasionally with slight white pruina on thalline margin. Disc: orange-red to red. Thalline margin: grey, persistent but sometimes becoming thin in old apothecia, usually smooth and continuous, rarely discontinuous in very old apothecia; in section: 60 - 80 µm wide, pale brown to dark brown in outer 5 - 10 µm, colourless in inner part; cortex 25 - 40 µm wide that is well delimited from algal layer. Exciple: not visible externally; in section: 15 - 25 µm wide at the top, but only 8 - 12 µm at mid-hymenium level, usually entirely colourless, but sometimes epithelial pigment spreads onto top surface, hyphal, hyphae broaden irregularly in upper part giving there a weak cellular structure with elongated lumina; aspect ratio of lumina 1.5 - 2; surface layer K+ violet (not purple, distinct from reaction of the epithecium, but this reaction masked if any epithelial pigment present). Epithecium: orange-brown to brown-orange, in K diffusing a red or red-purple pigment into solution, and afterwards appearing pale red or pale red-purple. Hymenium: 60 - 70 µm tall,
colourless, occasionally with some epiphytic pigment in uppermost part, KI+ blue. Hypothecium: 75 - 80 µm tall, colourless. Paraphyses: often branched in upper part, 1 µm wide at base, 2-3.5 µm at apex, sometimes moniliform. Asci: 43-45 x 15-17 µm, Teloschistes type. Ascospores: colourless, polariocular, ellipsoid, 12.5-16 x 7-7.5 µm, septum 4-8 µm, 8 per ascus. Pycnidia: not visible externally; in section: 100% immersed, subglobose, 100 µm tall, 80 µm wide, wall colourless. Conidia: colourless, bacilliform (‘weakly bifusiform’), straight, 3-4 x 0.75 µm. Chemistry: disc K+ purple; thallus K- in spot test. Photobiont: green, cells subglobose to globose, 10-18 µm diameter, forming a regular layer 40-60 µm tall that is continuous except where interrupted by pycnidia.

This species can not be confused with any other. The disc of C. cerina never has a red tinge. In section, the contrasting K reactions of the epithecium and the surface of the exciple also differ from C. cerina.

Throughout Greece. Nearly always on bark, rare on wood. Recorded from a very wide range of phorophytes, avoiding only strongly acidic bark of conifers. At all altitudes where there are suitable substrates. The lichenicolous fungi Lichenodiplis lecanorae and Zwackhioniomyces coepulonus have each been recorded once from it.

Basically a southern European species, though it reaches southern England, where it is rare. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). An old report for N. America (Texas) is almost certainly incorrect, and a report for S. America (Chile) seems doubtful to me.

Caloplaca herbidella (Nyl. ex Hue) H. Magn. (1932)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Of the two Peloponnesian collections referred to this species by Abbott (2009), one definitely belongs to C. furfuracea. The other is discussed under C. coralliza.

Scattered throughout Greece, usually not very far from the sea. On bark at all altitudes where there are suitable substrates. Reported from Abies cephalonica, Pinus nigra, Platanus orientalis, Quercus ilex and Q. pubescens. The lichen Candelariella xanthostigma has been reported “on” this species, but was probably merely overgrowing it, not parasitic.

Throughout Europe except for arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). Reports for N. and S. America are said to be incorrect.

Caloplaca (Athallia) holocarpa (Hoffm.) A. E. Wade (1965)

Lichenologist 3(1): 11; Verrucaria holocarpa Hoffm. (1796), Deutschl. Fl. 2: 179; Athallia holocarpa (Hoffm.) Arup, Frödén & Söchting; Callopisma pyraceum var. pyrithroma (Ach.) Müll. Arg.; Caloplaca pyracea f. pyrithroma (Ach.) Flagey; Caloplaca pyracea var. pyrithroma (Ach.) H. Olivier.

Thallus: crustose, generally immersed, sometimes showing a few spots of pale yellow. Apothecia: sessile, flat, not pruinose, 0.3 - 0.6 mm diameter. Disc: orange to brown-orange. Thalline margin: absent. Exciple: orange to yellow-orange, paler than disc; in section: of anastomosing hyphae.

Some Greek collections fit well with the descriptions of C. holocarpa in the literature, but they seem to intergrade, in several directions, into other collections that do not. The morphological criteria suggested by Arup (2009) to separate C. holocarpa from C. pyracea do not work when applied to Greek collections.

The most recent published description, and the best one to consider, is that in Arup (2009).

Throughout Greece, at altitudes 0 - 2400 m, but usually below 1200 m (94% of records). Usually on calcareous rock. Arup (2009) remarks that it can occur on other kinds of nutrient-enriched rock as well as on bark and wood. However, in view of the ample scope for confusion with other species, it seems best, at present, to discount Greek reports from substrates other than calcareous rock. The lichenicolous fungus Intralichen baccisporus has been reported once from this lichen.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside tropics), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (widespread), Antarctica (Antarctic Peninsula and nearby islands). However, some reports may be unreliable, owing to confusion with other species.

Caloplaca (Blastenia) hungarica H. Magn. (1944)


Caloplaca subathallina may be distinct, but it is morphologically very similar to C. hungarica, and for the present I treat it as a synonym.

Thallus: crustose, very thin and continuous, to thicker (to 200 µm) and then cracked or slightly warted, forming small patches to about 8 mm in diameter, pale grey-brown to grey, not pruinose. Cortex: true cortex absent; pseudocortex: 25 - 60 µm thick, colourless to pale brown, without distinct structure, K-. Apothecia: sessile, flat or slightly convex, 0.25 - 0.5 (0.65) mm diameter, not pruinose. Disc: red-orange, red-brown or rust red. Thalline margin:
absent. Exciple: dark orange, orange red or rust red, paler than disc, persistent or becoming almost excluded; in section: 30 µm wide, orange-brown in outer 5 - 8 µm, colourless in inner part, formed of anastomosed hyphae; I-, pigmented part K+ red, pigment diffusing into solution. Epithecium: orange-brown, K+ red, pigment diffusing into solution. Hymenium: 60 - 70 µm tall, colourless. Hypothecium: 50 - 75 µm tall (including the poorly differentiated subhymenium), colourless to very pale yellow-brown. Paraphyses: sometimes branched in uppermost part, 1.5 µm wide in lower part, 2 - 2.5 µm near apex, slightly moniliform. Ascii: 40 - 15 x 17 µm, usually broadest in middle part when mature and then distinctly tapering towards apex, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12.5 - 17 x 6 - 8 µm, septum 4 - 6 µm, 8 per ascus. Chemistry: thallus K-, UV- . Photobiont: green; cells globose, 7 - 12 µm diameter. Photobiont layer: to 120 µm thick when thallus well developed, often discontinuous and moderately irregular.

Collections with distinctly rust red apothecia can not be confused with any other species. C. ferruginea has consistently much larger apothecia. The apothecia in which the apothecia have an orange tinge must be examined carefully to avoid confusion with numerous other species.

Scattered, with no clear pattern. On bark at altitudes 150 - 1160 m. Known from Ficus carica, Pinus halepensis, Pinus nigra and Quercus coccifera. All my collections were on twigs or very small branches, suggesting that this is a pioneer species.

Widespread from southern Sweden to Cyprus. Also Macaronesia (Canary Is), Asia (Turkey, Iran, Syria, Russia).

**Caloplaca hymetti** J. Steiner (1893)


Description: See the protologue. Steiner's description clearly refers to one of the black-fruited species of *Caloplaca*, and it suggests a slightly aberrant form of *C. albopruinosa*. However the identity of this lichen will remain unclear until the type specimen is studied.

Only known from the type collection, from Mt. Hymettus in Attica, at an altitude of about 1000 m.

**Caloplaca inconnexa** (Nyl.) Zahlbr. (1931) var. *inconnexa*


Thallus: crustose, usually orange, sometimes orange-yellow, not pruinose, generally in small patches to 1 cm diameter, several such patches sometimes coalescing, clearly areolate when well developed, but sometimes poorly developed and discontinuous and the small areoles sometimes then little more than large granules; to 0.3 mm thick when well developed but usually less. Hypothallus: occasionally present, black. Cortex: 20 - 30 µm thick, orange-brown, sometimes colourless in inner part, ±cellular, K+ purple-red. Apothecia: always present, sometimes much more conspicuous than thallus, immersed when very young, soon becoming sessile to sessile, usually flat, sometimes convex, 0.25 - 0.7 (0.9) mm diameter, not pruinose. Disc: orange. Thalline margin: sometimes present but not prominent, usually soon excluded; in section: 80 - 100 µm wide, cortex 10 - 20 µm wide. Exciple: pale orange to orange, paler than disc, persistent; in section: 15 - 50 µm wide, orange-brown in outer part, colourless in inner part, inner part of radiating hyphae, outer part sometimes distinctly cellular; pigmented part K+ purple-red. Epithecium: orange-brown, K+ purple-red; crystals: abundant, granular, colourless, 1 - 1.5 µm diameter, soluble in K. Hymenium: 75 - 100 µm tall, usually colourless, occasionally with epithelial pigment in top 20 µm. Subhymenium: sometimes present, to 50 µm thick, colourless. Hypothecium: (50) 125 - 130 µm tall, colourless, of predominantly horizontal hyphae. Paraphyses: simple, 1.5 µm wide in lower part, to 4 µm at apex, final 1 or 2 septa generally visible, uppermost 1 or 2 cells often slightly swollen, giving a slightly capitate or slightly moniliform appearance. Ascii: 50 - 55 x 12 - 14 µm, ±cylindrical to narrowly clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 10 - 13 x 6 - 8 µm, septum (2) 3 - 5 (8) µm wide, 8 per ascus. Chemistry: disc K+ purple. Photobiont: green; cells globose, 10 - 18 µm diameter. Photobiont layer: 25 - 60 µm thick, continuous and regular within a single granule, but appearing irregular and discontinuous if a section includes several granules

Material referred here is rather variable. Most collections agree well with *C. inconnexa* var *inconnexa*, but it is possible that more than one taxon is involved.

When obviously parasitic this species will probably not be confused with any others. Apparently free-living specimens often betray their parasitic origin by being closely associated with other lichens, especially *Aspicilia* species. When genuinely free-living, it can usually be separated from other species by its tendency to occur in small patches, typically about 1 cm diameter; *C. dalmatica* usually spreads more widely.

Widespread in the southern half of Greece, scattered in the north, at altitudes 0 - 1750 m. Lichenicolous on saxicolous lichens in about two-thirds of collections, otherwise free-living on rock, usually but not always calcareous. It parasitises *Acarospora cervina*, several species of *Aspicilia* s. lat. (including *Lobothallia*), *Caloplaca aurantia*, *Lecanora rupeicola*, and *Verrucaria nigrescens*.

Southern Europe and parts of central Europe. Absent from British Is and Nordic countries. Also Macaronesia (Azores), western Asia (Turkey, Iran, Syria), N. Africa (Morocco, Algeria, Tunisia). I am sceptical of a report for
Thailand.

**Caloplaca inconnexa var. nesodes** (Athallia nesodes) Poelt & Nimis (1987)

*Studia Geobot.* 7(1): 66; *Athallia nesodes* (Poelt & Nimis) Halicki & Vondrák; (?) *Caloplaca nectator* Poelt & Clauzade.

Vondrák, Halicki et al. (2016) argue that *C. nectator* is distinct, but the characters they list to separate the species overlap considerably, and are probably ineffective for reliable determination.

Description: see the protologue.

Scattered, with no clear pattern, at altitudes 200 - 900 m. On *Aspicilia* species or directly on siliceous rock.

In Europe, var. *nesodes* appears to have much the same distribution as var. *inconnexa*, though there are fewer records. Also central Asia (Tajikistan; also Turkey, Mongolia if *C. nectator* is synonymous).

**Caloplaca (Xanthocarpia) interfulgens** (Nyl.) J. Steiner (1902)


Scattered and rare in the southern half of mainland Greece, on calcareous rock. The two reports to date were at altitudes of 100 and 2150 m. Not recorded since 1970.

Southern and south-central Europe. Also Macaronesia (Canary Is), Asia (Turkey, Iran, Kazakhstan), N. Africa (Algeria, Tunisia).

**Caloplaca interna** Poelt & Nimis (1987)


Description: See the protologue.

All the Greek reports were regarded as tentative by the authors who published them, so Abbott (2009) did not accept this as a confirmed Greek species. Reports were from the islands of the southern Aegean, on siliceous rock at altitudes of 25 - 200 m.

A rare species, known from a few sites in Spain, Italy, Austria, perhaps Greece. Also Macaronesia (CVI), Asia (Turkey). Its taxonomic status merits review; *C. interna* may fall within the range of variation of one of the other *Caloplaca* species parasitic on *Aspicilia*.

**Caloplaca irrubescens** (Nyl. ex Arnold) Zahlbr. (1898)


The basionym is not "*Lecanora irrubescens* Nyl. (1874) in *Flora* 57: 318", as often stated. The name does not appear there. There is only *Lecanora aurantiaca* *irrubescens*, and it is not validly published.

Thallus: crustose, cracked, orange-brown. Apothecia: sessile to subsessile, flat, 0.2 - 0.35 mm diameter, not pruinose. Disc: red-orange. Thalline margin: absent. Exciple: paler than disc, persistent. Paraphyses: occasionally branched, 1.5 µm wide at base, 5 µm at apex, moniliform. Ascospores: ellipsoid, 11 - 13 x 6 - 8 µm, septum 4 - 5-µm wide.

Rare and scattered, with no clear pattern, on siliceous rock at altitudes 0 - 130 m.

Widespread in southern and central Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), Caribbean (Cuba, DR, Netherlands Antilles), C. America (Mexico), S. America (Argentina, Uruguay, Brazil, Australasia (Western Australia, NZS), Pacific (Hawaii). Reports for Western Hemisphere and Pacific are as *C. americana* or *C. subsoluta*.

**Caloplaca (Gyalolechia) klementii** (Kalb) ined.


Descriptions: Clauzade & Roux (1985); Poelt & Vězda (1977), both as *Fulgensia klementii*..

Mt. Olympus, on limestone at 1300 m altitude.

A rare species of southern Europe, from Spain and France to Greece.

**Caloplaca lactea** (A. Massal.) Zahlbr. (1901)


Thallus: crustose, often immersed and inconspicuous, sometimes superficial but very thin, continuous, white to grey-white, forming small patches about 1 cm diameter. Apothecia: 0.15 - 0.3 (0.4) mm diameter, subimmersed to sessile, flat. Disc: dull orange or brown-orange, often roughened and appearing obscurely pruinose as a result, but true
Caloplaca lacteoides **Nav.-Ros. & Hladun** (1996)


Thallus: crustose, forming irregular patches to 2 cm diameter but often less, usually entirely endolithic, less commonly thinly superficial and white; one collection had what appeared to be an very thin brown layer (?prothallus). Apothecia: (0.25) 0.3 - 0.5 mm diameter, sessile, usually ±flat, not pruinose. Disc: brown-orange or yellow-orange. Thalline margin: usually absent, occasionally weakly present in section. Exciele: orange to yellow, paler than disc, persistent; in section: (15) 40 - 75 µm wide, orange-brown in outer 7 - 15 µm, colourless in inner part, outer part with definite though sometimes rather weak cellular structure, inner part distinctly hyphal; pigmented part K+ red, pigment diffusing into solution. Epithecium: brown, K+ red, pigment diffusing into solution. Hymenium: 75 - 100 µm tall, colourless. Hypothecium: 50 - 75 µm tall, colourless, sometimes with oil droplets 1 - 2.5 µm diameter; divided rather obscurely into a hypothecium proper, in which small hyphal lumina are sometimes visible, and a subhymenium that lacks distinct structure. Paraphyses: simple, 1 µm wide in lower part, 2.5 - 3.5 µm at apex, usually not capitate, occasionally weakly moniliform. Ascii: 55 x 15 µm, ±clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12 - 15 x 6 - 8 (10) µm, septum 1 - 2.5 (4) µm wide, 8 per ascus. Photobiont: green.

*C. lactea* can be identified fairly easily by its combination of very small apothecia and small to medium sized (never large) ascospores.

Throughout Greece, on calcareous rock, at altitudes 0 - 2000 m. Some older reports may refer to *C. lacteoides*, which was only described in 1996. The lichenicolous fungus *Muellerella lichenicola* has been recorded once from this lichen.

Throughout Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (scattered), Australasia (Western Australia, both islands of NZ).

Caloplaca (Variospora) latzelii **(Servít) Clauzade & Cl. Roux** (1985)

Likenoj de Okcidenta Eŭropo 824; *Blastenia latzelii* Servít (1934), *Hedwigia* 74: 151.


Attica, on calcareous rock. The substrate was not reported. Perhaps present elsewhere, but all my collections that may belong here lack mature ascospores and can not be determined with certainty.

SE Europe (Croatia, Montenegro, Serbia, Greece). Also western Asia (Turkey, Israel, Syrian and Iran).

Caloplaca (Variospora) ligustica **de Lesd.** (1936)


Description: Clauzade & Roux (1985).

The single report was from Macedonia at an altitude of about 100 m. The substrate was not reported.

Southern Europe (Spain, France, Italy, Greece). Also N. Africa (Morocco). Reports for S. Africa are incorrect.

Caloplaca limitosa **(Nyl.) H. Olivier** (1909)


Similar to *C. crenularia*, but with a prominent, continuous, marginal, black hypothallus.

Some Greek collections of *C. crenularia*, including some from the site in which *C. limitosa* occurred, have traces of a marginal hypothallus, though the hypothallus is discontinuous and very inconspicuous. It is not clear to me whether *C. limitosa* is a good species or merely represents one of the extremes of variation within *C. crenularia*. 
For a published description of this taxon, see Clauzade & Roux (1985), as *C. festiva var. decussata*.

Islands of the Aegean and adjacent coast of the mainland. On siliceous rock at altitudes 5 - 700 m.

Only southern Europe; Portugal, France, Italy, Greece.

**Caloplaca (Flavoplaca) limonia Nimis & Poelt (1994)**


*Caloplaca britannica* R. Sant. is not synonymous, although some authors have claimed that it is.

Thallus: crustose, 1 cm diameter, areolate, yellow to yellow-orange, not pruinose. Areoles: those in central part of thallus 0.5 - 2 mm wide, flat, ±contiguous though separated by deep cracks; those at margin of thallus smaller, 0.15 - 0.5 mm diameter, often discrete, sometimes developing on a black hypothallus. Marginal areoles: basically absent, but a few marginal areoles may have weakly developed lobes to 0.3 x 0.1 mm. Blastidia: abundant, obscuring central part of thallus, ±globose, 0.05 - 0.12 mm diameter. Soralia: not seen. Apothecia: 0.4 - 0.75 mm diameter, ±sessile, slightly concave to ±flat, not pruinose. Disc: orange. Thalline margin: present, abundantly blastidiate. Exciple: pale orange, persistent.

My only collection is scanty. For additional descriptions, see: Nimis & Martellos (2004); Vondrák, Říha et al. (2009).

The blastidia are said to become sorediate eventually, but my collection lacked soredia.

Islands of the Aegean, on calcareous rock or soil at altitudes 0 - 230 m.

Much of Europe, to southern Scandinavia, though avoiding the NE quadrant. Also Macaronesia (Azores), Asia (Turkey, Georgia, Russia), N. Africa (Morocco).

**Caloplaca lithophila H. Magn. (1946)**


Thallus: crustose, of scattered, orange, corticate granules about 0.05 mm diameter; granules sometimes aggregated into groups to 0.2 mm diameter. Apothecia: subsessile to sessile, flat, 0.15 - 0.25 mm diameter, not pruinose. Disc: dark orange to orange-red. Thalline margin: absent. Exciple: orange, paler than disc. Hymenium: 50 µm tall. Ascospores: colourless, polarilocular, ellipsoid, 11 - 12 x 5 - 6 µm, septum 4 - 5 µm wide, 8 per ascus.

I use this name for a taxon that is distinctive and appears to be well defined, but it may not be the *C. lithophila* of western European authors (which was discussed by Clauzade & Roux (1985) under the name *C. tenuatula var. lithophila*). The status of Magnusson's name is unclear according to Arup (2009), as the type is in poor condition.

The combination of very small apothecia with a reddish disc, and the discontinuous thallus formed of orange granules is distinctive.

Crete and southern Peloponnesse, on calcareous rock at altitudes 500 - 1000 m.

There are reports under this name from many parts of Europe and from several other continents. Until the status of the name has been clarified, they are difficult to interpret.

**Caloplaca (Calogaya) lobulata (Flörke) Hellb. (1897)**


Description: Clauzade & Roux (1985).

Scattered, in the southern half of Greece at altitudes 0 - 800 m, with a single report from about 1500 m. There are old reports for the Peloponnesse from limestone and schist. Modern reports are all from bark. This species is not very well known, but Nimis (1993) seems to imply that it is exclusively corticolous and lignicolous, so the Peloponnesse reports may be incorrect.

Southern and central Europe, to as far north as mid Scandinavia, but absent from British Is. Also Asia (widespread), northern Africa (Morocco, Algeria, perhaps elsewhere), perhaps Australasia (Tasmania). Reports for N. America are incorrect and an old report for S. America (Argentina) is very doubtful.

**Caloplaca (Cerothallia) luteoalba (Ach.) Th. Fr. (1860)**

*Lich. arct. 120; Lecidea cinereofusca* (as cinereo-fusca) f (= var.) *luteoalba* Ach. (1803),*Methodus* (Suppl.) 12-13; *Cerothallia luteoalba* (Ach.) Arup, Frödén & Sochting.

The basionym is sometimes cited as *Lichen luteoalbus* Turner, in *Trans. Linn. Soc. London* 7: 92, but Turner's name was published in 1804. Although Turner introduced the name without reference to Acharius, and it is probable (Patrick Frödén pers. comm.) that he had not at the time seen a copy of Acharius's *Methodus*, his name was clearly intended to denote the same taxon that Acharius discussed. Acharius indicated that the specimen he described came from Turner and he cites in synonymy the then unpublished name "Lichen luteo-albus TURNER. Act. Soc. Linn.". It therefore seems reasonable to treat Turner's name as a presumed new combination.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Western Crete, close to sea level. The substrate was not stated. Although there is only a single Greek report, and it is nearly half a century old, it seems plausible, as this species is fairly distinctive.

Widespread to as far north as southern Scandinavia, but probably most frequent in Mediterranean regions. Also Macaronesia, western Asia (widespread as far east as Iran), N. Africa (Morocco). Reports from elsewhere (N. America, C. America, Australasia) are probably in need of confirmation.

**Caloplaca maritima** (de Lesd.) de Lesd. (1953)

Not a Greek species. The collection cited by Abbott (2009), but not accepted by him, belongs to *C. calcitrapa*.

**Caloplaca (Xanthocarpia) marmorata** (Bagl.) Jatta (1900)


Thallus: immersed, to 2 cm diameter. Apothecia: sessile, flat, rounded, ±uniformly scattered over thallus, 0.5 - 0.75 mm diameter, not pruinose. Disc: dark brown-red at first, becoming black in older apothecia. Thalline margin: absent. Exciple: red-orange at first, becoming dark brown in older apothecia, persistent; in section: 70 µm wide, colourless in inner part, brown-orange to brown in outer part, of hyphae with visible lumina on an overall radiating trend; K reaction of pigmented part as for epithecium. Epithecium: brown-orange to brown, K+ diffusing red-purple pigment into solution, leaving an insoluble violet pigment. Hymenium: 75 - 90 µm tall, colourless. Hypothecium: 50 - 100 µm tall, colourless to very pale brown. Paraphyses: sometimes branched in upper part, 1.5 µm wide in lower part, 1.5 - 3 µm at apex, not capitate, sometimes slightly moniliform. Asci: 65 - 70 x 22 - 30 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12.5 - 13 x 7 - 8 µm, septum 2.5 - 3 µm, 8 per ascus. Chemistry: disc K+ purple; exciple K+ purple; exciple K+ purple in spot tests. Photobiont: green; cells globose to ellipsoid, 10 - 15 x 5 - 15 µm diameter.

Scattered, in parts of Greece close to the Aegean Sea, on calcareous rock at all altitudes.

Commonest in southern Europe, but present as far north as southern Sweden. Also western Asia (widespread as far east as Kazakhstan), N. Africa (Morocco, Algeria, Tunisia), N. America (California), C. America (Mexico).

**Caloplaca monacensis** (Leder.) Lettau (1912)

Hedwigia 52(3-4): 240; Pyrenodesmia monacensis Leder. (1896), Ber. bayer bot. Ges. 4: 26; Caloplaca cerina var. cyanolepra (DC.) Zwackh; Placodium cerinum f. cyanoleprum (DC.) Anzi.

Description: Šoun et al. (2011).

Scattered, with no clear pattern, though usually not very far from to the coast. On bark at all altitudes. Probably widespread in Europe, to as far north as southern Sweden, though not often reported. Also Asia (Turkey, Iran, northern India).

**Caloplaca (Flavoplaca) navasiana** Nav.-Ros. & Cl. Roux (1995)

Crypt., Bryol.-Lich. 16(2): 90-95; Flavoplaca navasiana (Nav.-Ros. & Cl. Roux) Arup, Söchting & Frödén.

Description: See the protologue.

Islands of the southern Aegean and adjacent coast of the mainland, on calcareous rock at altitudes 0 - 55 m. Circum-Mediterranean. Southern Europe from Portugal to Cyprus. Also N. Africa (Morocco, Tunisia).

**Caloplaca neotaurica** Vondrák, Khodosovtsev, Arup & Söchting (2012)


Description: See the protologue.

Peloponnesse and Samothraki, on siliceous rock at altitudes 5 - 770 m. Scattered, from Wales to Cyprus, but absent from cold regions. Not reported for other continents.

**Caloplaca nigroblastidiata** (Arup, Halici & Vondrák) ined.


Description: See the protologue.

Epiros, on bark at an altitude of 1210 m. In Europe reported only for Sweden and Greece. Also Asia (Turkey), N. America (Alaska).

**Caloplaca (Flavoplaca) nigromarina** Vondrák et al. (2009)

Lichenologist 41(6): 598-599; Flavoplaca nigromarina (Vondrák et al.) Arup, Söchting & Frödén.

Description: See the protologue.

Island of Samothraki, on rock at an altitude of 34 m.

Bulgaria, European Turkey and Greece. Also Asia (Asian Turkey, Georgia).
Caloplaca nigubena (Kremp.) Dalla Torre & Sarnth. (1902)
Description: Clauzade & Roux (1985).
Athen Peninsula, on calcareous rock at an altitude of 300 m. Not reported since 1941, based on a collection made in 1934. This species is usually parasitic on Clauzadea imersa, but the single Greek report did not mention a host. However, the thallus of C. imersa is sometimes inconspicuous, so the report can not be discounted on those grounds alone. Abbott (2009) accepted it, but confirmation is desirable as there are no other reports of this species for regions with a Mediterranean climate.

Many mountains of central and southern Europe. I have not seen any reports for other continents.

Caloplaca (Flavoplaca) oasis (A. Massal.) Szatala (1932)
Scattered, with no clear pattern. Usually on calcareous or base rich rock, once parasitic on an undetermined species of Verrucaria, at all altitudes. According to Nimis (1993) it has often been overlooked.
Widespread to as far north as southern Scandinavia, . Also western Asia (Turkey, Syria, Ural Mts).

Caloplaca obscurella (J. Lahm ex Körb.) Th. Fr. (1871)
Lichenogr. Scand. 182; Blastenia obscurella J. Lahm ex Körb. (1860), Parerga Lichenol. 130; Caloplaca sarcopisisoides auct. (lapsus for sarcopisisoides).
Thallus: crustose, to a few cm diameter, white-grey to green-grey, thin (about 80 µm), usually at least slightly discontinuous. Soralia: often present, green to grey-green, generally delimited though individual soredia may become scattered over thallus surface, ±circular, 0.2 - 0.3 mm diameter, initially ±ulcerose with raised thalline margin, later concave, sometimes becoming convex; soredia granular. Cortex: present, 20 µm thick, colourless, cellular; cells 5 - 6 µm wide, rounded or slightly extended with long axis horizontal. Apothecia: 0.3 - 0.5 mm diameter, sessile to subsessile, flat to slightly convex, not pruinose. Disc: pale brown to brown. Thalline margin: usually absent, sometimes weakly present on lower surface of apothecia in section. Exciple: present, generally persistent though becoming very thin, sometimes becoming excluded in a few apothecia, almost colourless to pale brown, distinctly paler than disc; in section: 30 - 50 µm wide, pale brown to orange-brown in upper part, colourless within, distinctly cellular at least in upper part and sometimes throughout. Epithecium: almost colourless to orange-brown or brown, K- but becoming paler in K. Hymenium: 50 - 60 µm tall, colourless, strongly KI+ blue. Hypothecium: 50 - 120 µm tall, colourless, generally without distinct structure. Paraphyses: 1.5 µm wide at base, 2 - 3 µm at apex, sometimes slightly moniliform or capitate, apical cell generally not pigmented though a thin pigment layer may be present in a few paraphyses. Ascii: 32 - 40 x 10 - 14 µm, Teloschistites type. Ascospores: colourless, polarilocular, ellipsoid, 10 - 11 x 4 - 6 µm. septum 4 - 5 µm in mature ascospores, 8 per ascus. Chemistry: thallus and soralia K-, KC-: Photobiont: green; cells globose or subglobose 7 - 15 µm diameter, forming a continuous, though sometimes slightly irregular, layer 40 - 50 µm thick.
My collections do not entirely match descriptions in the literature. In particular, the apical cell of the paraphyses generally lacks pigment, or has only a very thin pigment layer.
Scattered, usually not very far from the sea. On bark at altitudes 0 - 700 m.
Throughout Europe except for the arctic. Also Macaronesia, Asia (widespread), N. America (widespread).

Caloplaca (Xanthocarpya) ochracea (Schaer.) Th. Fr. (1861)
Thallus: crustose, forming irregular patches to several cm diameter, immersed or thinly superficial, to 150 µm thick, usually white or pale grey with pale orange patches, rarely entirely pale orange. Prothallus: occasionally present, black, 0.1 mm wide. Cortex: true cortex absent; layer above photobiont cells 70 - 100 µm thick, mostly colourless, sometimes pale brown near surface, without distinct structure, with abundant crystals 1 - 2 µm diameter, not soluble in K. Medulla: poorly developed, photobiont layer often directly overlying substrate. Apothecia: frequent, 0.25 - 0.5 mm diameter, usually sessile, sometimes submersed when young, usually ±flat, occasionally becoming slightly convex. Disc: orange to dark orange. Thalline margin: absent. Exciple: usually orange, sometimes yellow-orange, paler than disc, sometimes slightly shiny, persistent; in section: 50 - 75 µm wide, orange-brown in a surface layer 5 - 15 µm thick, colourless in inner part, of radiating hyphae which broaden and develop small, but generally distinct, lumina, 5 - 7 x 2 - 3 µm in outer half of exciple; outer, pigmented part diffusing a red-purple solution in K and becoming pale red to red.
afterwards, outer part KI+ deep red-brown; crystals abundant, mainly in outer part, 1 - 2 µm diameter, soluble in K, not soluble in N. Epithecium: orange to orange-brown, diffusing a red-purple solution in K and becoming pale red to red afterwards; with abundant granular crystals about 1 µm diameter, soluble in K, not soluble in N. Hymenium: 60 - 80 µm tall, usually colourless, sometimes with epiphytic pigment in upper part, KI+ blue. Subhymenium: 40 - 60 µm tall, not always very distinct from hypothecium; generally KI-, but a few patches faintly KI+ blue. Hypothecium: 70 - 80 µm tall, colourless, KI-.

Paraphyses: sometimes branched in upper part, 1 - 2 µm wide at base, 3 - 5 µm at apex, slightly to strongly moniliform. Asci: 33 - 55 x 15 - 17 µm, clavate, Teloschistes type. Ascospores: colourless, ellipsoid, 14 - 19 x 5 - 7 µm, appearing 3-septate when mature (see note below), 8 per ascus. Chemistry: apothecia and orange parts of thallus K+ purple; thallus UV+ orange. Photobiont: green; cells globose, 7 - 11 µm diameter. Photobiont layer 30 - 40 µm thick, irregular, often discontinuous; isolated cells often present in “cortex” well above main layer.

ascospores appear conventionally polarilocular at first, except that the septum is unusually broad. The septum broadens further and the channel perforating it becomes unusually wide. This channel then broadens markedly in its central part. At this state the interior of an ascospores is sometimes described as "dumb-bell shaped"; the long, broad central channel connects two rather small lumina at the extreme ends of the ascospore. Ascospores eventually developed 4 distinct lumina. The lumina may be rather irregular, but sometimes they become very regular and the ascospore then appears conventionally 3-septate.

If mature, or even semi-mature, ascospores are present, this species can not be confused with any other. Otherwise, it can sometimes be recognised by the distinctive 'white flecked with orange' thallus, though this character is rather variable.

Probably throughout Greece, but more common in the southern half. On calcareous rock at altitudes 0 - 1100 m. Once reported as parasitic on Bagliettoa marmorea.

Most of Europe, except Nordic countries. Also Asia (Turkey, Israel, Syria, Russia), Africa (Morocco, Algeria, Tunisia, S. Africa), S. America (Argentina), Australasia (NZS).

**Caloplaca oleicola** (J. Steiner) van den Boom & Breuss (1995)


Thallus: crustose, white, very thin, continuous, without vegetative propagules. Apothecia: abundant, sessile, ±flat, 0.2 - 0.3 mm diameter, not pruinose. Disc: black. Thalline margin: absent, even in section. Exciple: in section: 40 µm wide, brown in outer part, colourless in inner part, of radiating hyphae with broad lumina, often appearing ±cellular. Epithecium: mostly brown to dark brown sometimes grey, K- (in my collection). Hymenium: 50 - 70 µm tall, colourless, KI+ intensely blue. Hypothecium: 25 m tall, colourless. Paraphyses: sometimes branched in upper part, 1.5 µm wide at base, to 3 µm at apex, slightly capitulate or moniliform. Asci: 52 x 15 µm, ±Teloschistes type. Ascospores: colourless, polarilocular, lumina of immature ascospores sometimes hourglass shaped, ellipsoid, 15 x 7 µm, septum 5 - 10 µm, 8 per ascus. Photobiont: green.

According to the protologue, the epithecium and exciple of *C. oleicola* react K+ violet in section (sedifolia grey pigment). I did not observe a K+ reaction in any of four apothecia tested. However, my collection agrees well with *C. oleicola* in all other respects, and perhaps the concentration of sedifolia grey is variable in *C. oleicola*. Alternatively, since the type and the only other European collection were from bark, whereas the Greek collection was from hard wood, the latter may be a closely related, but undescribed species.

Western Peloponnese and Macedonia. The Peloponnesian collection was on wood of *Pinus halepensis* at a coastal site at an altitude of 10 m. The Macedonian one was on bark at an altitude of 1400 m. The Peloponnesian site was destroyed by fire in 2007.

In Europe, only Liguria in Italy (type collection) and Greece. Also N. America (BC).

**Caloplaca (Flavoplaca) ora** Poelt & Nimis (1987)


Description: See the protologue.

Cret and Chios, on siliceous rock at a altitudes 5 - 35 m.

European coast of the Mediterranean, from Spain to Greece. However, according to Vondrák, Říha et al. (2009) material that has been referred to this name is heterogeneous.

**Caloplaca pellodella** (Nyl.) Hasse (1913)


For the moment, I follow current practice and use the epithet *pellodella*. However, the epithet *conglomerata* has priority if the synonymy can be established with certainty. If not synonymous, it may be that *C. pellodella* is a Western Hemisphere taxon and *C. conglomerata* is Eastern Hemisphere. The matter needs to be clarified.
Caloplaca (Scythioria) phlogina (Ach.) Flagy (1886)

Mém. Soc. émil. Doubs 1886: 250; Parmelia citrina γ (= var.) phlogina Ach. (1803); Caloplaca citrina f. phlogina (Ach.) de Lesd.; (?) Caloplaca citrinella auct. græc.; Polycauliona phlogina (Ach.) Arup, Frödén & Söchting; Scythioria phlogina (Ach.) S. Y. Kondr., Kärnefelt, Elix, A. Thell & Hur.

Descriptions: Arup (2006a); Smith et al. (2009).

Crete and Macedonia. Presumably widespread but overlooked. On bark at altitudes 50 - 1400 m. The only phorophyte explicitly reported was Quercus coccifera. Last recorded in 1966. Abbott (2009) accepted this as a Greek species, but clearly with some hesitation, and confirmation of its presence in Greece is desirable.

Much of Europe to as far north as southern Scandinavia. Also Macaronesia (Azores), Asia (northern India), Africa (S. Africa, perhaps Algeria, N. America (Nova Scotia), S. America (Chile).

Caloplaca (Huneckia) pollinii (A. Massal.) Jatta (1900)


Abbott (2009) tentatively synonymised Lecanora ferruginea var. nigricans with Caloplaca ferruginea, but according to Wetmore (1994) it is a synonym of C. pollinii. However, both of those species are usually corticolous or lignicolous, but the single Greek report of Lecanora ferruginea var. nigricans, for the island of Lefkada, was from calcareous rock. It probably refers to some other species.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Northern Greece, on bark at altitudes 0 - 1200 m. Reported from Olea europaea and Pinus heldreichii. An old report from calcareous rock may be unreliable.

Probably throughout southern and west-central Europe. Also Macaronesia (CVA), Asia (Turkey, Iran, perhaps Russia, India), N. Africa (Morocco), N. America (widespread), Caribbean (PR), C. America (CR, Mexico), S. America (Colombia). If C. pheocarpella is synonymous, as some have suggested, its range extends well into arctic and antarctic regions.

Caloplaca (Flavoplaca) polycarpa (A. Massal.) Zahlbr. (1919)

Öst. Bot. Z. 68: 317; Callopusia aurantium var. polycarpum A. Massal. (1855), Symm. Lich. Nov. 31-32; Caloplaca fiumana Zahlbr.; Flavoplaca polycarpa (A. Massal.) Arup, Frödén & Söchting; Placodium polycarpum (A. Massal.) Szatala.


Fairly easily recognised by the very small apothecia that are parasitic on calcareous species of Verrucaria. It is said that it can occur free-living, and the thallus may then be better developed.

Scattered throughout Greece at all altitudes. Parasitic on crustose species of Verrucariaceae on calcareous rock, or directly on the rock.

Throughout Europe to as far north as British Isles and southern Scandinavia. Also western Asia (Lebanon, Israel, Syria, Turkey), N. Africa (Morocco).

Caloplaca (Gyalolechia) pruinosa (Körb.) Zahlbr. (1905)


Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Poelt & Vézda (1977), all as Fulgensia pruinosa.

Mt. Olympus, on soil above 1800 m altitude.

Mountains of central and southern Europe. Also Asia (Turkey).
Caloplaca (Athallia) pyracea (Ach.) Zwackh (1862)
*Flora* 45: 487; *Parmelia cerina* ζ (= var.) *pyracea* Ach. (1803), Methodus 176; *Athallia pyracea* (Ach.) Arup, Frödén & Sochting; *Callopsisma pyraceum* (Ach.) Arnold; (?) *Caloplaca pyracea* var. *flavovirescens* sensu Jatta; *Lecanora pyracea* (Ach.) Nyl.

Thallus: crustose, but otherwise very variable; poorly developed and ± immersed to moderately well developed; if well developed then continuous and thinly cracked, or discontinuous, rarely developing a slight areolation; usually pale grey, sometimes white, pale brown, green-grey, grey, dark grey, or pale orange. Prothallus: absent. Apothecia: sessile, flat to slightly convex, rarely strongly convex, not pruinose, (0.25) 0.3 - 0.7 (1.2) mm diameter. Disc: usually orange, sometimes dark orange, rarely with a yellow or red tinge. Thalline margin: sometimes present in young apothecia, grey, thin, inconspicuous, becoming excluded; in section: present or absent, to 70 µm wide, cortex 15 - 25 µm wide, of rather fine pseudoparenchyma, with crystals that are soluble in K. Exciple: rather variable, but most commonly pale orange to yellow-orange, paler than disc, prominent and persistent; in section: 20 - 120 µm wide, brown-orange in outer part, colourless in inner part, basically hyphal, but sometimes with some elongated lumina in outer part. Epithecium: orange to orange-brown, with crystals that are not soluble in K (or at least not all of them). Hymenium: (50) 60 - 100 µm tall, colourless, KI+ blue. Hypothecium (+ subhymenium if present): 50 - 150 µm tall, colourless, sometimes divided into a ± distinct subhymenium in upper half and a true hypothecium below, sometimes not. Subhymenium: colourless to very pale grey, individual hyphae not visible, ± opaque as a result of many small oil droplets mostly less than 1 µm diameter (rarely to 2 µm). True hypothecium: of ± horizontal hyphae. Paraphyses: simple, 1 µm wide in lower part, 1 - 2 µm at apex, not capitulate, sometimes slightly moniliform. Asci: 50 - 60 x 14 - 16 µm, ± clavate, Teloschistes type. Ascospores: colourless, polariocular, usually ellipsoid, 11 - 15 x 6 - 8.5 (10) µm, 8 per ascus, septum (3.5) 4 - 7.5 µm. Photobiont: green, cells globose to subglobose, 10 - 12 µm diameter.

Typical *C. pyracea* is easily recognised and unlikely to be confused with any other common species, though collections from humid coastal sites should be checked against *C. aegatica*. However, some collections referred here deviate from the typical form, and since the *C. pyracea* complex does not have any really distinctive characters, in practice those collections are best determined by excluding all the other possibilities.

*C. pyracea* and *C. holocarpa* are very similar. Arup (2009) found slight but clear differences in Scandinavian material, but the criteria that he used to separate them do not work well in Greece. Pending a revision of the holocarpa complex in Mediterranean regions it seems best to call corticolous and lichenicolous collections *C. pyracea* and saxicolous ones *C. holocarpa*; at worst, that will probably lead to no more errors than any other approach. It the names prove to be synonymous, it will be easy to merge records made under the two names.

Throughout Greece. On bark of a very wide range of trees and shrubs, but not often on strongly acidic bark. Occasionally on wood. Greek reports from rock are probably best discounted. At all altitudes where there are suitable substrates. The lichenicolous fungi *Lichenodiplis lecanorae* and *Lichenocodium lecanone* have each been reported once from this lichen, but the latter may be an error for *Lichenodiplis lecanone*.

Distribution unclear, owing to confusion with other species, but reported for most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread), perhaps C. America (Mexico), S. America (Colombia; perhaps elsewhere), Antarctica (subantarctic Heard Is). Reports for Australasia (NZ) are incorrect.

Caloplaca rubelliana (Ach.) Rabenh. (1863)
*Hedwigia* 2(20): 211; *Lecanora rubelliana* Ach. (1810), Lichenogr. Universalis 376; (?) *Caloplaca rubelliana* var. *areolata* (Wedd.) Zahlbr.

Descriptions: Clauzade & Roux (1985); Nash et al. (2007).

Scattered, in small islands of the Aegean, on siliceous rock at altitudes around 450 m. Last reported in 1943.

Widespread in southern and central Europe. Also Asia (Turkey, Syria, southern Siberia, Bhutan), Africa (widespread outside humid tropics), N. America (scattered in western USA), C. America (Mexico), Australasia (widespread if *C. scarlatina* is synonymous).

Caloplaca sarcopodioides auct.

The collections cited under this name by Abbott (2009) belong to *C. fuscoblastidiata* and *C. oleicola*.

Caloplaca (Calogaya) saxicola (Hoffm.) Nordin (1972)

Description: Because this species has been misunderstood, it may be best to refer only to Gaya (2009).

According to Gaya (2009) this is a species of predominantly temperate distribution, with a preference for cold environments. There are scattered reports under this name from much of Greece, but I have never seen it in Greece, and
many Greek reports are probably unreliable. However, there are reliable recent reports for Macedonia. Abbott (2009) accepted all the Greek reports, but he had not seen Gaya's monograph. Most Greek reports are from calcareous rock; two are from silicious rock.

Apparently throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (southern parts of Australia, NZS), Antarctica (widespread). However, many reports are probably incorrect.

**Caloplaca (Athallica) saxifragarum Poelt (1955)**

*Feddes Rep.* 58: 176; *Caloplaca schoeferi* Poelt.


Rare in the mountains of northern Greece, overgrowing saxicolous bryophytes at altitudes 1450 - 2150 m.

Mountains of central and southern Europe. Also Asia (Tajikistan, Mongolia), N. America (Arizona).

**Caloplaca (Calogaya) schistidii (Anzi) Zahlbr. (1898)**


Thallus: crustose, inconspicuous or of discontinuous, slightly convex, orange-yellow or pale orange patches, not pruinose; without vegetative propagules. Apothecia: sessile, ±flat, 0.5 - 1.3 mm diameter, not pruinose. Disc: dark orange to orange. Thalline margin: sometimes present but thin and obscure, pale orange to orange-yellow; in section: with distinctly cellular cortex. Exciple: orange to pale orange, usually slightly paler than disc, smooth, persistent; in section: 70 - 125 µm wide, orange in outer 15 - 25 µm, colourless in inner part, of interwoven (?)anastomosed) hyphae. Epithecium: brown-orange, K+ red. Hymenium: 60 - 90 µm tall, colourless. Hypothecium: 50 - 100 µm tall, upper 25 - 50 µm weakly differentiated as a subhymenium, colourless. Paraphyses: simple, 2 µm wide at base, to 4 µm at apex, slightly moniliform to ±capitate. Asci: 52 - 62 x 14 - 18 µm, narrowly clavate, Teloschistes type. Ascospores: colourless, 1-septate, ±ellipsoid when young, later distinctly constricted at septum and hourglass shaped, 15 - 20 x 5 - 8 µm, 8 per ascus. Photobiont: green, cells globose, 10 - 15 µm diameter.

Provided that ascospores are examined, this species is not likely to be confused with any other.

Scattered on Crete and the mainland, Overgrowing bryophytes on calcareous rock or soil, usually at altitudes 1000 - 1800 m, though there is a single anomalous report from 300 m.

Southern Europe, and parts of central Europe not far from the Alps, though there are disjunct reports for Sweden and perhaps Greenland. Also Macaronesia (Tenerife), western Asia (Turkey, Israel, Iran, Armenia), N. Africa (Morocco, Tunisia).

**Caloplaca (Rufoplaca) scotoplasa (Nyl.) H. Magn. (1944)**


Description: Clauzade & Roux (1985).

Reliably reported for Skyros, on schist at an altitude of 100 m. Reports for Crete and Santorini are incorrect.

Throughout Europe, though less common in the south. Also Macaronesia, Asia (Turkey, Russia, India), N. Africa (Morocco), N. America (New York).

**Caloplaca (Parvoplaca) servitiana Szatala (1943)**


Description: Vondrák, Khodosovtsev et al. (2010). See also the protologue.

Szatala's description does not suggest any lichen known to me. The disc is said to be "atro-fusco aut livido-fusco", and Szatala never mentions any orange colour in the thallus or apothecia, so presumably it does belong in group I. The apothecial pigments, both in epithecium and exciple, are described as "KHO pulchre violascens, HNO3 non reagens", which is puzzling as *Sedifolia* grey reacts N+ violet. According to Vondrák, Khodosovtsev et al. (2010), who examined the type, the pigment most likely is Sedifolia grey, but the lichen does not belong to the *Pyrenodesmia* group.

Scattered, with no clear pattern. On bark, especially *Quercus*, at altitudes 200 - 1400 m.

Only Italy, Albania and Greece.

**Caloplaca (Bryoplaca) sinapisperma (DC.) Maheu & A. Gillet (1914)**


Mt. Olympus, on soil at altitudes 700 - 1200 m.

Widespread in central Europe, extending northward well into Nordic countries. Rare south of the Alps, and restricted to the mountains. Also Asia (widespread in Russia; Mongolia), N. America (widespread).
Caloplaca (Athallia) skii Khodosovtsev, Vondrák & Šoun (2011)
Description: See the protologue.
Crete, on bark at low altitude.
Southern and south-central Europe. Also Asia (Turkey).

Caloplaca sororicida M. Steiner & Poelt (1993)
in Poelt & Hinteregger, Biblioth. Lichenol. 50: 201.
Description: none seen.
Western Crete, parasitic on Caloplaca transcaspica at an altitude of 1030 m.
In Europe only reported for Greece. Also Asia (Turkey, Iran).

Caloplaca (Haloplaca) suaedae O. L. Gilbert & Coppins (2001) s. lat.
Description: Smith et al. (2009), or see the protologue.
Crete, on bark at low altitude.
C. suaedae s. str. may be restricted to the British Isles and NW France, but a closely related species is present in Greece, Turkey and Morocco.

Caloplaca (Gyalolechia) subbracteata (Nyl.) Lettau (1958)
Feddes Rep. 62: 28; Lecanora subbracteata Nyl. (1883), Flora 66: 534; Caloplaca fulgens var. campestris sensu J. Steiner (1919); Fulgensia subbracteata (Nyl.) Poelt; Gyalolechia subbracteata (Nyl.) Søchting, Frödén & Arup.
Thallus: crustose with distinct marginal lobes, egg yellow, strongly pruinose, K+ purple. Isidia: abundant, globose to slightly scale-like, 0.1 - 0.2 mm diameter.
My only Greek collections lacked apothecia. For fuller descriptions see: Nash et al. (2004); Nimis & Martellos (2004), both as Fulgensia subbracteata.
The combination of abundant isidia, well-developed marginal lobes, and egg yellow, strongly pruinose thallus separates it clearly from other species.
Widespread in the southern half of Greece, usually at altitudes 0 - 600 m, but with an outlier at 1280 m. Usually on calcareous soil, sometimes on calcareous rock.
Southern ad south-central Europe. Also Macaronesia, Asia (widespread in warm, dry regions as far east as Afghanistan), N. Africa (Morocco, Tunisia, Egypt), N. America (scattered), C. America (Mexico), S. America (Argentina), Australasia (widespread in southern parts of Australia).

Caloplaca (Blastenia) subochracea (Wedd.) Werner (1955)
The name is said to have been generally used in a sense different from Weddell's type, but the matter has not yet been sorted out.
Description: Clauzade & Roux (1985).
Crete, on calcareous rock at an altitude of about 50 m. Only var. subochracea is confirmed for Greece.
Mainly southern Europe, but also reported for Poland and Ukraine. Also western Asia (Turkey, Syria), N. Africa (Morocco, Tunisia).

Caloplaca substerilis Vondrák et al. (2013)
Description: See the protologue.
Amorgos, on bark of Olea europaea at an altitude of 190 m. The Greek report is the most southerly one for this species.
Austria, Czech Republic, Solvakia, Bulgaria and Greece. Also Asia (southern Urals).

Caloplaca (Flavoplaca) tavaresiana Nav.-Ros. & Cl. Roux (1993)
Description: See the protologue.
Scattered in the southern Aegean and adjacent coat of the mainland. On calcareous rock at altitudes 2 - 200 m
Southern Europe, from Portugal to Cyprus. Also western Asia (Turkey), N. Africa (Morocco, Tunisia).
Caloplaca teicholyta (Ach.) J. Steiner (1895)


The name Lecidea lallavei Clemente (1807) has priority if synonymous. Clemente’s name is often assumed to be a synonym of Caloplaca erythrocarpa, but the protologue fits C. teicholyta better.

Thallus: crustose, grey-white, to 4 cm diameter, rather thin (140 - 170 µm), but usually continuous except sometimes near margins. Prothallus: not present in my collections. Soralia: abundant, grey or blue-grey, diffuse, not delimited. Cortex: (?pseudocortex), 50 - 80 µm thick, colourless, K-,
structure obscured (even in K) by abundant crystals. Medulla: very thin and poorly developed. Apothecia: subsessile, flat, 0.3 - 0.8 mm diam, not pruinose. Disc: rust red. Thalline margin: often weakly present on lower surface of apothecia. Exciple: prominent, rust red, paler than disc, persistent; in section: 50 - 70 µm wide, colourless in inner part, brown-orange at surface, hyphal, tips pf hyphae expanding near surface; brown-orange part diffusing a red-purple pigment in K and then becoming colourless. Epitheciun: brown-orange, diffusing a red-purple pigment in K and then becoming colourless. Hymenium: 70 µm tall, colourless. Hypothecium: 50 µm tall, colourless. Paraphyses: sometimes branched, 1.5 µm wide at base, 2.5 - 3 µm at apex, upper part with visible septa, rarely slightly moniliform. Asci: 52 x 17 - 20 µm, Teloschistes type. Ascospores: colourless, polarilocular, usually ellipsoid, sometimes swollen at septum, 13 - 16 x 7 - 9 µm, septum 2.5 - 5 µm, 8 per ascus. Chemistry: apothecia K+ red-purple, thallus and soralia K-. Photobiont: green, cells globose, 6 - 10 µm diameter, forming a continuous layer 60 - 75 µm thick. Plant of C. erythrocarpa lacks soralia and has a thicker, whiter thallus.

Widespread to as far north as southern Scandinavia, but probably commonest in the south. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia Egypt), perhaps S. America (Argentina). Reports for N. America are incorrect.

Caloplaca tenuata (Nyl.) Zahlbr. (1931)


Description: Clauzade & Roux (1985).

C. tenuata resembles C. teicholyta var. nigrescens in the thalline margin, but the protologue states that it is a much more robust species. Apothecia are sessile, slightly concave to slightly convex, 0.35 - 0.7 (1.0) mm diameter, not pruinose. Disc: dull yellow or orange yellow, sometimes almost orange. Thalline margin: weakly present in some apothecia, grey, thin, generally becoming excluded or confined to lower surface of apothecia. Exciple: yellow or yellow-orange, quite prominent, persistent; in section: 45 µm wide, orange-brown in outer part, colourless in inner part, of ±radiating hyphae; pigmented part K+ purple. Epitheciun: orange-brown, with orange crystals not soluble in K; K+ purple. Hymenium: 60 - 65 µm tall, colourless. Hypothecium: 45 - 50 µm tall, colourless. Paraphyses: 1.5 µm wide at base, 4 µm at apex, distinctly moniliform in final 2 - 3 cells. Ascospores: colourless, polarilocular, ellipsoid, 12 - 16 x 7 - 10 µm, septum 3 - 6 µm broad, 8 per ascus. Chemistry: disc K+ purple. Photobiont: green.

As this report is very disjunct I sought the opinion of a specialist, Dr. Ulrik Sochting, who kindly examined the material and confirmed the determination.

C. tiroliensis could perhaps be confused with C. schoeferi or C. saxifragarum, but those species have smaller ascospores and apothecia that are not, or not so distinctly yellow. C. cerina var. muscorum is a much more robust species, with a prominent, persistent thalline margin and discs that are unambiguously orange, without any trace of yellow.

Mount Mikri Ziria, in the northern Peloponnese, overgrowing bryophytes on non-calcareous soil at an altitude of 1750 m.

Northern Europe, and high mountains further south. Also Macaronesia, Asia (widespread), N. America
Caloplaca transcapsica (Nyl.) Zahlbr. (1931)

Description: The only description I have found is Nylander's protologue. It indicates that this is one of the black-fruited species, but is otherwise inadequate.

Crete, at altitudes of 900 - 1100 m on limestone. The lichenicolous lichen Caloplaca sororicida has been reported once from this host.

Eastern Europe (Russia, Ukraine, Greece). Also Asia (widespread in warm, dry regions from Turkey to China). Reports for N. America are incorrect.

Caloplaca ulcerosa Coppins & P. James (1979)
Lichenologist 11(2): 139-141.

Description: Clauzade & Roux (1985); Smith et al. (2009).

Crete and Iraklia, on bark at altitudes 40 - 55 m. Reported from Juniperus phoenicea and Olea europaea.

Mainly central Europe and southern parts of northern Europe. In southern Europe, widely distributed, from Spain to Greece, but rare. Also western Asia (Turkey, Israel, Iran), N. Africa (Morocco), N. America (scattered in USA).

Caloplaca (Pyrenodesmia) variabilis (Pers.) Th. Fr. (1861)
Gen. Heterolich. Eur. 71: Lichen variabilis Pers. (1794), AnnL Bot. (Usteri) 7: 26; (?) Blastosina agardhiana var. cinereovinosa (J. Steiner) Szatala; Blastosina rhinodinoides (J. Steiner) Szatala; (?) Caloplaca agardhiana f. cinereovinosa (J. Steiner) Zahlbr.; Caloplaca falva (Anzi) J. Steiner; (?) Caloplaca intercedens f. cinereovinosa J. Steiner; Caloplaca paepalostoma (Anzi) Jatta; Caloplaca paepalostoma var. ochracea Zahlbr.; Caloplaca rhinodinoides J. Steiner; Caloplaca variabilis f. acrustacea Müll. Arg.; Caloplaca variabilis var. acrustacea (Müll. Arg.) Szatala; (?) Caloplaca variabilis var. cinereovinosa (J. Steiner) J. Steiner; Caloplaca variabilis f. fusca (A. Massal.) J. Steiner; Caloplaca variabilis var. ocellulata (Ach.) Boistel; Caloplaca variabilis f. ochracea (Müll. Arg.) J. Steiner; Caloplaca variabilis β (= var.) ochracea Müll. Arg.; Lecanora variabilis (Pers.) Ach.; Lecanora variabilis var. subimmersa Nyl.; Placodium paepalostomum Anzi; Placodium variabile (Pers.) Hepp; Placodium variabile var. acrustaceum (Müll. Arg.) A. L. Sm.; (?) Placodium variabile var. continuum (Harm.) Szatala; Placodium variabile var. fuscum (A. Massal.) Szatala; Pyrenodesmia variabilis (Pers.) A. Massal.

The application of the name Caloplaca variabilis f. acrustacea Müll. Arg. is not entirely clear to me. It may be a synonym of Caloplaca alociza rather than C. variabilis.

The various ochracea forms and varieties were probably described from thalli that had absorbed some iron oxide. This is a fairly common phenomenon, in both this species and in Caloplaca chalybaea, and is not of taxonomic significance.

Thallus: crustose, usually superficial and areolate, usually around 200 µm thick, sometimes less, usually brown or brown-grey, sometimes paler, occasionally white pruinose in outer part. Prothallus: absent or poorly developed in my collections. Areoles: subangular, 0.3 - 1.0 mm wide. Vegetative propagules: absent. Cortex: 40 - 50 µm thick, brown in upper half, colourless below, in places with a rather weak cellular texture on a scale of 2 - 4 µm, K+ faintly violet in upper part. Medulla: with a few patches that react distinctly K+ violet. Apothecia: 0.4 - 1.1 (1.3) mm diameter, sessile, or sub sessile, usually flat, sometimes becoming convex, usually 1 (3) per areole, usually with at least some white pruina on disc or exciple or both. Disc: dark brown to black when dry, brownish when wet. Thalline margin: usually present, about 0.1 mm wide, sometimes restricted to lower surface of apothecia; in section: 130 µm wide, with abundant crystals in outer part. Exciple: always present, thin, 0.05 mm wide, sometimes not very distinct externally if thalline margin well developed; in section: 25 - 70 µm wide, brown to grey near surface, colourless in inner part, K+ violet in outer part, inner part with distinct radiating hyphae which broaden near surface to give a weak cellular texture. Epithecium: usually brown, without crystals (except those derived from pruina), usually K- (Sedifolia grey pigment usually present only in low concentration). Hymenium: 65 - 125 µm tall, colourless, strongly K+ blue, without crystals. Hypothecium: to 130 µm thick, colourless, usually without distinct structure though a weak cellular texture sometimes present in lower part, without crystals, rarely with oil droplets. Paraphyses: sometimes branched in upper part, 2 µm wide at base, 2 - 3 µm at apex, sometimes slightly moniliform. Ascii: 65 - 75 x 18 - 25 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, usually ellipsoid, occasionally slightly swollen at septum, 12 - 17 x 6 - 10 µm, septum 3 - 5 µm, 8 per ascus. Pycnidia: sometimes frequent near margin of thallus, dark brown to black, 0.1 mm diameter, 100% immersed. Chemistry: spot tests usually negative, as pigments are present in low concentration. Photobiont: green; cells globose or subglobose, 8 - 15 µm diameter, forming a continuous layer 40 - 70 µm thick.

In one collection, most photobiont cells had a conspicuous black inclusion, like a developing tadpole in a frog's egg. I have observed the same phenomenon in a collection of C. chalybaea.

Material with a well-developed thallus is usually easy to determine, though confusion with C. circumalbata might
be possible. The larger and sessile apothecia can distinguish *C. variabilis* from *C. chalybea*, but unfortunately forms with ambiguous characters are common. Material with a thin thallus is much more problematic, and may be difficult to separate from *C. albopruinosa*.

The characters used in the key to separate *C. chalybea* and *C. variabilis* do not work particularly well. Also, both species displays a great deal of variability. The group needs a thorough revision incorporating molecular evidence.

Throughout Greece, on calcareous rock at all altitudes, though some reports may refer to other species. The following taxa have been reported on it, though some may have merely been growing over it, rather than parasitic: *Arthonia muscigena*, *Dermatocarpon subcrustosum*, *Lecania rabenhorstii*, *Placopyrenium fuscellum*, *Verrucaria minor*, and *Zwackhiomyces coepulonus*.

Widespread in Europe, but uncommon in the north and absent from arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread). A report for S. America (Argentina) may refer to some other species.

**Caloplaca veneris** Cl. Roux & Nav.-Ros. (1992)


Description: See the protologue.

Attica and Santorini, on calcareous rock at altitudes 0 - 250 m.

Mediterranean Europe: Corsica (but not mainland France), Italy, Greece, Cyprus; extending into the Black Sea region (Ukraine). There are no reports for other continents.

**Caloplaca viridirufa** (Ach.) Zahlbr. (1931)

*Cat. Lich. Univ.* 7: 198; *Lecidea viridirufa* Ach. (1810), *Lichenogr. Universalis* 204; *Caloplaca aractina* (Fr.) Häyrén; *Caloplaca fuscoatra* auct. graec.; *Lecanora fuscoatra* (Bayrh.) Nyl., nom. illeg.

Vondrák & Vetíkainen (2008), who had seen both holotypes, consider that *C. viridirufa* and *C. aractina* are probably synonymous. Although the name *Caloplaca aractina* has been used even in some recent Floras, such as Smith et al. (2009), the epithet *viridirufa* has priority.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as *Caloplaca aractina*.

Scattered, mainly in the southern half of Greece, but not reported for Peloponnese. On siliceous rock, usually at altitudes 0 - 1000 m, though there is a single report that may be from much higher. A report for calcareous rock on the island of Lefkada may be unreliable.

Commonest in central and southern Europe, but there are scattered records as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, S. Africa).

**Caloplaca (Athallia) vitellinula** (Nyl.) H. Olivier (1897)


This species is normally saxicolous, but the type was corticolous. Some authors have therefore assumed that saxicolous collections belong to a different taxon, which they have called *C. vitellinula* auct. However, as shown by Arup (2009), Nylander’s type is conspecific with the saxicolous material. According to Vondrák, Halici et al. (2016) it may be a synonym of *C. (Athallia) holocarpa*.

Description: Arup (2009) is best.

Scattered, in the eastern half of the country, on calcareous and siliceous rock, at altitudes 0 - 1150 m. However, some reports, especially those on calcareous rock, may be unreliable owing to confusion with other species, especially *C. holocarpa*. According to Arup (2009), *C. vitellinula* does occur on calcareous rock, but only rarely.

I have not definitely encountered this species, though some undetermined collections seem quite close to it.

Widespread in Europe outside arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), Australasia (Victoria, NZS). Reports for the Pacific (Hawaii) and Antarctica (Kerguelen Is) are in need of confirmation.

**Caloplaca (Leproplaca) xantholyta** (Nyl.) Jatta (1902)


The earliest name may be *Byssus aureus* (as *aurea*) L. (1753), which was described from Italy, well within the range of *C. xantholyta*. The epithet *aurea* is not available in *Caloplaca*, owing to the earlier *C. aurea* (Schaer.) Zahlbr. (1890). It is available in *Leproplaca*.

Thallus: crustose, yellow, entirely leprose, usually well delimited and often forming circular patches to several cm. diameter, sometimes with obscure marginal lobes, 0.2 mm thick; central parts of the thallus sometimes decaying leaving only an outer ring. Soredia: 0.05 - 0.07 mm diameter. Medulla: white, often clearly visible in places; in section: formed

This species can not be confused with any other. In *C. chrysodeta* the thallus is not so well delimited and is not pure yellow.

Scattered throughout Greece on rock, usually calcareous, at altitudes 60 - 1800 m. Commonly on underhangs that are protected from direct rain. The lichenicolous lichen *Diplotomma scheideggerianum* has been recorded once on this host.

Warm and temperate parts of Europe; absent from Nordic countries. Also Macaronesia, Asia (widespread), Australasian (NZS). Reports for N. America are incorrect.

**Caloplastra xerica Poelt & Vézda (1975)**

Thallus: crustose, 2 cm diameter, pale grey-white in outer part, darker in inner part, not pruinose, weakly areolate, rather thin, about 250 µm (including lowermost part which has some rock debris), without marginal lobes. Areeoles: flat overall, but surface rather irregular on a scale of 0.1 mm. Hypothallus: absent. Isidia-like structures: present in older parts of thallus, forming very small, very dark grey to black warts, 0.05 mm diameter on thallus surface; they do not resemble "typical" lichen isidia, but are presumed to function as vegetative propagules. Soralia: absent. Cortex: true cortex absent; pseudocortex: colourless, 10 - 30 µm thick, without distinct structure in water; in K formed of a network of fine hyphae, but in outer part these are fragmented and disorganised; K-. Medulla: in section: colourless to pale brown, generally darker in lower part, owing to presence of rock debris. Apothecia: abundant, subsessile, 0.5 - 0.7 mm diameter, flat when young, often slightly convex later, not pruinose. Disc: orange-brown, C-. Thalline margin: sometimes weakly present in young apothecia, excluded early; in section: present on lower surface of apothecium, 50 - 70 µm wide. Exciple: present, orange-brown, paler than disc, rather thin but persistent, C+ blackish in a thin ring adjacent to disc, elsewhere C-; in section: 30 - 40 µm wide, colourless except at surface which is orange-brown, of radiating hyphae. Epithecium: orange-brown, K+ red-purple. Hymenium: 80 µm wide, colourless. Hypothecium: 90 µm tall, colourless, lower part continuous with exciple and formed of a dense network of hyphae; hyphae oriented in all directions but (except near centre of apothecium) with an overall horizontal trend. Paraphyses: simple, widening gradually from 1 µm at base to 2 µm at apex, not capitate or moniliform. Asci: 37 x 16 - 18 µm, broadly clavate or bulging in middle. Ascospores: colourless, polarilocular, ellipsoid, 13 - 15 x 7 - 8 µm, septum 5 - 5.5 µm, 8 per ascus. Pycnidia: sometimes present in outer part of thallus, dark orange-brown, 0.08 - 0.12 mm diameter; in section: 85% immersed, subglobose, 200 µm tall, 140 µm wide, colourless except at surface which is orange-brown, without distinct wall. Conidia: colourless, narrowly ellipsoid to bacilliform, 3 x 0.75 µm. Chemistry: thallus K-. Photobiont: green, cells globose, 11 - 13 µm diameter. Photobiont layer: irregular, discontinuous, 0 - 65 µm thick.

The small, dark isidia-like structures are diagnostic, but can easily be overlooked as debris. However, the combination of a grey thallus, brown-tinged apothecia (never pure orange and never with a red tinge), and the siliceous substrate exclude most other species. *C. atroflava* may have these characters, but also has a black hypothallus, which *C. xerica* lacks.

Scattered in the southern half of Greece, on siliceous rock at altitudes 100 - 920 m. Probably commoner than the few reports suggest, but any old reports will be under other names.

Southern and central Europe. Also Asia (Turkey, Iran, Pakistan).

**Candelaria A. Massal. (1852)**

*Flora* 35: 567-568. Type: The matter needs to be clarified. Clements & Shear, *Gen. Fung.* 322. 1931 designated *C. concolor*, but that was not one of the species originally included, though it is a heterotypic synonym of *C. vulgaris* A. Massal. which was included. Family: *Candelariaceae.*

Literature: There is no monograph, but the only widespread European species is discussed in all the standard Floras.

Nine species, but only 2 in Europe. They usually occur on nutrient enriched substrates, as do those of the closely related *Candelariella*. *Candelaria* is separated from *Candelariella* by its distinctly foliose rather than crustose to placodioid growth form, a distinction that may prove difficult to maintain. Recent molecular evidence (Westberg et al. 2009) suggests that the traditional classification of species in these two genera is likely to change in the future.

11 Lower surface corticate, not sorediate. *C concolor*
1 Lower surface arachnoid, not corticate, sometimes with soredia. *C. pacifica*
Candelaria concolor (Dicks.) Stein (1879)
Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).
Rare and scattered in the northern half of Greece. On bark of Platanus and on conglomerate rock at altitudes 25 - 930 m.
Cosmopolitan in cool temperate to warm regions; absent only from arctic, desert, and humid tropical regions. Throughout Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

Candelariella Müll. Arg. (1894)


Literature: There is no recent monograph of the European species, and information is very scattered. Westberg (2005) is a good introduction to the genus in general, but treats mainly N. American species.

Thallus: crustose (when present), yellow in most species, brown to grey in a few, of scattered to dispersed granules in most species, less commonly areolate. Vegetative propagules: present or absent. Apothecia: sessile, rounded, flat to slightly convex, small to medium sized (typically 0.2 - 0.7 mm diameter). Disc: yellow to yellow-brown. Thalline margin: usually present, sometimes almost confined to lower surface of apothecia, externally often difficult to distinguish from exciple. Exciple: yellow in most species, usually persistent but becoming crenulate and irregular in older apothecia; in section: colourless in inner part, pigmented in outer parts, of radiating hyphae. Epithecium: orange-brown to brown, K-. Hymenium: colourless. Hypothecium: colourless. Paraphyses: simple in most species, 1 - 1.5 µm wide at base, usually broadening only slightly at apices. Ascii: clavate, ±Lecanora type (see below). Ascospores: colourless, simple but often appearing spuriously 1-septate, ellipsoid to reniform in most species, 8 to 32 per ascus. Chemistry: thallus and apothecia K- (or almost). Photobiont: green, trebouxioid.

Ascii differ from those of Lecanora in having an apex with a central axis that stains weakly in KI, rather than not staining. This can sometimes be observed, but the distinction is usually difficult to make and for routine determination asci can be considered to be ±Lecanora type. In this Flora they are described as such.

Candelariella contains a few very well known species, and a surprisingly large number of poorly known ones that do appear to be good species. Overall it has about 65 species, of which about 36 occur in Europe. The genus is quite well represented in Greece, and a few species are very common, but most are represented by very few records. Species of Candelariella occur on a wide range of substrates, but generally avoid strongly acidic substrates.

C. faginea Nimis, Poelt & Puntillo is not included in the key, as I have insufficient information.

111 Thallus placodioid, ±orbicular. On rock, usually calcareous.
22 Centre of thallus with coarse granules or coralloid isidia which sometimes give rise to soralia. Apothecia often absent. Margins of apothecia sometimes becoming granular, but not crenulate; sometimes excluded eventually. Ascospores 12 - 18 x 5 - 7 µm. C. medians
2 Centre of thallus without granules, isidia or soralia. Apothecia always present. Margin of apothecia often crenulate.
33 Ascospores 10 - 14 x 4 - 5 µm. (C. rhodax), (C. senior)
3 Ascospores usually more than 14 µm long, 5 - 7 µm wide. (C. rosulans)
11 Thallus not placodioid. Apothecia present. On various substrates.
22 Ascospores 8 per ascus. Thallus, if present, yellow, grey or brown.
33 Thallus yellow.
44 Thallus of powdery granules 0.1 - 0.2 mm diam, well developed. Apothecia often absent. On bark or wood. C. reflexa
4 Thallus not powdery, of coarser granules (0.2 - 0.3 mm diam), or areolate, sometimes poorly developed. Apothecia usually present. Usually on calcareous rock, sometimes on other substrates. 55 Ascospores usually less than 18 µm long.
66 Thallus granular to areolate, usually well developed. Exciple not forming a distinct stipe below hymenium. If present in Greece, probably restricted to montane levels. (C. aggregata)
6 Thallus often poorly developed. Exciple forming a distinct stipe below hymenium. At all altitudes. C. aurella
5 Ascospores 16 - 28 x 7 - 8 µm. C. unilocularis
3 Thallus grey, brown-grey or absent.
444 Lichenicolous on Lecanora populicola. (C. superdistans)
4 On bark or wood.
55 Apothecia without a thalline margin, and ± entirely immarginate when mature. Thallus poorly developed.
   Blastidia absent. (C. subdeflexa)
5 Apothecia with a thalline margin. Thallus various. Blastidia present or absent.
66 Thallus granular to coralloid or squamulate. Blastidia sometimes present. Paraphyses unbranched. C. viae-lactae
   6 Thallus very variable, but never coralloid or squamulate; it may sometimes be granular. Blastidia absent.
   Paraphyses mostly club-shaped to submoniliform, frequently branched near apices. C. antennaria
4 On rock, usually limestone.
55 Thallus poorly developed. C. aurella Note 1.
5 Thallus ± well developed.
66 Thallus 0.5-1 mm thick, with isidia or isidia-like structures and sometimes with soralia, grey to grey-green. Ascospores 14-18 (20) μm long. C. plumbea
6 Thallus 0.07-0.3 mm thick, without vegetative propagules, grey to grey-brown. Ascospores 15-25 μm long.
77 Thallus areolate, grey, areoles with prominent margin. Discs lemon yellow. Ascospores 12-18 μm long. (C. minuta)
7 Thallus granular to squamulose, grey-brown. Discs dull yellow. Ascospores 15-25 μm long. C. oleaginescens
2 Ascospores 12-32 per ascus. Thallus, if present, yellow, orange-yellow, green-yellow or greenish.
33 Bright yellow soralia present. Thallus dull yellow-green. Ascospores 32 per ascus. On bark. (C. efflorescens)
3 Soralia absent (but thallus may consist of granules). Other characters various.
444 Thallus areolate, forming small patches to 4 mm diameter. Areoles flat to convex, to 0.25 mm wide, scattered or crowded. Apothecia 0.15-0.4 mm diameter. On bark; often associated with irregularities in the bark. C. lutella
4 Thallus granular, usually ± well developed (though granules may be scattered), usually much more than 4 mm diameter. On bark or rock.
55 Ascospores globose, 4-5.5 μm diameter. Thallus of scattered, rounded, yellow to greenish granules, 0.05-0.15 mm diameter, not forming a continuous crust. Apothecia 0.15-0.4 mm diameter, yellow, with yellow pruina. On bark. C. boleana
5 Ascospores ellipsoid. Thallus and apothecia various. On bark or rock.
666 Thallus granules rounded, about 0.05 mm diam, forming a thin, uniform crust. On bark. C. xanthostigma
6 Thallus of ± continuous, rounded coralloid granules, 0.1-0.3 mm diam, bright golden yellow. Usually on siliceous rock, occasionally on wood or dust-covered bark in nutrient-enriched habitats. C. coralliza
4 Thallus absent, or consisting of just a few egg-yellow granules 0.1 mm in diameter. On rock. If present in Greece then probably restricted to uplands. (C. athallina) Greek report doubtful.
1 Thallus not placodioid. Apothecia absent. Note 2.
22 Thallus of small squamules or areoles, which become finely sorediate. On nutrient enriched bark. C. reflexa
2 Thallus consisting entirely of granules or soredia. On various substrates.
333 Thallus of fairly large granules, 0.1-0.5 mm diameter, rounded or flattened to subsquamulose, often clustered. Thallus dull yellow-orange. On bark or rock. Very common. C. vitellina
33 Thallus of very small, globose granules or soredia, 0.05-0.07 mm diameter.
44 Thallus dull yellow, consisting entirely of corticate granules. On bark or wood that is not nutrient enriched. C. xanthostigma
4 Thallus bright yellow, consisting entirely of soredia (not corticate). On nutrient-enriched bark. C. reflexa
3 Thallus of medium-sized granules, 0.1-0.3 mm diameter, that are rounded and form a ± continuous bright golden-yellow crust. On siliceous rock, especially when nutrient-enriched. C. coralliza

(1) If a grey prothallus is present, this is C. deflexa, which some authors regard as a distinct species.
(2) This branch is incomplete, but it includes some widely distributed species.
Candelariella antennaria Räisänen (1939)


Description: Nash et al. (2004); Westberg (2005).

Crete, on bark of *Quercus coccifera* at an altitude of 1500 m. It was parasitised by the lichenicolous fungus *Intralichen christiansenii*.

In Europe, known only from Crete. The Cretan collection was determined by a specialist in the genus, so the report should be reliable. Also Asia (Turkey, Iran, Armenia), N. America (western half of USA), S. America (Argentina, Chile), Australasia (S. Australia).

Candelariella aurella (Hoffm.) Zahlbr. (1928)

*Cat. Lich. Univ. 5: 790; Verrucaria aurella Hoffm. (1796), Deutschl. Fl. 2: 197; Candelaria subsimilis (Th. Fr.) Arnold; Candelaria subsimilis f. alpina Arnold; Candelariella aurella var. decolorans (Müll. Arg.) Zahlbr.; Candelariella deflexa (Nyl.) Zahlbr.; Candelariella subsimilis (Th. Fr.) J. Steiner; Gyalocheia aurella (Hoffm.) Körb.; Gyalocheia vitellinella (Mudd) J. Steiner.*

Thallus: poorly developed, of a few scattered yellow corticate granules 0.1 mm diameter, or almost absent. Prothallus: often present, sometimes well developed, black. Vegetative propagules: absent. Apothecia: sessile, flat to slightly convex, 0.2 - 0.45 (0.8) mm diameter. Disc: yellow. Thalline margin: present, yellow, brighter than disc, 0.05 - 0.08 mm wide, persistent, sometimes crenulate in older apothecia; in section: 40 - 60 µm wide. Exciple: not usually distinguishable externally; in section: 25 µm wide, colourless except at surface which is orange-brown, of radiating hyphae with visible lumina in outer part. Epithecium: orange-brown to brown. Hymenium: 60 µm tall, colourless, KI+ blue. Hypothecium: 70 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, sometimes with visible septa. Asci: 42 - 48 x 11 - 15 µm, clavate, ±Lecanora type. Ascospores: colourless, simple, ellipsoid to slightly reniform, 10 - 15 x 4 - 7 µm, 8 per ascus. Chemistry: apothecia K-; Photobiont: green, cells globose, 9 - 15 µm diameter.

Usually easily recognised by its scanty thallus, bright yellow apothecia that react K-, and 8-spored asci with small ascospores.

Throughout Greece, at all altitudes. Nearly always on calcareous or at least base-rich rock, occasionally on other substrates. I have seen it on an old bone of a sheep or goat. Once reported as overgrowing *Intralichen christiansenii*.

Subcosmopolitan outside the tropics. Common throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, Egypt, perhaps Tanzania), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Uruguay, perhaps elsewhere), Australasia (widespread), Antarctica (subantarctic islands).


Thallus: crustose, granular, yellow, not pruinose, to 1 cm diameter, without vegetative propagules. Granules: abundant but not forming a continuous crust, flat to slightly convex, ±rounded, 0.03 - 0.08 mm diameter. Prothallus: absent. Cortex: not well developed; outermost part of granules with abundant orange-brown polarising granules, K-, not soluble in K. Medulla: white. Apothecia: sessile, flat to slightly convex, 0.15 - 0.35 mm diameter. Disc: yellow, sometimes with faint yellow pruina. Thalline margin: present, persistent, yellow, paler than disc; in section: 50 µm wide, cortex poorly developed. Exciple: not distinguishable externally; in section: sometimes almost absent; when present to 15 µm wide, of radiating hyphae with elongated lumina in outer part. Epithecium: with dull brown pigment and orange-brown polarising granules, K-, brown pigment soluble in K, granules insoluble. Hymenium: 70 µm tall, colourless, sometimes with dull brown pigment in upper part, KI+ blue. Hypothecium: 50 - 60 µm tall, colourless. Paraphyses: simple, 1.5 µm wide in lower part, 2 µm at apex, not capitate or moniliform. Asci: 25 - 45 x 14 - 15 µm, broadly cylindrical to weakly clavate, ±Lecanora type. Ascospores: colourless, simple, globose, 5 µm diameter, 16 per ascus. Chemistry: disc K-; thalline exciple K-; Photobiont: green, trebouxioid; cells globose, 6 - 15 µm diameter. Photobiont later: very variable, cells within a granule sometimes forming a regular layer, sometimes massed in one large clump, sometimes scattered.

Crete, Peloponnese and Epiros, at altitudes 600 - 1100 m. The Peloponnesian collection was on bark of *Juniperus drupacea*. Substrate was not reported for the other records.

Only Slovakia, Spain, Switzerland and Greece.

Candelariella coralliza (Nyl.) H. Magn. (1935)


Description: Smith et al. (2009).

Known from a single locality in northern Macedonia, where it occurred on granite at an altitude of 750 m.

Throughout northern and central Europe, but rare south of the Alps and Pyrenees. Also Asia (widespread), perhaps Africa (S. Africa), N. America (Ontario, Colorado, Wisconsin), S. America (Chile), Australasia (cool parts of NZ).
**Candelariella faginea** Nimis, Poelt & Puntillo (1989)

*Nova Hedwigia* 49: 276.

Western Crete, on bark at altitudes 1100 - 1340 m. The only phorophyte reported was *Acer sempervirens*.

Southern Europe: Spain, Italy, Albania, Greece, Ukraine. I have not seen any reports for other continents.

**Candelariella lutella** (Vain.) Rääsänen (1939)


Thallus: crustose, inconspicuous, pale green to yellow, 3 x 1 mm (in my only collection), without vegetative propagules. Areoles: scattered, discontinuous, flat, 0.2 mm wide. Apothecia: subsessile to sessile, ±flat, 0.2 mm diam, not pruinose. K-: Yellow. Thalline margin: weakly present in section, on lower surface of apothecia. Exciple: pale yellow, paler than disc. Ascospores: colourless, simple, ellipsoid, 9 - 11 x 4.5 - 5 µm, 16 (?) per ascus.

My only collection was scanty. For another description, see Westberg in Nash et al. (2004).

Very scattered, with no clear pattern, at altitudes 350 - 1050 m. On bark or wood. The Peloponnesian collection was on wood of *Quercus coccifera*. According to J. Vondrák (pers. comm.) it is common in parts of the central Peloponnes.

Mainly Alps northwards to Svalbard, but present in the south. Also Asia (Turkey, Armenia, Russia), N. America (widespread in western half).

**Candelariella medians** (Nyl.) A. L. Sm. (1918)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Easily recognised by the yellow, placodioid thallus with distinct radiating marginal lobes, and the K- reaction.

Scattered, with no clear pattern, though not yet reported from the westernmost parts of the country. On rock, usually calcareous, at altitudes 0 - 1050 m.

Widespread to as far north as southern Sweden, but probably commonest in southern Europe. Also Asia (widespread), Africa (Morocco, Algeria, Tunisia). Reports for N. America are incorrect; a report for S. America (Argentina) may also be unreliable.

**Candelariella oleaginescens** Rondon (1966)


Thallus: crustose, areolate, pale grey, pale brown or brown, occasionally dark brown, forming small patches about 1 cm diameter, well developed but not very thick, 0.15 - 0.3 mm, without vegetative propagules. Areoles: contiguous, 0.3 - 0.5 mm wide, ±flat. Cortex: poorly developed, 7 - 25 µm thick, colourless, poorly structured or with horizontal hyphae. Medulla: of broad hyphae, 3 µm wide, without crystals. Apothecia: sessile, flat to slightly convex, 0.35 - 0.55 µm thick, colourless, poorly structured or with horizontal hyphae. Epithecium: brown to orange. Hymenium: 50 - 70 µm tall, colourless. Hypothecium: 50 - 150 µm tall, colourless. Ascospores: colourless, simple, usually ellipsoid, sometimes slightly reniform, 15 - 24 x 5.5 - 7 µm, 8 per ascus. Chemistry: thallus and apothecia K-. Photobiont: green, cells globose, 11 - 13 µm diameter. Photobiont layer: 50 - 110 µm tall, irregular, sometimes discontinuous.

One collection had a more continuous thallus, only becoming slightly areolate in central parts, and much smaller ascospores, 10 - 13 µm long, though all the apothecia were immature. It is not clear whether it belongs to a distinct species or is merely juvenile material of *C. oleaginescens*.

I am using the name *C. oleaginescens* in a broad sense. Greek collections appear to combine some of the characters of *C. oleaginescens* and *C. minuta* Reichert & Galun, if the key and descriptions of those species in Wasser & Nevo (2005) are trustworthy. If the two names prove to be synonymous, the epithet *minuta* has priority.

Well characterised by the combination of a brown or grey, not yellow, thallus, without vegetative propagules, and 8-spored asci. Darker coloured areoles can be distinguished from the hypothallus of *C. aurella* because they contain algae.

Scattered, mainly in the southern half of Greece, on limestone at altitudes 0 - 2030 m. According to Claude Roux (pers. comm.) *C. oleaginescens* is a lowland species, and reports from the uplands may belong to *C. aurella* subspp. *globulosa*.

Basically a circum-Mediterranean/Macaronesian species. Southern Europe from the Iberian Peninsula to Greece; but also Austria. Also Macaronesia (Canary Is), western Asia (Israel), N. Africa (Morocco).
Candelariella plumbea Poelt & Vězda (1976)


Most reports are from Crete, but also known from one site in northern Epiros. On calcareous or siliceous rock, at altitudes 35 - 2100 m.

SE Europe and southern part of central Europe. Also Asia (Turkey, Iran, Tajikistan), N. America (Colorado).

Candelariella reflexa (Nyl.) Lettau (1912)


Descriptions: Clauzade & Roux (1985); Poelt & Vězda (1977); Smith et al. (2009).

Scattered, with no clear pattern. On bark at altitudes 50 - 900 m. Reported from a wide range of phorophytes, with no distinct preference.

Most of Europe to as far north as southern Scandinavia. Also Asia (widespread), Malesia (PNG), N. Africa (Algeria), Australasia (Tasmania, NZN, NZS). Reports for N. America are incorrect. The status of reports for S. America is not clear to me.

Candelariella unilocularis (Elenkin) Nimis (1994)


Descriptions: Clauzade & Roux (1985) as as *C. aurella* var. *unilocularis*; Nimis & Martellos (2004); Poelt & Vězda (1977) as *C. aurella* var. *unilocularis*.

Crete and Mt. Olympus, at altitudes 1250 - 1500 m. On calcareous rock or overgrowing bryophytes. The Cretan collection was parasitised by the lichenicolous fungus *Intralichen lichenum*.

SE Europe, from Italy and Austria to the Caucasus; reports from elsewhere are doubtful. Also Asia (Turkey, Iran, Tajikistan), N. Africa (Algeria).

Candelariella viae-lactae G. Thor & V. Wirth (1990)


Descriptions: Roux (2005), or see the protologue.

Islands of the southern Aegean, including Crete, and adjacent coasts of the mainland, at altitudes 5 - 350 m. On bark of *Juniperus phoenicea* and *Olea europaea* and on wood of *Pistacia*.

Southern Europe and the southern part of central Europe. Also Asia (Turkey, Iran, Mongolia).

Candelariella vitellina (Hoffm.) Müll. Arg. (1894)


Thallus: crustose, to 7 cm diameter, yellow to orange-yellow, of discrete to contiguous corticate granules, without soralia. Granules: rounded to flattened, sometimes subquamulose when well developed, 0.1 - 0.7 mm wide. Apothecia: subsessile to sessile, flat to slightly convex, 0.25 - 0.7 mm diameter, usually not pruinose, sometimes with slight white pruina. Disc: dull yellow to yellow-brown, occasionally almost brown, duller than exciple. Thalline margin: in section: 25 - 125 µm wide, sometimes almost restricted to lower surface of apothecia; cortex 5 - 12 µm wide, not well differentiated. Exciple: bright yellow, sometimes difficult to distinguish from thalline margin, persistent, sometimes becoming crenulate or irregular in old apothecia; in section: 10 - 25 µm wide, mostly colourless, sometimes orange-brown in outer part, of radiating hyphae, sometimes with visible lumina in outer part. Epithecium: orange-brown to brown, K-, pigment not soluble in K. Hymenium: 55 - 80 µm tall, colourless. Hypothecium: 50 - 100 (200) µm tall, colourless, of randomly oriented hyphae. Paraphyses: simple, 1 - 1.5 µm wide at base, 2 µm at apex. Asci: 65 x 10 µm, clavate, ±Lecanora type, though central axis often poorly developed. Ascospores: colourless, simple, sometimes appearing spuriously 1-septate, ellipsoid to slightly reniform, 10 - 12 x 4.5 - 6 µm, 16 - 32 per ascus. Pycnidia: abundant if present, forming small warts 0.1 mm diameter, with slightly raised rim same colour as thallus and slightly darker centre, resembling tiny apothecia with a thalline exciple; in section: 100% immersed in wart, almost hemispherical but top domed rather than flat, 110 µm tall x 150 µm wide; wall colourless except at surface where it has same pigment as thallus. Conidia: colourless, ellipsoid to slightly dacyroform, 2.5 x 1.5 µm, borne singly at tip of a conidiophore. Conidiophores: not branched, ±straight, often with visible septa. Chemistry: apothecia K-; thallus K- or sometimes K+ slightly pinkish, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter.

Collections from hard siliceous rock are usually well developed, have typical characters and are easy to determine. Collections from other substrates are often problematic. Some collections from those substrates that I have tentatively
referred to this species may belong elsewhere.

In two collections from lava at the summit of the volcano on Methana, both thallus and apothecia were covered in an unusual pruina of fine, needle-like, colourless crystals, 0.05 - 0.2 mm long; it was probably an environmental effect, and not of taxonomic significance.

Well-developed material is easy to recognise by the combination of polyspored asci and large, flattened thalline granules. Poorly developed or juvenile material may be difficult to separate from other species.

Common throughout Greece at all altitudes. On rock (70% of reports) usually siliceous, or bark (20%), less commonly on a wide range of other substrates. The lichenicolous lichen *Caloplaca grimmiae* is quite common on this host, and the lichenicolous fungus *Carbonea vitellinaria* has also been reported.

Cosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), C. America (Mexico, CR), S. America (widespread), Australasia (widespread), Pacific (Easter Is, Hawaii, Tuamotu), Antarctica (subantarctic islands, Antarctic Peninsula).

**Candelariella xanthostigma** (Ach.) Lettau (1912)


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Distribution and ecology in Greece uncertain, owing to the likelihood of confusion with other species, but there are reports under this name from much of the country. Most are from bark.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Tunisia, Rwanda), N. America (widespread), C. America (Mexico), S. America (Chile, Uruguay), Australasia (widespread in Australia, NZS).

**Carbonea** (Hertel) Hertel (1983)


Type: *C. atronivea* (Arnold) Hertel. Family: *Lecanoraceae*.

Literature: There is no monograph, and information is scattered. All taxa keyed below are treated in Clauzade & Roux (1985), though sometimes under different names. There are better descriptions of some in Smith et al. (2009).

*Carbonea* has 24 species, 12 of which are European. It is predominantly northern in Europe, and there are few Greek records.

11 Parasitic on saxicolous lichens.

22 Exciple carbon black. Not lichenised

33 On Candelariella vitellina. Ends of ascospores rounded. *C. vitellinaria*

3 On *Lecanora polytropa*. Ends of ascospores 4pointed. *C. supersparsa*

22 Exciple dark brown in inner part, more intense brown to carbonized towards outer part. Lichenised, but thallus not discernible outside host. On *Rhizocarpon geographicum* and related species. (C. intrudens)

2 Exciple colourless in inner part, green-black in outer part. Lichenised. (C. assimilis), (C. distans)

1 Not parasitic.

22 Ascospores 5 - 9 µm wide. Hypothecium yellow to red-brown. Thallus K+ yellow. (C. latypizodes)

2 Ascospores 3.5 - 4.5 µm wide. Hypothecium dark brown. Thallus K-. *C. vorticosa*

**Carbonea supersparsa** (Nyl.) Hertel (1983)


Descriptions: Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Smith et al. (2009).

Island of Samothraki, parasitic on *Lecanora polytropa* at an altitude of 775 m.

Scattered throughout Europe. Also Asia (Turkey, Russia), N. America (Alaska, Michigan). Tentatively reported for Macaronesia (Canary Is).

**Carbonea vitellinaria** (Nyl.) Hertel (1983)


Thallus: inapparent. Apothecia: concave, 0.12 - 0.18 mm diam Disc: black. Thalline margin: absent. Exciple: black, shiny; in section: 25 µm wide, black, opaque. Epithecium: blue. Hymenium: 50 µm tall, colourless in lower part, blue in upper part. Hypothecium: 75 µm tall, mostly very dark brown to black, but colourless just below hymenium. Ascospores: colourless, simple, ellipsoid, 10 x 5 - 6 µm.

This species can not be confused with any other. The blue epithelial pigment and the restriction to *Candelariella*...
vitellina are distinctive. Scattered, at altitudes 900 to about 2350 m. Always parasitic on Candelariella vitellina. Widespread but not common. Most of Europe, though south of the Alps probably restricted to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread in western half), C. America (Mexico), S. America (Chile), Australasia (NZS), perhaps Antarctica.


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Known from a single locality in Sterea Ellada, on siliceous rock at an altitude of about 1850 m. Not recorded since 1909.

Subcosmopolitan on siliceous rock in ±arctic-alpine habitats. Mainly northern and central Europe, rare in the Mediterranean mountains. Also Asia (widespread), Africa (S. Africa), N. America (widespread), S. America (Ecuador, Peru, Venezuela), Australasia (NSW, Tasmania, NZS), Antarctica (widespread).


Literature: The two European species are treated in the standard floras, under Hypocenomyce.

Description: Bendiksby & Timdal (2013).

Three species, formerly placed in Hypocenomyce, but not closely related to it. Two occur in Europe. They generally occur on the unusual (for lichens) substrate of burnt wood.

11 Squamules grey-green to medium brown, margin pale brown to white. Soredia grey. Thallus P+ orange-red. C. anthracophila

1 Squamules green-brown to dark brown, margin concolourous. Soredia brown. Thallus P-. C. myrmecina


Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009), all as Hypocenomyce anthracophila.

Macedonia, on bark and wood of Pinus, at altitudes 1600 m and above.

Mainly central Europe northwards to southern Scandinavia, but present in the south. Also Macaronesia, Asia (Turkey, Russia, Japan), Africa (Namibia), N. America (scattered), C. America (Mexico), Australasia (NSW).


Descriptions: Clauzade & Roux (1985); Nash et al. (2002), both as Hypocenomyce castaneocinerea.

There is a single Greek report, from dry wood at an altitude of 1200 m on Mt. Olympus. It was not stated that the wood was burnt, and Abbott (2009) cited it under Hypocenomyce scalaris. However, it might be correct.

Mainly northern Europe, with a few reports from central and southern regions. Also Asia (Russia), N. Africa (Morocco), N. America (widespread in the western half), C. America (Mexico).


Literature: Breuss (1990), Prieta et al. (2010), and Smith et al. (2009) are all helpful.

The genus Catapyrenium in the traditional sense, and in the sense of Breuss (1990), consists of ±squamulose members of Verrucariaceae with simple ascospores. Since 1990 it has been subdivided into several more naturally circumscribed genera, leaving about 23 species, some of them poorly known, in Catapyrenium sensu stricto. Three species occur in Europe. There are few Greek records, and some may be unreliable; all reports of species of Catapyrenium s. lat. before 1990 are of doubtful value.

11 Rhizohyphae dark. Not on rock.

22 Thallus with dark, paraplectenchymatous lower cortex. Ascospores 17 - 23 x 6 - 9 µm. On soil or overgrowing bryophytes or decaying vegetation on the ground. C. cinereum

2 Thallus without lower cortex.
species, especially substrates, but are not terricolous. The genus does not form a conspicuous part of the Greek lichen biota but a few
species of this genus by default. There are also numerous poorly known taxa. Species of Catillaria occur on a wide range of
substrates, but are not terricolous. The genus does not form a conspicuous part of the Greek lichen biota but a few
species, especially C. nigriloavata, are common.

C. heterocarpoides Zahlbr. and C. nideri J. Steiner are not included in the key, as I have insufficient information.

Catillaria A. Massal. (1852)


Literature: There is no convenient modern monograph, and information is scattered. The best starting point is probably Smith et al. (2009), but it does not include all the southern European species. van den Boom (2002) includes a key to Catillaria s. str. in western Europe. Early publications are apt to be confusing, as many taxa once treated in Catillaria are now placed elsewhere.

Thallus: crustose, small, thin and inconspicuous in most species but larger and more prominent in some. Apothecia: sessile, small, rarely more than 0.5 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, thin, usually persistent unless apothecia become convex; in section: with dark brown pigment at least along outer margin. Epithecium: usually with some brown pigment between paraphyses, though sometimes in low concentration. Hypothecium: colourless. Paraphyses: strongly capitate, apical cell with dark brown pigment in upper part; this pigment K-, N-, not dissolving in K or N. Ascii: Catillaria type (apical cell uniformly KI+ blue); with 8 ascospores in most species, but a few species have multi-spored asci. Ascospores: colourless, 1-septate, usually ellipsoid, rather small, typically 7 - 13 µm long. Photobiont: green.

The small, pure black apothecia, without a thalline margin, the small, 1-septate, ellipsoid ascospores, and the strongly capitate paraphyses with internal dark brown pigment form a distinctive combination, and those species that belong to Catillaria sensu stricto are unlikely to be confused with other genera.

Catillaria has been used as a 'dustbin' in the past, and the number of species that truly belong to it is still not clear; recent estimates range from 30 to 150. Many species that do not belong to Catillaria sensu stricto still remain in the genus by default. There are also numerous poorly known taxa. Species of Catillaria occur on a wide range of substrates, but are not terricolous. The genus does not form a conspicuous part of the Greek lichen biota but a few species, especially C. nigriloavata, are common.

Catapyrenium cinereum (Pers.) Körb. (1855)


Very scattered, with no clear pattern. On soil at altitudes 700 m and above.

Widespread in Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile), Australasia (NSW, NZS), Antarctica (S. Shetland Is). Some reports are old and may refer to other species.

Catapyrenium daedaleum (Kremp.) Stein (1879)


According to Nimis (1993), citing a publication that I have not seen, this species is present in the mountains of Greece. I have no further information.

Most of Europe, though in Mediterranean regions restricted to the highest mountains. Also Asia (widespread), N. Africa (Morocco), N. America (widespread in western half), S. America (Chile), Australasia (NZS), Antarctica (subantarctic islands).

Catapyrenium psoromoides (Borrer) R. Sant. (1980)


Descriptions: Breuss (1990); Nash et al. (2002); Smith et al. (2009).

Very scattered, with no clear pattern except that reports are all from sites fairly close to the sea. On bark at altitudes 20 - 600 m; reported from Juniperus phoenicea, Quercus macrolepis and Q. pubescens.

Much of Europe to as far north as southern Scandinavia. Also eastern Asia (Japan), Africa (Morocco, Tanzania), N. America (SW USA), perhaps C. America, S. America (Chile), Australasia (NZN, NZS).
11 Apices of paraphyses abruptly swollen, with well defined, dark brown apical cap. 
Asci with KI+ blue outer coat and uniformly blue apical dome (Catillaria type). 
On various substrates; some species parasitic.

22 Exciple blackish throughout. Usually on rock.

33 Hypothecium dark brown. 
C. chalybeia s. lat. Note 1.

44 Hymenium pale blue-green, at least in lower part. C. chalybeia v. chalybeia

4 Hymenium entirely colourless. C. chalybeia v. chloropoliza

3 Hypothecium colourless. C. atomarioides

2 Exciple pale, or dark coloured only at outer edge.

33 Thallus with dark brown to blackish soralia. On nutrient-rich bark. 
(C. fungoides)

3 Soralia absent. On various substrates.

444 Asci with (16) 24 - 32 (48) ascospores. On bark, usually in coastal Mediterranean vegetation, never above 850 m. C. servitii

44 Asci with 8, 12 or 16 ascospores, even in same apothecium. Parasitic on macrolichens. C. mediterranea

4 Asci always with 8 ascospores. On bark or rock, rarely parasitic,

55 Ascospores 10 - 16 x 4.5 - 6 µm. On nutrient enriched rock at the coast. (C. subviridis)

5 Ascospores 8 - 10 (12) x 2.5 - 3.5 µm.

66 Hypothecium usually pale brown, at least in upper part, sometimes almost colourless. Usually on bark, rarely on siliceous rock or lichenicolous. C. nigroclavata

6 Hypothecium ±colourless, sometimes very pale brown. On rock. C. lenticularis

1 Paraphyses usually not as above. Asci Bacidia type. On calcareous rock, not parasitic. (These species do not belong in Catillaria s. str.)

22 Hypothecium dark brown, K+ purple. (C. picila)

2 Hypothecium colourless or almost.

33 Epithecium and exciple colourless, pale yellow or pale brown, K-. In shaded microhabitats in regions with a cool climate. C. minuta

3 Epithecium and exciple brown, sometimes with slight violet tinge, K+ slightly reddish, N+ reddish. Not confined to shaded habitats or to regions with a cool climate. C. detractula

(1) If thallus immersed, consider Toninia athallina.


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the southern Aegean, on calcareous or siliceous rock at altitudes 5 - 600 m.

Most reports are from central and northern Europe; rare south of Alps and Pyrenees. Also Macaronesia (widespread but uncommon), Asia (Turkey, Russia), southern Africa (Zimbabwe, S. Africa), N. America (Maine). According to Smith et al. (2009) it has been much overlooked in British Is, and that may be the case elsewhere.

Catillaria chalybeia (Borrer) A. Massal. (1852) var. chalybeia


Thallus: crustose, grey or inapparent, very thin. Apothecia: sessile, usually flat, sometimes becoming convex when old, 0.15 - 0.45 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, sometimes becoming excluded in convex apothecia; in section: 25 - 50 µm wide, very dark brown to black, sometimes with some blue-green pigment at margins, generally opaque. K-, N+ purple-red (best seen along inner edge). Epithecium: dark brown to dark green-black, K-, usually N- (sometimes a few small patches N+ red-purple), some of pigment between paraphyses dissolving in K but not in N. Hymenium: 35 - 65 µm tall, pale blue-green to blue green in lower part, rarely in upper part which is usually colourless. KI+ blue, blue-green pigment dissolving in N but not in K. Hypothecium: 50 - 110 µm tall, brown to dark brown, K- N+ reddish in places. Paraphyses: usually simple, sometimes branched in upper part, 1 - 1.5 µm wide in lower part, 3 - 5 µm at apex, capitate, apical cell with dark brown pigment usually confined to upper hemisphere, pigment K-, N-, not soluble in K or N. Asci: 35 - 55 x 10 - 12 µm, cylindrical to clavate, Catillaria type. Ascospores: colourless, (0) 1 (3) -septate, ±narrowly ellipsoid, ends slightly pointed, 8 - 11 x 3 - 3.5 µm, 8 per ascus. Photobiont: green.

All my collections have poorly developed, small thalli, no more than about 1 cm across. However, it is said that the thallus can be as varied as that in var. chloropoliza (see below).

The uniformly dark-coloured, often opaque exciple and the brown hypothecium easily separate this species from
others of the genus. For comparison with var. *chloropoliza* see under that variety.

Throughout Greece, usually not very far from the sea. At altitudes 0 - 2100 m, but rare above 1000 m. Usually on non-calcareous rock, sometimes on bark or calcareous rock.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico), perhaps S. America (Uruguay, Brazil), Australasia (Western Australia, NZS), Antarctica (S. Georgia).

**Catillaria chalybeia** var. *chloropoliza* (Nyl.) H. Kilias (1981)


Thallus: crustose, grey, grey-green or brown, sometimes covering large areas (to more than 10 cm diameter), thin (0 - 200 µm), rather variable in appearance: poorly developed and discontinuous to well developed and ±continuous, cracked to areolate, smooth or warted. Cortex: poorly developed; layer above photobiont: 5 - 16 µm thick, colourless to pale grey, without distinct structure or sometimes obscurely hyphal, K-, some pigment dissolving in K. Medulla: (if present) white, not well developed. Apothecia: sessile, usually ±flat, sometimes moderately convex when old, 0.2 - 0.45 (0.7) mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, sometimes eventually excluded; in section: 22 - 50 µm wide, very dark brown to almost black, opaque, formed of an intricate mass of randomly oriented hyphae (best seen after bleaching with C), K-, N-. Epithecium: dark brown to dark green-grey, sometimes almost black, K- or sometimes slightly K+ red-purple in places, N-, some pigment dissolving in K. Hymenium: 30 - 40 (60) µm tall, colourless, without any blue-green pigment (occasionally some brown pigment present in lower part), KI+ blue. Subhymenium: clearly present (not contiguous with exciple), but not well delimited from hypothecium, 15 - 60 µm tall, pale brown. Hypothecium: 30 - 70 µm tall, dark brown, sometimes paler brown in upper part, K-, N-. Paraphyses: simple, 1 - 1.5 µm wide at base, apex 3 - 5 µm, capitate, upper hemisphere of apical cell with dark brown pigment that is K-, N- and not soluble in K or N. Asci: 25 x 8 µm, clavate, *Catillaria* type. Ascospores: colourless 1-septate, ±narrowly ellipsoid, one end sometimes broader than other, 8 - 13 x 2.5 - 4 µm, 8 per ascus. Pycnidia: in section: 60% immersed, 160 µm tall, 100 µm wide, colourless except for dark brown surface layer. Conidia: colourless, simple, ellipsoid, 3 x 1 µm. Chemistry: medulla K-; thallus UV-.

Easily separated from var. *chalybeia* by the complete absence of blue-green pigment in the hymenium. (Some blue-green pigment may be present along the inner edge of the exciple)

Scattered, mainly in the southern half of Greece, usually fairly close to the sea. On calcareous or base rich siliceous rock at altitudes 0 - 1400 m, but half of all records are from below 200 m.

Much less often recorded than var. *chalybeia*. I have not seen any reports for eastern Europe, but otherwise its European distribution is broadly similar to that of var. *chalybeia*. Also Asia, Africa (S. Africa).

**Catillaria detractula** (Nyl.) H. Olivier (1901)

*Expos.* Syst. 2: 129; *Lecanora detractula* Nyl. (1875), *Flora* 58: 444; *Lecania detractula* (Nyl.) Arnold.

Thallus: crustose, grey, to 2 cm diameter, poorly developed, ±immersed. Apothecia: sessile, usually convex, 0.2 - 0.35 mm diameter, not pruinose. Disc: brown to dark brown. Thalline margin: absent. Exciple: black, excluded early; in section: 25 µm wide, colourless in inner part, brown to red-purple in outer part, of radiating hyphae, a few elongated lumina present in outermost part; pigment N+ reddish. Epithecium: pale brown, sometimes with slight violet tinge, K-, N- (in material seen to date, which did not have much epithecial pigment), pigment dissolving in K and N. Hymenium: 65 µm tall, colourless. Hypothecium: 100 µm tall, colourless. Paraphyses: 1.5 µm wide at base, expanding gradually, apex 3 - 5 µm, not or scarcely capitate, often with visible septa, occasionally Anastomosed. Ascii: Bacidia type. Ascospores: colourless, 1-septate with thin septum, ellipsoid, 11 - 12 x 5 - 6 µm, 8 per ascus. Photobiont: green; cells rather speckly (perhaps not Trebouxia), globose to slightly ellipsoid, 12 - 15 x 12 - 13 µm.

The non-capitate paraphyses and the Bacidia type ascii indicate that this species does not belong in *Catillaria*.

Very scattered, with no clear pattern, but never very far from the sea. On calcareous rock at altitudes 0 - 650 m. The lichenicolous fungus *Muellerella lichenicola* has been recorded on this lichen.

Southern Europe and southern parts of central Europe. Also Asia (Iran, southern Siberia). An old report for N. America is incorrect.

**Catillaria heterocarposoides** Zahlbr. (1932)

*Annls Mycol.* 30: 440.

Description: none seen.

Lefkada, on limestone at an altitude of 50 m.

Known only from Croatia and Greece.
**Catillaria lenticularis** (Ach.) Th. Fr. (1874)
Lichenogr. Scand. 567-568; Lecidea lenticularis Ach. (1814), Syn. Meth. Lich. 28; Biatorina lenticularis (Ach.) Körb.; Catillaria lenticularis var. erubescens (Flot.) Th. Fr.; Catillaria lenticularis f. vulgaris Zanfr., nom. inval.

Thallus: crustose, inconspicuous, white, grey-white or white-grey, very thin to almost immersed, to 2 cm diameter. Apothecia: scattered rather sparsely over thallus, sessile, flat to convex, 0.15 - 0.3 mm diameter, not pruinose. Disc: dark brown to black. Thalline margin: absent. Exciple: pale brown to black, often excluded; in section: 40 µm wide, mostly colourless or pale brown, outer parts dark brown in places, cellular at least when mature. K-, N-, Epithecium: brown, K-, N-, pigment between epithecium dissolving in K and (more slowly) in N. Hymenium: (25) 50 - 55 µm tall, mostly colourless, upper part sometimes with some epithelial pigment, KI+ blue. Hypothecium: 50 - 80 µm tall, colourless to very pale brown. Paraphyses: often branched in upper part, 1.5 - 2 µm wide at base, 2.5 - 4 µm at apex, capitulate, apical cell with internal cap of brown pigment; this pigment K-, N-, not soluble in K or N. Asci: 27 - 35 x 10 - 13 µm, narrowly clavate to very pale brown. Paraphyses: often branched in upper part, 1.5 - 2 µm wide at base, 2.5 - 4 µm at apex, capitulate, apical cell with internal cap of brown pigment; this pigment K-, N-, not soluble in K or N. Ascospores: 1 - 1.2 x 0.6 - 0.8 µm, 8 per ascus. Photobiont: green, cells globose to slightly ellipsoid, 8 - 11 x 6 - 10 µm.

The three collections seen to date were rather variable in several characters, including: ascospore dimensions, colour of the disc, height of hymenium, and the degree to which paraphyses were capitulate. Additional collections are needed to assess whether more than one taxon is involved.

Could be confused with *C. detractula* but distinguished by its *Catillaria* type asci.

Throughout Greece, though generally preferring localities not very far from the sea. On calcareous rock at altitudes 0 - 1200 m.

Throughout Europe. Also Asia (Turkey, Israel, southern Siberia), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), S. America (Argentina), perhaps Australasia (Western Australia; reports for NZ incorrect), Antarctica (subantarctic islands).

**Catillaria mediterranea** Hafellner (1982)
*Herzogia* 6(1-2): 293.

The earliest name is *Scutula pleiospora* Vouaux (1911), but the epithet pleiospora is not available in *Catillaria* owing to *C. pleiospora* (J. Steiner) J. Steiner (1898).

Description: Clauzade, Diedrich & Roux (1989).

Scattered in southern Greece, never very far from the sea, at altitudes 500 - 1100 m. Lichenicolous. Hosts explicitly recorded include: *Anaptychia ciliaris*, *Parmelina tiliae*.

Probably circum-Mediterranean/Macaronesian, though not yet reported for N. Africa. Spain, France, Italy, Greece, Cyprus. Also Macaronesia (widespread in Canary Is.), western Asia (Turkey).

**Catillaria minuta** (A. Massal.) Lettau (1912)

The name is unrelated to *Lecidea anomala* γ (= var.) minuta Schae. (1833), Lich. Helv. Spic. 170, which is a superficial name and an obligate synonym of *Bacidia arceutina*.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in Macedonia, on calcareous rock at altitudes 200 to at least 1700 m.

Uncommon, but widespread to as far north as southern Sweden. South of the Alps it is largely restricted to the uplands. Also Asia (Turkey, southern Siberia), perhaps S. America.

**Catillaria nideri** J. Steiner (1898)

Description: See the protologue. Steiner says that this species belongs in the "Catillaria tristis" (=*Toninia tristis*) group, so it may belong in *Toninia*. It has an endolithic thallus, which suggests *Toninia athallina* but the K+ violet apothecial pigments do not fit that species and ascospores are too large for *T. athallina*. The name is not mentioned in the monograph of *Toninia* by Timdal (1991).

Sterea Ellada, on limestone at altitudes 2150 - 2500 m.

Known only from two localities in Sterea Ellada.

**Catillaria nigroclavata** (Nyl.) J. Steiner (1898)

Thallus: crustose, inconspicuous, almost immersed to thinly superficial, grey, green-grey or olive brown when well developed, forming poorly delimited patches to about 1 cm diameter; in section: 40 - 80 µm thick. Cortex: poorly developed; layer above photobiont 0 - 15 µm thick, colourless, without distinct structure. Medulla: poorly developed. Apothecia: sessile, usually flat, sometimes becoming convex, 0.15 - 0.3 (0.35) mm diameter, not pruinose. Disc: black.
Thalline margin: absent. Exciple: black, persistent; in section: 15 - 30 µm wide, of radiating hyphae with swollen apical cell, dark brown in outer part, colourless to brown in inner part, pigment K-, N-. Epithecium: dark brown, sometimes almost black, K-, N-, pigment between paraphyses soluble in K and N. Hymenium: 20 - 35 (45) µm tall, colourless. Hypothecium: 20 - 35 (50) µm tall, usually pale brown, sometimes almost colourless, K-, N-. Paraphyses: usually simple, 1 - 2.5 µm wide at base, apex 3.5 - 6 µm, distinctly capitata, apical cell with internal, dark brown, crescent-shaped or hemispherical pigment cap; this pigment K-, N-, not soluble in K or N. Ascii: 25 x 7 µm, clavate, Catillaria type. Ascospores: colourless, 1-septate, ± narrowly ellipsoid (though ends often not rounded), 7 x 3 µm, 16 or more per ascus (exact number difficult to count). Photobiont: green.

This species is unlikely to be confused with any other provided that the apothecial anatomy is studied. Throughout Greece at altitudes 0 - 1400 m, rarely higher. Usually on bark, and recorded from a wide range of trees, with no clear preference. Occasionally on wood or rock, and recorded once lichenicolous on Pertusaria leioplaca.

Most of Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), C. America (Guatemala). Its status in Australasia is unclear.

Catillaria servitii Szatala (1943)


Thallus: crustose, inconspicuous, almost immersed, 1.5 cm diameter. Apothecia: sessile, flat, 0.15 - 0.2 mm diameter, not pruinose. Thalline margin: absent. Disc: black. Exciple: black, usually persistent; in section: 25 µm wide, colourless to very pale brown in inner part, brown to dark brown in outer part, hyphal. Epithecium: brown, K-, N-. Hymenium: 35 - 45 µm tall, colourless. Hypothecium: 50 µm tall (including subhymenium) colourless to very pale brown, upper half rather obscurely differentiated into a subhymenium. Paraphyses: 1.5 µm wide at base, 3 - 4 µm at apex, distinctly capitata, upper part of apical cell with internal dark brown pigment; pigment K-, N-, not soluble in K or N. Ascospores: colourless, 1-septate, ellipsoid, 7 x 3 µm, 16 or more per ascus (exact number difficult to count). Photobiont: green.

Very similar to C. nigroclavata, but differing in the multispored asci.

Scattered, mainly in the southern half of Greece, never far from the sea, at altitudes 5 - 850 m. On bark of a wide range of species.

Spain, Italy and Greece. Also western Asia (Turkey, Syria). Probably circum-Mediterranean, though not yet reported for N. Africa.

Catinaria Vain. (1922)


Literature: There is no monograph. Smith et al (2009) discuss the two described European species.

Catinaria contains 7 species. Only two described species occur in Europe. Species of Catinaria occur on bark, usually in humid places. The genus is not often encountered in Greece.

11 Ascospores mostly 1-septate, wall warted or not.
22 Ascii 8-spored.
33 Ascospore wall not worted. C. atropurpurea
3 Ascospore wall worted. (C. sp. undescribed). Note 1.
2 Ascii 12 - 16-spored. (C. neuschildii) Greek report doubtful.
1 Ascospores 3-septate, wall worted. (C. papillosa Coppins ined.). Note 1.

(1) Dr. B. J. Coppins (pers. comm.) kindly provided information on the undescribed species.

Catinaria atropurpurea (Schaer.) Vězda & Poelt (1981)
in Poelt & Vězda, Biblioth. Lichenol. 16: 363; Lecidea sphaeroides β (= var.) atropurpurea Schaer. (1833), Lich. Helv. Spic. 165; Biatorina atropurpurea (Schaer.) A. Massal.; Catillaria atropurpurea (Schaer.) Th. Fr.
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Scattered, with no clear pattern. At all altitudes where there are suitable substrates. On bark, usually of conifers but also reported from Platunus orientalis.

Almost throughout Europe, but rare in Mediterranean regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps C. America, perhaps S. America, perhaps Australasia (Australia; reports for NZ are incorrect).
Cephalophysis (Hertel) H. Kilias (1985)


**Literature:** Hertel (1967).

_Cephalophysis_ contains only one species.

_Cephalophysis leucospila_ (Anzi) H. Kilias & Scheid. (1985)

in Kilias, _Herzogia_ 7: 183; _Lecidea leucospila_ Anzi (1862), _Comment. Soc. Crittogam. Ital._ 1(3): 156; _Lecidea ultima_ Th. Fr. Descriptions: Clauzade & Roux (1985); Hertel (1967), both as _Lecidea ultima_.

Mt. Olympus at an altitude of about 2700 m. The substrate was not reported, but this species is always saxicolous. A rather poorly known arctic-alpine species. Almost all European records are from the Alps or further north. Also Asia (Turkey, Tajikistan, arctic Siberia), N. America (Nunavut, Oregon).

Cercidospora Körb. (1865)

Parerga Lichenol. 465–466. Type: _C. ulothii_ Körb., the only species originally included. Family: of uncertain position in _Dothideomycetes_.

**Literature:** Species of southern Europe were monographed by Navarro-Rosinés et al. in _Biblioth. Lichenol_. 68. 1996 (not seen). Otherwise, information is scattered. Clauzade, Diederich & Roux (1989) is still a fairly good starting point, though they treat some species under _Didymella_. Navarro-Rosinés et al. (2009) give a good description of the genus itself, and discuss a few species.

About 32 described species of lichenicolous fungi, of which 27 have been reported for Europe. There are few Greek reports.

111 Ascospores simple.
   22 On Pertusaria pertusa. (C. anomala)
   2 On Lobothallia species. **C. lobothalliae**
11 Ascospores (0) 1 (3) -septate.
   222 Exciple entirely dark brown (sometimes with a purple tinge). **C. epicarphinea**
   22 Upper part of exciple dark red-brown, lower part pale reddish. (C. crozalsiana), (C. verrucosaria)
   2 Upper part of exciple brown-green, green or blue green; lower part pale.
   33 Most ascospores less than 20 µm long.
      44 Ascospores 17 - 21 x 5 - 6 µm, the two cells very different in shape and size. On species of Aspicilia. (C. solearispora)
      4 Ascospores 14 - 18 x 4 - 6 µm. Usually on _Lecanora polytropa_. **C. epipolytropa**
   3 Most ascospores more than 20 µm long.
      44 Ascospores 22 - 31 x 5 - 6 µm. On _Aspicilia desertorum_. (C. werneri)
      4 Ascospores 20 - 24 x 5 - 7 µm. On _Lecanora muralis_ s. lat. (C. macrospora)
1 Ascospores 3 - 6 -septate. Several northern species that are unlikely to occur in Greece.

Cercidospora epicarphinea (Nyl.) Grube & Hafellner (1990)


Epiros, parasitic on _Xanthoria parietina_ at an altitude of 770 m, as _C. xanthoriae_. Scattered throughout Europe. Also Macaronesia (Canary Is), Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (Arizona, California), C. America (Guatemala, Mexico), S. America (Chile).

Cercidospora epipolytropa (Mudd) Arnold (1874)


Scattered, on the mainland, at all altitudes. The only recent report was from _Lecanora polytropa_. There is a 19th century report from _Caloplaca aurantia_ (as var. _callopisma_), but _Caloplaca_ is not an expected host for this species.

Widespread in central and northern Europe, less common in the south. Also Macaronesia (Canary Is), Asia
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(widespread), N. Africa (Morocco), N. America (western half).

**Cercidospora lobothalliae Nav.-Ros. & Calatayud (2004)**
Description: See the protologue.
Crete, on Lobothallia radiosa at an altitude of 350 m.
In Europe, known only from France, Spain and Crete. Also Asia (arctic Siberia), N. America (Saskatchewan, California).

**Cetraria Ach. (1803)**

Methodus 292. The name is conserved against Platyphyllum Vent. (1799). Type: C. islandica (L.) Ach., listed in Appendix of the ICN. Family: Parmeliaceae.

Literature: Kärnefelt (1986) is a good introduction to cetrarioid lichens, though it treats only a few species. Most European taxa that still remain in *Cetraria* s. str. are treated in Clauzade & Roux (1985), or in Smith et al. (2009); the others are unlikely to occur in Greece.

Differs from *Parmelia* in the brown colour of the upper surface, the long and narrow lobes resulting in a fruticose or almost fruticose growth form, the absence of rhizines, and the predominantly terricolous habit. About two-thirds of lichens with a cetrarioid growth form appear to form a monophyletic group within the Parmeliaceae, which could perhaps be recognised as a subfamily. For the phylogeny of this group, see Thell et al. (2009). The species around *Cetraria islandica* and *C. aculeata* form a well-defined group, *Cetraria* sensu stricto.

*Cetraria* was at one time a rather large and heterogeneous genus, but many species were transferred to *Arctocetraria*, *Cetrariella*, *Flavocetraria*, *Melanelia*, *Tuckermannopsis*, *Vulpicida* and other segregates. *Coelocaulon* is now regarded as synonymous with *Cetraria*, but *Cornicularia* is regarded as distinct. *Cetraria* s. str. is a rather small genus of about 24 species, of which 10 occur in Europe. They are usually terricolous.

11 Lobes less than 3 mm wide, rounded or slightly flattened in section. Thallus appearing fruticose.
22 Thallus attached to substrate. Lower lobes anastomosing. Conidia rod-shaped. Usually on bark, occasionally on soil. (C. crespoae)
2 Thallus not directly attached to substrate. Lower lobes not anastomosing. Conidia bifusiform. On soil.
33 Main lobes flattened, to 1 mm diameter. Surface sometimes with faint, longitudinal folds. Pseudocyphellae concave. C. aculeata
3 Main lobes rounded, to 0.5 mm diameter. Surface flat and even. Pseudocyphellae flat. C. muricata
1 At least some lobes more than 3 mm wide, clearly flattened in section (but rolled margins may make lobe may appear rounded in external view). Thallus appearing fruticose or ±foliose. Medulla P+ red. Surface ridged and pitted. Marginal pseudocyphellae ±absent. Lobes more than 4 mm wide, ±channeled but not appearing tubular. C. islandica
2 Medulla P-. Surface smooth. Marginal pseudocyphellae in lines. Lobes less than 4 mm wide, strongly channeled and inrolled, appearing tubular. C. ericetorum

**Cetraria aculeata** (Schreb.) Fr. (1826)
Nov. Sched. Crit. 32; Lichen aculeatus Schreb. (1771), Spic. Fl. Lips. 125-126; Coelocaulon aculeatum (Schreb.) Link; Cornicularia aculeata (Schreb.) Ach.
Thallus: fruticose, in clumps to 7 cm diameter and about 2 cm high. Branches: to about 2 cm long; main branches distinctly flattened, terminal ones less so; 0.3 - 1 x 0.3 mm in cross-section, much divided, and terminating in small cylindrical spines 0.15 x 0.03 mm; surface brown, shiny, sometimes with faint longitudinal folds in main branches. Cilia: absent. Isidia: (some authors call them 'lateral spines') present, globose to shortly cylindrical, distinctly shorter than apical spines, 0.03 - 0.1 x 0.03 mm. Pseudocyphellae: frequent, white, strongly concave, usually slightly elliptical, 0.5 x 0.2 - 0.3 mm. Rhizines: absent. Soralia: absent. Medulla: white. Chemistry: thallus UV-. Photobiont: green.
Scattered throughout Greece. On soil, usually non-calcareous, at altitudes 150 - 2000 m.
Subcosmopolitan in cold to temperate regions (map in Kärnefelt 1986). Widespread in Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), S. America (widespread), Australasia (SE Australia, NZS), Antarctica (widespread).

**Cetraria ericetorum** Opiz (1852)
Seznam 175.
Description: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).
Known from a single mountain in northern Macedonia, on the ground overlying siliceous rocks at altitudes 1250 - 1400 m.
Throughout northern and central Europe, but rare south of the Alps and Pyrenees. Also Asia (Turkey, Russia, Mongolia, China), North America (widespread), South America (Argentina, Bolivia).

Cetraria islandica (L.) Ach. (1803)
Methodus 293; Lichen islandicus L. (1753), Sp. Pl. 1145; (?)
Cetraria islandica var. minor Harm.; Cetraria islandica δ C. (= var. platyna Ach.; Cetraria islandica var. rigida (Retz.) Savicz.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).
Scattered in the northern half of Greece. On soil at high altitude. Reports from bark and calcareous rock are probably unreliable. Most reports are from above 1500 m, but it has been reported as low as 1100 m.
Throughout Europe, but in the south restricted to the mountains. Also Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread), Pacific (Hawaii). Reports for S. America, Australasia, Antarctica probably refer to subsp. antarctica.

Cetraria muricata (Ach.) Roum. (1880)
Rev. Mycol. 2: 31; Lichen muricatus Ach. (1799), Lichenogr. Svec. Prodr. 214; Cornicularia tenuissima var. muricata (Ach.) Dalla Torre & Sarnth.
Descriptions: Nimis & Martellos (2004); Smith et al. (2009).
Reported for "Kodza Jaila", an unidentified locality in Thrace or eastern Macedonia. No substrate was reported.
Throughout northern and central Europe, but rare in the south. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Tanzania, S. Africa), N. America (widespread), S. America (widespread), Australasia (NZS), Antarctica (subantarctic islands).

Chaenothece (Th. Fr.) Th. Fr. (1860)
Literature: Northern hemisphere species were monographed by Tibell, Symb. Bot. Upsal. 23(1):1-65. 1980 [not seen], but Ahti et al. (1999), and Smith et al. (2009) are adequate for Greece.
About 29 species worldwide, 22 in Europe. Most require humid, shaded habitats, so there are few Greek records.

111 Pruina on lower side of exciple and/or upper part of stalk red-brown to brown (C. gracillima)
11 Pruina on lower side of exciple and/or upper part of stalk green, yellow or red-yellow.
22 Photobiont cells globose (trebouxioid or Trentepohlia).
33 Thallus intensely yellow. C. chrysocephala
3 Thallus green-grey or inconspicuous. (C. hispidula), (C. laevigata), (C. phaeocephala)
2 Photobiont cells small, cylindrical, sometimes forming chains (Stichococcus). (C. brachypoda), (C. chlorella), (C. furfuracea)
1 Pruina on lower side of exciple and/or upper part of stalk white, grey or absent.
22 Photobiont cells small, cylindrical, sometimes forming chains (Stichococcus). Stalk usually pruinose, at least in places.
33 Thallus granular to minutely squamulose. C. trichialis
3 Thallus crustose or immersed, not squamulose. (C. gracilenta), (C. xylorena)
2 Photobiont cells large or medium sized, globose (trebouxoid or Dictyochloropsis). Stalk shining black, not pruinose.
33 Ascospores 6 - 7 µm diameter. Thallus superficial, white to grey, often with yellow or red patches reacting K+ deep red. C. ferruginea
3 Ascospores 3.5 - 4.5 µm diameter. Thallus immersed, without yellow or red patches. C. brunneola

Chaenothece brunneola (Ach.) Müll. Arg. (1862)
Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Muñiz & Hladun (2011); Smith et al. (2009).
Mt. Olympus, on wood at an altitude of over 1700 m.
Widespread in Europe, though in the south probably restricted to the uplands. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), Africa (Tanzania), N. America (widespread), Caribbean (DR), C. America (CR),
S. America (widespread), Australasia (widespread), Pacific (Hawaii).

**Chaenotheca chrysocephala (Ach.) Th. Fr. (1860)**

Lich. Arct. 250; *Calicium chrysocephalum* Ach. (1803), Methodus (Suppl.) 15; (?) *Chaenotheca chrysocephala f. nuda* (Schaer.) Zahlbr.

Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Muñiz & Hladun (2011); Nash et al. (2004); Smith et al. (2009).

Rare and scattered in northern Greece. On bark or wood at altitudes 700 to over 1700 m.

Widespread in Europe, but rare south of the Alps. Also Asia (widespread), Malesia (PNG), central Africa (Kenya, Rwanda, Zaire), N. America (widespread), C. America (CR, Mexico), S. America (Chile, Venezuela), Australasia (temperate parts).

**Chaenotheca ferruginea (Turner ex Sm.) Lettau (1912)**


Description: Ahti et al. (1999); Clauzade & Roux (1985); Muñiz & Hladun (2011); Smith et al. (2009).

Epiros, on bark at altitudes 940 - 980 m.

Throughout Europe except for truly arctic regions, but probably rare in regions with a true Mediterranean climate. Also Asia (Turkey, Russia, Sichuan), East Africa (Ethiopia, Uganda), N. America (widespread), C. America (CR), S. America (Argentina, Chile), Australasia (widespread).

**Chaenotheca trichialis (Ach.) Th. Fr. (1860)**


Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Muñiz & Hladun (2011); Smith et al. (2009).

Epiros, on bark at an altitude of 940 m.

Subcosmopolitan in cold to warm-temperate regions. Throughout Europe, except for the high arctic. Also Asia (widespread), Africa (Congo, Kenya, Rwanda), N. America (widespread), C. America (CR), S. America (Argentina, Chile, Colombia, Venezuela), Australasia (SE Australia, NZ).

**Chaenothecopsis Vain. (1927)**


Family: *Sphinctrinaceae*.

Literature: There is a key to non-resinicolaous European species in Groner (2006). Most species included in the key below are described more fully in Ahti et al. (1999). There is additional information on some of then in Clauzade & Roux (1985), Clauzade, Diederich & Roux (1989), Smith et al. (2009).

Over 60 species, including lichenicolous fungi and saprophytes, of which about half occur in Europe. Most are rare, and many are restricted to undisturbed forests. There are only two reports for Greece.

The key is largely based on that in Groner (2006).

11 Ascospores simple.
   22 Ascomata K+ red (reaction sometimes fleeting). (C. hospitans)
   2 Ascomata K-. C. nana

1 Ascospores 1-septate.
   222 Parasitic on Chaenotheca trichialis. Ascospores 6 - 8 x 2 - 2.5 µm. Stalk entirely black or brown below.
      Hypothecium greenish and then often K+ brownish, or brownish and K-; N-. Ascospores septum appearing as dark as spore wall. (C. epithallina)
   22 On saxicolous leprose lichens (especially Haematomma ochroleucum). Apothecia black, sometimes aggregated. Stalk 0.2 - 0.3 mm tall. Outer layer of stalk with strongly sclerotized, intertwined hyphae. Exciple greenish, K-, N-. (C. subparoica)
   2 Not as above.
   33 Stalk reddish in squash, N+ violet-red. (C. debilis)
   3 Stalk not N+ violet-red.
   44 Stalk and head with yellow-red, yellow-brown or green pigment, K+ red to purple (pigment fast dissolving); N+ green > red-brown. (C. pusiola)
   4 Stalk and head K- or K+ brownish.
   55 Hypothecium less than 70 µm tall. Ascospores 6 - 9 (11) µm long. Apothecia K+ dull brown, N+ slowly red-brown. On bark, rarely wood; associated with Trentepohlia or lichens containing Trentepohlia. C.
**vainioana**

5 Hypothecium usually more than 80 µm tall. Ascospores 5 - 7 (9) µm long. Apothecia K- or K+ brownish, N-.

On various substrates, mainly bark and wood; saprobic or parasitic. (C. pusilla)

**Chaenothecopsis nana** Tibell (1979)


Descriptions: Ahti et al. (1999); Muñiz & Hladun (2011).

Epiros, on bark at an altitude of 940 m. This species is saprobic on bark, not lichenicolous.

The Greek report is rather disjunct, but plausible as *C. nana* has been reported for Sardinia.

Northern and Central Europe; very rare in the south. Also Asia (Russia, Sichuan, Japan), Africa (Namibia), N. America (widespread), probably S. America, Australasia (SE Australia, NZN, NZS).

**Chaenothecopsis vainioana** (Nådv.) Tibell (1979)


Descriptions: Ahti et al. (1999); Clauzade, Diederich & Roux (1989); Muñiz & Hladun (2011); Smith et al. (2009).

Attica, at an altitude of about 980 m. No substrate was reported.

Tibell, in Ahti et al. (1999), says that *C. vainioana* is "known only from temperate parts of northern Europe".

However, Tibell (pers. comm. 20-Aug-2004) advised that, although the species has not been recorded for central Europe, and although species circumscriptions will need to be revised for many species in *Chaenothecopsis* in the light of molecular studies, the Greek record should be accepted for the moment.

Widespread in northern parts of Europe, becoming rarer southwards. Also Asia (Russia), S. America.

**Circinaria Link (1809)**

*Neues J. Bot.* 3: 5 Type: *Urceolaria hoffmannii* Ach., listed in Apendix of ICN. [= *C. contorta*]. Family: *Megasporaceae*.

Literature: Most species are treated in the standard floras, usually under *Aspicilia*.

A segregate from *Aspicilia*, recognised using molecular evidence. There are no clear-cut morphological differences, but most species have 4-spored asci, whereas asci in *Aspicilia* they are usually 8-spored.

As presently delimited, there are 9 species, of which 7 have been reported for Europe. In Greece the genus is a significant component of of the lichen biota of calcareous rock.

*C. cheresina* var. *granuligera* is reported for Greece, but is not included in the key as I have insufficient information. It needs a modern description from type material.

111 Terricolous, or overgrowing bryophytes on siliceous rock. Thallus squamulose to subfruticose. (C. crespiana), (C. mansouri)

11 On rock, or parasitic on saxicolous lichens. Thallus ±fruticose.

22 Branches short, not delicate, with conspicuous pseudocyphellae at tip. Branching dichotomous. **C. fruticulosa**

2 Branches short to elongate, sometimes delicate, without pseudocyphellae at tip. Branching dichotomous or irregular. **C. hispida**

1 On rock, or parasitic on saxicolous lichens. Thallus crustose to (occasionally) subsquamulose-areolate.

22 Most asci with (6) 8 ascospores (Note 1). On nutrient-rich siliceous rock. **C. caesiocinerea**

2 Most asci with 4 ascospores. (A few asci may have 6 and, rarely, more.) Usually on calcareous rock.

33 Thallus of rounded, often almost circular areoles, that are usually well separated (Note 2). Medulla K-. **C. contorta**

3 Thallus of ±contiguous areoles. Medulla K- or K+ (Note 2).

44 Thallus grey, fairly dark. Areoles angular to almost rounded, contiguous or slightly separated. Thalline margin of apothecia distinctly raised. Edge of thallus diffuse, not zoned. Medulla K-.. Not common. **C. hoffmanniana**

4 Thallus pale, usually chalk-white, sometimes grey-white. Areoles angular or subangular, always contiguous. Thalline margin of apothecia not distinctly raised. Edge of thallus sharp, well defined, sometimes conspicuously zoned; marginal areoles often slightly radiating. Medulla K- or K+. Common.

55 Medulla 400 - 1300 µm thick. Central part of thallus sometimes with a slight brown tinge. (C. serenensis)

5 Medulla to 300 µm thick. Thallus never with a brown tinge. Very common. **C. calcarea** s. lat.

66 Medulla K-. **C. calcarea f. calcarea**

6 Medulla K+ yellow, orange or red. **C. calcarea f. reagens**
(1) Cut a fairly thick section to count ascospores. In a normal thin section asci may be cut and may lose ascospores.
(2) It is best to test with K on a thin section under the transmission microscope. Spot tests are often misleading in this genus.

Circinaria caesiocinerea (Nyl. ex Malbr.) A. Nordin, S. Savić & Tibell (2010)
in Nordin et al., Mycologia 102(6): 1341; Lecanora caesiocinerea Nyl. ex Malbr. (1870), Bull. Soc. Amis Sci. Nat. Rouen 5: 320; Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold Aspicilia caesiocinerea var. planior (J. Steiner) Szatala; Aspicilia subdepressa (Nyl.) Arnold; Lecanora subdepressa (Nyl.) Nyl.

Thallus: crustose, grey to brown, not pruinose but sometimes with small white patches or white lines, well developed, about 500 µm thick, cracked to areolate, to 3.5 cm diameter, sometimes bounded by black prothallus 0.1 - 0.3 mm wide. Areoles: (if developed), 0.5 - 1 mm wide, flat, subangular. Cortex: 27 - 40 µm thick, pale brown in upper part, colourless in lower part, of rounded to subangular cells 5 - 10 µm diameter, brown pigment K-; cortex sometimes overlain by colourless, ±structureless epicortex about 5 µm thick. Medulla: white. Photobiont: immersed in thallus, round to slightly irregular, 0.2 - 0.55 mm diameter, concave, not pruinose. Disc: black. Thalline margin: in mature apothecia present, distinctly raised above level of surrounding thallus, giving apothecia a crateriform appearance; in immature apothecia sometimes obscure, not raised, and only slightly differentiated from thallus. Exciple: not visible externally; in section: 15 µm wide, colourless except at surface which is green-brown, formed of a network of anastomosed hyphae. Epithecium: green to brown-green (Aspicilia green; small amounts of brown pigment often also present), K- (green pigment dissolves in K but a little brown pigment remains), N+ blue-green or intensifying green. Hymenium: 165 µm tall, colourless in lower part, upper part usually with some epithelial pigment, K+ blue. Hypothecium: 50 µm tall, colourless. Paraphyses: rather sparingly branched and anastomosed, often with visible septa even in lower parts, 1 µm wide at base, 2.5 - 3 µm at apex, moniliform but not strongly so. Ascii: 100 - 130 x 20 - 28 µm, slightly clavate, apex K-, wall rather fuzzily and faintly K+ blue. Ascospores: colourless, simple, ellipsoid, 6 - 8 per ascus, 18 - 27.5 x 11 - 18 µm. Pycnidia: generally not visible externally, 100% immersed, pyriform, 150 µm tall, 120 µm wide, colourless. Conidia: colourless, straight, 6 - 9 x 1 µm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, of globose cells 7 - 13 µm diameter, not present below apothecia. Photobiont layer: 25 - 35 µm thick, regular, continuous.

Aspicilia cinerea and A. cupreoglaucia are quite similar, and occur on similar substrates but contain norstictic acid and have narrower ascospores.

Throughout Greece, on siliceous rock at all altitudes. The lichenicolous lichen Caloplaca insularis has been reported once from this host. According to Nimis (1993), material from the lowland Mediterranean may not belong to C. caesiocinerea s. str. My collections have slightly broader ascospores than usually reported for C. caesiocinerea.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (widespread), perhaps S. America (Argentina - old report), Australasia (SE Australia, NZS).

Circinaria calcarea (L.) A. Nordin, S. Savić & Tibell (2010) f. calcarea

in Nordin et al., Mycologia 102(6): 1341.; Lichen calcarea L. (1753), Sp. Pl. 1140. The name has a conserved type.; Aspicilia calcarea (L.) Bagl.; Aspicilia calcarea f. atomaria (A. Massal.) Szatala; Aspicilia calcarea var. concreta Körb., nom. superfl.; Aspicilia calcarea f. ochracea (Körb.) Anzi; Aspicilia calcarea f. opegraphoides (DC.) Kickx; Lecanora calcarea (L.) Sommerf.; (?) Lecanora calcarea var. alpina (Anzi) J. Steiner; Lecanora calcarea f. atomaria (A. Massal.) J. Steiner; Lecanora calcarea var. concreta Hepp, nom. superfl.; Lecanora calcarea f. ochracea (Körb.) Zühlbr.; Lecanora calcarea f. opegraphoides (DC.) Nyl.; Lecanora concreta J. Steiner, nom. superfl.

Thallus: crustose, white or white-grey, areolate, 250 - 450 µm thick, to several cm diameter, sometimes with zoned margin. Areoles: flat, 0.5 - 1.5 mm wide, mostly angular, those at margin of thallus often slightly radiating. Prothallus: sometimes present, white to grey. Cortex: 30 - 75 µm tall (including epicortex), mostly colourless, formed of vertical hypheae with broad rounded lumina, often giving a cellular appearance (cells about 4 µm diameter), though this may be obscured by abundant crystalline debris; often overlain by a colourless epicortex, 2 - 15 µm thick, swelling to 25 µm in K, in which fine horizontal lines are often visible; cortex and epicortex K-. Medulla: white. Photobiont: usually immersed in thallus, flat, often slightly irregular or angular in shape. Disc: black, often slightly white pruinose. Thalline margin: usually zabsent; the part of the areole adjacent to an apothecium differing little from the remainder. Exciple: poorly developed; in section: 15 - 25 µm wide but not very distinct from hymenium. Epithecium: green to dark green-brown, K- (green pigment mostly dissolves, brown pigment remains), N+ strongly blue-green. Hymenium: 85 - 95 µm tall, colourless in lower part, usually with some green pigment in upper part, K+ blue. Hypothecium: 75 µm tall, colourless. Paraphyses: sparingly branched, 1 - 1.5 µm wide at base, 3 - 5 µm at apex, moniliform, with visible septa throughout. Ascii: 90 - 95 x 22 - 25 µm, almost cylindrical, KI- (or almost). Ascospores: colourless, simple, subglobose to broadly ellipsoid, 4 per ascus, 18 - 26 x 13 - 23 µm. Pycnidia: inconspicuous but sometimes visible externally as black dots, 0.05 mm wide; in section: 100% immersed, ±globose, 100 µm tall, 90 µm wide, wall brown in upper half, colourless elsewhere. Conidia: colourless, narrowly ellipsoid to bacilliform, 3 - 6 x 1.5 -

Typical material is easily recognised by its white thallus with angular areoles and flat, entirely immersed apothecia that are often slightly irregular in shape. However, I have numerous collections that might belong here but which are difficult to place with certainty.

Very common throughout Greece. On calcareous rock at all altitudes. Many lichenicolous fungi and lichenicolous lichens have been recorded from this host, including: Aspicilia cherasina var. microspera, Caloplaca inconnessa (*), Candelariella aurella, Endococcus propinquus, Endococcus stigma, Heteroplacidium fusculum (*), Muellerella pygmaea, Placopyrenium canellum, Placopyrenium fuscellum, Toninia episema (*), and Verrucaria polyysticta. Those marked with (*) are quite commonly encountered on C. calcarea.

Most reports do not distinguish between infra-specific taxa within this species. C. calcarea s. lat. is present throughout Europe except for the high arctic. Also Macaronesia, Asia (widespread, except in eastern half), northern Africa (widespread), N. America (widespread in western half), perhaps C. America (Mexico - old report), perhaps S. America (Argentina, Chile, Uruguay), Australasia (warm temperate Australia, NZS).

**Circinaria calcarea f. reagens** (Zahlbr.) ined.


Like f. calcarea, but medulla K+ yellow or orange. In some collections the reaction is due to what is probably stictic acid (in section, a yellow pigment diffuses into solution but no crystals are formed), in others to norstictic acid (abundant crystals) probably also with some stictic acid. It is unclear to me whether there are two distinct chemotypes, or a single chemotype with varying concentrations of the two lichen substances. The discussion in Roux et al. (2016: 177) suggests the latter. This taxon may merit recognition at the rank of species.

Throughout Greece, though less common than f. calcarea (or perhaps just under-recorded). On calcareous rock at altitudes 0 - 1150 m. The lichenicolous fungus Toninia episema has been recorded once on this lichen.

Circinaria calcarea is widely distributed. In Europe known from Iberian Peninsula, Italy and Greece. Also western Asia (Syria), N. Africa (Morocco).

**Circinaria contorta** (Hoffm.) A. Nordin, S. Savić & Tibell (2010)

in Nordin et al., Mycologia 102(6): 1341; Verrucaria contorta Hoffm. (1790), Descr. Pl. Cl. Crypt. 1: 97-98; Aspicilia contorta (Hoffm.) Körb.; Aspicilia contorta f. albocincta (J. Steiner) Szatala; Aspicilia contorta var. albocincta (J. Steiner) Szatala; Aspicilia contorta var. bullosa (A. Massal.) Szatala; Aspicilia contorta var. (= var.) cinereovirens (A. Massal.) Kremp.; Aspicilia contorta var. disseminata (J. Steiner) Szatala; Aspicilia contorta var. (= var.) glaucopis (Flörke) Kremp.; Aspicilia contorta var. muorum (A. Massal.) Szatala; Aspicilia contorta var. ochrocincta (J. Steiner) Gattefosse & Werner; Aspicilia viridescens (A. Massal.) Bagl.; Lecanora calcarea var. bullosa (A. Massal.) J. Steiner; Lecanora calcarea var. contorta (Hoffm.) Hepp; Lecanora calcarea var. viridescens (A. Massal.) Zahlbr.; Lecanora concreta var. viridescens (A. Massal.) J. Steiner; Lecanora contorta (Hoffm.) J. Steiner; Lecanora contorta var. albocincta J. Steiner; Lecanora contorta var. cinereovirens (A. Massal.) Zahlbr.; Lecanora contorta var. disseminata J. Steiner; Lecanora viridescens (A. Massal.) Müll. Arg.; (?) Lecanora viridescens f. ferruginea Kremp.; (?) Lecanora viridescens f. pruinosa (Kremp.) J. Steiner.

Thallus: crustose, areolate, to several cm diameter, without prothallus. Areoles: 0.4 - 2 mm diameter, slightly to strongly convex, mostly pale grey but often white at margins and around apothecia (white colour seems to be a 'continuous' layer of pruina), usually not contiguous, rounded, often almost circular, 250 - 600 µm thick. Cortex: 35 - 70 µm thick, mostly colourless, sometimes very pale brown in upper part, of subrounded cells 4 - 7 µm wide, often over lain by a colourless epicortex, 3 - 5 µm thick, with faint traces of horizontal layering; cortex K-, sometimes N+ blue-green where pigment present. Medulla: white. Apothecia: immersed in centre of an areole, concave, 0.2 - 0.55 mm diameter. Disc: black, usually white pruinose when young. Thalline margin: distinctly raised, paler than rest of areole. Exciple: poorly developed; in section: 15 µm wide, scarcely distinguishable from hymenium. Epithecium: green to brown-green, K- (some green pigment dissolves, brown pigment remains), N+ bright blue-green. Hymenium: 90 - 150 µm tall, colourless in lower part, usually green in upper part. Hypothecium: 35 - 50 µm tall, colourless. Paraphyses: rather sparingly branched and anastomosed, 1.5 µm wide at base, 3.5 - 5 µm at apex, moniliform, with visible septa throughout. Ascospores: colourless, simple, globose to ellipsoid, 4 (6) per ascus, 21 - 37 x 20 - 27 µm. Chemistry: medulla K-, I-; thallus K-, C-, KC-, -; Photobiont: green, usually not present below apothecia; cells globose, 11 - 16 µm diameter. Photobiont layer: 40 - 60 µm thick, slightly irregular, sometimes slightly discontinuous.

The rounded, usually well separated areoles are distinctive, and typical forms of this taxon can not be confused with any other. C. hoffmanniana sometimes has ± rounded, and sometimes slightly separated, areoles, but is much darker in colour.

Throughout Greece. On rock, usually calcareous, at all altitudes. The lichenicolous lichens Caloplaca inconnessa
has been recorded from this lichen.

Present in most of Europe, except for the high arctic. Also Macaronesia (warmer parts), Asia (widespread in western half), Africa (Morocco, Algeria, Tunisia; also St Helena), N. America (southern Canada, widespread in USA), C. America (Mexico), S. America (Argentina, Bolivia, Uruguay), Australasia (SE Australia, NZS), perhaps Pacific (Hawaii).

Circinaria fruticulosa (Eversm.) Sohrabi (2012)

Description: McCune & Geiser (2009) as Aspicilia fruticulosa.

Mt. Olympus, on soil at an altitude of 2670 m.

A rare species in Europe, known only from Spain (a single province), Greece (one site), Ukraine and Russia. Widespread in dry but not desert regions of Asia; also reported for N. Africa (Morocco, Algeria), N. America (western USA).

Circinaria hispida (Mereschk.) A. Nordin, S. Savić & Tibell (2010)

Description: McCune & Geiser (2009); Nash et al. (2007); Nimis & Martellos (2004), all as Aspicilia hispida.

Sterea Ellada, on calcareous soil at an altitude of 1850 m.

Scattered, and rather rare, in warm, dry regions of southern Europe Also Asia (widespread as far east as Mongolia), N. America (inland regions of western USA, and SW Canada).

Circinaria hoffmanniana (S. Ekman & Fröberg) A. Nordin (2016)

The epithet hoffmannii has often been misapplied to this lichen, but the original Lichen hoffmannii Ach. nom. illeg., and names derived from it, are obligate synonyms of Aspicilia contorta.

Thallus: crustose, grey, areolate but a few areoles almost squamulose, 200 - 230 µm thick. Cortex: 35 µm thick, pale brown-green in top 10 µm, colourless in lower part, of fairly large cells 6 - 10 µm wide, K-. Medulla: white. Apothecia: immersed in thallus, 0.8 - 1.3 mm diameter, flat. Disc: black, white pruinose. Thalline margin: distinctly raised around apothecia. Epithecium: brown to green, K- (green pigment partly or entirely dissolving), N+ bright green-blue. Hymenium: 110 - 150 µm tall, colourless in lower part, usually with some green pigment in upper part, KI+ blue. Hypothecium: 70 - 110 µm, colourless. Paraphyses: sparingly anastomosed, 1 µm wide at base, 5 µm at apex, moniliform. Asci: 120 x 25 µm, ±cylindrical, KI- or almost. Ascospores: colourless, simple, subglobose to broadly ellipsoid, 4 (6) per ascus, 22 - 28 x 15 - 18 µm, often uniseriate. Chemistry: medulla K-, C-, KC-, I-; thallus K-, C-, KC+, UV-. Photobiont: green, not present below apothecia; cells subglobose to globose, 9 - 10 x 7 - 10 µm. Photobiont layer: 100 - 130 µm thick, ±continuous; cells showing some tendency to form large clumps.

Well-developed material is easily separated from A. calcarea by its much darker thallus and the distinctly raised thalline margin of the apothecia. However, some collections are difficult to place.

Scattered throughout Greece. On rock, usually calcareous, at all altitudes.

Throughout Europe to as far north as southern Scandinavia, but probably commonest n the south. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia, Egypt), perhaps elsewhere (?North America, ?Argentina, ?Australia).

Cladonia P. Browne (1756)


Literature: There is no recent monograph of the European species. The only world monograph, Vainio (1887, 1894, 1897), contains much interesting information, but has no keys and is dated. Ahti (2000) discusses the characters of the genus as a whole, but includes only a few European species. However, nearly all of the taxa in the keys below are covered in one or more of: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985), Nimis & Martellos (2004), Smith et al. (2009). Most non-European Floras treat at least some species that also occur in Europe. Huovinen et al. (1990) has much information on the chemistry of many species.

The thallus is usually squamulose; in a few species (subgenus Cladina) it is crustose but disappears early. The podetia are, in origin, apothecial stipes, and I avoid the term 'thallus' when discussing them. Some authors have used the terms 'primary thallus' and 'secondary thallus' to refer to what are here termed 'thallus' and 'podetia'. In this Flora
the word 'thallus' when applied to Cladonia means the true thallus, not the podetia. The word 'squamule', if unqualified, means the squamules of the true thallus, i.e. to what some authors have termed the 'basal squamules'. Squamule-like outgrowths from podetia are here called podetial squamules.

Thallus: squamulose, but appearing fruticose in some species with inconspicuous squamules or foliose in a few species with very large squamules, several cm to many cm diameter. Upper surface of squamules: usually green, grey-green, brown-green or brown, not normally pruinose. Lower surface of squamules: white in most species. Squamules: very varied, conspicuous to very inconspicuous, always with upper cortex, never with lower cortex; soredia present in a few species. Podetia: very varied, present or absent; usually hollow, with or without soralia and/or podetial squamules and/or cups; outer cortex: absent, present everywhere, or discontinuous in various ways; inner cortex-like layer present adjacent to central hollow. Rhizines: not present, but some species with cilia at margins of squamules, and occasionally elsewhere, and these may resemble rhizines. Cortex: formed of hyphae embedded in a gel, often distinctly swelling in K. Medulla: white, of loosely interwoven hyphae. Apothecia: in podetiate species usually on apex of podetia or on rim of cups, usually globose. Disc: brown in most Greek species, red in a few. Thalline margin: absent. Pycnidia: often present, usually on apex of podetia or rim of cups, usually ±same colour as apothecia, globose, often sessile; in section: wall brown, centrum colourless. Conidia: colourless, very thin, 5 - 15 x 0.5 - 1 µm, straight to distinctly curved.

Chemistry: very varied. Photobiont: green, Trebouxioid; cells usually forming a continuous layer below cortex where cortex present.

Cladonia is a large genus of about 440 species, of which about 100 occur in Europe. Most occur on soil or decaying vegetation, usually preferring slightly acidic substrates in temperate to cool conditions, requirements that are not easily met in much of Greece. Although numerous species have been recorded for Greece, many are uncommon and present only in the north of the county. However, a few species of calcareous soil in ±open habitats, especially C. foliacea, C. furcata, C. pocillum and C. rangiformis, are very common.

The genus has suffered more than most from a proliferation of infra-specific names. There are over 2000 of them. Very few represent good taxa, and nearly all are best ignored.

Key to Cladonia main groups

1. Apothecia or pycnidia red, K+ purple. Restricted to northern Greece. Group 1.
   1. Apothecia and pycnidia brown or absent. Not restricted to northern Greece.
   2. Squamules absent (Note 1). Podetia without a true cortex, and thus often appearing arachnoid. Cups, podetial squamules and soredia all absent. Group 2.
   2. Squamules present. Podetia present or absent; if present, cortex present or absent. Cups, podetial squamules and soredia present or absent.
   3. Podetia prominent.
   4. Podetia with well-developed cups, wider than stalk. Group 3
   4. Podetia without cups, or with cups narrower than stalk. Group 4
   3. Podetia absent, or much less prominent than squamules. Group 5.

(1) Group 2 species are rare in Greece. The very common C. furcata and C. rangiformis do not belong here. They have squamules, though they may be few, inconspicuous, and obscured by the abundant podetia.

Key to Cladonia group 1: apothecia red.

   These species are conspicuous but there are few Greek records, so they are genuinely uncommon.

1. Squamules densely sorediate on margins and lower surface. (C. digitata)
   1. Squamules not, or only very slightly, sorediate.
   2. Podetia with at least some soredia.
   3. Basal squamules dominant. Podetia short, sometimes ±absent and apothecia then ±sessile on squamules. C. macilenta
   3. Podetia dominant, taller than squamules. Apothecia on ends of podetia. C. polydactyla
   2. Podetia entirely without soredia.
   3. Podetia with well-developed cups. This is the C. coccifera aggregate.
   4. Podetia KC+ yellow or yellow-orange (barbatic acid), surface uniformly smooth or slightly areolate. C. borealis
   4. Podetia KC-, smooth or not.
   5. Podetia densely squamulose. C. diversa (here treated as synonymous with C. coccifera but recognised by some authors.)
5 Podetia with few squamules. **C. coccifera** s. str.
3 Podetia without cups. **C. floerkeana**

**Key to Cladonia group 2**: apothecia brown; basal squamules absent at all stages of development.
This group has sometimes been assigned generic status, as *Cladina* (Nyl.) Nyl., but most authors now treat it as a subgenus of *Cladonia*. There are few Greek records.

11 Podetia richly branched; branching dichotomous to polychotomous.
   22 Apices from a single main branch with a tendency to be oriented in ± same direction. Podetia P+ red.
   33 Branching and apices mainly dichotomous.
      44 Podetia grey-white, without any green tinge. **C. ciliata var. ciliata**
      4 Podetia greenish. **C. ciliata var. tenuis**
   3 Branching and apices mainly tetrachotomous, sometimes trichotomous at apices. (C. rangiferina) Greek reports probably incorrect.
   2 Apices not oriented in one direction. Podetia P-.
      33 Apices of main branches consisting of a whorl of 4 - 6 branchlets around a central, open axis. (C. stellaris) Greek report doubtful.
      3 Apices of main branches consisting of 2 - 3 branchlets.
      44 Branching trichotomous. Apical branches very thin, ± curved. (C. portentosa)
      4 Branching dichotomous. Apical branches not very thin, not curved. **C. mediterranea**

1 Podetia sparingly branched; branching dichotomous. **C. uncialis** subsp. **biuncialis**

**Key to Cladonia group 3**: apothecia brown; thallus squamulose; podetia constituting most of the biomass; cups well-developed.
Care is required in determining material in this group, as three of the common species, *C. chlorophaea*, *C. fimbriata* and *C. pyxidata* often occur together.

111 Podetia with soredia.
   22 Cups perforate at base. (C. cenotea)
   2 Cups not perforate at base.
      33 Podetia corticate for 0.5 - 3 mm at base.
      44 Cups wide in relation to length of podetial stalk.
         55 Podetia to 5 (7) mm tall. Upper part of podetia with fine soredia. Cups not proliferating. Thallus K+ yellow. **C. humilis**
         5 Podetia 5 - 15 mm tall. Upper part of podetia with coarse soredia. Cups sometimes proliferating from margins. Thallus K reaction various. **C. chlorophaea** aggregate.
      4 Cups narrow in relation to length of podetial stalk. **C. ochrochlora**
   3 Podetia entirely sorediate.
      44 Podetia green to grey, opening rather abruptly into a regular, rounded cup. Podetia rarely proliferating. **C. fimbriata**
      4 Podetia ash grey, antler-like, mostly with pointed apices. Cups, if present, narrow and irregular, often with marginal proliferations. **C. subulata**

11 Podetia without soredia but with corticate granules (or similar) (Note 1).
   22 Podetia K+ yellow. (C. magyarica)
   2 Podetia K-.
      33 At least some podetial ‘granules’ in the form of ± flat plates.
      44 Squamules well-developed, often coalescent (Note 2) and ± rosette-forming; lower surface and medulla chalk-white. Podetia usually not abundant. On calcareous soil or overgrowing bryophytes on calcareous soil. **C. pocillum**
      4 Squamules less well developed, not coalescent. Podetia sometimes abundant. On mesotrophic or acid soil and rock.
         55 Squamules green-brown, 3 - 10 mm long and wide, margins curved downward. ‘Corticate granules’ on podetia and inside of cups bullate plates, to 1.5 mm diameter. Apothecia-bearing proliferations of podetia up to 10 mm long, mostly branched. Apothecia often glomerulose. On acid soil and siliceous rock. **C. monomorpha**
      5 Squamules grey-brown, not often exceeding 4.5 mm long and wide, margins flat. Corticate granules ± globose or slightly flattened, to 0.4 mm diameter. Apothecia-bearing proliferations to 2 (5) mm long, not
longitudinally fissured, not branched. Podetia usually brownish in part. On a wide range of non-calcareous substrates, but most commonly on soil, bryophytes or decaying vegetation.  

C. pyxidata

3 Podetial 'granules' more spherical.

44 Squamules (of thallus) 1 - 3 x 2 mm. Apothecia bearing proliferations to 20 mm long, longitudinally fissured, branching and anastomosing. Podetia white-grey. (C. dimorpha)

44 Squamules 2 - 3 x 4 mm. Margin of podetia smooth. (C. hammeri)

4 Squamules 3 - 4 x 3 - 5 mm. Margin of podetia toothed. (C. pulvinella)

1 Podetia without soredia or true corticate granules. Podetial squamules often present. (Caution: when young they may resemble corticate granules.)

22 Podetial squamules formed by peeling away of cortex. Medulla of squamules P- or P+ orange, K- or K+ yellow. C. squamosa s. lat.

2 Podetial squamules absent or formed as outgrowths. Medulla of squamules P+ red, K-.

33 Cups ± regular. Podetia proliferating from centres of cups. Lower part of podetia not becoming blackened. C. cervicornis subsp. verticillata

3 Cups often irregular. Podetia not proliferating or proliferating from margins of cups.

44 Medulla of podetia and squamules K+ yellow. (C. subcervicornis)

4 Medulla of podetia and squamules K-.

55 Podetia with many podetial squamules.

66 Base of podetia becoming black when old. C. phyllophora

6 Base of podetia not becoming black when old. C. prolifica

5 Podetia with few or no podetial squamules. (C. gracilis) Greek report doubtful.

(1) Granules in this group are usually too large to be confused with soredia, but doubtful specimens occur. In a squash preparation, the cortex is often not very distinct: it is formed of hyphae oriented perpendicular to the surface but may be quite thin, not sharply separated from the algal layer, of a rather loose texture, and it may have numerous projecting hyphae. The latter are often apparent under the dissecting microscope, and may at first suggest a soredium.

(2) The adpressed, coalescent squamules of C. pocillum tend to be best developed in mature, central parts of the thallus. Young thalli may be difficult to separate from C. pyxidata on morphology alone.

Key to Cladonia group 4: apothecia brown; thallus squamulose; podetia constituting most of the biomass; cups poorly developed.

11 Podetia longitudinally lacerate.

22 Podetia 3 - 10 mm tall, sparingly lacerate. Margins of squamules ± rounded. Thallus K-. (C. peziziformis)

2 Podetia 10 - 30 mm tall, strongly lacerate. Margins of squamules incised. Thallus K+ yellow. C. cariosa

1 Podetia not longitudinally lacerate.

22 Podetia with obvious soredia (entirely sorediate, or corticate only in lower part)

33 Lower half of podetia corticate.

44 Cortex of podetia smooth, finely mosaic areolate. Soredia farinose. Podetia UV-. (C. cornuta) Greek reports doubtful.

4 Cortex of podetia verrucose granular. Soredia ± granular. Podetia UV+ white. C. rei

3 Podetia not corticate, or corticate for only a few mm at base.

444 Podetia P+ red or orange-red, K- or K+ faint yellow.

5 Podetia not arising from inflated squamules. Many podetial squamules present. Pycnidia mostly on squamules. C. pseudopityrea

5 Podetia not arising from inflated squamules. Podetial squamules present or absent. Pycnidia mostly on podetia.

66 Podetia often branched towards apices, and becoming antler-like. On well-drained soil. C. subulata

6 Podetia not, or not much, branched. On moist bark or wood, or damp soil.

77 Cups absent. Squamules deeply incised. Base of podetium only thinly corticate. Soredia farinose, not usually in well-defined soralia. Podetia greenish, without a grey tinge, usually no more than 1.5 mm diameter, usually straight. C. coniocraea

7 Cups present. Margins of squamules ± entire. Cortex of podetia thick, extending beyond immediate base, often longitudinally rugose. Soredia larger, often in well-defined soralia. Podetia with a grayish tinge, often more than 1.5 mm diameter, often somewhat branched and twisted. C. ochrochlora

44 Podetia P+ orange, K+ yellow-orange. C. macilenta
4 Podetia P-, K-.  
   C. glauca
2 Podetia without soredia (or in C. scabriuscula sometimes with a few, coarse, scaly soredia in upper part).
33 Podetia less than 1 cm tall. Apothecia frequent.
   44 Podetia longitudinally fissured.  (C. peziziformis)
   4 Podetia not longitudinally fissured.  C. ramulosa
3 Podetia more than 1 cm tall. Apothecia rare (except in C. crispata var. cetrariiformis).
44 Surface of podetia rough; podetial squamules formed by peeling away of cortex. Medulla P-, P+ yellow, orange, or red (Note 1). All species uncommon.
   55 Podetia ± dichotomously branched, sometimes with a few coarse soredia in upper part. Medulla P+ rust red.  
   C. scabriuscula
5 Podetia mostly unbranched or irregularly branched, without soredia. Medulla P-, or P+ yellow, orange or red.
   66 Medulla of squamules K-, P+ red. Podetia with many downturned squamules (Note 2).  
   C. graeca
   66 Medulla of squamules K+ yellow, P+ yellow.  
   C. parasitica
   6 Medulla of squamules K-, P-; or K+ yellow, P+ orange.  
   C. squamosa s. lat.
   77 Medulla of squamules K-, P-, UV+ white.  
   C. squamosa var. squamosa
7 Medulla of squamules K+ yellow, P+ orange, UV-. (C. squamosa var. subsquamosa)
4 Surface of podetia ± smooth; podetial squamules formed as outgrowths. Medulla P- or P+ red (Note 1). Some species very common.
   55 Apices of podetia perforate. Rare and confined to northern Greece.  
   C. crispata var. cetrariiformis
5 Apices of podetia not perforate. Some species common and widespread.
   66 Podetia prostrate. Medulla P+ red.  
   C. subrangiformis
6 Podetia ascending.
   (C. gracilis) Greek report doubtful.
7 Podetia branching at all levels. Cups absent. Medulla P+ red or P-.
   88 Algae confined to dispersed, raised green areoles. Podetia grey to green, usually without a brown tinge.
   Medulla K+ yellow (Note 1), P- or P+ red.  
   C. rangiformis
   8 Algae ± continuous, or if discontinuous then not raised. Podetia grey to green, but often developing a brown tinge in exposed situations. Medulla K- (Note 1), P+ red.  
   C. furcata

(1) Spot tests should be done on the medulla, not a corticated surface as tests on the latter are often hard to interpret. In species with well developed squamules, it is easiest to test the lower surface of a squamule. Otherwise, remove a patch of cortex from a podetium.
(2) It is not clear from the protologue whether the podetial squamules ("phyllidia") of C. graeca are peeling or are outgrowths.

Key to Cladonia group 5: apothecia brown; podetia few.

The chemistry of the medulla is an important character in this group. Since the squamules lack a lower cortex, spot tests are most easily carried out on their lower surface.

11 Lower surface of squamules not white.
   22 Lower surface of squamules pale yellow (Note 1). Medulla of squamules K-, KC+ yellow, P+ red.  
   C. foliacea
2 Lower surface of squamules not pale yellow. Medulla reactions various.
   333 Medulla of squamules K+ yellow, P-. Lower surface of squamules with a pale violet tinge.  
   (C. iberica)
   3 Medulla of squamules K+ yellow, P+ red. Lower surface of squamules with a grey-brown tinge.  
   C. firma
   3 Medulla of squamules K-, P+ red. Lower surface of squamules with a grey-pink tinge.  
   C. cervicornis subsp. cervicornis
1 Lower surface of squamules ± white.
   222 Medulla of squamules K+ yellow > red (norstictic acid), P+ orange-yellow.  
   C. symphycarpa
22 Medulla of squamules K+ yellow (sometimes becoming brownish later), P+ yellow, orange or red.
   33 Margins of squamules coralloid-sorediate. Medulla of squamules P+ yellow-orange.  
   C. parasitica
3 Squamules not sorediate, or weakly sorediate below. Medulla of squamules P+ orange or red.
   44 Medulla of squamules P+ red.
   55 Squamules with distinct pinkish or brownish veins below. Upper surface of squamules grey-green.  
   C. cyathomorpha
   5 Squamules without distinct veins below. Upper surface of squamules grey or blue-grey.
66 Squamules pure white below. (C. macrophyllodes) Greek report very doubtful.
6 Squamules grey below, often with a black necrotic zone at the base itself. (C. subcervicornis)
4 Medulla of squamules P+ orange.
55 Podetia with farinose soredia in upper part, corticate at base. Squamules rarely sparingly sorediate below.
C. maclenta
5 Podetia not sorediate; usually with many podetial squamules. Squamules not sorediate. (C. squamosa var. subsquamosa)
2 Medulla of squamules K- or K+ faintly brownish; P reactions various.
33 Medulla of squamules P-.
C. squamosa var. squamosa
3 Medulla of squamules P+ red or (rarely) P+ yellow.
44 Apothecia usually present, almost sessile on the squamules. Very rare. C. caespiticia
4 Apothecia, if present, on ±well-developed podetia. Some species very common.
55 Squamules thin, often delicate and brittle. Podetia if present, without cups or with poorly developed, narrow cups.
C. ramulosa
5 Squamules thick, often tough. Podetia, if present, with well-developed, broad, ±regular cups.
66 Squamules adpressed. Lower surface white. On strongly calcareous soil or rock. C. pocillum
6 Squamules not adpressed, forming cushions. Lower surface often with a grey or mauve tinge. On acidic to moderately basic soil, bark or wood. C. cervicornis s. lat.
77 Podetia not or only weakly proliferating.
88 Medulla of squamules P+ red. C. cervicornis subsp. cervicornis
8 Medulla of squamules P+ yellow. (C. cervicornis subsp. pulvinata)
7 Podetia strongly proliferating from centres of cups. C. cervicornis subsp. verticillata

(1) The yellow tinge is faint. In case of doubt, examine the lichen against a pure white background, such as a piece of paper.

**Cladonia borealis** S. Stenroos (1989)
Description: Ahti et al. (2013); Burgaz & Ahti (2009); Nash et al. (2002); Smith et al. (2009).
Known from a single site in northern Macedonia, on granite at an altitude of 1540 m.
Widespread in northern and central Europe; rare in the mountains in the south. Also Asia (widespread), N. America (widespread), C. America (Mexico), S. America (Chile, Falkland Is, Colombia, Venezuela), Antarctica (widespread).

**Cladonia caespiticia** (Pers.) P. Gaertn., B. Mey. & Scherb. (1802)
Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).
Thrace, on soil, at an altitude of 930 m. There is also a poorly localised published report.
Widespread in moister regions, rare south of the Alps. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Tanzania, Uganda), N. America (widespread), C. America (Mexico), S. America (Brazil, perhaps Guyana).

**Cladonia cariosa** (Lilj.) Spreng. (1827)
Acharius discussed the name *Lichen cariosus* in Lichenogr. Svec. Prodr. 198. 1799, without reference to Liljeblad. Some authors have therefore regarded "Lichen cariosus Ach. (1799)" as an independent name. It would be an illegitimate later homonym. On that view, the basionym would be *Baeomyces cariosus* Ach. in: Methodus 326-327. 1803, a name which is homotypic with *Lichen cariosus* Ach". However, I consider it preferable to assume that Acharius knew that he was discussing the same lichen as Liljeblad. Both authors mention the same Swedish name for it. Acharius (1801b: 343) made it clear that he considered that the two discussions refer to the same lichen.
Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).
Very scattered, with no clear pattern, on soil at altitudes 700 - 1700 m.
Throughout Europe, but in the south rare and confined to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, perhaps elsewhere), perhaps Pacific (Marquesas, New Caledonia).
**Cladonia cervicornis (Ach.) Flot. (1850) subsp. cervicornis**


Thallus: squamulose, 4 cm diameter, upper surface green, lower surface white. Squamules: 5 x 1 mm, erect, margins strongly incised and recurved, rarely with a few small white cilia. Podetia: 1.5 - 4 mm tall, 0.3 - 0.6 mm wide at base, not blackened towards base, not branched, broadening rather abruptly at ups, cortex ±continuous, or becoming discontinuous in upper part, rarely with podetial squamules. Cups: always present, 0.8 - 4.5 mm diameter, well developed but often irregular, sometimes rather flat when mature, not perforate, sometimes proliferating from centre and less commonly edges, margins often with well-developed podetial squamules, inside corticate. Soralia: absent. Pycnidia: frequent on rim of cups. Chemistry: medulla of squamules K- or K+ pale brownish, KC-, P+ orange or orange-red.

Easily distinguished from the very common *C. foliacea* by lacking any yellow tinge on the lower surface. It also has much smaller squamules than the commonest morph of *C. foliacea*.

Scattered throughout Greece, usually fairly close to the sea at altitudes 100 - 1400 m. Usually on soil, calcareous or not, rarely on rock.

Throughout Europe. Also Macaronesia (widespread), Asia (widespread), Malesia (Western Papua), N. Africa (Morocco), N. America (widespread), C. America (Mexico), Australasia (widespread in NZ). Reports for S. America may be incorrect.

**Cladonia cervicornis subsp. verticillata (Hoffm.) Ahti (1980)**

*Lichenologist* 12(1): 126; *Cladonia pyxidata* [indefinite rank] verticillata Hoffm. (1796), Deutschl. Flora 2: 122; (?) *Cladonia verticillata* var. graec., non (Raddi) Fr.; *Cladonia verticillata* (Hoffm.) Schaer.; (?) *Cladonia verticillata* f. caesia (Delise) Harm.

Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Scattered, with no clear pattern. On soil at altitudes 0 - 900 m.

Present in most of Europe. Also Macaronesia (Azores), Asia (widespread), Malesia (Malaysia), Africa (Morocco, Socotra, S. Africa), N. America (widespread), perhaps Caribbean (Bahamas), perhaps S. America, Australasia (widespread outside dry parts), Pacific (New Caledonia).

**Cladonia chlorophaea (Flörke ex Sommerf.) Spreng. (1827) aggregate**

*Syst. Veg.* 4(1): 273; *Cenomyce chlorophaea* Flörke ex Sommerf. (1826), Suppl. Fl. Lapp. 130; *Cladonia chlorophaea* f. costata (Flörke) Sandst.; *Cladonia chlorophaea* f. intermedia Sandst.; *Cladonia chlorophaea* var. intermedia (Sandst.) Szatala; (?) *Cladonia chlorophaea* f. pachyphyllina Wallr.; (?) *Cladonia chlorophaea* var. pachyphyllina (Wallr.) Vain.; *Cladonia cryptochlorophaea* Asahina; *Cladonia grayi* G. Merr. ex Sandst.; *Cladonia homosekikaica* Nuno: *Cladonia merochlorophaea* var. novochlorophaea Sipman; *Cladonia pyxidata* var. chlorophaeae (Flörke ex Sommerf.) Flörke.

This entity is chemically variable, and the chemotypes are sometimes treated as independent taxa. There do appear to be slight differences in ecology in some cases, though this is hardly conclusive evidence; genes within a single species can be, and frequently are, expressed differently in response to different environments. Culberson et al. (1988) demonstrated gene flow between the *grayi* and *merochlorophaea* chemotypes, a finding which is inconsistent with their being distinct species. The chemotypes are difficult to separate without sophisticated chemistry facilities, which is a further, practical, reason for not recognising them unless they can be proven to be distinct. For the present, I take a broad view of *C. chlorophaea*, and treat all these chemical races as synonyms. A more detailed study of the chemical variation within this group in Greece, and in SE Europe more generally, to determine whether it correlates with ecology, and what conclusions, if any, may be drawn from such correlations, is desirable. The key in Orange (1992) determines the chemotypes using only spot tests and simple microcrystal tests, and there is more helpful information in Smith et al. (2009).

Thallus: squamulose, to 8 cm diameter, upper surface green to brown, not pruinose, rarely white maculate, lower surface white, not corticate. Squamules: 1 - 2 x 0.5 - 1.5 mm, ±isodiametric or slightly elongated, usually ascending at least at margins, 150 - 200 µm thick; margin crenulate to incised, rarely smooth, rarely disintegrating slightly and developing a few soredia. Podetia: always present, (4) 5 - 14 mm tall, (0.35) 0.5 - 1.2 mm wide at base, usually widening upwards rather uniformly into cups, sometimes opening out into cups more abruptly, corticate for at least 1 mm at base, the corticate area sometimes with a few podetial squamules, upper part with coarse soredia 0.03 - 0.08 mm diameter, not proliferating (in Greek material seen to date). Cups: always present, regular, wider than podetia, 0.8 - 3 (3.8) mm diameter, inner surface with rather coarse soredia. Upper cortex of squamules: of two layers; upper layer: 5 - 15 µm thick, colourless, structureless; lower layer: 15 µm thick, brown, pigment K-, soluble in K, of densely interwoven hyphae of all orientations but ±vertical ones predominating. Medulla of squamules: white, of loosely interwoven hyphae 2 - 4.5 µm wide, often branched, without visible septa, encrusted in small crystals 0.5 - 1 µm wide. Pycnidia: often present on rim of cups, sessile, brown, 0.1 - 0.3 mm diameter (those sectioned were all immature). Chemistry:
podetia and medulla of squamules K- or K+ faintly brownish, C-, KC-, P- or P+ orange, I-, UV- in material tested (not all collections tested). Photobiont: green, trebouxioid, of globose cells 10 - 11 µm diameter, forming (in the squamules) a continuous, ±regular layer 50 - 70 µm thick.

Unlike to be confused with any species except C. fimбриата. C. chlorophaea has coarser soredia. Its podetia are corticate, at least near the base, whereas those of C. fimбриата entirely lack a cortex. Podetia in C. chlorophaea widen gradually upwards whereas those of C. fimбриата expand abruptly at the cups. Cups in C. chlorophaea are much less sharply delimited than in C. fimбриата.

Throughout Greece. On ±acidic substrates that are rich in organic material. Usually on non-calcareous soil or on slightly decaying bark, occasionally on wood or overgrowing bryophytes on bark or soil. At all altitudes from sea level to about 2400 m, but commonest at altitudes 1000 - 1500 m in upland forests. The lichenicolous lichen Diploschistes muscorum has been recorded once from this species.

The C. chlorophaea aggregate is cosmopolitan outside hot deserts and the humid tropics. Most of the chemical races appear to be widely distributed too, though they may not all be cosmopolitan.

Cladonia ciliata Stirr. (1888) var. ciliata
Scott. Nat. 9: 308.
Descriptions: Ahiti et al. (2013); Burgaz & Ahiti (2009); Clauzade & Roux (1985); Smith et al. (2009).

Rare, in northern Greece. The single report was from an upland site (altitude probably about 1000 m). No substrate was reported.

The distribution of var. ciliata is not entirely clear, owing to confusion with var. tenuis, but it appears to be a taxon mainly of central and northern Europe. According to Nimis & Martellos (2004) only var. tenuis is present in Italy.

Cladonia ciliata var. tenuis (Flörke) Nimis (1993)
Lich. Italy 227 ( A 1977 combination by Ahiti was not validly published); Cladonia rangiferina γ (= var.) tenuis Flörke (1828), De Cladon. 164-165.

If treated at the rank of form, as in some recent publications, the correct name is C. ciliata f. flavicans (Flörke) Ahiti & DePriest; basionym Cladonia rangiferina f. flavicans Flörke.

Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Rare, in northern Greece. The single report was from an altitude of about 100 m. No substrate was stated.

The range of var. tenuis in Europe is similar to that of var. ciliata, except that it extends a little further south. Also Macaronesia, Asia (widespread), N. America (widespread), Pacific (Hawaii).

Cladonia coccifera (L.) Willd. (1787) aggregate

Descriptions: Ahiti et al. (2013); Burgaz & Ahiti (2009); Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Scattered in NE Greece, on soil or siliceous rock at altitudes 675 - 1540 m.

C. coccifera s. lat. is subcosmopolitan in cold to temperate regions.

Cladonia coniocraea (Flörke) Spreng. (1827)
Syst. Veg. 4(1): 272-273; Cenomyce coniocraea Flörke (1821), Deutsche Lichenen Fasc. 7 pages 14-15. The name has a conserved type.; Cladonia coniocraea f. pycnotheliza (Nyl.) Sandst.; Cladonia coniocraea var. pycnotheliza (Nyl.) Vain.

With the conserved type, this taxon is distinct from, though close to, Cladonia ochrochlora Flörke.

Thallus: squamulose, to 3 cm diameter; upper surface pale green, not pruinose; lower surface white, not corticate, often sorediate. Squamules: discrete, rather scattered, to 2.5 x 2.5 mm but usually much less, erect, margins incised. Podetia: 6 - 15 mm tall, 0.3 - 0.7 mm wide at base, width not varying much except near apex, not branched, cortex present in basal 1.5 - 4 mm, corticate part occasionally with podetial squamules, finely sorediate in upper part, cups absent. Pycnidia: often present on apex of podetia. Chemistry: medulla K-, P+ red-orange, UV-.

My only Greek collection is scanty, so the description is brief. For published descriptions see: Nimis & Martellos (2004); Smith et al. (2009).’

The sorediate podetia easily separate this species from C. fuscata and C. rangiformis, the other common species of this group. For separation from C. ochrochlora see under that species.

Scattered in mainland Greece, but commonest in the north. On ±acidic and often slightly decaying bark, or on wood, at altitudes 700 - 1600 m.

Throughout Europe, though some reports may be unreliable owing to confusion with C. ochrochlora. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps Caribbean (Guadeloupe, St Lucia), C. America (Mexico), Pacific (Hawaii, Marquesas, Tahiti). Reports for S. America may be incorrect.
Cladonia crispata var. cetrariiformis (Delise) Vain. (1886)
in Olivier, Rev. Bot. Bull. Mens. 4: 238; Cenomyce gracilis o (=var.) cetrariiformis Delise (1830) in Duby, Bot. gall. 2: 625 as cetrariaeformis.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Smith et al. (2009).

Thasos, on soil at an altitude of 675 m.

Scattered in cooler parts of Europe; rare in the south. Also Macaronesia, Asia (India, China, Japan), Malesia (widespread), perhaps N. Africa (Morocco), N. America (cooler parts), Australasia (cooler parts).

Cladonia cyathomorpha W. Watson (1935)
J. Bot. (Lond.) 73: 156.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Scattered, mostly in northern Greece, at altitudes 600 - 2000 m. Overgrowing bryophytes on limestone, or directly on rock or soil.

An uncommon species of Mediterranean Europe and the Atlantic margin. Also Macaronesia, Asia (Turkey), S. America (southernmost Argentina).

Cladonia fimbriata (L.) Fr. (1831)
Lichenogr. Eur. Reform. 222; Lichen fimbriatus L. (1753), Sp. Plant. 1152; (?) Cladonia carneola f. prolifera (Flot.) Aigret; Cladonia fimbriata f. denticulata (Flörke) Anzi; (?) Cladonia fimbriata f. integra Schaer.; Cladonia fimbriata var. simplex (Weiss) Flot.; Cladonia fimbriata f. tubaeformis (Hoffm.) Fr.; Cladonia major (K. G. Hagen) Sandst.; Cladonia minor (K. G. Hagen) Vain.; Cladonia minor f. denticulata (Flörke) Szatala; (?) Cladonia minor f. integra (Wallr.) Szatala.

Thallus: squamulose, to 12 cm diameter. Squamules: always present, but sometimes few and not well developed, to 2 x 1.5 mm, sometimes dissolving almost entirely into soredia, margins slightly incised; upper surface green to brown, not pruinose; lower surface white, not corticate. Podetia: 6 - 12 mm tall, 0.5 - 1.8 mm wide at base, broadening to 0.7 - 2.5 mm wide just below cups, not corticate, covered ±everywhere in fine soredia. Cups: 1.6 - 7 mm diameter, regular, not proliferating, inside covered in fine soredia. Cortex of squamules: present. Medulla of squamules: white. Pycnidia: often present on rim of cups, sessile, brown, 0.1 - 0.3 mm diameter (all those sectioned were immature). Chemistry: medulla of squamules K- or K+ faintly brownish, P+ orange or red; podetia K- or K+ faintly brownish, P+ orange.

For separation from C. chlorophaea, see under that species.

Almost throughout Greece, though probably commoner in the north. At all altitudes. On ±acidic substrates rich in organic material, most commonly bark and soil, but also on wood, overgrowing bryophytes on bark and soil, occasionally directly on rock, and once overgrowing an undetermined species of bracket fungus. Almost cosmopolitan outside deserts and the humid tropics. The few reports for the moist tropics may refer to other species.

Cladonia firma (Nyl.) Nyl. (1861), non (Laurer) Kremp. (1868)

Descriptions: Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

The colour of the lower surface of the squamules distinguishes C. firma from the common C. foliacea.

Almost throughout Greece, though probably commoner in the north. At all altitudes. On ±acidic substrates rich in organic material, most commonly bark and soil, but also on wood, overgrowing bryophytes on bark and soil, occasionally directly on rock, and once overgrowing an undetermined species of bracket fungus. Almost cosmopolitan outside deserts and the humid tropics. The few reports for the moist tropics may refer to other species.

Cladonia floerkeana (Fr.) Flörke (1828)

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Smith et al. (2009).

Thasos, on soil at an altitude of 675 m.

Subcosmopolitan in cold to temperate regions.

Cladonia foliacea (Huds.) Willd. (1787)
Fl. Berol. Pradr. 363; Lichen foliaceus Huds. (1762), Fl. Angl. 457; Cenomyce alcicornis Ach., nom. superfl.; Cenomyce damaecornis Ach., nom. superfl.; Cenomyce endiveaefolia auct.; Cladonia alcicornis Ljung., nom. superfl.; (?) Cladonia alcicornis var. microphyllna (Fr. ex Körb.) Hepp; (?) Cladonia alcicornis b. (= var.) prolifera Rabenh.;
Cladonia convoluta (Lam.) Anders; Cladonia endivifolia (Dick.s.) Fr. (sometimes as "endiviaefolia") Cladonia foliacea var. alicosornis Schae.: Cladonia foliacea var. convoluta (Lam.) Vain.

Cladonia convoluta, which has been distinguished in the past because of its much larger squamules, is synonymised with C. foliacea here on the basis of molecular evidence. It seems to be just an ecotype that grows robustly on calcareous substrates.

Thallus: squamulose, usually forming large, prominent patches, to 20 cm diameter. Squamules: 10 - 25 x (2) 3 - 6 mm, not adpressed, not rosette-forming, often overlapping, 150 - 350 µm thick; margins incised, tips rolled inwards, clearly displaying lower surface; upper surface grey-green to brown-green, not pruinose; lower surface pale yellow to very pale green-yellow, not corticate. Cilia: quite common on margins of squamules in some specimens, white, 0.4 x 0.03 mm diameter. Podetia: rare, 1.5 - 2.5 x 0.5 - 0.8 mm, corticate, without soredia or podetial squamules, sometimes branched, not proliferating. Cups: always present on podetia, 0.4 - 0.65 mm diameter, regular. Cortex of squamules: 35 - 45 µm thick, swelling to 65 - 75 µm thick in K, usually colourless but sometimes brown in upper part, formed of hyphae embedded in a gel. Medulla of squamules: white; in section: 170 - 200 µm thick, of loosely interwoven hyphae 6 - 9 µm wide with a few small crystals. Pycnidia: nearly always present if cups present, sessile on rim of cups, brown, 0.15 mm diameter; in section: 280 µm tall x 200 µm diameter, wall brown, centrum colourless. Conidia: colourless, 6 - 8 x 0.5 µm, sometimes curved. Chemistry: cortex K-; medulla K-; KC yellow, P+ red-orange, UV+ briefly blue-white, then UV-. Photobiont: green; cells globose, 8 - 12 µm diameter, forming a continuous layer 50 - 75 µm thick.

The yellow tinge on the lower surface easily prevents confusion with other species.

Cladonia convoluta is very common throughout Greece. Usually on calcareous soil, sometimes on other substrates. Reported from all altitudes, but with a definite preference for lower altitudes. About half of all reports are from below 500 m.

Present in most of Europe. Also Macaronesia, Asia (widespread), northern Africa (widespread). Reports for N. and S. America are incorrect.

Cladonia furcata (Huds.) Baumg. (1790)

Fl. Lips. 577; Lichen furcatus Huds. (1762), Fl. Angl. 458-459; Cenomyce racemosa (Hoffm.) Ach.; Cladonia furcata var. corymbsa (Ach.) Nyl.; Cladonia furcata f. foliolosa (Delise) (Delise) Grognot; Cladonia furcata f. foliosa auct. graec. (probably lapsus for 'foliolosa'); Cladonia furcata var. foliosa Flörke; Cladonia furcata var. palamaba (Ach.) J. Steiner; Cladonia furcata var. pinnata Vain.; Cladonia furcata var. polyphylla (Flörke) F. Wilson; Cladonia furcata η (= var.) racemosa (Hoffm.) Flörke; Cladonia furcata f. recurva (Hoffm.) Nyl.; Cladonia furcata f. spinulosa (Delise) A. Massal.; Cladonia furcata f. stricta (Ach.) Arnold.

Thallus: squamulose, but appearing fruticose as basal squamules inconspicuous, forming large clumps to 12 cm diameter. Squamules: inconspicuous, but each podetium arises from a squamule and the squamule persists until base of the podetium starts to decay, to 3 x 2 mm. Podetia: hollow, erect, to 5 cm tall, 1.1 - 1.3 mm wide in lower parts, width not varying much until podetium branches; branching frequent at all levels, usually dichotomous, often anisotomic, branches not strongly divergent (angle between them typically 30 - 60°), axes between branches closed; apices closed, ±pointed, without cups; corticate everywhere, never with soredia, rarely with a few small podetial squamules; podetia 210-320 µm thick from outer surface to central cavity. Surface of podetia: usually dark brown in upper part, paler brown in lower part, but shade specimens sometimes greenish; smooth or slightly verrucose, sometimes with a few small cracks. Outer cortex of podetia: 20 - 25 µm thick, swelling slightly in K to about 30 µm, pale brown in outer 8 - 10 µm, colourless in inner part. Medulla of podetia: white; in section: 60 - 90 µm thick, of loosely interwoven hyphae about 5 µm wide, covered in abundant small crystals. Inner cortex of podetia: 120 - 210 µm thick, swelling to 150 - 300 µm in K, colourless, formed of rather narrow hyphae, 1 - 2 µm wide, embedded in a gel. Apothecia: not common, at apex of podetia, very convex (almost globose), usually slightly elongated, 0.8 - 1.1 x 0.6 - 0.8 mm. Disc: dark brown. Thalline margin: absent. Exciple: excluded early, poorly developed in section. Epithecium: dark brown, K-, paler brown in K as some pigment dissolves. Hymenium: 75 µm tall, colourless in lower part, often with epiphtelial pigment in upper part. Hypothecium: 50 µm tall, colourless to very pale yellow-brown. Paraphyses: slightly capitiate, apex 3 µm wide, with a thin crescent-shaped cap of brown pigment. Ascii: rather obscurely Porphidium type when weakly stained in KI; when stained more strongly a large part of the apex becomes KI+ blue. Ascospores: colourless, simple, elongate with ±rounded ends, 13 - 16 x 3 µm, 8 per ascus. Pycnidia: common on apices of podetia, 0.1 - 0.2 mm diameter, sessile; in section: globose, to 230 x 220 µm, wall brown, centrum colourless. Conidia: colourless, 7 x 1 µm, sometimes slightly curved. Chemistry: medulla of podetia K-, P+ red; podetia UV-. Photobiont: green; cells globose, 8 - 10 µm diameter, present throughout medullary layer and not forming a clearly distinct photobiont layer. The medulla reacts K-, but K can mobilise brown pigment from the cortex if insufficient care is taken when testing the medulla. The podetia are always branched and ±erect, but in some specimens the branches are all rather uniformly ±vertical, whereas in others they are more contorted and variable in direction. The growth form in the latter case may superficially resemble that of subgenus Cladina.

Easily distinguished from C. conioscræa and C. ochrochloræa by the absence of soredia. For separation from C. rangifôrminus, see under that species.
Almost throughout Greece, though not reported from a large area of central Greece. Usually on soil, occasionally on other substrates. From sea level to over 2000 m.

Subcosmopolitan, though reports for Antarctica are probably incorrect.

**Cladonia glauca Flörke (1828)**

De Cladon. 140-141.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Rare in northern Greece. A report for Naxos is doubtful. On bark of Quercus cerris and on terricolous bryophytes at altitudes of 800 - 1700 m.

Widespread in northern and central Europe, but rare south of the Alps. Also Asia (widespread), N. America (widespread).

Cladonia graeca Sipman & Ahti (2011)


Evia and Thasos, on schist at altitudes 1200 - 1370 m.

So far known only from Greece.

Cladonia humilis (With.) J. R. Laundon (1984)


*Cladonia conista* is a chemotype of *C. humilis* containing bourgeanic acid, though according to Ahti et al. (2013) there are also some subtle morphological differences and they treat it as an independent species. For the moment I prefer to treat it as a synonym of *C. humilis*.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Scattered in northern Greece to Crete. On soil, wood or siliceous rock from sea level to alpine levels.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Ethiopia, S. Africa), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (temperate parts), Pacific (Marianas), Antarctica.

Cladonia macilenta Hoffm. (1796)

Deutschl. Fl. 2: 126 (The name has a conserved type); *Cladonia macilenta* var. *squamigera* (Vain.) de Lesd.; *Cladonia macilenta* var. *styracella* (Ach.) Rabenh.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Scattered from northern Greece to Crete. On soil, wood or siliceous rock from sea level to alpine levels.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Ethiopia, S. Africa), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (temperate parts), Pacific (Marianas), Antarctica.

Cladonia mediterranea P. A. Duvign. & Abbayes (1947)


Descriptions: Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Very scattered, with no clear pattern. On soil at altitudes of 100 - 750 m.

Southern Europe, plus a few records from strongly oceanic sites in the NW (Brittany, Cornwall). Also Macaronesia, N. Africa (Morocco, Tunisia).

Cladonia monomorpha Aptroot, Sipman & van Herk (2001)

*Lichenologist* 33(4): 273-278; (?) *Cladonia neglecta* auct. graec.; (?) *Cladonia neglecta* var. *scyphosa* auct. graec. (?) *Cladonia pyxidata* var. *neglecta* auct. graec.

Description: See the protologue. Possibly just a morph of *C. pyxidata* according to Ahti et al. (2013). However, the pyxidata complex is very variable, and not well understood, and I retain *C. monomorpha* as distinct for the time being.

The only confirmed reports are those for northern Greece in Christensen & Alstrup (2012). Its ecology is similar to that of *C. pyxidata*. However, according to Aptroot et al. (2001), the names *C. neglecta* and *C. pyxidata* var. *neglecta...
have sometimes been misapplied to this lichen. If Greek reports under those names do belong here, then this species is scattered throughout Greece.

Probably throughout Europe. Also Asia (Turkey, Russia, Mongolia).

**Cladonia ochrochloara Flörke (1828)**

De Cladon. 75-79 (The name has a conserved type. Also conserved against *Cenomyce carneopallida* (Flörke) Sommerf., = *Capitularia pyxidata* var. *carneopallida* Flörke); *Cladonia coniocreaea* f. *catadiodes* (Flörke) Dalla Torre & Santh.; *Cladonia coniocreaea* f. *odontata* (Flörke) Sandst.; *Cladonia coniocreaea* f. *truncata* (Flörke) Dalla Torre & Santh.

Thallus: squamulose, 5 x 3 cm; upper surface blue-grey to green-grey, not pruinose; lower surface white, sometimes slightly sorediate, not corticate. Squamules: to 3 x 1 mm but usually much less, erect, margins incised, 200 µm thick. Podetia: 4 - 12 x 0.5 - 1.1 mm, width not varying much along length, often corticate at base, corticate area sometimes with podetial squamules, coarsely sorediate in upper part. Cups: sometimes present, irregular, to 1.2 mm diameter. Cortex of squamules: 45 - 60 µm thick in water, swelling slightly to 50 - 70 µm in K, colourless, formed of very thin hyphae, less than 1 µm wide, embedded in a gel; hyphae variously oriented. Medulla of squamules: of loosely interwoven, broad hyphae, 2.5 - 5 µm wide; hyphae sometimes with a few inconspicuous crystals. Pycnidia: often present, on short proliferations, 0.5 - 1 mm long, from margins of cups, brown, 0.1 - 0.15 mm diameter. Chemistry: squamules K-; medulla K-, C-, KC-, P+ orange-red, I-, UV-. Photobiont: green, cells globose, 10-15 µm present, on short proliferations, 0.5 - 1 mm long, from margins of cups, brown, 0.1 - 0.15 mm diameter. Chemistry: squamules K-; medulla K-, C-, KC-, P+ orange-red, I-, UV-. Photobiont: green, cells globose, 10-15 µm thick.

The sorediate podetia easily separate this species from *C. furcata* and *C. rangiformis*. If the limited material seen to date is representative, *C. ochrochloara* has much more robust podetia than *C. coniocreaea*, has coarser sorediate, and about half the podetia have cups whereas *C. coniocreaea* entirely lacks cups. For a careful comparison with *C. coniocreaea* see Nash et al. (2002).

Very scattered on the mainland, at altitudes from sea level to over 2000 m. On soil, bark or wood.

Throughout Europe. Also Macaronesia, Asia (widespread), Malèisia (PNG, Sabah), E. Africa (Kenya, Tanzania, S. Africa), N. America (widespread), Caribbean (widespread), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (temperate parts), Pacific (Hawaii, New Caledonia), Antartica (Prince Edward Is). Some reports may be unreliable owing to confusion with *C. coniocreaea*.

**Cladonia parasitica** (Hoffm.) Hoffm. (1796)


Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Rare and scattered in the NE quadrant of Greece, near the coast. On bark of *Castanea sativa* and wood of *Pinus nigra* at altitudes of 500 - 1100 m.

Most of Europe, though in the south restricted to the uplands. Also Macaronesia, Asia (widespread), N. America (widespread), Caribbean (DR, perhaps elsewhere), perhaps S. America (Bolivia).

**Cladonia phyllophora** Hoffm. (1796)

Deutschl. Fl. 2: 123; *Cladonia degenerans* (Flörke) Spreng.

Descriptions: Ahti et al. (2013); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

There is a single report for Macedonia, without substrate. The reported locality information contains some contradictions.

There are reports from most of Europe, though they may not all be reliable. Also Macaronesia, Asia (widespread), N. America (widespread in cooler regions), perhaps S. America, Antartica (subantarctic islands). Reports for Malèisia, Africa, Australasia (NZ), and Pacific (Hawaii) are incorrect or doubtful.

**Cladonia pocillum** (Ach.) Grognot (1863)


Most contemporary lichenologists treat *C. pocillum* at the rank of species, infra-specific ranks being out of fashion. I have followed the majority view here, though reluctantly. *C. pocillum* is very close to *C. pyxidata*, and seems to be a specialisation to calcareous substrates derived from *C. pyxidata*. It should only be treated at species rank if there is no longer any gene flow between the two, but unfortunately that topic is difficult to investigate in lichens. The fact that the two taxa have a similar distribution is consistent with there being some gene flow, though it does not prove it. If we follow the well thought out concepts for infra-specific taxa suggested by Lücking (2008), it would be recognised at a rank no higher than that of form, and the name *Cladonia pyxidata* f. *pocillum* (Ach.) Nyl. is available. *C. pocillum* could
even be merely a response of perfectly ordinary C. pyxidata to calcareous substrata, like the Cladonia convoluta morph of C. foliacea. Molecular investigations may clarify the matter.

Thallus: squamulose, to 8 cm diameter, sometimes rosette-forming; upper surface usually green, green-brown or brown, sometimes dark brown or with a grey tinge when squamules over-mature, rarely slightly white pruinose near margins of squamules; lower surface white, not corticate. Squamules: to 4.5 x 3.5 mm but usually much less, often adpressed in centre of thallus but with ascending margins elsewhere, rarely entirely erect, often overlapping, sometimes coalescing in centre of thallus, 500 µm thick in centre of thallus; margins wavy, crenulate or clearly incised; never with soredia. Podetia: usually present but sometimes few, 1 - 4.5 (7) mm tall, 0.4 - 1.7 mm wide at base, ±inverted conical in shape and widening very uniformly into the cups, not proliferating, usually corticate at base and sometimes further up, corticate part sometimes with a few small podetial squamules, upper part with coarse, corticate granules, 0.15 - 0.25 (0.3) mm diameter, never sorediate. Cups: always present on podetia, 0.7 - 4.5 mm diameter, wider than podetia, regular, inside with coarse corticate granules, 0.2 - 0.4 mm diameter, usually noticeably larger than granules on exterior of podetia. Cortex of squamules: 20 - 30 µm thick (in water), formed of two layers; upper epicortical layer: 8 - 10 µm thick in water but swelling to 25 µm in K, colourless, ±structureless, probably formed from dead or decaying hyphae; lower layer (true cortex): 10 - 20 µm thick, of predominantly vertical hyphae; both layers K-. Medulla of squamules: white. Pycnidia: usually present on rim of cups, sessile, brown (all sectioned ones were immature). Chemistry: medulla of squamules K-, C-, KC-, P+ orange or orange-red, I-; upper surface of squamules UV-; podetia K-, C-, KC-, P+ orange, UV-. Photobiont: green, cells globose, 12 - 15 µm diameter, forming a continuous layer 90 - 130 µm thick.ss

C. pocillum is easily distinguished from C. fimбриата and C. chlorophaea by its coarse corticate granules, rather than fine soredia. It also usually has more robust squamules, and also differs in its preference for calcareous substrates. Separation from C. pyxidata, which has ascending squamules which do not coalesce, is easy in those specimens with (at least in the centre of the thallus) adpressed, and sometimes coalescing, squamules, but these characters are not always well developed, especially in young thalli. However C. pyxidata never occurs on calcareous substrates.

Throughout Greece at all altitudes. Usually on calcareous soil, less often overgrowing bryophytes on calcareous substrates, rarely directly on limestone. Reports from other substrates are doubtful. The facultatively lichenicolous lichens Diploschistes muscorum and Megaspora verrucosa have been reported from this species.

Subcosmopolitan outside tropical regions.

**Cladonia polydactyla** (Flörke) Spreng. (1827)


Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Known to be present in Greece, but no further information is available.

Wide distribution and common north of the Alps; rare in southern Europe. Also Macaronesia, Asia (Turkey; other reports doubtful). Reports for N. America refer to var. umbricola. Reports for S. Africa and S. America are incorrect or doubtful.

**Cladonia prolifica** Ahti & S. Hammer (1990)


Description: Burgaz & Ahti (2009).

Halkidiki in Macedonia. The locality was not specified precisely enough to shown on a map. No substrate or altitude information is available.

Scattered in the south, from Portugal to Greece; also reported for Netherlands. Also western N. America (widespread).

**Cladonia pseudopityrea** Vain. (1887)

Monogr. Cladon. 1: 452-453.


Very scattered, in the islands. On bark and soil at altitudes 20 - 800 m.

Mediterranean regions of Europe, plus a few outlying records for Switzerland. Also western Asia (Turkey).

**Cladonia pyxidata** (L.) Hoffm. (1796)


Greek reports of C. neglecta and C. pyxidata var. neglecta are discussed under C. monomorpha.

Thallus: squamulose, to 12 cm diameter; upper surface green to brown, not pruinose; lower surface white, not
corticante. Squamules: to 3 x 3 mm but usually less, erect or at least ascending at margins, rarely ±adpressed, sometimes slightly overlapping, not coalescing, not rosette-forming, usually abundant but sometimes distributed only sparsely over substrate, 160 - 220 µm thick; margins usually slightly incised, sometimes smooth or merely wavy. Podetia: 2 - 8 mm tall, 0.6 - 1.5 mm wide at base, widening uniformly to cups, usually corticate at base and sometimes further up, corticate area sometimes with a few small podetial squamules, upper part usually (but not always) with coarse corticate granules 0.15 - 0.25 mm diameter, never with soreidia, not proliferating. Cups: always present, regular, 1.3 - 4.5 mm diameter, wider than podetia, inside with coarse corticate granules 0.1 - 0.3 mm diameter, granules often appearing slightly tomentose owing to projecting hyphae, occasionally becoming slightly squamule-like. Cortex of squamules: 17 - 30 µm thick (swelling by about 50% in K), colourless, of predominantly vertically hyphae, K-. Medulla of squamules: white; in section: 65 - 70 µm thick, of rather broad hyphae about 3.5 µm thick, forming a ±continuous layer, though sometimes with some clumping of cells, 25 - 30 µm thick.

*C. pyxidata* is easily distinguished from *C. fimbriata* and *C. chlorophaea* by its coarse corticate granules, rather than fine soreidia. The uniformly widening, funnel-shaped podetia also help separate it from *C. fimbriata*. For separation from *C. pocillum* see under that species.

Throughout Greece, at altitudes 0 - 2200 m. Usually on non-calcareous soil or slightly acidic, and often slightly decaying bark, especially bark near the base of trees. Less commonly overgrowing bryophytes or directly on rock; once on a decaying bracket fungus. The few reports from ±calcareous substrates may refer either to *C. pocillum*.

Subcosmopolitan outside tropical regions.

**Cladonia ramulosa** (With.) J. R. Laundon (1984)


Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985) as *Cladonia anomaea*; Nimis & Martellos (2004); Smith et al. (2009).

Very scattered, in the islands. On soil and rock at altitudes 130 - 300 m.

Throughout Europe, though in the south probably restricted to moist or upland regions. Subcosmopolitan outside Europe.

**Cladonia rangiformis** Hoffm. (1796)

Deutschl. Fl. 2: 114-115 (The name has a conserved type.); *Cladonia klementii* Oxner; *Cladonia pungens* (Ach.) Gray; *Cladonia racemosa* var. foliosa (Delise) Bory; *Cladonia racemosa* var. rangiferina (Delise) Bory; (?) *Cladonia rangiformis* f. densa de Lesd.; *Cladonia rangiformis* f. foliosa (Flörke) Arnold; *Cladonia rangiformis* var. foliosa (Flörke) Müll. Arg.; *Cladonia rangiformis* var. muricata (Delise) Arnold; *Cladonia rangiformis* f. pungens (Ach.) Vain.; *Cladonia rangiformis* var. pungens (Ach.) Vain.; (?) *Cladonia rangiformis* f. reptans (Delise) Aigret; (?) *Cladonia sylvatica* f. pygmaea (Sandst.) ined.

Thallus: forming cushion-like clumps to 20 cm diameter, though most specimens are under 8 cm diameter, appearing fruticose as squamules are usually inconspicuous. Squamules: sometimes present if bases of podetia have not decayed, to 6 x 2.5 mm but usually smaller. Podetia: always present, to 15 mm tall, 0.5 - 0.7 mm wide near base, not narrowing much except after branching, hollow, 150-210 µm thick (surface to central hollow), branching at all levels (branching usually dichotomous, ±isotomic, widely divergent, 60-90°), axils sometimes open, without soralia, sometimes with podetial squamules, occasionally with longitudinal holes, without cups, apices closed; surface usually grey-green, sometimes grey-brown or brown in upper parts. Cortex of podetia: continuous in lower part, in upper part breaking up into discontinuous, rounded, often raised areoles; in section: 15 - 25 µm thick, not swelling much in K, pale brown, K-, pigment soluble in K, of rather thin hyphae embedded in a gel. Medulla of podetia: white; in section: 55 - 75 µm thick. Inner cortex of podetia: 45-65 µm thick, swelling to 70-120 µm in K, colourless, of hyphae embedded in a gel, orientation of hyphae various but predominantly vertical; before treatment with K hyphae appear narrow, afterwards they are 3 - 4 µm wide. Cilia: (see note below) occasionally present, white or black, 0.05 mm wide, to 1.2 mm long but usually less. Pycnidia: always present, on apices of podetia, sessile, globose, 0.1 - 0.2 mm diameter, the smaller ones usually immature; in section: 200 x 170 µm, wall brown, centrum colourless. Conidia: colourless, 7 x 1 µm, straight. Chemistry: cortex K-, UV-; medulla K+ yellow (reaction often faint), P- or (in about 40% of specimens) P+ red, UV-. Photobiont: green, cells ±globose, 6 - 10 µm diameter, distributed throughout medulla and not forming a clearly distinct photobiont layer.
Two of my Greek collections bears cilia-like or rhizine-like structures on the margins of the podetial squamules, sometimes also at the apex of the podetia (and even growing out of pycnidia), and occasionally elsewhere on the podetia especially in response to damage. I have not found any reference in the literature to this phenomenon in *C. rangiformis*, but Vainio (1897: 9) names four species in which it occurs, including the related species *C. glauca*, and says that it also occurs in several other species. He states that "...on trouve des rhizines insérées sur les bords des squamules ... quelquefois même sur les bords des scyphus et sur les pointes des branches des podétions.". One of these collections is now in BM (as BM920439).

The absence of soredia easily separates this species from *C. coniocraea* and *C. ochrochlora*. It is quite close to the very common *C. furcata*, but it is a less robust species with narrower and more richly branched podetia. It is best separated from *C. furcata* by the areolation of its cortex, though this may not be very apparent in some podetia. In material seen to date, the axils between branches are often open in *C. rangiformis*, but never in *C. furcata*; however, Purvis et al. (1992) state the opposite for British material. Podetial squamules are uncommon and usually poorly developed in *C. furcata*, but some specimens of *C. rangiformis* have numerous, well-developed podetial squamules. Podetia in *C. rangiformis* sometimes develop a brown tinge in their upper part in response to sunlight, but they are less prone to do so than in *C. furcata*. The two species also differ in chemistry; the medulla is K- in *C. furcata* and K+ yellow in *C. rangiformis*, and difficult cases can always be separated by this means if sufficient care is taken. However, this chemical difference is not very helpful for routine identification, as the reaction is often faint in *C. rangiformis* and the situation in *C. furcata* can be confused by mobilisation of cortical pigment. A specimen with a P- medulla belongs to *C. rangiformis*, but some specimens react P+ red, as do all specimens of *C. furcata*.

Common throughout Greece, at altitudes 0 - 1400 m. Usually on calcareous soil, occasionally on other substrates. There are about 130 records of this species for Greece, all from below 1400 m, so it must genuinely be absent or very rare at higher altitudes. The lichenicolous lichen *Diploschistes muscorum* has been recorded once from this host.

Throughout Europe. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, Tunisia; other reports incorrect or doubtful), N. America (at least Newfoundland; most other reports doubtful). Reports for Caribbean and S. America seem doubtful to me.

### Cladonia rei Schaer. (1823)


Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Known from a single locality in northern Greece, at an altitude of about 700 m. The substrate was not reported.

Widely distributed north of the Alps, but rare in the south. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread in E. Africa), N. America (widespread), perhaps Caribbean (Bermuda), Australasia (NZN, NZS, perhaps Australia), perhaps Pacific (Hawaii), Antarctica (S. Georgia). Reports for S. America may be unreliable.

### Cladonia scabriuscula (Delise) Nyl. (1876)


Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Known from a single locality in northern Greece, at an altitude that was probably around 1000 m. No substrate was reported.

Mostly central and northern Europe; very rare south of the Alps. Also Asia (widespread), N. America (widespread), Caribbean (Haiti, Jamaica), C. America (CR, Guatemala, Mexico), S. America (Argentina, Chile, perhaps elsewhere), Australasia (widespread), Antarctica (widespread). Reports for Africa (Morocco) and Pacific (Hawaii) are doubtful.

### Cladonia squamosa Hoffm. (1796) var. squamosa


*Var. subsquamosa* (Nyl. ex Leight.) Vain. (non *C. subsquamosa* Kremp.) is distinguished in the key, but may prove to be synonymous. It is not reported for Greece.

Thallus: squamulose, 3 cm diameter; upper surface usually brown, green in shade; lower surface white, not corticate. Squamules: 0.6 - 1 x 0.3 - 0.7 mm, erect, 160 - 220 µm thick, margins usually crenulate. Sorals: absent. Cortex of squamules: 20 - 25 µm thick, mostly colourless, sometimes pale brown in upper part, hyphal, hyphae mostly vertical. Medulla of squamules: white; in section: 70 - 130 µm thick, of loosely interwoven hyphae 2 µm wide. Chemistry: upper surface of squamules K-, C-; medulla K-, P-. Photobiont: green, cells ±globose, 6 - 10 µm diameter, forming a continuous layer in the squamules 20 - 30 µm thick.

My only collection lacked podetia, but morphology, chemistry and ecology all match *C. squamosa*. For a more
complete description, see: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

The absence of soralia clearly distinguishes this species from *C. coniocraea* and *C. ochrochlora*. The well-developed squamules distinguish it from *C. furcata* and *C. rangiformis*.

Reliably reported for Thasos, where it occurred on soil at an altitude of 900 m. My Peloponnesian collection was on non-calcareous soil at an altitude of 1750 m.

Throughout Europe, but in the south probably restricted to the mountains. Outside Europe subcosmopolitan in cold and temperate regions.

**Cladonia subrangiformis** L. Scriba ex Sandst. (1924)  


Very scattered, on the mainland and the two large islands (Crete and Evia). On soil at altitudes from sea level to about 2200 m.

Fairly widely distributed outside northern regions. Also Asia (widespread), N. Africa (Morocco), perhaps N. America. (Arkansas) A disjunct report for Malesia (PNG) may be unreliable.

**Cladonia subulata** (L.) F. H. Wigg. (1780)  

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Smith et al. (2009).

Known from a single site in Macedonia, on soil at an altitude of about 1400 m.

Common in northern and central Europe, rare in the south. Also Macaronesia, Asia (widespread), Africa (Morocco; other reports incorrect or doubtful), N. America (widespread), Australasia (widespread), Antarctica (widespread). Reports for S. America and the Pacific are probably incorrect.

**Cladonia symphycarpa** (Ehrh. ex Schrad.) Fr. (1826)  

The epithet is *symphycarpa*, not *symphycarpia*.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Scattered in the northern half of Greece. On soil at all altitudes.

Widespread in northern and central Europe, rare in the south. Also Asia (widespread), perhaps N. Africa (Tunisia), N. America (widespread), Caribbean (DR), S. America (widespread).

**Cladonia uncialis** subsp. *biuncialis* (Hoffm.) M. Choisy (1951)  

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Thasos, on soil or overgrowing bryophytes at altitudes 675 - 1050 m. Subsp. *uncialis* is not reported for Greece.

Cool to temperate parts of Europe, Asiatic Russia and eastern N. America.

**Clauzadea Hafellner & Bellem.** (1984)  

Literature: Meyer (2002) monographed the genus. Good descriptions of the four widespread species are also readily available elsewhere, e.g. Clauzade & Roux (1985); Smith et al. (2009).


Differs from *Porpidia* in its preference for calcareous, rather than siliceous, substrates, but should perhaps be synonymised with that genus.

Four species, all widely distributed. and all present in Greece, where three of them are common. They occur on calcareous rock.

Differs from *Porpidia* in its preference for calcareous, rather than siliceous, substrates, but should perhaps be synonymised with that genus.

Four species, all widely distributed. and all present in Greece, where three of them are common. They occur on calcareous rock.
11 Epithecium with K+ purple or red-purple granules; reaction often faint (Note 1). Exciple dark brown only in outermost part, colourless to pale orange-brown in inner part. Thallus immersed or very thin. Apothecia 0.4 - 0.9 mm diameter, ±sessile and often ±convex when mature, sometimes flat and immersed in shallow pits in substrate when young, not pruinose. Ascospores 11 - 17 µm long. See Protoblastenia lilacina

1 Epithecium K- Exciple dark brown throughout. Thallus, apothecia and ascospores various.

22 Apothecia sessile, often becoming strongly convex, not pruinose. Ascospores 8 - 12 µm long. Thallus immersed or very thinly superficial. C. monticola

2 Apothecia immersed in thallus or substrate, flat or at most slightly convex, pruinose or not. Usually some ascospores more than 12 µm long. Thallus immersed or superficial.

33 Thallus superficial, thick. Apothecia 0.5 - 1.5 mm diameter, immersed in thallus. Ascospores 8 - 16 µm long.

C. chondrodes

3 Thallus immersed (Note 2). Apothecia 0.3 - 0.8 mm diameter, immersed in pits in substrate. Ascospore length various. Note 3.

44 Ascospores mostly 10 - 16 (18) µm long. Apothecia sometimes slightly pruinose. C. immersa

4 Ascospores mostly (15) 16 - 20 µm long. Apothecia not pruinose. C. metzleri

(1) Only the granules in the epithecium react K+ purple. The brown-orange epithelial pigment is K-. As the granules may not be abundant, the K+ reaction can easily be overlooked.
(2) The thallus is usually completely immersed when on limestone. On other substrates, such as calcareous sandstone, it may be superficial but very thin and rather poorly developed.
(3) Characters of C. immersa and C. metzleri overlap. The size of mature ascospores is the most definitive character separating them, but immature ascospores in C. metzleri are common and their size often lies in the range of C. immersa. Ascospores in both species are usually ellipsoid, but I have observed a few pyriform ascospores in C. metzleri but not in C. immersa. Some keys quote other characters, but I have not found them helpful, as there is too much overlap. Those characters are: (i) bigger apothecia in C. metzleri; (ii) slightly less immersed apothecia in C. metzleri (50 - 100%, rather than 75 - 100%); (iii) a broader perispore in C. metzleri (1 - 2 µm, versus 1 µm) - note that the perispore often resembles an ascospore wall, especially in C. immersa; (iv) pycnidia are sometimes said to be common in C. immersa and uncommon in C. metzleri. (v) a prothallus is said sometimes to be present in C. immersa but not in C. metzleri, but in my experience the presence or absence of a prothallus is strongly influenced by the nature of the substrate.

Clauzadea chondrodes (A. Massal.) Clauzade & Cl. Roux ex Hafellner & Türk (2001)

Stapfia 76: 151 (A 1985 combination by Clauzade & Roux was not validly published.); Biatora chondrodes A. Massal. (1855), Symm. Lich. Nov. 39-40; Protoblastenia chondrodes (A. Massal.) Zahlbr.; Protoblastenia cyclisca (A. Massal.) Szatala.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, never very far from the sea, on calcareous rock at altitudes 0 - 600 m.

Southern and central Europe, just reaching Sweden. Also western Asia (Turkey, Israel), N. Africa (Morocco, Algeria, Tunisia), N. America (Missouri), Caribbean (Bahamas, DR), perhaps C. America.

Clauzadea immersa (Hoffm.) B. Meyer (2002)

Sendtnera 8: 130 (A 1984 combination by Hafellner & Bellemère was not validly published.); Verrucaria immersa Hoffm. (1789), Descr. Pl. Cl. Crypt. 1, part 1: 58-59; Biatora immersa (Hoffm.) Hepp; Lecidea calcivora (Hoffm.) A. Massal.; Lecidea immersa (Hoffm.) Ach.; Protoblastenia immersa (Hoffm.) J. Steiner; (?) Protoblastenia immersa f. pruinosa auct. grac.

Thallus: crustose, immersed, inconspicuous, to 4 cm diameter. Apothecia: 75 - 100% immersed in pits in substrate, ±flat, sometimes slightly to moderately white pruinose, 0.25 - 0.6 (0.7) mm diameter. Disc: very dark red-brown to black. Exciple: black, persistent; in section: 35 - 45 µm wide, dark brown in outer part, ±colourless in inner part, of hyphae that are ±parallel to paraphyses, lumina becoming more apparent in upper part of exciple, which may even appear subcellular; pigment K-, N+ slightly reddish. Thalline margin: absent. Epithecium: red-brown to brown, K-, N-, pigment soluble in N but not in K. Hypothecium: 65 - 100 µm tall, colourless, sometimes brown in upper part. Hypothecium: 50 - 100 µm tall. colourless to pale brown. Paraphyses: simple, 1 µm wide at base, 2 µm at apex, sometimes slightly capitulate or moniliform. Asc: 75 x 18 µm, Porpia type. Ascospores: colourless, simple, ellipsoid, 10 - 16 x 5 - 10 µm, perispore distinct, about 1 µm thick; 8 per ascus, sometimes uniseriate in ascus. Chemistry: thallus K-, C-, KC-, P-. Photobiont: green; cells globose, 6 - 9 µm diameter; photobiont layer apparently continuous (when surface of limestone scraped).

For separation from C. metzleri, see under that species. Otherwise, could only be confused with Rinodina immersa,
but that has very different ascospores.

Widespread and common in the southern half of Greece, rarer in the north. On calcareous rock at all altitudes. Reported once on "hardened soil".

Widespread to as far north as British Is and southern Sweden. Also Macaronesia, western Asia (Turkey, Lebanon, Israel, Syria), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America, Caribbean and Australasia seem in need of confirmation.

**Clauzadea metzleri** (Körb.) Clauzade & Cl. Roux ex D. Hawksw. (1992)

in Coppins et al., Lichenologist 24(4): 367 (A 1985 combination by Clauzade & Roux was not validly published.);

*Biotara metzleri* Körb. (1860), Parerga Lichenol. 162-163;  *Protoblastenia metzleri* (Körb.) J. Steiner.

Thallus: crustose, to 5 cm diameter, usually entirely immersed when on limestone, sometimes thinly superficial and white on calcareous sandstone. Apothecia: 0.3 - 0.8 mm diameter, 50 - 100% immersed in pits in substrate, flat, not pruinose. Disc: dark red-brown to black. Thalline margin: absent. Exciele: black, persistent; in section: 60 - 90 μm wide, dark brown to almost black in outer part, ±colourless in inner part; hyphae in outer part with distinct lumina, 5 - 10 x 3 μm in size, and exciple sometimes appearing subcellular; pigment K-, N+ reddish, pigment partly dissolving in N but not in K. Epithecium: orange-,brown-, K-, N+ reddish, pigment partly dissolving in N but not in K. Hymenium: 75 - 100 μm tall, colourless. Hypothecium: 75 - 100 μm tall, colourless to pale brown, central part sometimes forming a deep 'root' of cellular tissue that is paler than rest of hypothecium. Paraphyses: 1 μm wide at base, 1.5 - 2.5 μm at apex, usually not capitate. Ascii: 80 - 100 x 17 - 22 μm, narrowly clavate, Porpidia type. Ascospores: colourless, simple, usually ellipsoid, occasionally pyriform, 15 - 20 x 6 - 9 μm, perispore usually distinct, 1 - 2 μm wide, 8 per ascus. Photobiont: green.

*C. metzleri* overlaps with *C. immersa* in all characters, and some collections are difficult to place. It is not at all clear to me that they are distinct species. I have used ascospore length as the basic separating character, as it seems to overlap less than others. This pair of "species" might benefit from a close investigation.

Probably throughout Greece, on calcareous rock at altitudes 0 - 1100 m. Reported once on "hardened soil".

Widespread to as far north as southern Scandinavia. Also Asia (Turkey, Israel, southern Siberia), N. Africa (Tunisia), N. America (at least Missouri), Caribbean (DR, PR).

**Clauzadea monticola** Hafellner & Bellem. (1984)


Thallus: crustose, pale brown, to 2 cm diameter, immersed or very thinly superficial. Apothecia: sessile, ±flat, 0.3 - 0.65 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciele: black, persistent, often shiny; in section: 75 - 100 μm wide, dark brown, almost opaque, K-, N+ slightly reddish, pigment partly dissolving in N but not in K. Epithecium: orange-brown to brown, K-, N-, pigment partly dissolving in N but not in K. Hymenium: 80 μm tall, colourless. Hypothecium: 100 μm tall, brown. Paraphyses: sometimes branched, 1 - 1.5 μm wide, not capitate or moniliform. Ascii: 60 x 15 μm, almost cylindrical, Porpidia type. Ascospores: colourless, simple, ellipsoid, 10 - 12.5 (15) x 6 - 7.5 μm, perispore 1 μm wide, 8 per ascus.

Can be confused with *Protoblastenia lilacina*, but that species has epithecal granules reacting faintly K+ purple or red-purple. The sessile apothecia easily separate *C. monticola* from other species of the genus. Externally, it could be confused with some species of *Lecidella*, but apothecial sections do not have the blue-green-black pigment that is characteristic of *Lecidella*. *Lecidella* also has a different ascus type.

Throughout Greece, on calcareous rock at all altitudes.

Throughout Europe, except for truly arctic regions, though probably commonest in the south. Also Macaronesia, Asia (Turkey, Jordan, Russia), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), S. America (Chile), Australasia (NZS).

**Cliostomum Fr.** (1825)


Ekman (1997) monographed the genus. There are good descriptions of the widespread European species in Clauzade & Roux (1985); Smith et al. (2009).

Sixteen species, 8 of which are European. Greece is outside the expected range of most of them
11 Apothecia pink-brown to black. Pycnidia to 0.2 mm diameter. **C. griffithii**

1 Apothecia whitish to pale yellow. Pycnidia 0.2 - 0.5 mm diameter. (C. corrugatum)

**Cliostomum griffithii** (Sm.) Coppins (1980)

Description: Smith et al. (2009).

Known from a single site in Macedonia, on *Pinus sylvestris* at an altitude of 1380 m.

Throughout northern and central Europe, scattered and uncommon in the south. Also Macaronesia, Asia (Turkey, Russia, Japan), N. Africa (Algeria, Tunisia), N. America (widespread), C. America (Mexico), S. America (Brazil), Australasia (SE Australia, widespread in NZ).

**Clypeococcum** D. Hawksw. (1977)


Literature: Apart from the protologue [not seen] there is no unified discussion. Helpful publications include: Clauzade, Diederich & Roux (1989), though several taxa are not under their current name; and Nash et al. (2004).

Eight species of lichenicolous ascomycetes, six of which occur in Europe. Only two are known from Greece, and there are few records.

111 Ascospores 15 - 26 x 6 - 10 μm. On Squamarina. **C. psoromatis**

11 Ascospores 13 - 18 x 5 - 8 μm. On Parmelia or Cetraria. (C. cladonema)

1 Ascospores 9 - 13 x 4 - 7 μm. On Hypocenomyce scalaris. **C. hypocenomycis**

**Clypeococcum hypocenomycis** D. Hawksw. (1980)


Description: Clauzade, Diederich & Roux (1989) as *Clypeococcum hypocenomyceae*; Nash et al. (2004).

Known from a single site in Epiros, on *Hypocenomyce scalaris* at an altitude of 980 m.

Throughout much of Europe, though probably avoiding both the high arctic and truly Mediterranean vegetation. Also Asia (Turkey, Russia), North America (widespread).

**Clypeococcum psoromatis** (A. Massal.) Etayo (2010)

Recently transferred to *Polycoccum*, but no supporting evidence was presented, and for the present I retain this species in *Clypeococcum*.

Forming dark, circular patches, 0.25 - 0.5 mm diameter, in thallus of *Squamarina cartilaginea* and related species, each patch containing several perithecia; a reddish (‘necrotic’) zone sometimes also present, red colour sometime extending patchily below perithecia. Perithecia: immersed in thallus of host, black, 0.06 mm diameter; in section: globose, 300 μm diameter. Exciple: black, opaque, unchanged in K. Paraphyses: 1.5 μm wide. Asci: 85 x 20 μm, acylindrical. Ascospores: brown, 1-septate, one cell often distinctly narrower than the other, 16 - 23 x 6 - 10 μm, sometimes with visible ornamentation, 8 per ascus.

The patches of black, immersed perithecia in the thallus of species of *Squamarina* are distinctive.

Peloponnese and Rhodes, at altitudes 20 - 260 m. Reported from *Squamarina cartilaginea* and *S. concrescens*.

Given the abundance of the former, this fungus is probably more common than the few records suggest.

Mediterranean regions and Atlantic margin of Europe to as far north as British Is. Also Macaronesia, N. Africa (Morocco), perhaps N. America. Greece is its most easterly known locality.

**Coenogonium Ehrenb. (1820)**

in Nees von Esenbeck, Horae Phys. Berol. 120. Type: *C. linkii* Ehrenb., the only species originally included. Family: *Coenogoniaceae*.

Literature: Clauzade & Roux (1985), Egea et al. (2004) and Smith et al. (2009) treat the important European species, under *Dimerella*. Less helpful from a purely European viewpoint, but with an extensive discussion of this mainly tropical genus, including a good explanation of the reasons for combining *Dimerella* into it, is Lucking (2008).

About 100 species, mostly tropical or subtropical. Only 3 are reported for Europe. They usually occur on bark or moss in humid habitats. The genus is rare in Greece.
11 Apothecia 0.4 - 1.5 mm diameter. Disc orange-yellow. Ascospores 8 - 11 \( \mu m \) long. **C. luteum**

1 Apothecia 0.2 - 0.4 mm diameter. Disc white to dull yellow or pink. Ascospores 9 - 14 \( \mu m \) long.

22 Base of apothecia not constricted. Disc white to dull yellow. Hymenium 70 - 90 \( \mu m \) tall. Ascospores 2 - 5 \( \mu m \) wide. **C. pineti**

2 Base of apothecia constricted. Disc brown-pink. Hymenium 100 - 120 \( \mu m \) tall. Ascospores 2 - 3.5 \( \mu m \) wide. (C. tavaresianum)

**Coenogonium luteum** (Dicks.) Kalb & Lücking (2000)

Thallus: crustose, to several cm diameter, smooth, continuous, green-grey, not pruinose, thin, 30 - 100 \( \mu m \) in section, without vegetative propagules. Cortex: poorly developed; photobiont layer overlain by a colourless layer, 7 - 12 \( \mu m \) thick, without distinct structure. Medulla: present in some places but poorly developed, elsewhere photobiont cells directly overly the bark. Apothecia: 0.35 - 0.7 mm diameter, sessile, flat, not pruinose. Disc: brown-orange. Thalline margin: absent. Exciple: pale brown-orange, sometimes almost colourless, much paler than disc, 0.03 - 0.05 mm wide, persistent; in section: 50 - 70 \( \mu m \) wide, colourless, of radiating hyphae with visible lumina in outer part of exciple, giving a cellular texture there. Epithecium: colourless. Hymenium: 75 \( \mu m \) tall, colourless in upper part, pale brown-orange in lower part, K-, pigment not soluble in K. Hypothecium: 50 \( \mu m \) tall, colourless to very pale brown-orange. Paraphyses: usually appearing simple, occasionally branched, 1 - 1.5 \( \mu m \) wide in lower part, 2 - 2.5 \( \mu m \) at apex, slightly capitate, sometimes slightly moniliform, a few septa sometimes visible in uppermost part. Ascospores: colourless, 1-septate, narrowly ellipsoid to fusiform, 10 x 3 \( \mu m \), 8 per ascus. Chemistry: thallus K-, C-, KC-, UV-. Photobiont: Trentepohlia; cells globose, 8 - 13 \( \mu m \) diameter, forming a continuous, regular layer 25 - 40 \( \mu m \) thick.

A distinctive species that can not be confused with any other when examined in section. Externally it could be confused with some species of *Bacidia*, but they have much longer ascospores and do not have *Trentepohlia* as photobiont.

Rare, in the northern half of Greece, near the coast, at altitudes 0 - 280 m. The only substrate explicitly reported is *Quercus ilex*.

Widespread in moister parts of Europe, rare south of the Alps. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, Tanzania, S. Africa), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda, Guadeloupe, St Lucia), C. America (CR, El Salvador), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Kermadec Is, New Caledonia, W. Samoa).

**Coenogonium pineti** (Ach.: Fr.) Lücking & Lumbsch (2004)

Descriptions: Clauzade & Roux (1985); Egea et al. (2004); Smith et al (2009), all as *Dimerella pineti*.

Rare and scattered, with no clear pattern, on bark at altitudes 100 - 800 m.

The least strongly oceanic of the European species, but still with a distinctly western distribution and rare in Mediterranean regions. Also Macaronesia, Asia (widespread), N. America (widespread), S. America (Brazil, perhaps elsewhere), Australasia (SE Australia), Pacific (Hawaii, New Caledonia).

**Collema** F. H. Wigg. (1780)

Prim. Fl. Holsat. 89. The name is conserved against *Gabura* Adans. (1763) and *Kolman* Adans. (1763). Type: *C. lactuca* (Weber) F. H. Wigg., listed in Appendix of the ICN. Family: *Colemataceae*.

Literature: Between them, Ahti et al. (2007), Carvalho (2012), Clauzade & Roux (1985) and Smith et al. (2009) cover all the taxa likely to occur in Greece.

Thallus: foliose, to several cm diameter, homoiomerous, without a cortex. Lobes: black or brown-black, not pruinose, in some species with distinct ridges and pustules. Isidia: sometimes present. Apothecia: often present, sessile or shortly stalked, 0.35 - 1.1 (2) mm diameter, not pruinose. Disc: brown, orange-brown or brown-orange. Thalline margin: present. Exciple: usually inconspicuous externally; in section: present but sometimes thin and poorly developed. Epithecium: brown or orange-brown, K-, pigment not soluble in K. Hymenium: 50 - 80 \( \mu m \) tall, colourless. Hypothecium: 50 - 75 \( \mu m \) tall, \( \pm \) colourless. Paraphyses: simple. not capitulate or moniliform. Asci: Collema type. Ascospores: colourless, 3 - 8 (or more) -septate, 25 - 63 x 3 - 8 \( \mu m \), 8 per ascus. Pycnidia: sometimes present, appearing externally as pale brown dots, much paler than lobes, 0.1 - 0.25 mm diameter; in section: 100% immersed, colourless, globose or subglobose. Conidia: colourless, bifusiform, 3 - 5 x 1 \( \mu m \). Photobiont: Nostoc; cells globose, 3 - 6 \( \mu m \)
diameter, forming chains.

After recent major changes to the taxonomy of *Collemataceae*, the now more narrowly delimited *Collema* has 47 species, though some will probably soon be placed elsewhere. There are 11 species in Europe, 7 of which occur in Greece. Some are widespread and common.

Determination of collections in *Collema* s. lat. (i.e. the species in the key below, plus *Enchylium*) is often difficult, as some species are variable. It is best to collect only mature specimens, as juvenile ones may lack important characters, and to collect ample material, so as not to be misled by an atypical specimen. Apothecial characters vary less than vegetative ones, so, in most species, fertile material is preferred: sometimes it is essential. In my experience, about one fifth of all collections can not be determined with certainty.

**Key to Collema main groups**

11 Isidia present. Group 1.
1 Isidia absent. Group 2.

**Key to Collema group 1:** Isidia present.

11 Thallus with prominent longitudinal ridges and/or pustules. Usually on bark.

22 Isidia coarse, to 0.2 mm diameter, remaining ±globose (or slightly ellipsoid by compression) even when mature.

  Apothecia often present. **C. nigrescens**

2 Isidia fine, about 0.05 mm diameter, extending longitudinally as they mature but not increasing much in diameter, eventually cylindrical or coralloid. Apothecia usually absent. **C. furfuraceum**

1 Thallus ±smooth, without prominent ridges or pustules (Note 1). On various substrates.

222 Mature isidia distinctly squamulose (Note 2).

33 Lobes (3) 5 - 15 mm wide at tips, ±rounded. Apothecia usually absent. **C. flaccidum**

3 Lobes 0.5 - 3.5 (6) mm wide. Apothecia often present.

44 Ascospores 1-septate. Thallus usually less than 1 cm diameter. Usually on bark. See **Paracollema italicum**

4 Ascospores 3-septate, submuriform or submuriform. Thallus often more than 1 cm diameter. Usually on calcareous rock or soil.

55 Lobes repeatedly branched, often overlapping. Exciple cellular. Ascospores subglobose or ±cuboid. See **Lathagrium latzelii**

5 Lobes ±rounded, not repeatedly branched. Exciple subcellular or hyphal. Ascospores ellipsoid or fusiform. See **Blennothallia**.

22 Ascospores ±fusiform to ellipsoid. On siliceous rock. **C. ryssoleum**

2 Ascospores acicular or bacilliform or irregularly clavate. Usually on bark. **C. subflaccidum**

3 Lobes either rounded, or linear and concave. On various substrates.

44 Thallus olive-green. Ascospores 5 - 7 -septate. Lobes 5 mm or more wide at tips, ±rounded. Usually on bark. **C. subflaccidum**

4 Thallus brown to black. Ascospores 3-septate or submuriform. Lobes various. On calcareous rock or overgrowing bryophytes of calcareous rock or bark, rarely directly on bark. See **Lathagrium**

2 Lobes ±narrow and linear, usually convex or plane. On calcareous rock. See **Scytinium**

2 Lobes either rounded, or linear and concave. On various substrates.

44 Thallus olive-green. Ascospores 5 - 7 -septate. Lobes 5 mm or more wide at tips, ±rounded. Usually on bark. **C. subflaccidum**

4 Thallus brown to black. Ascospores 3-septate or submuriform. Lobes various. On calcareous rock or overgrowing bryophytes of calcareous rock or bark, rarely directly on bark. See **Lathagrium**

2 Lobes ±cylindrical or coralloid (Note 2).

33 Lobes ±rounded, not deeply divided. On bark or overgrowing bryophytes, from sea level to the uplands, but not subalpine. **C. subflaccidum**

3 Lobes ±elongate, deeply divided. On rock at subalpine levels. **C. glebuletum**

(1) A few collections have fine isidia and a weak development of pustules. They may also have fine striations. Generally, only some lobes (not all) are pustulate, some pustules are not oriented longitudinally, and young isidia are not confined to the pustules.

(2) Examine mature isidia at the centre of mature lobes. Others are usually globose.

**Key to Collema group 2:** Isidia absent.

11 Lobes with prominent longitudinal ridges. Lobes rounded, often more than 5 mm wide at the tips.

22 Ascospores ±fusiform to ellipsoid. On siliceous rock. **C. ryssoleum**

2 Ascospores acicular or bacilliform or irregularly clavate. Usually on bark.

33 Ascospores usually 3-septate, to 40 µm long. Very rare. (C. curtisporum)
3 Ascospores more than 3-septate, usually more than 40 µm long. Common.
44 Ascospores usually curved, 4 - 5 (7) -septate, (5) 6 - 6.5 µm wide, ±clavate or irregularly clavate. Disc 0.8 - 1.5 mm diameter. C. subnigrescens
4 Ascospores straight or curved, (4) 5 - 12 -septate, 3 - 5 µm wide, acicular or bacilliform, sometimes slightly clavate. Disc 0.4 - 1 mm diameter. C. nigrescens

1 Lobes without prominent longitudinal ridges. Lobes less than 5 mm wide at the tips, sometimes indistinct.
22 Ascospores 1-septate. On bark. See Paracollema italicum
22 Ascospores 3-septate. Usually on calcareous rock or soil.
33 Exciple subcellular. Ascospores usually 13 - 15 µm wide. See Blennothallia
3 Exciple cellular. Ascospores to 9 µm wide.
444 Ascospores 2 - 5 µm wide, 3 - 5 -septate, often distinctly curved, sometimes spirally arranged in ascus.
Lobes irregular, rounded, adpressed with somewhat ascending margin. C. leptaleum
444 Ascospores 4.5 - 6.5 µm wide, 3 - 4 -septate. Lobes ±convex, not channeled, richly branched, without distinctly wavy margin. See Callome multipartita
4 Ascospores 6.5 - 9 µm wide, 3-septate. Lobes concave, channelled, not richly branched, with distinctly wavy margin. See Lathagrium undulatum var. undulatum
2 Ascospores submuriform or muriform.
33 Thallus crustose to subfoliose.
3 Exciple cellular. Ascospores to 9 µm wide.
444 Ascospores 2 - 5 µm wide, 3 - 5 -septate, often distinctly curved, sometimes spirally arranged in ascus.
Lobes irregular, rounded, adpressed with somewhat ascending margin. C. leptaleum
444 Ascospores 4.5 - 6.5 µm wide, 3 - 4 -septate. Lobes ±convex, not channeled, richly branched, without distinctly wavy margin. See Callome multipartita
4 Ascospores 6.5 - 9 µm wide, 3-septate. Lobes concave, channelled, not richly branched, with distinctly wavy margin. See Lathagrium undulatum var. undulatum

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33 Thallus crustose to subfoliose.
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444 Ascospores 4.5 - 6.5 µm wide, 3 - 4 -septate. Lobes ±convex, not channeled, richly branched, without distinctly wavy margin. See Callome multipartita
4 Ascospores 6.5 - 9 µm wide, 3-septate. Lobes concave, channelled, not richly branched, with distinctly wavy margin. See Lathagrium undulatum var. undulatum

**Collema flaccidum** (Ach.) Ach. (1810)

Thallus: foliose, to 4 cm diameter. Lobes: 3 - 7 mm wide, about 100 µm thick when dry, swelling to 120 - 180 µm when wet, round, not adpressed, not swollen, without ridges or pustules. Upper surface: black, not pruinose. Lower surface: brown-black, smooth, without rhizines or hairs (in material seen). Isidia: present, laminal, initially globose and 0.05 - 0.3 mm wide. Upper and lower cortex: absent, but upper 20 µm and lower 25 µm of lobes yellow-brown to brown, contrasting with the ±colourless central part; pigment not soluble in K but bleaches in C; fungal hyphae 1 µm wide, without visible septa. Photobiont: Nostoc; cells globose, 3-5 µm diameter, in chains, not confined to a distinct layer.

The broad lobes and squamulose isidia ensure that well developed specimens are unlikely to be confused with any other species. The absence of longitudinal ridges on the lobes also helps separate it from many other isidiate species.

Probably throughout Greece. Usually on bark or bryophytes on bark, less commonly on rock or bryophytes on rock, at altitudes from 50 to about 2000 m. The lichenicolous fungus *Stigmidium congestum* has been recorded once on this species.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (Tunisia, Eritrea, Socotra, Mozambique), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda), Australasia (SE Australia), Pacific (Hawaii, Tahiti), Antarctica (Kerguelen Is).

**Collema furfuraceum** (Schaer.) Du Rietz (1929)

There may be a problem here. *C. furfuraceum* in the usual sense is normally corticolous, but Schaerer's lichen was on rock. Mudd (1861: 40) considered Schaerer's name to be a synonym of *Collema cheileum* (= *Blennothallia crispa*). Schaerer cited the same collection (Lich. exs. n. 426) which he had previously named *Parmelia crispa* b. (= f.) *fulginea* in Lich. Helv. Spic. 536. 1842. This collection should be examined, to determine the application of Schaerer's name.

Thallus: foliose, homoiomerous, to 4.5 cm diameter. Lobes: rounded, weakly adpressed but sometimes ascending at
and recorded from a wide range of rest. Photobiont: Nostoc; cells top, 140 - 180 µm wide, only rarely with visible septa, not capitate or moniliform. Conidia: 3 - 4 x 1 µm, 8 per ascus. Pycnidia: sometimes present but easily overlooked, 100% immersed, laminal, pale brown, 0.15 mm diameter; in section: colourless, globose or with flattened top, 140 - 180 µm tall, 160 x 200 µm wide. Conidia: colourless, 3 - 4 x 1 µm, zoblong, but tips slightly wider than the rest. Photobiont: Nostoc; cells ±globose to ellipsoid, 5 - 6 x 4 - 6 µm diameter, in chains. Collections with isidia can not be confused with any other species. Non-isidiate specimens may be difficult to separate from C. subnigrescens, as the characters separating the two species differ only slightly and may overlap. Throughout Greece, at altitudes from sea level to well over 1500 m, but commonest below 1000 m. Usually on bark and recorded from a wide range of phorophytes, occasionally on rock. Most of Europe outside arctic regions. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread), C. America (Mexico, perhaps CR), S. America (Chile, perhaps Brazil, Galapagos Is), Pacific (Hawaii). The reports refer to var. furfuraceum, the only European variety. **Collema globulatum** (Nyl. ex Cromb.) Degel. (1952) in Magnusson, Ark. Bot. Ser. II, 2(2): 88; *Leptogium globulatum* Nyl. ex Cromb. (1882), *J. Bot.* 20: 272. Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009). Known from a single site in Epiros, where it occurred on limestone at an altitude of 2150 m. Northern and central Europe, to as far south as the Alps and Pyrenees. Very rare further south. Also Asia (northern Urals, China), N. America (widespread). **Collema leptaleum** Tuck. (1866) *Proc. Amer. Acad. Arts Sci.* 6: 268. Descriptions: Ahti et al. (2007); Swinscow & Krog (1988). Amorgos, on siliceous rock at an altitude of 32 m. The Greek report is very disjunct, and confirmation is desirable. In Europe, only Amorgos and one site in Norway. Also Asia (widespread in eastern half), Malesia (widespread), Africa (Kenya, Tanzania, S. Africa, Mauritius), N. America (widespread), Caribbean (Cuba, Guadeloupe, PR), C. America (Mexico, CR, Panama), S. America (widespread), Australasia (Queensland, NZS), Pacific (New Caledonia, Marianas). **Collema nigrescens** (Huds.) DC. (1805) in Lamarck & de Candolle, Fl. Franç. Ed. 3, 2: 384; *Lichen nigrescens* Huds. (1762), Fl. Angl. 450; (?) *Collema nigrescens* var. papillosum Lam.; *Collema vespertilio* Hoffm.; *Lathagrium fasciculare* (Schaer.) A. Massal. (as *'Lethagrium'*); *Lathagrium nigrescens* (Huds.) Gray (as *'Lethagrium'*); *Synechoblastus nigrescens* (Huds.) Trevis.; *Synechoblastus vespertilio* Hepp. Thallus: foliose, homoiomerous, to 7 cm diameter. Lobes: 3 - 11 (15) mm wide, rounded, with distinct longitudinal folds; margins smooth, adpressed or ascending; upper surface grey-black to black, not pruinose, lower surface dark grey to black, without rhizines; 100 - 200 µm thick when dry, swelling to 180 - 550 µm when wet. Isidia: sometimes present in central parts of lobes, globose, 0.1 - 0.2 mm diameter. Cortex and lower cortex: absent. Lobes in section: colourless to pale yellow-brown; hyphae: 1 - 2.5 (4) µm wide, sometimes with visible septa. Apothecia: common, laminal, sessile to slightly stalked, stalk if present often hollow, 0.35 - 1 (2) mm diameter, slightly concave when young, ±flat when mature, not pruinose. Disc: orange-brown, brown or brown-orange. Thalline margin: present, elevated slightly above level of disc, smooth, persistent; in section: 60 - 75 µm wide. Exciple: not visible externally; in section: 15 µm wide, not very distinct from hymenium. Epithecium: pale orange-brown to orange-brown, K-, not soluble in K. Hymenium: 70 - 80 µm tall, colourless. Hypothecium: 50 - 65 µm tall, colourless. Paraphyses: simple, 2 µm wide in lower part, broadening slightly to 3 µm at apex, sometimes with visible septa, not capitate or moniliform. Asci: 60 x 15 µm, clavate. Ascospores: colourless, 5 - 8-septate, widest part often displaced towards one end, sometimes slightly curved, one end sometimes slightly pointed, 33 - 63 x 3 - 5 (6) µm, 8 per ascus. Pycnidia: sometimes present but easily overlooked, 100% immersed, laminal, pale brown, 0.15 mm diameter; in section: colourless, globose or with flattened top, 140 - 180 µm tall, 160 x 200 µm wide. Conidia: colourless, 3 - 4 x 1 µm, zoblong, but tips slightly wider than the rest. Photobiont: blue-green; cells 5 - 8 x 0.5 - 1 µm, ellipsoid. Collections with isidia cannot be confused with any other species. Non-isidiate specimens may be difficult to separate from *C. subnigrescens*, as the characters separating the two species differ only slightly and may overlap. Throughout Greece, at altitudes from sea level to well over 1500 m, but commonest below 1000 m. Usually on bark and recorded from a wide range of phorophytes, occasionally on rock. Most of Europe except for arctic regions. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread, C. America (Mexico, perhaps CR), S. America (Chile, perhaps Brazil, Galapagos Is), Pacific (Hawaii).
N. America (widespread), perhaps Caribbean (Bahamas, Bermuda), C. America (CR, Mexico), S. America (Brazil), Pacific (Kiribati, Marquesas, Micronesia, W. Samoa).

**Collema ryssoleum** (Tuck.) A. Schneid. (1898)


Thallus: foliose, homoiomerous, to 6 cm diameter. Lobes: 4 - 8 mm wide, rounded, flat to slightly concave overall but with prominent longitudinal ridges, ±adpressed except sometimes at tips, 150 - 200 µm thick when dry, 250 - 270 µm when wet. Upper surface: black, not pruinose. Lower surface: grey to dark grey. Isidia: absent. Rhizines: rare, forming tufts of white hairs. Upper and lower cortex: absent; in section: lobes usually colourless in central part, yellow-brown near surfaces, but sometimes yellow-brown throughout; hyphae 1.5 - 2 µm wide, sometimes with visible septa. Apothecia: 0.3 - 0.8 mm diameter, flat, sometimes becoming convex. Disc: not pruinose. Thalline margin: present, raised, prominent in young apothecia but later becoming thin and almost excluded; in section: 35 - 55 µm wide. Exciple: present but not visible externally; in section: thin, poorly developed, hyphal. Epithecium: orange-brown, K-, pigment not soluble in K. Hymenium: 70 µ pale orange-brown and formed of expanded tips of hyphae forming a closed layer resembling a cortex. Exciple: in µsides of apothecia, thicker on lower part, mostly colourless and formed of a loose network of hyphae, outermost 5 - 10 µm pale orange-brown and formed of expanded tips of hyphae forming a closed layer. Some collections have ambiguous floristic record.

**Collema subfurvum** Degel. (1974)


Thallus: foliose, homoiomerous, to 4 cm diameter, but sometimes in clusters to 8 cm diameter. Lobes: 4 - 8 mm wide, rounded, usually without ridges or pustules, rarely a few lobes with poorly developed pustules) 80 - 100 µm thick (when wet), not swollen at tips. Upper surface: brown to black, not pruinose. Lower surface: grey to black, with occasional clumps of white rhizines. Isidia: abundant and crowded in centre of thallus, absent from youngest parts of lobes, laminal, globose, 0.05 mm diameter. Upper and lower cortex: absent; in section lobes yellow-brown in top 25 µm, colourless elsewhere; hyphae 1 - 3 µm wide. Pycnidia: common, laminal, visible externally as pale brown dots, much paler than lobes, 0.1 - 0.12 mm diameter; in section: 100% immersed, colourless, subglobose, 70 µm tall x 60 µm wide. Conidia: colourless, 4 - 5 x 1 µm, ±oblong, but tips slightly wider than the rest. Photobiont: *Nostoc*; cells globose, 5 - 6 µm diameter; in chains; not forming a distinct layer.

Easily distinguished from other species by its short, broad ascospores, the absence of isidia, and its ecology.

Fairly widely distributed in the south-east half of the country, never very far from the sea. On non-calcareous rock at altitudes 0 - 970 m.

Mostly southern European, plus a few records for southernmost central Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread).

**Collema subnigrescens** Degel. (1954)


Thallus: foliose, homoiomerous, 4 cm diameter, black, not pruinose, without vegetative propagules. Lobes: rounded, 2 - 5.5 mm wide, 50 - 60 µm thick when dry, often with folds or pustules oriented mostly parallel to main axis. Apothecia: sessile, flat, 0.6 - 1.1 mm diameter, not pruinose. Disc: brown. Thalline margin: in section: 100 µm wide at sides of apothecia, thicker on lower part, mostly colourless and formed of a loose network of hyphae, outermost 5 - 10 µm pale orange-brown and formed of expanded tips of hyphae forming a closed layer resembling a cortex. Exciple: in section: 40 - 60 µm wide, colourless except for thin orange-brown surface layer, of loosely arranged hyphae. Epithecium: orange-brown. Hymenium: 70 µm tall, colourless. Paraphyses: 1.5 - 2.5 µm wide, not broadening at apices, often overlapping but branches or anastomoses scarce except near base of hymenium. Ascospores: 3 - 5-septate, 4 - 6 µm wide, often curved, one end usually rounded. Photobiont: blue-green, cells in chains.

Diffs from *C. nigrescens* mainly in having broader ascospores. A few Peloponnesian collections have ambiguous...
characters, but I have referred to *C. subnigrescens* only a single collection that certainly belongs there.

Probably throughout Greece, but less common than *C. nigrescens*. On bark of a wide range of species at altitudes 20 - 1050 m.

Most of Europe outside arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, Natal), N. America (Arizona, California), perhaps S. America (Brazil) Pacific (W. Samoa).

**Cornicularia (Schreb.) Ach. (1803)**


Literature: The only species that is generally accepted is treated in all the standard floras.

**Cornicularia normoerica** (Gunnerus) Du Rietz (1926)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Known from a few sites in northern Macedonia, on granite and gneiss rock at altitudes 1400 - 1775 m. Widespread in cooler parts of northern and central Europe, very rare in the mountains of the south. Also Asia (widespread), N. America (widespread).

**Cresponea Egea & Torrente (1993)**


Literature: The best starting for European species is Egea & Torrente (1993b).

*Cresponea* is a segregate of *Lecanactis* s. lat., with about 17 species, most of which occur on bark in tropical regions. Only two occur in Europe. As with all groups lichenised with *Trentepohlia*, there are few Greek records.

11 Ascospores 11 - 17 µm long, 3-septate. If present in Greece, probably restricted to high mountains. (C. chloroconia)

1 Ascospores 20 - 28 µm long, 4 - 7-septate. Not montane. *C. premnea*

**Cresponea premnea** (Ach.) Egea & Torrente (1993)


Thallus: crustose, white, to several cm. diameter, usually thin (about 100 µm) and firmly adpressed, in places becoming thicker and looser, without vegetative propagules. Cortex: true cortex absent or poorly developed; layer above photobiont cells 30 µm thick, colourless, with distinct hyphae and abundant crystals. Medulla: poorly developed. Apothecia: 0.4 - 0.7 mm diameter, subsessile to sessile, flat to slightly convex, not pruinose (in material seen). Disc: black. Thalline margin: absent. Excieple: black, sometimes slightly shiny; in section: 100 µm wide, dark brown, opaque, individual hyphae not visible. Epithecium: usually grey-blue, less commonly green-blue, K-, grey-blue pigment not soluble in K but any green tinge disappears in K. Hymenium: 60 µm tall, colourless. Subhymenium: 50 µm tall, pale brown. Hypothecium: 75 µm tall, dark brown. Paraphyses: simple, 1.5 µm wide in lower part, capitate, apical cell 3 - 5 µm wide with blue-grey pigment. Asci: 55 x 15 µm, narrowly clavate, with distinct KI+ blue apical ring. Ascospores: colourless, 3 - 5 -septate, (13) 17 - 25 x 4 µm, rather variable in shape, sometimes slightly curved, sometimes with one end slightly wider than the other, 8 per ascus. Chemistry: thallus K-, C-, KC-, UV- (but may appear slightly white by reflection). Photobiont: Trentepohlia, forming a discontinuous layer 25 - 60 µm thick.

Youth apothecia are said to have a greenish pruina, but I have not observed any pruina in Greek collections.

Rare and scattered in the northern half of Greece, on bark at altitudes 280 m to 980 m. The only phorophyte explicitly recorded was *Quercus ilex*.

Southern and central Europe, reaching southern British Is. Also Macaronesia, Asia (Russia, Taiwan), N. Africa (Morocco, Algeria), N. America (widespread in USA), Pacific (Hawaii, New Caledonia, Western Samoa). Reports for S. America are all old and may be unreliable.

**Cyphelium Ach. (1815)**

Literature: The genus was monographed in Europe by Tibell in *Svensk Bot. Tidskr*. 65: 138-164. 1971 [not seen]. Otherwise, for European species as a whole, Clauzade & Roux (1985) is an adequate starting point but there are better descriptions of some species in: Ahti et al. (1999), Muñiz & Hladun (2011); Nash et al. (2004) and Smith et al. (2009).

As circumscribed here, *Cyphelium* contains about 16 species, of which 10 occur in Europe. However, its delimitation from *Calicium* is unsatisfactory, both genera are paraphyletic, and some species will eventually have to be placed elsewhere. The genus is very rare in Greece.

111 Thallus yellow or yellow-green. Not parasitic. (C. notarisii), (C. pinicola), (C. tigillare)

11 Thallus grey (rarely green-grey). Parasitic or not.

22 Apothecia in thallus warts. Parasitic or not. (C. marcianum), (C. tigillare)

2 Apothecia not in thallus warts. Not parasitic. (C. inquinans), (C. karelicum), (C. lecideinum)

1 Thallus immersed. Parasitic on *Pertusaria* species on bark. C. sessile

**Cyphelium sessile** (Pers.) Trevis. (1862)


Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Muñiz & Hladun (2011); Smith et al. (2009).

Naxos, parasitic on *Pertusaria coccodes* at an altitude of about 560 m.

Widespread in northern and central Europe, but very rare south of the Alps. Also Asia (India), perhaps N. America.

**Dendrographa** Darb. (1895)


Literature: The two European species are treated in the standard Floras, often under *Lecanactis* or *Schismatomma*.

Seven species, only two of which are European.

11 On dry bark at low altitude. Medulla UV-. Not resembling *Lepraria*. D. decolorans

1 On shaded, acidic rock; if present in Greece, probably restricted to the uplands. Medulla UV+ ice blue. Resembling a species of *Lepraria*, but with Trentepohlia as photobiont. (D. latebrarum)

**Dendrographa decolorans** (Turner & Borrer ex Sm.) Ertz & Tehler (2011)

*Fungal Diversity* 49: 53; *Spiloma decolorans* Turner & Borrer ex Sm. (1812) in Smith & Sowerby, Engl. Bot. 34, tab. 2399; *Schismatomma albocinctum* (Nyl.) Zahlbr.; *Schismatomma decolorans* (Turner & Borrer ex Sm.) Clauzade & Vězda

Thallus: crustose, white, pale grey-white or pale pink-brown, forming small patches to 1.5 cm diameter, older parts slightly cracked, younger parts continuous, thin (150 - 220 µm). Prothallus: sometimes present, black, 0.05 - 0.1 mm wide. Soralia: abundant, pale grey-white, pale green or pale brown (becoming white in herbarium), usually delimited, a few sometimes coalescing, flat or very slightly concave, 0.2 - 0.5 mm diameter. Cortex: 100 µm thick, mostly colourless, sometimes grey in outermost 15 µm. Medulla: poorly developed. Apothecia: usually absent, only a single apothecium seen. Epithecium: black. Hymenium: 55 µm tall, colourless. Hypothecium: brown. Ascospores: colourless, 3-septate when mature, 35 - 45 x 3.5 - 5 µm, often curved. Chemistry: thallus and soralia C-, K-, KC-, P-, UV-. Photobiont: Trentepohlia.

The name *Schismatomma albocinctum* has been used in the past for the rare fertile morph.

Fairly well characterised by the thin, sorediate, usually sterile, thallus with negative reactions and Trentepohlia photobiont. Other species with these characters have not (yet) been reported for Greece.

Scattered, in sites close to the sea, at altitudes 10 - 300 m. On bark, and recorded from a wide range of phorophytes.

Southern and western Europe, to as far north as British Is and southern Sweden. Almost absent from eastern Europe. Also Macaronesia, western Asia (Turkey, Syria, Iran, Yemen), N. Africa (Morocco, Algeria, Tunisia), N. America (Michigan, perhaps elsewhere).

**Dermatocarpon** Eschw. (1824)


Literature: There is no convenient monograph, but useful starting points are Smith et al. (2009), and Wasser & Nevo (2005).
This is the only foliose genus in Verrucariaceae and so is usually easily recognised, though a few species presently placed here are transitional to other growth forms. The genus has about 50 species, of which about 17 occur in Europe; they are almost always saxicolous. Many of the species present further north in Europe are associated with damp or aquatic habitats, but this is generally not the case for the only widespread Greek species, *D. miniatum*. Three other species have been reported for Greece, but there is some uncertainty about two of them.

1. Thallus foliose.
   2. Lower surface with rhizine-like structures. (D. pellitum), (D. schaechtelinii), (D. vellereum)
   3. Lower surface without rhizine-like structures.

3. Thallus single-lobed (or with secondary lobes that are not attached directly to substrate) with a single, central holdfast. Lobes 10 - 70 mm diameter. **D. miniatum**

4. Thallus multi-lobed, attached by several scattered holdfasts.

4. Thallus bright green when wet. Medulla IM+ brown-red (Note 1). On calcareous or siliceous rocks that are submerged or inundated for most of the year. Altitude range in Greece poorly known. **D. luridum**

5. Thallus not changing colour much when wet, never bright green. Medulla IM- (Note 1). Not submerged, though may be associated with seepage tracks. At subalpine to alpine levels. **D. intestinaliforme**

1. Thallus squamulose or squamulose-areolate.
   2. Thallus squamulose, dark brown to black. Squamules convex. (D. convexum)
   3. Thallus squamulose-areolate, with grey pruina. Areoles ± flat. **D. subcrustosum**

(1) Note: Meltzer's iodine reagent, not Lugol's.

**Dermatocarpon intestinaliforme** (Körb.) Hasse (1912)

*Bryologist* 15: 46; *Endocarpon intestinaliforme* Körb. (1859), Parerga Lichenol. 42; *Dermatocarpon polyphyllum* (Wallr.) Dalla Torre & Sarnt.

Regarded as a synonym of *D. miniatum* by Moberg et al. (2017), but I have not seen the evidence on which that view is based.

Similar to *D. miniatum* but with multiple, slightly smaller, often overlapping lobes that may be attached at multiple points.

Abbott (2009) considered all the Greek reports to be in need of confirmation, but the two Peloponnesian collections that he tentatively referred here do belong to *D. intestinaliforme*, and there is a reliable recent report for Epiros.

Widespread from the Alps northward, but in the south confined to high mountains. Also Macaronesia, Asia (scattered in cooler parts), N. Africa (Morocco), N. America (widespread). Reports for Antarctica are incorrect.

**Dermatocarpon luridum** (With.) J. R. Laundon (1984)


The earliest name is *Lichen aquaticus* L. (1753), but the epithet is not available in *Dermatocarpon* owing to *D. aquaticum* Herre. (1906), a legitimate heterotypic synonym of *D. luridum*.

Descriptions: Clauzade & Roux (1985) as *Dermatocarpon weberi*; Nash et al. (2004); Smith et al. (2009).

Thrace, on siliceous rock at an altitude of 930 m. There is also a report for Crete, on unspecified substrate at an altitude of 300 m, but that altitude is anomalously low for this species in southern Europe, and the report may be incorrect.

Widespread from the Alps to about the Arctic Circle; rare in the south and usually confined to the mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps C. America (Mexico). Reports for Australasia (NZ) are incorrect.

**Dermatocarpon miniatum** (L.) W. Mann (1825)


Thallus: foliose, to 4 cm diameter, usually formed of a single lobe attached by a single central holdfast, secondary
lobes sometimes present but lacking a holdfast, without vegetative propagules. Surface: pale grey, matt, not smooth, slightly white pruinose. Lobes: 250 µm thick, swelling to 420 µm near perithecia. Lower surface: brown, matt, ±smooth but with faint network of low rounded ridges or folds, without rhizines. Upper cortex: 15 - 40 µm thick, colourless, weakly cellular. Medulla: white, of loose network of randomly oriented hyphae. Lower cortex: 50 µm thick, mostly colourless, sometimes brown in outermost 5 µm, distinctly cellular; cells squareish, 7 - 10 µm wide. Perithecia: abundant everywhere on upper surface, though less common near centre of thallus, sometimes immersed in very low thalline warts 0.3 mm diameter when young, brown to black, 0.01 - 0.5 mm diameter; in section: globose, 330 - 500 µm diameter, wall colourless to very pale brown. Involucrellum: absent. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 10 - 13 x 6.5 - 7.5 µm, 8 per ascus, ±uniseriate. Chemistry: medulla IM-.

Photobiont: green; cells globose, 5 - 7 µm diameter. Photobiont layer: regular, continuous except at perithecia, 70 - 100 µm thick.

Easily recognised by the fairly large, pale grey monophyllous thallus with perithecia. *D. intestiniforme* has a polyphyllous thallus and is restricted to high altitude.

Throughout Greece, though not common. On calcareous or siliceous rock at all altitudes. About 35% of reports are from above 1800 m, but some high altitude reports may refer to *D. intestiniforme*.

*Dimelaena* is known only for Hungary, Bosnia and Greece. Also Macaronesia (Canary Is), western Asia (Israel, Jordan), N. Africa (Morocco, Algeria).

**Dermatocarpon subcrustosum** (Nyl.) Zahlbr. (1921)


According to Navarro-Rosinés, Roux & Gueidan (2007) the type has disintegrated and its identity is uncertain. I am using the name in the sense of Wasser & Nevo, 2005.

Eastern Peloponnese, at altitudes 20 - 100 m. One of the two collections was said to be overgrowing a black-fruited species of *Caloplaca* (reported as *C. variabilis*). Not reported since the 19th century.

A poorly known taxon reported in Europe only for Hungary, Bosnia and Greece. Also Macaronesia (Canary Is), western Asia (Israel, Jordan), N. Africa (Morocco, Algeria).

**Didymelopsis (Sacc.) Clem. & Shear (1931)**


A rather poorly known genus with about six species, four of which occur in Europe. There is only a single Greek record.

11 On species of Collemataceae. Perithecia 170 - 400 µm diameter. Exciple sometimes with a violet tinge.

22 Perithecia 200 - 400 µm diameter. Asci with 8 ascospores. *Didymelopsis collematum* (D. pulposi)

1 On squamulose species of Verrucariaceae Perithecia 100 - 200 µm diameter. Exciple brown, without a violet tinge. (D. perigena)

**Didymelopsis collematum** (J. Steiner) Grube & Hafellner (1990)


Descriptions: Clauzade, Diederich & Roux (1989) as *Cercidospora collematum*, Hawksworth et al. (2010). The single Greek report, the type of *Cercidospora collematum*, is from the western part of Sterea Ellada, where it occurred on _Lathagrium auriforme_ at an altitude of about 500 m. Not seen in Greece since then.

Temperate and cool parts of Europe, avoiding regions with a Mediterranean climate. Also Asia (arctic Siberia).

**Dimelaena Norman (1852)**


Literature: Clauzade & Roux (1985) treat both European species, but there are better descriptions in Brodo et al. (2001) and Nash et al. (2004).

Nine species. Two occur in Europe, and both have been reported from Greece. They occur on siliceous rock.
11 Thallus with a green-yellow tinge, usually not pruinose. **D. oreina**
1 Thallus grey or with a brownish tinge, often pruinose. **D. radiata**

**Dimelaena oreina** (Ach.) Norman (1852)
Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2004).
Crete and islands of the southern Aegean, on siliceous rock at altitudes 130 - 420 m.
Widespread in Europe. Also Macaronesia, Asia (widespread), Africa widespread outside humid tropics), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile).

**Dimelaena radiata** (Tuck.) Müll. Arg. (1884)
Rico et al. (2003) claim this species may be synonymous with *Buellia tesserata* Körb.
Islands of the southern Aegean (SE Spain, Corsica, Greece); not present north of the Alps. Also Macaronesia, Africa (Morocco; St Helena), N. America (California), C. America (Mexico).

**Diploicia** A. Massal. (1852)
Literature: Ahti et al. (2002); Clauzade & Roux (1985); Smith et al. (2009).
Differs from *Physcia* in the crustose growth form. Differs from most other crustose genera of *Physciaceae* in having marginal lobes. Differs from *Dimelaena*, which is also placodioid, most distinctly in the ascospores, which are Beltraminia type in *Dimelaena* but Physcia type in *Diploicia*. However, the present delimitation of genera in the crustose members of the *Physciaceae* is unsatisfactory.

About eight species, only one of which is European. Two species, *D. canescens* and *D. subcanescens*, have traditionally been recognised in Europe, but I regard them as synonymous, following Molina et al. (2002). No Greek reports refer to *D. subcanescens*.

**Diploicia canescens** (Dicks.) A. Massal. (1852)
Thallus: placoidioid with distinct marginal lobes, to 5 cm diameter, 0.7 mm thick (measured about 1 mm from margin), white to pale grey, sometimes dark grey in outermost 0.5 - 1 mm of marginal lobes, white pruinose everywhere, sometimes less strongly so at centre. Marginal lobes: flat to convex, sometimes slightly overlapping. Soralia: usually white, sometimes developing a grey tinge when older, initially delimited, 0.25 - 1 mm diameter, flat to slightly convex, sometimes coalescing later. Cortex: present, 10 - 20 µm thick, colourless, containing many small crystals soluble in 10% HCl but not in K, finely cellular (crystals must be dissolved before cellular tissue is apparent); cells 3 µm wide. Medulla: white, of loosely interwoven hyphae 2 - 3 µm wide; in section upper half is colourless, lower half often brown to grey (and could perhaps be described as a hypothallus). Chemistry: medulla and soralia C- or C+ red, K- or K+ yellow, P-; thallus C- (but may appear C+ red when medulla reaction shows through), K+ yellow, at least faintly, P-, UV+ faintly dull greenish (in both long wave and short wave). Phenobiont: green; cells globose, 10 - 12 µm diameter, forming a layer 70 - 140 µm thick.

The neat rosettes of this species, the placoidioid growth form and the colour exclude most other species. *Lecanora pruinosa* and *Solenopsora candidans* both lack soralia and are usually fertile; *Lecanora pruinosa* is C+ orange, and *Solenopsora candidans* has a P+ orange medulla.

Widely distributed, but usually near the sea. At altitudes 0 - 900 m, but uncommon above 400 m. Rather indifferent as to substrate, and common on bark and rock (calcareous and siliceous). Occasionally on wood.

Throughout Europe, except the far north. Also Macaronesia, Asia (widespread), Africa (widespread outside topics), N. America (coastal California), Caribbean (Bermuda), C. America (Mexico), S. America (Galapagos Is), Australasia (widespread in temperate parts), Pacific (Hawaii).

**Diploschistes** Norman (1852)
Literature: There is a key to all species in Rivas Plata et al. (2010). Between them, Clauzade & Roux (1985), Nash et al. (2002), and Smith et al. (2009) discuss all the species that are likely to occur in Greece.

Thallus: crustose, well-developed, to several cm diameter, thick, pale in colour (white, pale grey or pale brown-grey), pruinose or not. Apothecia often immersed but sessile in some species, perithecia-like to widely open. Epithecium and exciple: brown, K-, N-. Paraphyses: simple, narrow (about 1 µm), not or scarcely broadening at apices. Asci: fairly narrow, uniformly KI+ brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, ±ellipsoid, 4 - 8 per ascus, medium sized to fairly large (20 µm or more long in most species). Chemistry: varied, but many species C+ red in spot tests. Photobiont: green.

The KI+ brown-orange (never +blue) asci and the pigmented, distinctly muriform ascospores easily separate this genus from most others. Ingvariella is close to Diploschistes but has 2-spored asci, whereas asci in Diploschistes have 4 or more ascospores.

Diploschistes contains about 43 species, though several are poorly known and may eventually be reduced to synonymy. They occur on rock, soil, bryophytes or lichens, but are not corticolous or lignicolous (except, rarely, secondarily in D. muscorum). In Europe, where there are 12 species, the genus shows a clear preference for the south of the continent, though a few species are widely distributed.

11 Disc of apothecia punctiform, opening only by a small ostiole, ±resembling perithecia. On rock.

22 Thallus C+ red. On calcareous or siliceous rock.

333 Thallus brownish. On siliceous rock. D. aeneus

33 Thallus whiteish, pruinose. On calcareous rock. D. candidissimus

3 Thallus grey, white-grey, blue-grey or green-grey. On siliceous rock.

44 Most mature ascospores less than 30 µm long, with 1 - 6 transverse septa. Apothecia to 1 mm diameter. Exciple without hairs. Thallus never very dark in colour.

55 Gyrophoric acid as major substance (Note 1). Thallus white-green to green-grey. (D. gyrophoricus)

5 Lecanoric acid as major substance (Note 1). Thallus pale grey, white-grey or grey. D. actinostoma

4 Mature ascospores 28 - 45 x 12 - 25 µm (Note 2), with 5 - 9 transverse septa. Apothecia to 0.2 mm diameter. Exciple with minute projecting, inward-pointing white hairs (Note 3). Thallus sometimes dark in colour (grey, blue-grey or dark grey). D. caesioplumbeus

2 Thallus C-. On siliceous rock. D. euganeus

1 Disc not punctiform. On various substrates.

22 Thallus C+ red (sometimes faint), KC+ red. On various substrates.

33 Not on rock.

44 Ascospores 4 per ascus, 18 - 32 x 6 - 15 µm. Parasitic on Cladonia species or overgrowing plant debris on calcareous soil. Sometimes directly on soil (rarely on bark, wood or rock) after originally parasitising Cladonia on that substrate. D. muscorum

4 Ascospores 4 - 8 per ascus, 20 - 38 x 9 - 17 µm. On soil.

55 Thallus K+ yellow or orange-yellow; in section diffusing yellow pigment into solution. D. diacapsis subsp. diacapsis

5 Thallus K- or slightly K+ greenish, not diffusing yellow pigment into solution. D. diacapsis subsp. neutrophilus

3 On rock.

44 Ascospores (4) 8 per ascus. Hypothecium brown, usually dark brown. Thallus not pruinose, K+ or K-. On siliceous or weakly calcareous rock. D. scruposus

4 Ascospores 4 per ascus. Hypothecium colourless. Thallus densely white pruinose, K-. On calcareous rock. D. gypsaceus

2 Thallus C-. On calcareous rock. D. ocellatus (If asci 2-spored, see Ingvariella.)

(1) Gyrophoric and lecanoric acids are best distinguished by chromatography, but can be separated reliably by microcrystal tests (Orange et al., 2001). In spot tests, gyrophoric acid is C+ and KC+ pure pink or red-pink, whereas lecanoric acid gives a more red reaction. A slight purplish tinge, if present, would indicate lecanoric acid. D. gyrophoricus appears to be primarily a Southern Hemisphere species. In Europe it is only reliably reported for Catalonia.

(2) Immature ascospores may be much smaller.

(3) Use at least x30 magnification. At low magnification the hairs could be mistaken for pruina.

Diploschistes actinostoma (Ach.) Zahlbr. (1892)

_Hedwiga_ 31: 34 as actinostomus; _Verrucaria actinostoma_ Ach. (1810), _Lichenogr. Universalis_ 288; (?) _Diploschistes_
actinostoma var. electus J. Steiner as actinostomus; (?) Diploschistes calcareaus f. electus (J. Steiner) Lettau; Urceolaria actinostoma (Ach.) Schauer; Urceolaria actinostoma a. (= f.) contracta Schauer.

The epithet is a noun, not an adjective. (It means 'a rayed mouth', or 'a mouth with rays; the 'rays' are the radial striations or crenations on the inner part of the apothecial margin; the 'mouth' is the urceolate apothecium itself.) It should not be amended to actinostomus in this genus.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Widespread in and around the southern Aegean. never very far from the sea. On siliceous rock at altitudes 0 - 1100 m.

Widespread in southern Europe; uncommon north of the Alps, just reaching southern England. Also Macaronesia, Asia (widespread), Africa (widespread, N. America (widespread) Caribbean (PR, St Croix, St Lucia, St Thomas), C. America (CR, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Kermadec Is).


Description: Nash et al. (2002).

Paros, on siliceous rock at altitudes 25 - 400 m.

Albacete in Spain, and the island of Paros in Greece. Also Asia (Japan), Africa (S. Africa), N. America (scattered in USA), Caribbean (Netherlands Antilles), C. America (Mexico), S. America (Bolivia, Brazil, Paraguay, Uruguay), Australasia (scattered in Australia).

Diploschistes caesioplumbeus (Nyl.) Vain. (1921)

Bot. Mag. (Tokyo) 35: 70; Urceolaria actinostoma var. caesioplumbea Nyl. (1873), Flora 56(5): 70 (Commonly cited from Bull. Soc. Linn. Normandie, sér. II, 6: 264 but that was probably published later in 1873.); Diploschistes actinostoma var. caesioplumbeus (Nyl.) J. Steiner as actinostomus.

Thallus: crustose, grey, sometimes areolate, to 8 cm diameter, 150 µm thick. Cortex: true cortex absent; pseudocortex 20 - 30 µm thick, colourless, without distinct structure, with many crystals, K-. Medulla: white. Apothecia: 0.2 mm diameter, urceolate. Disc: not very apparent externally. Exciple: over-arching disc, with small, inward-pointing, white hairs; in section: 50 - 60 µm wide, pale brown to brown, hyphal; hairs in section: colourless to very pale brown, about 20 x 3 µm. Epithecium: ±colourless, K-. Hymenium: 150 µm tall, colourless. Hypothecium: dark brown. Paraphyses: simple, 2 µm wide at base, 3 µm at apex, not capitate or moniliform. Asci: 105 x 25 - 30 µm, clavate, K+ uniformly orange-brown, without apical apparatus. Ascospores: brown when mature, muriform, ellipsoid, (27) 30 - 39 x 15 - 20 µm, with 5 - 8 transverse septa and 1 - 4 longitudinal septa, KI- (but appearing KI+ red-purple when still in ascus), 4 - 8 per ascus. Chemistry: thallus K-, C+ red, P-, UV+ faintly white. Photobiont: green, cells globose, 7 - 11 µm. Photobiont layer 60 - 130 µm thick, rather irregular, sometimes discontinuous.

Easily separated from other species. D. candidissimus occurs on calcareous rock. D. actinostoma lacks epithecial hairs, and D. aeneus has a brown thallus.

Scattered, in coastal areas in the Aegean, on siliceous rock at altitudes 30 - 1100 m.

Atlantic margin as far north as British Is, and around the Mediterranean. Also Macaronesia, Asia (widespread, but not continental interior), Africa (widespread), N. America (Arizona, California), C. America (Mexico).

Diploschistes candidissimus (Kremp.) Zahlbr. (1924)

Cat. Lich. Univ. 2: 660; Limboria candidissima Kremp. (1865) in Unger & Kochyl, Die Insel Cypern 166; Diploschistes actinostoma var. farinosus (Anz.) Zahlbr. as actinostomus.

Thallus: crustose, cracked (cracks extending down 0.1 - 0.5 mm, but not to base of thallus), white pruinose everywhere, to 4.5 cm diameter, 1 mm thick. Prothallus: white, 0.5 mm wide. Cortex: opaque in water, K and N, so difficult to study, perhaps a pseudocortex. 30 - 40 µm thick, colourless to pale brown, K-, N-. Medulla: white (but brown where cracks descend into it), chalky. Apothecia: immersed, resembling perithecium, 0.25 - 0.3 mm diameter. Disc: not visible externally. Exciple: arched over disc, with white, inward-pointing hairs; in section: 50 - 70 µm wide, dark brown in outer part, very pale brown in inner part, K-, hyphal, some hyphae extending beyond main part of exciple as colourless hairs, 20 (40) x 2.5 - 3 µm. Epithecium: colourless to pale brown, K-. Hymenium: 110 - 160 µm tall, colourless. Hypothecium: 40 µm tall, dark brown in lower 25 µm, very pale brown in upper part. Paraphyses: simple, 1 µm wide, scarcely broadening at apex. Asci: 110 x 25 µm, broadest at middle level, KI+ uniformly brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, ellipsoid, 28 - 35 x 17 - 18 µm, with 5 - 7 transverse and 3 - 4 longitudinal septa; KI- even when mature, 4, 6 or 8 per ascus. Chemistry: medulla K-, C+ red, P-, I+ grey; thallus UV+ faintly white. Photobiont: green, forming a continuous, regular layer 70 - 100 µm thick.

This species is close to D. caesioplumbeus. The possibility that the differences may be merely a response of the same species to different substrates does not appear to have been investigated.

Very scattered in the southern half of Greece. On calcareous rock at altitudes 300 - 700 m.
Southern Europe and the more southerly parts of central Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Tunisia, Egypt), perhaps N. America, Australasia (S. Australia, Victoria).

_Diploschistes diacapsis_ (Ach.) Lumbsch (1988) subsp. diacapsis  

Thallus: crustose, to several cm diameter, pale grey, white pruinose, often warted, 1 - 1.5 mm thick. Cortex: true cortex absent; pseudocortex 12 - 30 µm thick, colourless, rather opaque, without distinct structure. Medulla: white. Apothecia: subimmersed, concave, 1.5 - 3 mm diameter. Disc: black, white or grey pruinose. Thalline margin: absent; may appear to be present externally, but in section not intimately part of apothecium. Exciple: visible externally as thin, grey rim to disc, 0.05 mm wide, persistent; in section: 150 µm wide, mostly dark brown, colourless to pale brown in innermost 15 - 20 µm, K, N-. Epithecium: grey to brown, K-, N-, pigment dissolving in K but not in N. Hymenium: 125 - 160 µm tall, colourless to pale brown. Hypothecium: 35 - 60 µm tall, dark brown in lower part, colourless to pale brown in upper part. Paraphyses: simple, 1 µm wide, scarcely broadened at apex. Asci: 150 x 15 - 23 µm, narrowly clavate, K+ uniformly brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, narrowly ellipsoid, 25 - 32 x 12 - 15 µm, with 5 - 6 transverse and 1 - 2 longitudinal septa, KI-, 8 per ascus. Pycnidia: 100% immersed; in section: colourless, 350 µm diameter. Conidia: colourless, simple, narrowly ellipsoid, 5 x 1.5 µm. Chemistry: medulla K+ yellow, C+ red (persistent), P+, I- grey; thallus K+ yellow or yellow-orange, C+ red (persistent), P-, UV+ faintly white; thin sections diffusing a yellow pigment into solution in K. Photobiont: green, cells globose, 8 - 13 µm diameter, forming a discontinuous layer 40 - 70 µm thick.

Could be confused with _D. muscorum_, though that species is usually parasitic, but easily separated microscopically by its 8-spored asci (_in D. muscorum_ they are 4-spored).

Scattered, mainly in the southern half of Greece, never very far from the coast, at altitudes 0 - 1000, usually on soil, rarely on rock.

Southern Europe and the more southerly parts of central Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (western USA), C. America (Mexico), S. America (Chile, Colombia, Peru), Australasia (NSW, S. Australia).


Description: Clauzade & Roux (1985) as _Diploschistes gypsaceus_ subsp. _neutrophila_.

Attica, on soil at an altitude of 1000 m.

Only mainland France, Corsica, Calabria and Greece.

_Diploschistes euganeus_ (A. Massal.) J. Steiner (1919)  

Descriptions: Clauzade & Roux (1985); Nash et al. (2002).

Islands of the Aegean, including Crete, on siliceous rock at altitudes 10 - 400 m.

Mostly southern Europe; rare north of the Alps and Pyrenees. Also Macaronesia (warmer parts), Asia (widespread), Africa (widespread outside humid tropics), C. America (Mexico), S. America (Brazil, Chile), Australasia (widespread), Pacific (Easter Is), perhaps Antarctica (St Paul Is).

_Diploschistes gypsaceus_ (Ach.) Zahlbr. (1892)  
*Hedwigia* 31: 35; *Urecelaria gypsacea* Ach. (1810), Lichenogr. Universalis 338-339; _Diploschistes albissimus_ (Ach.) J. Steiner; _Urecelaria albissima_ (Ach.) Arnold.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

For separation from _D. scruposus_, see under that species.

Scattered, with no clear pattern. On calcareous rock at altitudes 0 - 1200 m. Synonomy in _Diploschistes_ is rather confused, and some reports under old names, especially those from other substrates, may refer to other species. The report of Abbott (2009) for the Peloponness is incorrect, but a report for the Peloponness by Szatala, as _D. albissimus_, which was cited by Abbott (2009) under _D. diacapsis_, may belong here.

Most of Europe except for truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (scattered), C. America (Mexico), S. America (Argentina, Colombia, Venezuela), Australasia (SE Australia, NZN, NZS).
Diploschistes muscorum (Scop.) R. Sant. (1980)


I have tentatively referred to this species *Polyschistes subclausus* J. Steiner, described from Greece, because of its parasitic habit, although the description does not fit particularly well. It was said to be parasitic on the thallus of *Prototaxodium muralis*, not on *Cladonia*, and was said to have 2-spored asci. The latter character suggests *Ingvariella bispora*, but that species is not known to be lichenicolous. The type collection needs to be examined.

Thallus: crustose, to 6.5 mm diameter, white to very pale brown, often warted, thick (about 0.7 mm). Prothallus: sometimes present, inconspicuous, white, brown or black, 0.3 - 0.5 mm wide when well developed. Cortex: true cortex absent; pseudocortex: 20 - 50 µm tall, colourless, sometimes with distinct superficial (epinecral) layer about 5 µm thick, but otherwise without distinct structure, K-.

Medulla: white. Apothecia: 0.5 mm diameter (excluding thalline exciple, which is very variable in extent). Disc: black, slightly white pruinose. Thalline margin: present. Exciple: sometimes covered by thalline exciple in young apothecia, generally visible later, arched over disc, visible part black, slightly white pruinose, 0.05 mm wide, persistent; in section: 120 - 140 µm wide in upper part, tapering to 30 - 40 µm in lower part, mostly dark brown but innermost and outermost parts paler brown (a colourless layer sometimes present on inner side of uppermost part is a disconnected remnant of the thalline margin), pigment K-, N-.

Epithecium: brown, K-,

N-,

some pigment dissolving in K but not in N. Hymenium: 90 - 100 µm tall, colourless, K-. Subhymenium: 30 - 50 µm tall, colourless.

Hypothecum: 20 - 25 µm tall, brown to dark brown, clearly contiguous with exciple, K-,

N-.

Paraphyses: simple, 1 µm wide, scarcely expanded at apices. Asci: 75 - 85 x 15 - 20 µm, clavate, uniformly K+ brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, ellipsoid. 21 - 27 x 9 - 14 µm, narrowly clavate, K+ brown-orange everywhere (but some asci have traces of a KI- layer), without apical apparatus. Paraphyses: simple, 1 µm wide, scarcely expanded at apices. Asci: 75 - 85 x 15 - 20 µm, clavate, uniformly K+ brown-orange everywhere (but some asci have traces of a KI- layer), without apical apparatus.

Easily recognised in its early stages, when parasitic on *Cladonia* squamules. Later, its 4-spored asci will usually resolve any doubts.

Throughout Greece, at altitudes 0 - 1400 m, but 60 percent of records are from altitudes below 400 m. At first parasitic on *Cladonia* squamules, but later directly on the substrate used by the *Cladonia* (usually soil, but sometimes bark, wood or rock).

Most of Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), Caribbean (Jamaica), C. America (Mexico, Guatemala), S. America (Argentina, Chile, Galapagos Is, perhaps elsewhere), Australasia (NZS), Pacific (Easter Is). Some southern hemisphere reports may refer to subsp. *bartletti*, which is not present in Europe.

Diploschistes ocellatus "(Vill.) Norman" (1852)


Unfortunately the name *Lichen ocellatus* Vill. is illegitimate, being a later homonym of *L. ocellatus* Wulf. (1787). Villars's name was combined into *Urceolaria* by de Candolle, but *U. ocellata* DC. (1805) is a later homonym of *U. ocellata* (Hoffm.) Ach. (1803). The earliest legitimate name is *Lecanora villarsii* Ach. (1810), which is a nomen novum for *Lichen ocellatus* Vill., and at present the correct name is *Diploschistes ocellatus* (Ach.) ined. Conservation is desirable.

*D. ocellatus* is clearly not close to the other species treated here, and has recently been placed in the new genus *Xalocoa*.

Thallus: crustose, sometimes with obscuously placodioid margin, very pale grey-brown, but appearing grey-white owing to pruina, to 8 cm diameter (in material measured in lab; larger thalli seen in field), 0.5 - 1 (2) mm thick. Prothallus: sometimes obscuringly present, not well developed. Cortex: 40 - 60 µm thick, colourless in lower part, pale brown in upper part, of vertical hyphae (best seen in K), lumina sometimes broadening enough to give an obscure subcellular texture, weakly K+ (a few crystals of norstictic acid), N-, pigment mostly dissolving in K but not in N-, overlying pruina not dissolving in K. Medulla: white. Apothecia: sessile when mature, flat, 1.3 - 4 mm diameter. Disc: black, but appearing grey owing to pruina. Thalline margin: thick, persistent. Exciple: not visible externally; in section: poorly developed, 10 - 25 µm wide, colourless to pale brown. Epithecium: grey to brown, K-, N-, pigment soluble in K but not in N. Hymenium: 110 - 150 µm tall, colourless, sometimes with some epithecial pigment in upper part, K-. Hypothecium: poorly developed, colourless, 0 - 20 µm tall. Paraphyses: simple, 1 µm wide, scarcely expanded at apices. Asci: 110 - 130 x 15 - 18 µm, narrowly clavate, K+ brown-orange everywhere (but some asci have traces of a KI- outermost layer), without apical apparatus. Ascospores: brown when mature, muriform, narrowly ellipsoid to elliptoid, 22 - 28 (37) x 10 - 15 µm, with 3 - 5 transverse and usually 1 longitudinal septa, KI-, 8 per ascus. Chemistry: medulla
K+ yellow > red (abundant norstictic acid crystals in section), C-, KC-, P+ yellow, I-, KI-; thallus K- or K+ rather faintly yellow or red (norstictic acid in low concentration in cortex), C-, KC-, usually P- in spot tests (the P+ reaction of norstictic acid too faint to observe), UV+ pale green. Photobiont: green, cells globose, 8 - 11 µm diameter; photobiont layer continuous, regular, 40 - 50 µm thick.

This species, which resembles an Ochrolechia growing on limestone, can not be confused with any other.

Throughout Greece, but commoner in the southern half of the country. At altitudes 0 - 1150 m. Usually on limestone, sometimes on other calcareous rock. There is a single report from soil (where it had perhaps spread from adjacent limestone).

Widespread in southern Europe; rare north of Alps and Pyrenees. Also Macaronesia, Asia (widespread), Africa (widespread), Australasia (widespread). Reports for N. America are incorrect.

**Diploschistes scruposus** (Schreb.) Norman (1852)


Greek collections are problematic. Some collections that I have referred here have persistently 4-spored ascii, but otherwise resemble *D. scruposus* (thallus not pruinose, hypothecium dark, substrate unambiguously siliceous). Another collection has 8-spored ascii but a pruinose thallus. It is not clear to me whether *D. scruposus* is more variable than generally assumed, whether undescribed taxa are involved, or whether *D. scruposus* and *D. gypsaceus* are merely responses of the same species to different substrates. Unfortunately, because siliceous rocks are uncommon in Greece, I do not have enough collections to investigate the matter thoroughly.

The description below is based on a single collection with unambiguously 8-spored ascii and a non-pruinose thallus.


The open apothecia, C+ red thallus and saxicolous habit easily separate this species from all but *D. gypsaceus*. At present, it is probably best separated from *D. gypsaceus* by substrate.

Throughout Greece, on siliceous rock at altitudes from sea level to at least 2100 m.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread in temperate regions that are not too dry), C. America (CR, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Tahiti).

**Diplotomma Flot.** (1850)


Literature: The best starting point is probably Nordin (2000b), though he does not recognise the genus *Diplotomma* and treats its species in *Buellia*. He also has a broad concept of *D. alboatrum*.

Thallus: crustose, usually forming prominent white to pale grey patches to a few cm diameter. Cortex: ±colourless, usually poorly structured. Medulla: white, I-. Apothecia: always present, medium sized (typically 0.3 - 1 mm diameter), often with a false thalline margin. Disc black. Exciple: often not very well developed; in section: brown to dark brown, hyphal, hyphae either ±parallel to paraphyses or radiating. Epithecium: brown, K-. Hymenium: colourless. Hypothecium: usually some shade of brown. Paraphyses: simple, 1 - 1.5 µm wide at base, capitate, apical cell with internal brown pigment not soluble in K. Asci: clavate, Lecanora type. Ascospores: brown, 3-septate or submuriform, ±ellipsoid, medium sized (typically 12 - 25 µm long), 8 per ascus. Chemistry: norstictic acid present in some species. Photobiont: green.

Ascospores are distoseptate. This is sometimes apparent at x400, but is not an easy character to observe. *Diplotomma* has been used as a "dustbin" for species of *Buellia* s.lat. with multi-septate or submuriform ascospores.
In that sense, it is artificial. The name is restricted here to the group of species close to *D. alboatrum* and, as shown by Molina et al. (2002), this group is sufficiently distinct from *Buellia* s. str. to merit generic status. Species concepts in *Diplotomma* are not very clear, in part because Nordin (2000b) had a broad concept of *D. alboatrum*. In contrast to Nordin's lumping, the treatment here may recognise too many entities, but as it is easier to merge records recorded under different names than to split those recorded under a single name I prefer to err in that direction until the taxonomy of the genus is clarified.

Old records in this genus are often difficult to interpret. Species that are expected to be parasitic are often reported in a way that suggests, but does not clearly state, that they were free-living. In such cases it is usually not clear whether a parasitic habit was overlooked or whether the material was incorrectly determined. The ecology of the parasitic species is not very well understood, and it is generally not known how frequently, if at all, they occur free-living. Extensive modern collections will be needed to get a proper view of *Diplotomma* in Greece.

At present, I recognise 15 species in this genus (not all of which are included in the key); there are also at species rank a few names of uncertain application. Species of *Diplotomma* occur on a wide range of substrates.

In case of difficulty determining a specimen, it may be worth also consulting the key to *Buellia* group 1.

11 Parasitic on other lichens.

22 Parasitic on Teloschistaceae. Note 1.

33 Ascospores to 16 µm long. On Caloplaca xantholyta. *D. scheideggerinanum*

3 Most ascospores more than 16 µm long.

44 On Caloplaca teicholyta. (D. murorum) Greek reports need confirmation.

4 Usually on Xanthoria elegans. *D. nivale*

22 Parasitic on foliose Physciaceae, especially Physconia muscigena. Host usually terricolous or saxicolous, rarely corticolous. Ascospores not curved. Inner part of exciple slightly paller than outer part. *D. pulverulentum*

2 Parasitic on other lichens. Host corticolous or saxicolous, rarely terricolous. Ascospores sometimes curved. Inner part of exciple slightly to much paler than outer part.

33 Apothecia 0.2 - 0.7 mm diameter, not pruinose. Exciple distinct, at least in young apothecia. False thalline margin absent. Probably restricted to corticolous and lignicolous hosts. See *Buellia triseptata*

3 Apothecia 0.3 - 1.2 mm diameter, often white pruinose. Exciple present but often indistinct. False thalline margin sometimes present. Probably restricted to saxicolous hosts. *D. venustum*

1 Not parasitic.

22 Mature ascospores 3-septate, or predominantly 3-septate with occasional longitudinal septa.

33 On bark or wood. Thallus usually K-, rarely K+ yellow (atranorin).

44 Apothecia 0.2 - 0.3 mm diameter, usually without a false thalline margin. *D. populorum*

4 Many apothecia more than 0.3 mm diameter. Apothecia with a false thalline margin when young.

55 False thalline margin enclosing disc when young (Note 2). Apothecia 0.5 - 1.5 mm diameter. *D. pharcidium*

5 False thalline margin not enclosing disc. Apothecia 0.2 - 0.7 mm diameter. See *Buellia triseptata*

3 On rock. Reactions various.

44 Medulla at least locally K+ yellow > red (norystictic acid) (Note 3). *D. venustum*

4 Medulla everywhere K- (Note 4).

55 Thallus thin, often dispersed in small patches. Ascospores usually 13 - 15 µm long. (D. subdispersum)

5 Thallus thick, continuous. Ascospores usually 15 - 20 µm long. *D. epipolium* and *D. hedinii*. The relation between these two is not clear to me.

2 Mature spores predominantly submuriform.

33 Thallus pale yellowish, K+ yellow > red, C-, P+ yellow-orange. Ascospores smooth. On dead wood of conifers. (Buellia cedricola)

3 Not as above.

44 Medulla K+ yellow > red (norystictic acid) (Note 5). On slightly nutrient-enriched rock. *D. chlorophaeum*

4 Medulla K- (Note 5). On various substrates.

55 On rock. Thallus at least moderately thick (more than 100 µm). At least some apothecia usually with a false thalline margin. *D. ambiguum*

5 On nutrient enriched bark (perhaps also on rock). Thallus thin (no more than 100 µm in material seen to date). Apothecia nearly always without a false thalline margin. *D. alboatrum*

(1) The status of the three "species" in this branch is unclear. They may not all be distinct.
(2) This character is unmistakable, but may occur only in very young apothecia. The thalline covering of the disc develops a hole at the centre, and radial cracks.
(3) Norstictic acid is sometimes distributed patchily in this species. It may be abundant in fairly large, discrete regions of the medulla, but entirely absent elsewhere. It is advisable to study more than one thin section before concluding that norstictic acid is absent.

(4) I have seen material of D. epipolium with small brown or orange-brown inclusions in the medulla. They became more apparent in a spot test in K, suggesting a faint +yellow or even +red reaction. However, in section they were clearly distinct from the rest of the medulla, which clearly reacted K-. The nature of the inclusions was not clear.

(5) Test in thin section. Spot tests are not reliable enough. The positive reaction in D. chlorophaeum may be confined to a thin layer just below the algal zone.

**Diplotomma alboatrum** (Hoffm.) Flot. (1850)

*Uebers. Schles. Ges. vaterl. Kultur* 1849: 130, where it is validly published if, and only if, that was published after volume 8 of *Botanische Zeitung*; otherwise by Massalongo in Ric. Auton. Lich. Crost. 98. 1852; *Lichen alboatrum* Hoffm. (1784), Enum. Lich. 30; *Buellia alboatra* (Hoffm.) Th. Fr.; (?)*Diplotomma alboatrum* var. *virescens* Szatala; *Lecidea alboatra* (Hoffm.) Chevall.

Thallus: crustose, pale grey, not pruinose, forming small patches to about 1 cm diameter, thin (80 - 100 µm). Cortex: 10 - 45 µm thick, colourless, hyphae with elongated lumina sometimes visible but structure not well developed, K-.

Medulla: white. Apothecia: submersed to subsessile, flat to convex, 0.2 - 0.4 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, 0.04 mm wide, sometimes becoming excluded; in section: 25 - 40 µm wide, brown in outermost 10 - 20 µm, colourless to pale brown in inner part, of radiating hyphae, brown pigment K-

Epithecium: brown to dark brown, K-, pigment between paraphyses, but not internal pigment, dissolving in K.

Hymenium: 50 µm tall, colourless, KI+ blue. Hypothecium: 75 µm, pale brown at least in upper part. Paraphyses: simple, 2 µm wide at base, slightly capitate, apical cell 3 µm with internal brown pigment cap. Asc: 50 - 60 x 16 - 17 µm, clavate, apex KI+ blue. Ascospores: brown and submuriform with 3-transverse septa when mature, sometimes colourless and 1-septate when immature, ellipsoid, sometimes slightly curved, 13 - 17.5 x 7.5 - 8 µm, 8 per ascus.


Appears to differ from *D. ambiguum* by the thinner thallus, the almost complete absence of a thalline margin, and the substrate. However, it is unclear whether *D. ambiguum* can be maintained as an independent taxon.

According to published reports it occurs throughout Greece, at altitudes 0 - 1900 m (but uncommon above 1000 m), on bark, rock and wood.

Distribution uncertain, as the name has been used in both a narrow and a broad sense. There are reports for most of Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico, CR), S. America (Argentina, Chile, Falkland Is, perhaps elsewhere), Australasia (widespread), Pacific (Hawaii).

**Diplotomma ambiguum** (Ach.) Flagey (1894)

Mem. Soc. émul. Doubs sér. VI, 8: 84; *Lecidea ambigua* Ach. (1810), Lichenogr. Universalis 161; *Buellia alboatra* var. *subochracea* Zahlbr.; *Buellia ambigua* (Ach.) Malme; *Buellia subochracea* (Zahlbr.) J. Steiner; *Diplotomma subochraceum* (Zahlbr.) Szatala.

Thallus: crustose, well developed, to about 5 cm diameter, white to very pale grey, sometimes pruinose, cracked to areolate, 200 - 500 µm thick. Cortex: 27 - 37 µm thick, mostly colourless, sometimes pale brown or pale grey in outermost part, hyphal, orientation of hyphae various but predominantly horizontal especially in outer part, K-.

Medulla: white. Apothecia: immersed to subsessile, flat to convex, 0.2 - 0.5 mm diameter, sometimes white pruinose. Disc: black. Pseudo-thalline margin: always present on some apothecia, though sometimes not well developed. Exciple: present but sometimes poorly developed, black, very thin; in section: to 50 µm wide but usually less, brown in outer part colourless to pale brown in inner part, of parallel hyphae and similar to hymenium, K-, pigment not soluble in K; some sections lack a well-developed exciple. Epithecium: brown to pale grey-brown, K-, pigment not soluble in K. Hymenium: 70 - 90 µm tall, colourless to pale brown, KI+ blue. Hypothecium: 100 - 170 µm tall, pale brown to orange-brown. Paraphyses: simple, 2 µm wide at base, capitate, apical cell 3.5 - 5 µm wide with internal brown pigment cap. Asc: 75 x 16 µm, clavate, apex KI+ blue. Ascospores: brown, submuriform, usually with 3 transverse septa, distoseptate, ellipsoid, 15 - 22 x 8 - 12 µm, 8 per ascus. Pycnidia: 100% immersed, pyriform, 70 x 40 µm, mostly colourless but brown near ostiole. Conidia: colourless, ellipsoid, 2 x 1 µm. Chemistry: medulla K-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 20 µm diameter. Photobiont layer: continuous or discontinuous, ±regular, 40 - 90 µm thick.

The degree of pruinosity is influenced by the substrate. Collections on limestone are more likely to have a pruinose thallus and/or apothecia than those from siliceous rock.

For separation from *D. alboatrum* see note under that species. *D. chlorophaeum* differs in containing norstictic acid. Throughout Greece. On calcareous or siliceous rock at altitudes 0 - 1200 m.
Widespread outside truly arctic regions, but commonest in the south. Also Macaronesia, Asia (Turkey), N. Africa (Morocco), perhaps N. America (Nevada).

**Diplotomma chlorophaeum sensu Szatala (1956)**

Szatala intended to make a combination from *Lecidea chlorophaea* Hepp ex Leighton, but did not validly publish the combination as he did not cite the place of publication of Leighton's name. He did, however, provide a brief description in Latin and, even though he did not designate a type, that was sufficient at the time for valid publication of the name *Diplotomma chlorophaeum* Szatala, a name that, technically, is of uncertain application as it has never been typified. In 1984, K. P. Singh & S. R. Singh, recognising that Szatala had failed to validly combine *Lecidea chlorophaea* into *Diplotomma*, attempted to validate the combination, but the existence of Szatala's validly published 1956 name makes their combination an illegitimate later homonym. A possible solution would be to typify Szatala's 1956 name in a sense that is consistent with the usual usage of the name.

Thallus: crustose, white to pale grey, occasionally with slight brown tinge, not pruinose, usually in small patches 1 - 2 cm diameter, cracked or of ±contiguous areoles, less commonly of dispersed areoles, 100 - 500 µm thick. Prothallus: usually absent; inconspicuous, black prothallus 0.1 - 0.2 wide occasionally present. Cortex: 25 - 35 µm thick, colourless to pale grey, without distinct structure, K- Medulla: white. Apothecia: immersed in thallus at first, later sometimes subsessile, flat when young, often convex later, 0.2 - 0.7 mm diameter, usually not pruinose, rarely with slight white pruina. Disc: black. Pseudo-thalline exciple: sometimes present, especially in young apothecia. Exciple: black, thin, often inconspicuous; in section: 25 - 40 µm wide, brown in outer part, paler brown in inner part, of radiating hyphae. Epithecium: brown to dark brown, K- pigment between paraphyses soluble in K, internal pigment not soluble. Hymenium: 70 - 110 µm tall, colourless or sometimes with a little brown pigment, KI+ blue. Hypothecium: about 80 µm tall, pale to dark brown. Paraphyses: simple, 1 - 2 µm wide at base, capitate, apical cell 4 - 5 µm wide with internal brown pigment. Ascii: 60 - 85 x 17 - 20 µm, narrowly clavate to clavate, Lecanora type. Ascospores: brown, submuriform, usually with 3 transverse septa, ellipsoid, 16 - 20 x 8 - 12 µm, 8 per ascus. Chemistry: medulla K+ red (norstictic acid), P-, UV-, I-; thallus K-, C-, P-, UV-. Photobiont: green, cells globose, 8 - 18 µm diameter. Photobiont layer: slightly irregular, sometimes discontinuous, 50 - 80 µm thick.

Easily separated from other similar species by the present of norstictic acid.

Widespread in the southern half of Greece, rare in the north. On rock at altitudes 0 - 900 m. Usually on siliceous rock (90% of records) but occasionally on calcareous rock.

Southern and central Europe, reaching British Is. Also Macaronesia, Asia (Turkey, Russia, India), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America (Washington State), Australasia (NZS).

**Diplotomma epipolium (Ach.) Arnold (1868)**

Thallus: crustose, forming patches to about 2 cm diameter, white, chalky but not pruinose, continuous or lightly cracked, occasionally almost areolate, thick (300 - 500 µm). Cortex: 45 - 60 µm thick, colourless to pale grey, without distinct structure, K-. Medulla: white. Apothecia: immersed at first, later subsessile, flat, 0.5 - 0.9 mm diameter. Disc: black, not pruinose. Pseudo-thalline exciple: present, often persistent. Exciple: not visible externally; in section: not well developed, 15 µm wide at base expanding to 50 µm at surface, brown, of radiating hyphae. Epithecium: dark brown, K-, pigment not soluble in K. Hymenium: 70 µm, colourless, KI+ blue. Hypothecium: 75 µm, brown. Paraphyses: simple, 1.5 µm wide at base, capitate, apical cell 2.5 - 5 µm wide with internal brown pigment cap. Ascii: 70 x 15 µm, narrowly clavate, apex KI+ blue. Ascospores: brown, 3-septate, ellipsoid, sometimes slightly curved, 18 - 20 x 7 - 7.5 µm, 8 per ascus. Chemistry: medulla K-, C-, K-, I-; thallus K-, C-, K-, UV-. Photobiont: green, cells globose, 9 - 13 µm diameter. Photobiont layer: regular, usually continuous, 40 - 70 µm thick.

The 3-septate ascospores with no tendency to become submuriform, absence of norstictic acid and the well-developed thallus are distinctive among saxicolous species of the genus.

The relation of this species to *D. hedinii* needs to be clarified. The epithet *epipolium* has sometimes been misapplied.

Throughout Greece. On rock, usually calcareous, from sea level to 2300 m.

Throughout Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), perhaps N. America, perhaps C. America (Mexico). However, some of the reports may refer to *D. hedinii*.

Description: Smith et al. (2009).
Islands of the Aegean, on calcareous rock at altitudes 15 - 1280 m. The lichenicolous fungus *Arthonia rubescens* has been reported on from this lichen.
Scattered in temperate Europe, from the British Isles to Greece. Also Asia (widespread), N. Africa (Tunisia), and the Americas. Perhaps more widely distributed than the few reports suggest, as some reports of *D. epipolium* may belong here.

**Diplotomma nivele** (Bagl. & Car.) Hafellner (1995)

Confusion has been caused by authors who have made combinations from *Lecidea margaritacea* "Sommerf. in Suppl. Fl. Lapp., 148". Sommerfelt's name is, for nomenclatural purposes, identical with *L. margaritacea* Ach. (1810), which is a synonym of *Porpidia speirea*. However, the taxon actually described by Sommerfelt was probably not that species and probably close to *Buellia alboatra*, i.e. it probably belongs in *Diplotomma*.

Descriptions: Alstrup & Hawksworth (1990); Clauzade, Diederich & Roux (1989); Clauzade & Roux (1985), all as *Buellia nivalis*.
Scattered with no clear pattern. Reported altitudes 0 to at least 2300 m, but reports from low altitude are doubtful. Most reports state that the substrate was rock, usually calcareous, but once parasitic on an unspecified species of *Buellia*. *D. nivele* is expected to be parasitic, usually on *Xanthoria elegans* but sometimes on species of *Caloplaeca*.
Widespread but scattered in northern and central Europe and in the high mountains of southern Europe. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan, Mongolia), N. America (widespread), perhaps S. America (Venezuela).

**Diplotomma pharcidiurn** (Ach.) Choisy (1950)
*Bull. Mens. Soc. Linn. Lyon* 19: 156; *Lecanora pharcidia* Ach. (1814), *Syn. Meth. Lich.* 147; *Buellia caricae* (Bagl.) Lettau; *Buellia pharcidia* (Ach.) Malme; *Diplotomma alboatre* var. *zaboticum* (Körb.) Szatala (as *zaboticum*); *Diplotomma caricae* Bagl.

Thallus: crustose, 1 cm diameter, cracked, pale grey or pale brown-grey, not pruinose, 100 - 200 µm thick. Cortex: 30 µm thick, colourless or very pale brown or very pale grey, often with weak cellular texture in lower part, upper part without distinct structure, K-.
Phytothion: green, cells globose, 8 - 20 µm diameter, forming a continuous, ±regular layer 60 - 120 µm thick.

Provided that young apothecia are observed, this species can not be confused with any other.
Widespread but scattered in the southern half of Greece, rare in the north, at altitudes 10 - 1400 m. Usually on bark, rarely on wood. Reported from a wide range of phorophytes, but avoiding strongly acidic bark.
There are scattered reports of *D. pharcidiurn* for much of Europe. Also Asia (Russia, India, Mongolia, Japan), N. Africa (Morocco, Algeria, Egypt).

**Diplotomma populorum** A. Massal. (1852)

Description: Clauzade & Roux (1985) as *Buellia populorum*.

Macedonia, on bark of *Populus* at an altitude of 200 m.
Southern, and especially SE, Europe (Italy, Slovenia, Croatia, Greece, Cyprus), though there is a 19th century report for Germany. I have not seen any reports for other continents.

**Diplotomma pulverulentum** (Anzi) D. Hawksw. (2002)

The name *Buellia convexa* Th. Fr. in *Lich. Arct.* 234. 1860 is synonymous, and it is unclear which name has priority. Anzi's work was published in August, that of Fries at an unknown date during the period May to December.

This species is here treated in *Diplotomma* mainly for convenience. Generic boundaries in the old *Buellia* s. lat. are
in a state of flux, and it might be better placed elsewhere.

Thallus: absent. Apothecia: sessile, soon becoming convex, 0.3 - 0.55 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: excluded early; in section: 40 - 60 µm wide, dark brown, of radiating hyphae. Epithecium: dark brown, K-, pigment not soluble in K. Hymenium: 80 µm tall, colourless. Hypothecium: 100 µm tall, pale brown to brown. Paraphyses: simple, 1 µm wide at base, capitate, apical cell to 5 µm wide with internal brown pigment. Ascospores: brown, 3-septate, ±ellipsoid, sometimes curved, 18 - 20 x 7 - 7.5 µm, 8 per ascus.

Easily recognised from the host species.

Naxos, at an altitude of 600 m; once on bark of an unspecified species (probably an incorrect determination), and once parasitic on an unspecified species of Physcia. Northern Peloponnesse, parasitic on corticolous Physconia venusta at an altitude of 1400 m.

Mainly the western half of Europe, from Svalbard south, but avoiding the continental climate of eastern Europe. South of the Alps it is uncommon and restricted to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (mainly western half), S. America (Argentina, Chile).

**Diplotomma scheideggerianum** (Bricaud & Cl. Roux) Nimis (1993)


Description: See the protologue.

The type collection was from Sterea Ellada, on Caloplaca xanitholyta at an altitude of 200 m. There are no other Greek reports.

Most reports of *D. scheideggerianum* are from southern Europe, from Provence to Greece, but present in France, Austria and Poland. Also western Asia (Turkey).

**Diplotomma venustum** Körb. (1860)

Parerga Lichenol. 179-180; *Buellia epipolia* var. *venusta* (Körb.) H. Olivier; *Buellia pulverulenta* var. *venusta* (Körb.) Nyl.; *Buellia venusta* (Körb.) Lettau; *Diplotomma epipolum* var. *venustum* (Körb.) Arnold.

Thallus: crustose, white, not pruinose, cracked or slightly areolate, forming prominent patches to about 3 cm diameter, fairly thick (200 - 400 µm). Cortex: 50 - 100 µm thick, colourless, without distinct structure, K-. Medulla: white, rather chalky. Apothecia: immersed and flat at first, sometimes becoming emergent and strongly convex later, 0.3 - 0.6 (0.8) mm diameter, sometimes slightly white pruinose. Disc: black. Pseudo-thalline exciple: prominent, at least in young apothecia. Exciple: sometimes visible externally as a thin black ring that is darker than disc; in section: 30 µm wide, dark brown, formed of hyphae ±parallel to paraphyses, not continuous with hypothecium. Epithecium: brown to dark brown, K-, pigment not soluble in K. Hymenium: 65 - 80 µm tall, colourless or sometimes with a little brown pigment, K+ blue. Hypothecium: 65 µm tall, pale brown. Paraphyses: 1 - 1.5 µm wide at base, simple, usually capitate, apical cell 2.5 - 5 µm wide with internal brown pigment cap. Asci: 50 - 55 x 15 - 17 µm, clavate, apex K+ blue. Ascospores: brown, 3-septate, ±ellipsoid or slightly curved, 17 - 21 x 8 - 10 µm, 8 per ascus. Chemistry: medulla K+ yellow > red (norstictic acid), P+ yellow (both reactions patchy), C-, I-; thallus UV-. Photobiont: green, cells globose, 7 - 13 µm diameter. Photobiont layer: ±regular, sometimes discontinuous, 50 - 80 µm thick.

The strictly 3-septate ascospores, and (patchily) abundant norstictic acid are distinctive among non-parasitic species of the genus.

Widespread in the south-west half of Greece, but rare in the north-east half. On calcareous rock at altitudes 0 to about 2000 m, but rare above 1200 m. A single report from bark (Mt. Parnitha) is probably incorrect.

Throughout most of Europe. Also Asia (widespread as far east as southern Siberia), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread), C. America (Mexico), Australasia (SE Australia).

**Dirina Fr. (1825)**

Syst. Orb. Veg. 1: 244. Type: *D. repanda* Fr., the only species originally included. Family: Roccellaceae.

Literature: The genus was monographed by Tehler et al. (2013). Earlier publications may be misleading.


About 25 species, up to 7 of which may occur in Europe. *Dirina* is best represented in regions with a warm, maritime climate, and so is uncommon in Greece.

111 On calcareous rock.

22 Apothecia present.
Dirina ceratoniae (Ach.) Fr. (1831)
Lichenogr. Eur. Reform. 194; Lecanora ceratoniae Ach. (1810), Lichenogr. Universalis 361; Dirina repanda f. lignicola (Harm.) Zahlbr.

Thallus: crustose, white to grey, continuous or with a few cracks, smooth or slightly warted, to several cm diameter, 250 µm thick. Soralia: absent. Cortex: 25 - 75 µm thick, colourless, of horizontal hyphae, often with distinct lumina, sometimes with weak cellular texture, K-, I-. Medulla: white. Apothecia: sessile, ±flat, 0.7 - 2 mm diameter when mature. Disc: heavily white pruinose, pruina C+ red. Thalline margin: prominent, persistent, 0.15 - 0.25 mm wide, almost completely enclosing young apothecia, C+ red; in section: 110 - 125 µm wide, cortex 25 - 45 µm, structure as for cortex of thallus. Exciple: not visible externally; in section: poorly developed, 15 - 25 µm wide, colourless in upper part, hyphal. Epithecium: brown, K-, N-, some pigment dissolving in K but not in N. Hymenium: 130 - 150 µm tall, usually colourless, upper part sometimes with some epithecial pigment, KI+ blue in upper part but reaction not strong. Hypothecium: to 200 µm tall at centre of apothecia, dark brown, opaque, K- or K+ faintly greenish. Paraphyses: simple in lower part, upper part obscured by crystals, 1.5 µm wide in lower part. Asci: 85 - 90 x 15 - 16 µm, narrowly clavate, Opegrapha type. Ascospores: colourless, 3-septate, 24 - 30 x 4 - 5 µm, sometimes slightly curved, ends usually rounded, 8 per ascus. Pycnidia: appearing externally as black dots, 0.05 mm diameter; in section: 100% immersed, pyriform, 150 x 110 µm, wall brown in upper half, colourless in lower half. Conidia: colourless, usually curved, sometimes straight, 6 - 14 x about ¾ µm. Chemistry: medulla K-, C-, KC-, P-, I+ brownish in spot tests, KI+ violet in section; thallus K-, C+ red, P-, UV+ whiteish. Photobiont: Trentepohlia; cells globose to slightly ellipsoid, 10 - 17 x 10 - 12 µm, chloroplast occupying only part of cell. Photobiont layer: continuous but very irregular, 25 - 80 µm thick.

Easily recognised when corticolous, as all other European species of the genus are saxicolous. Said sometimes to be saxicolous, and could then be confused with D. massiliensis, for separation from which see the key. Externally, the massive thalline exciple resembles some Ochrolechia species, but the dark hypothecium, which is clearly visible in the field if an apothecium is sectioned, excludes that genus.

Southern and western Greece, always near the sea, usually at altitudes below 200 m. Usually on bark, rarely on wood. Recorded from a wide range of phorophytes, with no clear preference. The lichenicolous fungus Milospium graphideorum has been reported once from this lichen.

Widespread in southern Europe, not present north of the Alps. Also Macaronesia, Asia (Israel, perhaps elsewhere), Africa, (widespread in N. Africa, perhaps present elsewhere). Reports from further afield are doubtful.

Dirina cretacea (Zahlbr.) Tehler (1983)

Thallus: crustose, white, not pruinose, continuous or with a few cracks, to several cm diameter, 0.3 - 0.5 mm thick. Soralia: absent. Cortex: true cortex absent; pseudocortex 25 - 35 µm thick, colourless, formed of a poorly structured mix of hyphae and small crystals. Medulla: white, chalky. Apothecia: several grouped together to form a stroma; individual stromata: sessile and convex when mature, 0.7 - 2.2 mm diameter, white pruinose everywhere; in section individual apothecia about 0.4 - 0.5 mm wide. Disc: black, but covered by white pruina, often elongate or irregular. Thalline margin: present, persistent. Exciple: not visible externally; in section: 15 µm wide, formed of hyphae parallel to paraphyses, dark brown in outer part, colourless adjacent to hymenium, reactions of pigment as for epithecium. Epithecium: grey to dark brown, K- or K+ slightly greenish, N-, pigment not soluble in K or N. Hymenium: 125 - 160 µm tall, usually colourless, sometimes with some epithelial pigment in upper part, weakly KI+ blue at least in upper part. Hypothecium: 100 - 170 µm, dark brown, opaque, reactions as for epithecium. Paraphyses: simple, 1.5 µm wide at base, 2 µm at apex, not capitulate. Asci: 80 x 15 µm, narrowly clavate, Opegrapha type. Ascospores: colourless, 2 - 3 -septate, narrowly ellipsoid to tadpole shaped, 18 - 28 x 6 - 8 µm, 8 per ascus. Chemistry: medulla I-; thallus K-, C+ red, P-, UV+ whiteish. Photobiont: Trentepohlia; cells globose, 8 - 12 µm diameter, chloroplast sometimes forming a
distinct crescent at one side of cell. Photobiont layer: 50 - 70 µm thick, rather irregular, sometimes not continuous.

Thin sections of the thallus are difficult to study, as they contain many crystals and are not easily wetted. Adding K does not help much. I made my observations in 10% hydrochloric acid, which gives better, though still not good results.

The grouped apothecia are distinctive, and this species can not be confused with any other.

Widespread in the southern half of Greece, always close to the sea. On calcareous rock at altitudes 0 - 660 m, but usually below 400 m.

Southern Europe, from Spain to Cyprus. Also western Asia (Turkey), N. Africa (Libya, perhaps Egypt).

**Dirina fallax** de Not. (1846)


Description: Tehler et al. (2013).

Islands of the Aegean and adjacent coasts of the mainland. On siliceous rock, at altitudes 0 - 500 m.

Western Europe to as far north as England, and southern Europe to as far east as Greece. Also Macaronesia, N. Africa (Morocco).

**Dirina massiliensis** Durieu & Mont. (1847)


The earliest name, *Lichen conspurcatus* Sm. (1802), has been proposed for rejection. Then described as *Lecanora repanda* Fr. ex Duby (1830) in Bot. Gall. 2: 66, but the epithet is not available in *Dirina* owing to *D. repanda* Fr. (1825), a synonym of *D. ceratoniae*.

Thallus: crustose, white, pruinose, continuous or with a few cracks, forming well-delimited, circular patches without marginal lobes, 1 - 2.5 cm diameter, 150 - 250 µm thick. Prothallus: often present, 0.2 - 0.5 mm wide, pale brown. Soralia: abundant, well delimited, 0.3 - 0.5 mm diameter, flat when young, later convex, white in fresh material, becoming pale brown in herbarium. Cortex: true cortex absent; pseudocortex: 25 - 35 µm thick, colourless, K-. Medulla: white. Chemistry: medulla C+ red in upper part, C- in lower part, K-, I-; soralia C+ red, K-; thallus K-, C+ red, P-, UV+ whiteish. Photobiont: Trentepohlia; cells globose, 10 - 12 µm diameter, forming a layer 50 - 70 µm thick.

Gavalas & Sipman (2019) report a squamulose morph from the island of Iraklia.

Widely distributed in coastal localities in the southern half of Greece. (There is also a single modern report from an inland site in Thessaly.) On calcareous rock at altitudes 0 - 700 m, but half of reports are from below 200 m.

Widespread in Europe, though commonest in the south. Also Macaronesia, Asia (widespread in Near East and Arabian Peninsula), northern Africa (throughout N. Africa, also Socotra). Reports for elsewhere (S. Carolina, Bahamas) are in need of confirmation.

**Diromma Ertz & Tehler (2014)**


Literature: See the protologue.

*Diromma* contains a single species formerly placed in *Schismatoma*.

**Diromma dirinellum** (Nyl.) Ertz & Tehler (2014)


Description: The best description is in the protologue for the genus.

Corfu and Kos, on bark at altitudes 0 - 250 m. Some reports may refer to *Ocellomma picconianum*, which was formerly regarded as synonymous.

Southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Israel, Lebanon), N. Africa (Morocco, Algeria, Tunisia). However, some reports may refer to *Ocellomma picconianum*.

**Elixia Lumbsch (1997)**


Literature: Smith et al. (2009), Spribille & Lumbsch (2010).

A rather poorly known genus of two species of lirellate lichens that occur on bark or wood. Both occur in Europe,
but one is northern and will not be present in Greece.

**Elixia cretica** T. Sprib. & Lumbsch (2010)


Description: See the protologue.

Crete, on bark of *Pinus brutia* at an altitude of 1125 m.

Known only from the type collection.

**Encephalographa A. Massal. (1854)**

Geneac. Lich. 13. Type: Clements & Shear, Gen. Fung. 307. 1931 designated *E. cerebrina* (DC.) A. Massal.; this typification must be accepted unless it can be shown to be inconsistent with Massalongo's 1854 protologue. Hafellner, in *Beih. Nova Hedwigia* 79. 331. 1984, designated *E. elisae* as type, and described a new genus *Poeltinula* with type *P. cerebrina* = *E. cerebrina*. He offered no evidence that the earlier typification on *E. cerebrina* is inconsistent with Massalongo's protologue, nor have I seen such evidence published elsewhere. At present, therefore *Poeltinula* must be regarded as a superfluous name for *Encephalographa*, and *Encephalographa* must be used in a different sense than it has been used since 1984. Conservation may be required to preserve current usage in both genera. Here I use the name *Encephalographa* in the usual, but possibly incorrect sense. Family: *Melaspileaceae*. *(Rhizocarpaceae* if typified on *E. cerebrina*.)


Three species, only one of which occurs in Europe.

**Encephalographa elisae** A. Massal. (1855)

Symm. Lich. Nov. 66-67. (Published in 1854 as a nomen nudum.)

Description: Clauzade & Roux (1985).

Greek reports are poorly localised, and can not be mapped. The only substrate reported is calcareous rock.

Only southern Europe, from Portugal to Greece.

**Enchylium (Ach.) Gray (1821)**


Literature: Ahti et al. (2007), Carvalho (2012), and Smith et al. (2009) between them discuss all the Greek species, under *Collema*.


*Enchylium* is a segregate from *Collema* s.l. It was delimited on molecular grounds, but most species have lobes that are distinctly swollen and pleated, at least at the tips. There are 10 species, of which 8 occur in Europe. It is well represented in Greece, where 7 species occur; some are widespread and common.

11 Thallus crustose to subfoliose, forming a thin film. Ascospores submuriform or muriform, 26 - 34 x 10 - 15 µm, 4 per ascus. On damp, ± calciferous clay or sandy soil. **E. limosum**

1 Thallus distinctly foliose.

22 Ascospores 15 - 24 x 3 - 4.5 µm, with pointed ends, 1 (3) -septate. On bark. **E. conglomeratum**

2 Ascospores more than 5 µm wide; ends various. On various substrates.

33 Ascospores 1-septate, 13 - 25 x 6 - 9 µm. On soil. **E. coccophorum**

3 Ascospores 3-septate or submuriform. On various substrates.


55 Lobes 1 - 2 mm wide, numerous. Apothecia crowded, 0.3 - 1.5 mm diameter. Ascospores 18 - 28 µm long.

Isidia absent. **E. polycarpon subsp. polycarpon**
5 Lobes 2 - 6 mm wide, less numerous. Apothecia sparse, 1.5 - 3.5 mm diameter. Ascospores 15 - 34 μm long. Isidia sometimes present. **E. polycarpon subsp. corcyrense**

4 Lobes not raised on edge. Exciple hyphal. On various substrates.

55 Ascospores to 12 μm wide. On calcareous rock. **E. confertum**

5 Ascospores to 8.5 μm wide. Only rarely saxicolous.

66 On soil or decaying vegetation on the ground, or overgrowing bryophytes on soil or rock; less commonly directly on calcareous rock. **E. tenax**

6 On bark. **E. ligerinum**

(1) Most collections of E. polycarpon can easily be determined to subspecies, but a few are ambiguous.

**Enchylium coccophorum** (Tuck.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009), all as *Collema coccophorum*.

Crete, on calcareous soil at an altitude of 1000 m. Mostly central and northern Europe, very rare in the south; Crete is a substantial extension of its range. Also Asia (widespread), Africa (widespread), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Paraguay), Australasia (widespread), Antarctica (S. Shetland Is).

**Enchylium confertum** (Hepp ex Arnold) Otálora, P. M. Jørg. & Wedin (2013)


This species in not well understood. Some authors have regarded it as a synonym of *E. tenax*, perhaps because the differences from *E. tenax* seem minor. According to Nash et al. (2002) it may belong in *Lempholemma*. It was not included in the molecular analysis by Otálora et al. (2013).

Descriptions: Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009), all as *Collema confertum*.

Southern Peloponnese, and island of Kalimnos, on rock at altitudes 0 - 100 m. Both records were from close to the sea. Rare in Mediterranean and western Europe as far north as British Is. Also Asia (Turkey).

**Enchylium conglomeratum** (Hoffm.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009), all as *Collema conglomeratum*.

Scattered, with no clear pattern, on bark at altitudes 400 - 1000 m. Reported from *Olea europaea, Platanus orientalis* and *Quercus* sp. at altitudes 400 - 1000 m.

Southern and central Europe, just reaching British Is and southern Scandinavia. Also Asia (Turkey, Iran, Southern Siberia, Tajikistan), Africa (Kenya), N. America (widespread, C. America (Mexico), perhaps Pacific (New Caledonia - old report).

**Enchylium ligerinum** (Hy) Otálora, P. M. Jørg. & Wedin (2013)


The earliest name is *Lathagrium conglomeratum* A. Massal. (1856), but the epithet is not available in *Enchylium* because of *E. conglomeratum* Hoffm.) Otálora, P. M. Jørg. & Wedin.

Description: Carvalho (2012); Clauzade & Roux (1985), both as *Collema ligerinum*.

Rare and scattered in western parts of Crete and the mainland. On bark of *Platanus* at altitudes 75 - 425 m. Widespread in central and southern Europe. Also Macaronesia (CVI), Asia (Iraq, southern Siberia).

**Enchylium limosum** (Ach.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009), all as *Collema limosum*.

Rhodes, on soil close to sea level. Present in most of Europe, but nowhere common. Also Asia (widespread), perhaps Africa, N. America
Enchylium polycarpon (Hoffm.) Otálora, P. M. Jørg. & Wedin (2013) subsp. polycarpon

Fungal Diversity 64(1): 286; Collema polycarpon Hoffm. (1796), Deutschl. Fl. 2: 102; Collema stygiun auct.; Lathagrium polycarpon (Hoffm.) Arnold (sometimes as 'Lethagrium polycarpon'); (?) Lathagrium polycarpon f. pulvinatum (Kremp.) Szatala as Lethagrium.

Thallus: foliose, to 4 cm diameter. Lobes: 1 - 2 (3) mm wide, without ridges or pustules, occasionally weakly channelled, usually distinctly erect and on edge, 150 - 200 µm thick when dry, 250 µm when wet; margins slightly to moderately swollen, usually ±smooth but occasionally with small lobules. Upper surface: dark brown to black, not pruinose. Lower surface: grey-black to black. Isidia: absent. Rhizines: sometimes present, white, fasciculate. Upper and lower cortex: absent; entire thallus of loosely to compactly interwoven hyphae, 1.5 - 3.5 µm wide, sometimes with visible septa. Apothecia: always present and often abundant, usually marginal (but sometimes so crowded on the small lobes that their location is unclear), sessile or shortly stalked, at first flat but later often becoming slightly convex, 0.6 - 1.2 (1.6) mm diameter, not pruinose. Disc: when young dark brown to dark red-brown and often shiny; when mature brown to orange brown, matt. Thalline margin: present, thin except in very immature apothecia, eventually almost excluded; in section: 75 - 90 µm wide. Exciple: not visible externally; in section: thin, 10 - 15 µm wide, usually ±subcellular, sometimes weakly so and then appearing almost hyphal. Epithecium: pale brown, K-, pigment not soluble in K. Hymenium: colourless, 120 - 130 µm tall. Hypothecium: very pale yellow-brown, 60 µm tall. Paraphyses: simple, 2 µm wide at base, 3 µm at apex, not capitlate. Ascii: subcyllindrical to narrowly clavate, 58 x 16 µm, Collema type. Ascospores: colourless, 3-septate, 18 - 28 x (5) 7 - 8 (10) µm, ends slightly to strongly pointed, 8 per ascus. Photobiont: Nostoc, not forming a distinct layer; cells globose, 3 - 4 µm diameter, in unbranched chains with up to 50 cells.

The distinctly erect lobes, without ridges or pustules, are characteristic of this species, and are usually enough to separate it from others. Some collections could be confused as Bleennothallia crispa or Lethagrium cristatum. Both of those have lobe margins that are not swollen, but this character is not always clear-cut. However, B. crispa has much broader ascospores. L. cristatum has at least some submuriform ascospores, and its lobes are distinctly elongate and channelled; in E. polycarpon although some lobes may be slightly elongated and some may be ±channeled, the majority tend to be ±round and not channelled. In E. tenax, which may occasionally occur directly on limestone, the ascospore end tend to be less pointed.

Probably throughout Greece. On rock, usually calcareous, at altitudes 100 to at least 2300 m. Commonest above 1000 m (about 60% of records).

Most of Europe. Also Macaronesia, Asia (widespread), Africa (N. Africa, E. Africa, Transvaal, Reunion Is), N. America (widespread), C. America (Mexico), S. America (Peru).

Enchylium polycarpon subsp. corcyrense (Arnold) ined.

Lathagrium orbiculare f. corcyrense Arnold (1887), Flora 70: 152 as Lethagrium; Collema polycarpon subsp. corcyrense (Arnold) Pišút; Collema polycarpon var. corcyrense (Arnold) Degel.; Collema polycarpon f. isidiatum Degel.: Lathagrium orbiculare f. corcyrense Arnold.

This taxon has usually been treated at the rank of variety. However its morphology differs markedly from subsp. polycarpon and it has a different distribution. I agree with Nimis (1993) that these differences make the rank of subspecies more appropriate. The concepts of Lücking (2008) for infra-specific taxa also suggest the rank of subspecies.

Thallus: foliose, to 3 cm diameter. Lobes: 3 - 6 mm wide, not ridged, sometimes ±channelled, usually erect and on edge, 100 - 300 µm thick when dry, 450 - 650 µm when wet; margins ±swollen. Upper surface: dark brown, not pruinose. Lower surface: brown. Isidia: sometimes present, dark brown (same colour as lobes or only slightly darker), globose, 0.08 - 0.2 mm diameter, laminal and marginal. Rhizines: sometimes present, white. Upper and lower cortex: absent. Apothecia: often present but not abundant, (0.7)2.0 - 3.8 mm diameter. Disc: brown. Thalline margin: present, becoming almost excluded. Exciple: present, ±subcellular. Ascospores: colourless, 3-septate, broadly fusiform, 20 - 27.5 x 6 - 9(10) µm, one or both ends slightly to distinctly pointed, 8 per ascus.

Differs from subsp. polycarpon most obviously in the much broader lobes, which are sometimes also less erect. The apothecia also tend to be much larger (though there is some overlap) and usually fewer. May also possess isidia, unlike subsp. polycarpon. For separation from other species, see the note under subsp. polycarpon.

Widely distributed in Greece. On calcareous rock at altitudes 0 - 2200 m. Unlike subsp. polycarpon, this subspecies prefers lower altitudes, and about 75% of records are from below 1000 m altitude.

Commonest in the south of Europe, but present as far north as Svalbard. Also Asia (widespread), N. Africa (Algeria), N. America (northern Canada).
**Enchylium tenax** (Sw.) Gray (1821)


This species is variable, and at least 12 infra-specific taxa have been described. I consider that most, and perhaps all, of these infra-specific taxa are without taxonomic value, and I do not accept them in this Flora. My collections can be assigned to one of the following three varieties.

11 Thallus not or not very distinctly lobed. **var. tenax**
1 Thallus distinctly lobed.

22 Lobes at least partly erect, much divided. On soil or calcareous rock. **var. ceranoides**
2 Lobes entirely adpressed. **var. vulgare**

**Var. ceranoides** and **var. vulgare** are not sharply separated, while **var. tenax** seems to be merely a response to the physical characteristics of the substrate, unstable soil, on which it usually occurs.

Thallus: usually clearly foliose, almost crustose in some specimens of **var. tenax**, to 4 cm diameter. Lobes: very variable: well developed or not, to 4 mm wide (usually less than 1 mm wide in **var. tenax**), not ridged or channeled, adpressed or ascending, 150 - 250 µm thick when dry, 200) 300 - 600 µm thick when wet; margin swollen. Upper surface: black. Isidia: occasionally present, ± globose, 0.2 mm diameter, eventually becoming more flattened and squamule-like. Rhizines: often present, white, fasciculate. Upper and lower cortex: absent. Apothecia: often present, laminal, sessile, slightly concave to slightly convex, 0.6 - 2.0 (4.0) mm diameter, not pruinose. Disc: brown, orange-brown or red-brown. Thalline margin: present, persistent; in section 100 - 300 µm wide. Exciple: present, not visible externally; in section: thin, inconspicuous, 10 µm wide, hyphal. Epithecium: pale orange-brown to brown. Hymenium: colourless, 85 - 90 µm tall. Hypothecium: colourless, 50 µm tall. Ascospores: colourless, 3 (4)-septate or submuriform, narrowly ellipsoid to slightly clavate, often with one end slightly pointed, 20 - 27 x 6 - 10 µm, 8 per ascus. Photobiont: Nostoc.

Could only be confused with **E. polycarpon**, but lobes in these species are usually erect on their edges.

Throughout Greece. On calcareous rock or soil, or overgrowing bryophytes thereon, at all altitudes. Present in most of Europe. Also Macaronesia (widespread), Asia (widespread), Africa (widespread outside deserts and humid tropics), N. America (widespread), Caribbean (Guadeloupe, Haiti), C. America (Mexico), S. America (widespread), Antarctica (Signy Is, Antarctic Peninsula).

**Endocarpon** Hedw. (1789)


Literature: There is no monograph, but useful starting points are Clauzade & Roux (1985), Nash et al. (2002), and Smith et al. (2009).

The genus is easily recognised by the combination of hymenial algae and a squamulose growth form. Over 60 names at species rank are presently referred to **Endocarpon**, but many denote poorly known taxa and the number of good species is probably much lower. The corresponding number for Europe is 16. The genus needs a modern revision. Its species occur on a wide range of substrates. The genus is poorly represented in Greece.

11 Squamules ascending.
22 Lower surface with strands linking the squamules. Squamules elongate, 2 - 7 x 1 - 2 mm. **E. adsurgens**
2 Lower surface without strands. Squamules rounded, 0.7 - 1.5 mm diameter. (E. ascendens)
1 Squamules adpressed, except sometimes at margins.
22 Ascospores 1 per ascus, 42 - 120 x 24 - 35 µm. (E. simplicatum)
2 Ascospores 2 per ascus, mostly less than 60 µm long.
33 On rock.
44 Upper surface of squamules pale brown, lower surface pale. (E. latzelianum)
4 Upper surface of squamules green-brown or greenish, lower surface dark. (E. lunardii), (E. schisticola)
3 Usually on soil or mosses (sometimes on soil in rock crevices or on saxicolous mosses).
44 Squamules attached by rhizines; rhizohyphae present or absent. Lower surface pale or dark.
55 Rhizines black, with a carbonaceous outer layer and pale core. Lower surface of squamules black. **E. pusillum**
5 Rhizines white or becoming dark, but not carbonaceous. Lower surface of squamules pale. (E. loscosii)
4 Rhizines absent; squamules attached only by rhizohyphae. Lower surface pale. **E. pallidum**

**Endocarpon adsurgens** Vain. (1921)
Description: Clauzade & Roux (1985).
Known from a single site in western Crete, overgrowing bryophytes on rock at an altitude of 1050 m.
There are a few reports of this rather poorly known species scattered from Finland to Greece. Also Asia (widespread but scattered), perhaps N. America.

**Endocarpon pallidum** Ach. (1810)
Lichenogr. Universalis 301.
Thallus: squamulose, pale brown, without vegetative propagules. Squamules: 1 - 3 mm wide, adpressed or sometimes ascending at margins, overlapping, usually slightly convex. Lower surface: white to pale brown. Rhizines: absent; squamules attached by rhizoidal hyphae. Cortex: 30 - 45 µm thick, mostly colourless, brown in outermost 6 µm, cellular; cells subangular, isodiametric to slightly elongate, 6 - 10 x 6 - 7 µm. Perithecia: black, 0.1 mm diameter; in section: 100% immersed, pyriform, 430 x 430 µm. Exciple colourless in lower half, brown in upper half, continuous below perithecia, cellular; cells 8 x 4 µm, long axis parallel to wall. Hymenium: colourless, containing algal cells. Paraphyses: disappearing early. Periphyses: abundant surrounding ostiole. Ascospores: colourless to pale brown, muriform, 47 - 57 x 20 - 22.5 µm, 2 per ascus. Photobiont: green, present in thallus and hymenium.
Fairly easily recognised by the rhizoidal hyphae anchoring the squamules to the soil, and the absence of rhizines. A rare species reported only from Peloponnese and Evia. At altitudes 10 - 850 m, never far from the coast. On soil. The report for Evia was from serpentine rock, an unusual substrate for this species, and may be incorrect.
Southern and central Europe, reaching British Is, but not Baltic States or Nordic Countries. Also Macaronesia, Asia (Turkey, Iran, Siberia, perhaps elsewhere), Africa (widespread outside humid tropics), N. America (scattered), C. America (Mexico), S. America (Chile, Bolivia), Australasia (scattered in Australia).

**Endocarpon pusillum** Hedw. (1789)
Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).
Scattered, with no clear pattern. On soil and rock at altitudes 0 - 2300 m.
Widespread to about Arctic Circle. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread), C. America (Mexico, CR, Guatemala), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

**Endococcus** Nyl. (1855)
Literature: There is no comprehensive monograph, and information is very scattered.
**Endococcus** is a large genus of lichenicolous fungi, with 39 described species, of which 25 are reported for Europe. By the standards of lichenicolous fungi, there are quite a lot of records for Greece, but without a modern monograph many of them must be viewed with caution. The host preferences and the distribution of species outside Greece are also often unclear, owing to confusion between species.

11 Asci with 4 - 6 (8) ascospores.
22 Ascospores 10.5 - 13.5 x 5.5 - 6 µm. Ascomata to 100 µm diameter. Forming galls on Zahlbrucknerella calcarea. (E. zahlbrucknerelleae)
2 Ascospores 13 - 16 x 6.5 - 7.5 µm. Ascomata 230 - 260 x 190 - 250 µm (height x width). On Staurothele areolata, not forming galls. (E. variabilis)
1 Asci with 8 ascospores
22 Apothecia discolouring or forming galls on host lichen. On Usnea or Xanthoria. (E. apiciicola), (Sphaerelothecium parietinarium)
2 Apothecia usually not discolouring or forming galls on host; if so doing, then not on Usnea or Xanthoria.
33 Ascospores ellipsoid or weakly fusiform (ends rounded or at most only slightly pointed).
44 On Ramalina. Ascospores 10 - 13 µm long. (E. ramalinarius)
4 Not on Ramalina.
55 Ascospores to 12 µm long. **E. propinquus**

5 Ascospores more than 12 µm long.

66 Ascospore wall ± verrucose when mature. **E. verrucosus**

6 Ascospores wall smooth or ornamented, but not obviously verrucose.

77 Hymenium I+ red.

88 On Rhizocarpon. **E. macrosporus**

8 Not on Rhizocarpon. **E. perpusillus**

7 Hymenium I-. On Verrucaria. (E. rugulosus) Greek reports doubtful.

3 Ascospores not ellipsoid; distinctly fusiform or with one cell distinctly different from the other.

44 Wall of perithecium with irregular thickenings near ostiole. Ascospores 10.5 - 14 x 6 - 8 µm. On Placidiopsis cinerascens. (E. incrassatus)

4 Wall of perithecium without irregular thickenings. Ascospores 12 - 16 (20) µm long, width various. On various hosts.

55 Ascospores 3 - 6 µm wide. Cells similar. **E. exerrans**

5 Ascospores 4 - 8 µm wide (at widest part). Cells very dissimilar. **E. stigma**

**Endococcus exerrans** Nyl. (1879)

*Flora* 62: 360.

Description: Clauzade, Diederich & Roux (1989).

Known from a single locality in Macedonia, where it occurred on *Rhizocarpon geographicum* at an altitude of 1860 m.

Most reports are from northern and NW Europe, but also reported for Iberian Peninsula and Sicily. Also Asia (Turkey).

**Endococcus macrosporus** (Hepp ex Arnold) Nyl. ex Lamy (1880)


Description: Nash et al. (2004).

Scattered on the mainland, at altitudes 300 - 1900 m, usually on *Rhizocarpon geographicum*. A report from *Lecidella elaeochroma* is certainly incorrect.

Throughout Europe. Also Macaronesia, Asia (Turkey), N. Africa (Morocco), N. America (Alaska, BC, Arizona), S. America (Chile), Australasia (NZS).

**Endococcus perpusillus** Nyl. (1857)


Description: Hawksworth, Atienza & Coppins (2010). The description in Triebel (1989) is unreliable, as the author had too broad a concept of this species.

Reliably reported for Crete, on unspecified host, at an altitude of 830 m. The report in Triebel (1989) refers to *E. macrosporus*.

Mostly temperate Europe. Probably absent from truly arctic regions. In the south, probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Iran, Russia), N. Africa (Morocco), N. America (scattered in USA). A report for Australasia (NZ) is incorrect.

**Endococcus propinquus** (Körb.) Trevis. (1860)


The earliest name may be *Verrucaria gemmifera* Taylor (1836), but it has not been typified. Hawksworth (1985a) argued that the name must be rejected, as the original material consists of more than one species, but under the present Code it must be typified on one of those species.

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004); Triebel (1989).

Islands of the Aegean, including Crete, at altitudes 225 - 750 m. The only host explicitly cited was *Circinaria calcarea*. Several of the older records were reported as being from rock; these may be incorrect, or a host may have been present but overlooked. According to Nash et al. (2004), *Endococcus propinquus* s. str. is restricted to species of *Porpidia*.

Throughout Europe, though there are few reports from south of the Alps and Pyrenees. Also Macaronesia, Asia (Syria, Russia, Afghanistan, Japan), N. Africa (Morocco, Algeria, Egypt), N. America (widespread), S. America (Argentina, Chile), Australasia (Victoria).
Endococcus rugulosus Nyl. (1855)
This species is thought to be restricted to Verrucaria. All Greek reports are from other hosts and are probably incorrect. The Peloponnesian collection of Abbott (2009) belongs to E. verrucosus.

Endococcus stigma (Körb.) Stizenb. (1882)

The name Microthelia scabrida J. Lahm ex Körb. (1865), in Parerga 399 is synonymous, but Hawksworth (1985a: 164) adopted the epithet stigma, thereby establishing the priority of Tichothecium stigma Körb.

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004).

Scattered on the mainland, with no clear pattern, at altitudes 900 - 1100 m. Reported hosts are: Circinaria calcarea, Lecidella scabra, and Tephromela atra. Note that Nash et al. (2004) seem to imply that E. stigma is restricted to species of Acarospora.

Widespread in Europe, though in the south probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Iran, Russia, India), N. Africa (Morocco), N. America (widespread), C. America (CR), S. America (Colombia), Australasia (NZS), Antarctica (Macquarie Is).

Endococcus verrucosus Hafellner (1994)
Herzogia 10: 8.

Perithecia: 60% immersed in thallus of host; in section: 200 µm tall, 170 µm wide. Exciple: brown throughout, markedly thicker in uppermost 50 µm of perithecium. Paraphyses: disappearing early. Ascospores: brown, 1-septate, 15 - 16 x 7 µm, rarely slightly constricted at septum, with prominent ornamentation at x400, 8 per ascus.

Difficult to compare with other species until the genus is better known.

Crete and Peloponnese, on Aspicilia cupreoglauca and A. intermutans at altitudes 35 - 1750 m.

Seems to be widely distributed in Europe, though there are not many records. Also Macaronesia, Asia (Turkey, Russia, Azerbaijan), N. Africa (Morocco), N. America (Arizona, California).

Enterographa Fée (1825)

Literature: The genus was monographed by Sparrius in Biblioth. Lichenol. 89: 1-141. 2004 [not seen]. Between them Torrente & Egea (1989c) and Smith et al. (2009) treat all the European species.

About 65 species, of which 7 occur in Europe. There is only a single Greek record.

11 Soredia present. (E. zonata)
1 Soredia absent.
22 Apothecia punctiform, rounded or shortly ellipsoid.
33 Thallus areolate. Ascospores (4) 5 - 6-septate. Conidia 6 - 8 µm long. On non-calcareous rock. (E. pitardii)
3 Thallus smooth or faintly cracked. Ascospores 6 (7) -septate. Conidia 4 - 5 µm long. Usually on bark. E. crassa
2 Apothecia ± lirellate. (E. hutchinsiae)

Enterographa crassa (DC.) Fée (1825)
Essai Crypt. Écorc. XC (in the introduction); Opegrapha crassa DC. (1805) in Lamarck & de Candolle, Fl. Franç. Ed. 3, 2: 312.

Descriptions: Smith et al. (2009); Torrente & Egea (1989c).

Santorini, on lava at an altitude of about 10 m. This is not the normal substrate for E. crassa, and confusion with E. pitardii seems possible.

Widespread on the western side of Europe but, like most lichens with Trentepohlia, rare in the east. Also Macaronesia, eastern Asia (Japan), Africa (Morocco, Algeria, Tunisia, perhaps elsewhere). Reports for the Americas and Australasia are old and may be incorrect.

Epiphloea Trevis. (1880)

Literature: There is no monograph. Ahti et al. (2007) and Smith et al. (2009) are good starting points, but they do
not discuss *E. terrena* the only species that occurs in southern Europe.

The genus has two species, both present in Europe, but only one in southern Europe. There is only a single Greek record.

**Epiphloeoa terrena** (Nyl.) Trevis. (1880)


Santorini, on non-calcareous soil at an altitude of about 200 m. This is an inconspicuous species, and it may be more widely distributed

Southern Europe, from Spain to Cyprus. Also Macaronesia, N. Africa (Morocco).

**Evernia Ach.** (1809)


Literature: There is no monograph, but Clauzade & Roux (1985), and Thell & Moberg (2011) each cover all the European species, the former rather briefly.


**Differs from Parmelia** in having lobes which are much longer than broad, and in the absence of rhizines on the lower surface. Most species also differ in having a green upper surface (usnic acid).

Some specimens of *Evernia* species can easily be mistaken for *Ramalina*. Fertile material can be separated by the ascospores (simple in *Evernia*, 1-septate in *Ramalina*), but *Evernia* species usually lack apothecia. *Ramalina* can be separated definitively by its 2-layered cortex, though the flexible lobes in both genera make it hard to cut good sections and cortical anatomy may be difficult to observe.

Nine species, of which four occur in Europe. They are usually corticolous.

11 Lobes distinctly flattened, sparingly dichotomously branched. Upper and lower surfaces of lobes usually distinctly different. Soredia usually present in mature thalli. Cortex *K*+ yellow. **E. prunastri**

1 Lobes not distinctly flattened, much branched; branches sometimes interwoven. Upper and lower surfaces of lobes not distinctly different. Soredia present or absent. Cortex *K* or *K*+ yellow.

22 Thallus pale grey. Soredia rare. Cortex *K*+ yellow > orange. **E. illyrica**

2 Thallus yellow-green or grey-green. Soredia present or absent. Cortex *K*- (or almost).

33 Soredia present on ridges along lobes. Thallus bushy to pendent. (E. mesomorpha)

3 Soredia absent. Thallus pendent or prostrate. **E. divaricata**

**Evernia divaricata** (L.) Ach. (1810)

Lichenogr. Universalis 441; *Lichen divaricatus* L. (1767), Syst. Nat. Ed. 12, 2: 713; *Letharia divaricata* (L.) Hue.


Differs from *E. prunastri* most obviously in the overall growth form, subfruticose to fruticose rather than foliose (lobes not dorsiventral), and in the pointed tips of the lobes, those in *E. prunastri* being usually rounded to blunt. Also differs in the absence of soralia, and in the *K* reaction of the cortex. Species of *Ramalina* that lack soralia are often fertile, whereas *E. divaricata* is rarely fertile.

Scattered on the mainland, mainly in northern Greece, and on the island of Ithaki, at altitudes 400 - 2300 m, though most reports are from above 1000 m. On acidic to neutral bark, usually of conifers.

Fairly widespread in cool forests of Europe, from Scandinavia to mountains of the south. Also Macaronesia (only Azores), Asia (widespread), N. America (western half). Am old report for South Africa is probably incorrect.

**Evernia illyrica** (Zahlbr.) Du Rietz (1926)


Known from a few, scattered localities, none of them very far from the sea, at altitudes 1100 - 1600 m, usually on Abies cephalonica.

Southern Europe, from Spain to Greece, with a few scattered outliers further north. Also western Asia (Turkey), N. Africa (Morocco). Basically a circum-Mediterranean species.

Evernia prunastri (L.) Ach. (1810)
Lichenogr. Universali 442; Lichen prunastri L. (1753), Sp. Pl. 1147; Borreria prunastri (L.) Shibthorp; Evernia prunastri f. elongata (Gandog.) Szatala; Evernia prunastri f. gracilis (Ach.) Th. Fr.; Evernia prunastri var. gracilis Ach.; Evernia prunastri f. herinii (P. A. Duvign.) D. Hawksw.; Evernia prunastri f. munda (Schaer. ex H. Olivier) Zahlbr.; Evernia prunastri f. sorediifera (Ach.) Harm.; Evernia prunastri var. vulgaris Körb., nom. inval.

More than 20 infra-specific taxa have been described within E. prunastri, but probably none has any taxonomic value.

Thallus: foliose, pendent, to about 10 x 6 cm, or forming irregular clumps. Lobes: distinctly flattened in cross-section; older parts 1 - 2.5 (4) mm wide, 400 - 1000 μm thick, sparingly dichotomously branched, younger parts narrower, terminal lobes about 0.5 mm wide; tips of lobes usually rounded or blunt, rarely pointed. Upper surface: green-grey to green, matt, often with slight circular depressions and faint ridges. Lower surface: white, rarely pale green, matt. smooth or with faint ridges, sometimes channeled. Pseudocyphellae: probably absent, but white maculae common where underlying algal layer thin or absent; elongated cracks in upper surface quite common, probably arising from mechanical stress; a few thalli have distinct holes in upper surface. Soralia: scarce to abundant but nearly always present, usually white, pale green, grey-green or green, rarely blue-grey; at first delimited in circular patches, 0.2 - 0.6 mm diameter, flat to convex, rarely slightly concave, laminal and marginal on upper surface (laminal ones sometimes best developed on ridges), very rarely present on lower surface; sometimes becoming confluent later and occasionally spreading over much of upper surface; soredia 20 - 40 μm diameter. Upper cortex: 18 - 25 μm thick in water, swelling greatly in K, mostly colourless, outer part sometimes very pale brown, without distinct structure. Medulla: white, of loosely interwoven hyphae. Medullary hyphae: 3 - 5.5 μm wide, usually without visible septa, sometimes covered with fine crystals to 1 μm wide. Lower cortex: 40 - 70 μm thick, colourless, without distinct structure. Chemistry: thallus K+ yellow, C-, K+, P-, I-, UV-; medulla C-, K-, KC-, P-, I-, UV+ blue-white; soralia C-, K-, KC-, P-, I-. Photobiont layer: present below upper cortex, 25 - 80 μm thick, sometimes regular and continuous, but in other places formed of discrete clumps of cells; a few algal cells or clumps sometimes present adjacent to lower cortex, but there not forming a well-defined layer.

E. prunastri is usually easy to recognise, but in a few specimens the colour contrast between upper and lower surfaces is not great, and these specimens can be confused with Ramalina, especially R. farinacea. Any colour contrast may be more apparent if the material is examined in bright natural light. Soralia in E. prunastri are usually flat to convex and react K+ or P-. In R. farinacea they are often slightly excavate and, in the chemotypes I have seen to date in Greece, react K+ or P+, but always P+.

Throughout Greece, at altitudes 0 - 2000 m. Nearly always on bark and recorded from a wide range of phorophytes, avoiding only strongly nutrient enriched bark. I have seen it once on wood, of Juniperus oxycedrus. The lichenicolous fungus Unguiculariopsis lettai has been reported once from this host.

Subcosmopolitan in cool to warm parts of Northern Hemisphere, but absent from arctic and tropical regions. Present in most of Europe. Also Macaronesia, Asia (widespread), N. Africa (widespread in N Africa), N. America (widespread), C. America (Mexico). An old report for Peru may be incorrect.

Farnoldia Hertel (1983)


Literature: There is no monograph, but Hertel (1967) discusses all the European species, under Lecidea. Clauzade & Roux (1985) also discuss them, more briefly.

About six species, all of which are present in Europe. They occur on calcareous rock in cool or cold places.

11 Thallus immersed, or superficial but very thin.
22 Ascospores 12 - 21 x 5 - 9 μm. F. hypocrita
2 Ascospores 12 - 33 x 6 - 20 μm. F. juraana
1 Thallus superficial, areolate or verrucose-areolate. F. micropsis

Farnoldia hypocrita (A. Massal.) Fröberg (1989)
The calcicolous lichens on the Great Alvar of Öland, Sweden 57; Lecidea hypocrita A. Massal. (1855), Symm. Lich.
Nov. 53 as ypocrita; Lecidea lithyrga Fr., nom. illeg., non Ach.; Lecidea ypocrita auct.


Very scattered in northern Greece, at altitudes 1100 m and above, on calcareous rock.

Almost throughout Europe, though in the south confined to the mountains. Also Asia (Turkey, Russia), N. America (widespread). Most reports refer to var. hypocrita. The other variety, var. ligans, is endemic to the Alps and nearby regions.

Farnoldia jurana (Schaer.) Hertel (1983)


Descriptions: Smith et al. (2009) is best. See also Clauzade & Roux (1985); Hertel (1967) as Lecidea jurana.

Uncommon, but scattered throughout Greece if reports are reliable. However, reports for southern Greece (Crete, Naxos) may not be reliable. On calcareous rock, usually at altitudes above 1200 m.

Throughout Europe, though in the south confined to the mountains. Also Macaronesia, Asia (Turkey, Iran, Russia, Japan), northern N. America (widespread). Most reports refer to subsp. jurana. Two other subspecies, bicincta and muverani, are also recognised; they are endemic to the Alps and nearby regions.

Farnoldia micropsis (A. Massal.) Hertel (1983)


The epithet is micropsis, not micropis as often cited.

Descriptions: Clauzade & Roux (1985); Hertel (1967) as Lecidea micropsis.

Scattered in the northern half of Greece, on rock, usually calcareous, at altitudes above 2000 m.

Basically northern and alpine Europe, though present in the high mountains of the south. Also Macaronesia, western Asia (Turkey, Tajikistan, Russia, Pakistan), N. America (western half).

Fellhanera Vězda (1986)


Literature: Smith et al. (2009) is a good starting point for the European species.

About 90 species, best developed in humid tropical regions. There are 10 European species, but most of them prefer more humid climates than are generally available in Greece. There is only a single Greek report.

11 Thallus entirely sorediate or minutely granular. Apothecia pale.
22 Ascospores less than 15 µm long, 1-septate. (F. bouteillei)
2 Ascospores more than 18 µm long, 5 - 7 -septate. (F. colchicola)

1 Thallus continuous. Apothecia pale or dark.
22 Apothecia dark. Ascospores, 21 - 26 µm long, 3 - 5 -septate. (F. christiansenii)
2 Apothecia pale. Ascospores, 11 - 16 µm long, 3-septate. F. subtilis

Fellhanera subtilis (Vězda) Diederich & Sérs. (1991)

Description: Smith et al. (2009).

Macedonia, on bark of Picea abies at an altitude of about 1400 m.

Mostly NW and central Europe. Also Asia (Russia, Chagos Is, Taiwan), N. America (BC).

Flavoparmelia Hale (1986)


Literature: Many species are discussed in Hale (1976c), under Pseudoparmelia. The two widespread European species are treated in all the standard floras. For F. subcapitata see Nash et al. (2002).

Thallus: foliose with broad rounded lobes, pale green or yellow-green, to several cm diameter. Lower surface: black, paler at margin, attached by simple, black rhizines. Pseudocyphellae: absent. Isidia: absent in European species. Soralia: present in all European species.

Differs from Parmelia in the colour of the upper surface. Differs from other parmelioid genera with a green upper surface in the broad, rounded lobes.
About 36 species of which only 3 occur in Europe. They usually occur on bark, less commonly on siliceous rock, in areas with a temperate or warm-temperate climate. The genus is not particularly common in Greece.

11 Medulla K-. Lobes to 13 mm wide. Soredia coarse, granular. **F. caperata**
1 Medulla K+ yellow > red. Lobes to 7 mm wide. Soredia coarse or fine, granular or farinose.
22 Medulla KC+ blood-red. Soredia fine, farinose. Lobes to 7 mm wide. **F. soredians**
2 Medulla KC-. Soredia coarse or fine, granular or farinose. Lobes to 5 mm wide. (F. subcapitata)

**Flavoparmelia caperata** (L.) Hale (1986)

Thallus: foliose, to 10 cm diameter. Lobes: 7 - 11 mm wide, usually broadly rounded, margins sometimes slightly crenulate or incised, often wrinkled in central parts, weakly adpressed, 200 - 400 µm thick (when young). Upper surface: pale green, matt, not pruinose. Lower surface: black, sometimes pale brown at margin, smooth, attached by rhizines. Isidia: absent. Pseudocyphellae: absent. Rhizines: rather sparse, simple, black, 0.3 - 0.35 x 0.05 mm. Soralia: present, laminal, often developing along top of the larger folds in the lobes; at first delimited, globose, 0.3 - 0.7 mm diam, sometimes becoming confluent later; soredia granular, 40 µm diameter. Upper cortex: 15 - 20 µm thick, colourless, cellular; cells subrounded, 4 µm diameter; K-. Medulla: white, 100 - 110 µm thick, of loosely interwoven, much branched hyphae, 3 µm wide, septa not apparent, rather sparsely covered in small (0.5 µm) colourless crystals. Lower cortex: 10 - 15 µm thick, brown, cellular (most apparent when viewed at right angles to surface); cells subangular, 5 µm diameter; K-. Chemistry: medulla C-, K-, KC+ fleeting pale pink, P+ orange, I-, UV-; soralia C-, K-, KC+ fleeting pink, P+ orange, UV+ white; thallus C-, K-, KC+ yellow, P-, UV-. Photobiont: green; cells globose, 8-12 µm diameter, forming a continuous layer 40 - 65 µm thick that is not sharply differentiated from upper cortex.

In Greece often sterile and sometimes without soralia, but easily recognised even then as the large rounded lobes and K- medulla are distinctive. Species of *Xanthoparmelia* have much narrower lobes and are never corticolous. Specimens in which the yellowish tinge is faint can be confused with *Parmotrema*, but in all relevant species of that genus in which the medulla reacts P+ orange, it also reacts K+.

Scattered on the mainland and nearby islands at altitudes 0 - 900 m, though most reports are from below 500 m. On bark of a wide range of phorophytes. Subcosmopolitan in temperate to warm regions that are not too dry. Widespread in Europe as far north as Scotland and southern Scandinavia. Also Macaronesia, Asia (Turkey, Russia), Africa (widespread), N. America (widespread), C. America (Mexico, Guatemala), S. America (widespread), Pacific (widespread). Reports for Australia are incorrect.

**Flavoparmelia soredians** (Nyl.) Hale (1986)

Description: Smith et al. (2009).

There is an unlocalised report for Greece in James & Rose (1973e: 479). No altitude or substrate was indicated. Subcosmopolitan but more thermophilic than *F. caperata*. In Europe distinctly more southern than *F. caperata*. Also Macaronesia, Asia (Turkey, Russia), Africa (widespread), S. America (Argentina, Chile, Venezuela), Australasia (widespread in temperate parts). Its status in N. America is disputed.

**Fuscidea** V. Wirth & Vězda (1972)


Literature: Smith et al. and Clauzade & Roux (1985) both treat the few species that might occur in Greece. About 39 species, mostly in cold regions; 19 are reported for Europe. Most species occur on hard siliceous rock, a few are corticolous. Greece is at the edge of the range of *Fuscidea*, and there are few reports.

11 Soralia present.
22 Thallus cracked. Apothecia common. Soralia few. **F. cyathoides**
2 Thallus areolate. Apothecia uncommon. Soralia numerous. (F. praeruptarum)
1 Soralia absent.
22 Ascospores curved (reniform). Medulla P+ red. **F. cyathoides**
2 Ascospores spherical to ellipsoid, not curved. Medulla P-. **F. lygaea**
Fuscidea cyathoides (Ach.) V. Wirth & Vězda (1972)


**Description:** Smith et al. (2009).

Known from a single site in Macedonia, on *Pinus sylvestris* at an altitude of 1380 m. Throughout northern and central Europe; very rare in the south. Also Asia (widespread), N. Africa (Morocco), perhaps elsewhere.

Fuscidea lygaea (W. Mann) V. Wirth & Vězda (1972)


The basionym is not *Lecidea lygaea* Ach. in *Syn. Meth. Lich.* 34. 1814, as sometimes cited, Acharius included within the scope of *L. lygaea*, via his form *pelidna*, the name *Lecidea pelidna* Ach. (1810), making *L. lygaea* illegitimate. However, *L. lygaea* is not automatically typified on *L. pelidna* (Article 7.6, Shenzhen). When Mann cited *Lecidea lygaea* in synonymy, that name had not then been typified, and Mann did not include the type of any other name within the scope of *Biatora lygaea*, so his name is legitimate.

**Descriptions:** Clauzade & Roux (1985); Smith et al, (2009).

Known from a single site on the island of Samothraki, on siliceous rock (gabbro) at an altitude of 872 m. Throughout northern and central Europe, but absent from the high arctic, and very rare south of the Alps. Perhaps also Asia (old reports).

Fuscopannaria P. M. Jørg. (1994)


**Family:** Pannariaceae.

**Literature:** Jørgensen (1978) covers all the Greek species, under *Pannaria*. Another good starting point is the key to all European species in Jørgensen (2005b). Ahti et al. (2007), Burgaz et al. (2010), and Smith et al. (2009) are also useful.

**Thallus:** squamulose, in most species, crustose and granular in a few. Squamules: some shade of brown or grey, usually rather small, margin often crenulate. Soralia: present or absent. Isidia: absent in Greek species. Hypothallus: often present, blue-black to black. Upper cortex: distinctly cellular. Medulla: of loosely interwoven hyphae. Lower cortex: absent or poorly developed. Apothecia: sometimes present, flat to convex, 0.5 - 1.6 mm diameter, not pruinose. Disc: brown, orange-brown or red-brown, pale or dark. Thalline margin: often present, but becoming excluded in some species. Exciple: present but not always visible externally, in section appearing cellular on an overall radiating trend. Epithecium: pale yellow-brown to orange-brown. Hymenium: colourless, or with some epithecial pigment in upper part, I+ blue-green. Hypothecium: colourless. Asci: clavate, with distinct KI+ blue apical plug. Ascospores: colourless, simple, ellipsoid or with pointed ends, small to medium sized (12 - 25 µm long), perispore sometimes visible, 8 per ascus. Chemistry: all reactions of thallus and medulla negative. Photobiont: blue-green, cells not in chains or in short chains.

Differs from *Pannaria* in the small-squamulose, rather than foliose, growth form, and in the absence of pannarin. *Vahliella* is similar in external appearance but has a different type of ascus.

*Fuscopannaria* contains about 51 species, of which 10 occur in Europe. Most prefer ± moist habitats. They occur on a range of substrates, though most Greek reports are from bark.

Identification to species within *Fuscopannaria* can be difficult, since some of the characters separating species are subtle and some species are quite variable. Sterile or poorly developed specimens may be impossible to determine with confidence.

11 Thallus crustose. On soil or on liverworts of the genus Frullania.

22 Distinct white prothallus present. On liverworts of the genus Frullania. (F. frullaniae)

2 Prothallus black or absent. On soil. On various substrates. *F. nebulosa*

1 Thallus squamulose. Usually on bark, occasionally on wood or overgrowing bryophytes.

22 Soralia woolly, lead-grey. Thallus olivaceous, slightly swollen in appearance. *F. mediterranea*

2 Soredia absent. Thallus various. (If isidia present, see *Vahliella*.)

33 Squamules olivaceous or chestnut-brown with white felted margins. Thalline margin conspicuous. Usually on bark.

44 Thallus chestnut-brown. Exospore of ascospores with a broad point at each end. *F. leucosticta*

4 Thallus olivaceous. Exospore of ascospores with rounded ends. *F. olivacea*

3 Squamules variously coloured but margin not white felted (though it may be paler than centre). Thalline margin absent, excluded early or indistinct; rarely conspicuous. On various substrates.
44 Exospore of ascospores with at least one end distinctly pointed. Thallus nearly crustose, consisting of very small, ±adpressed squamules; margin of squamules paler than central parts (but not white-felted). Apothecia strongly convex. On bark, especially of Abies cephalonica. **F. ignobilis**

4 Exospore usually absent; ascospores with rounded ends. Thallus appearing squamulose; margins of squamules not paler than central parts. Apothecia flat or convex. On bark, especially of deciduous Quercus species, or on rock. See Vahlilla.

**Fuscopannaria ignobilis (Anzì) P. M. Jørg. (1994)**


Thallus: squamulose, grey to grey-brown, without vegetative propagules, though sometimes with small warts that may vaguely resemble isidia. Hypothallus: back. Apothecia: convex, 0.5 - 0.9 mm diameter, not pruinose. Disc: brown-orange to brown. Thalline margin: present but often discontinuous, becoming excluded. Exciple: not visible externally. Epithecium: pale brown-orange. Hymenium: 110 μm tall, colourless in lower part, pale brown-orange in upper part, I+ blue-green. Hypocortex: 110 μm tall, colourless. Ascospores: colourless, simple, ellipsoid, ends pointed, 15 - 22 x 8 μm (including perispore, the thickness of which is rather variable), often ±uniseriate in ascus, 8 per ascus.

Scattered, on the mainland and Crete, on bark at altitudes 75 - 1200 m, occasionally higher. Reported from Abies cephalonica, Castanea sativa and Pinus nigra.

Atlantic and Mediterranean Europe; absent from areas with arctic or distinctly continental climate. Also western Asia (Turkey), Africa (Morocco, Algeria, Tunisia, Kenya).

**Fuscopannaria leucosticta (Tuck. ex E. Michener) P. M. Jørg. (1994)**

*J. Hattori Bot. Lab. 76: 205; Parmelia leucosticta Tuck. ex E. Michener (1853) in Darlington, Fl. Cestr. Ed. 3, 441; Pannaria leucosticta (Tuck. ex E. Michener) Nyl.*


Most Greek reports are probably unreliable, but there is a reliable recent record in Spribille (2009) for Epiros on bark of Phillyrea latifolia at an altitude of 460 - 500 m.

A species of warm temperate to subtropical, humid regions that is very rare in Europe. Apart from the recent Greek report, and confirmed records for three areas in northern Italy, one in Slovenia and one in Albania, most European reports are probably incorrect. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Tanzania, Reunion Is; other reports doubtful), N. America (widespread), Caribbean, C. America (Mexico), S. America (Ecuador).

**Fuscopannaria mediterranea (Tav.) P. M. Jørg. (1994)**


Thallus: squamulose. Squamules: grey, grey-brown or olive-brown, matt, white felted at margins, 0.4 - 2.0 mm wide, 120 - 240 μm thick, ±flat, sometimes slightly ascending at margins; margins crenulate. Hypothallus: sometimes present but not usually conspicuous, blue-black. Isidium: absent. Soralia: always present, usually abundant, dark grey, distinctly darker than thallus, usually not delimited, sometimes forming large convex clusters 0.1 - 0.7 mm diameter, at first marginal, later often spreading to cover whole thallus; soredia 50 μm diameter. Upper cortex: 10 - 25 μm thick, colourless, not sharply differentiated from photobiont layer, cellular; cells surrounded, 5 - 9 μm wide; K-. Medulla: 80 μm thick, of loosely interwoven hyphae. Lower cortex: not well developed, scarcely distinguishable from medulla. Chemistry: thallus mostly K- but margins of squamules sometimes faintly +orange (perhaps a physical, not chemical, effect), C-, KC-, P, UV-. medulla K-, C-, KC-, P, I-; soralia K-, C-, KC-, P, UV-. Photobiont: blue-green, cells usually single or in small groups, rarely in short chains; photobiont layer 100 μm thick.

*F. mediterranea* is close to *F. olivacea*, but differs in having soralia and in usually lacking apothecia.

Fairly common in Crete and mainland Greece, at altitudes 110 - 1600 m. Usually on bark, occasionally overgrowing bryophytes on siliceous rock. Reported from several species of phorophyte, but avoiding strongly acidic and strongly basic bark.

Atlantic and Mediterranean Europe. Also Macaronesia, Asia (Turkey, Israel, Russia), N. Africa (Morocco, Tunisia), N. America (western half), S. America (Argentina, Chile).

**Fuscopannaria nebulosa (Hoffm.) E. Tripp & Lendemer (2018)**


Thallus: crustose, to several cm diameter, formed entirely of blue-grey to grey-brown granules. Granules: ±globose, 0.05 - 0.1 mm diameter, formed of a cluster of photobiont cells associated with fungal hyphae, but without well-developed fungal structures such as a cortex. Hypothallus: absent. Medulla: absent. Apothecia: 0.4 - 0.8 mm diameter, slightly immersed in thallus, usually ±convex, not pruinose. Disc: orange-brown to brown. Thalline margin: sometimes
In the Canary Is.), western Asia (Israel, widespread in Arabian Peninsula), Africa (Algeria, Tunisia, Socotra).


Islands of Amorgos, Iraklia and Karpathos, on calcareous rock at altitudes 12 - 300 m.

In Europe, only known from Greece. (Reports for "Spain" refer to the Canary Is.) Also Macaronesia (widespread in Canary Is), western Asia (Israel, widespread in Arabian Peninsula), Africa (Algeria, Tunisia, Socotra).

Fuscopannaria olivacea (P. M. Jørg.) P. M. Jørg. (1994)


Thallus: squamulose. Squamules: olive brown, with white felted margins, 0.4 - 1.0 mm wide, usually ±adpressed, sometimes with ascending margins; margins crenulate. Hypothallus: usually present and well developed, but may appear inconspicuous on some types of bark, blue-black to black. Isidia and soralia: absent. Upper cortex: 30 µm thick, pale yellow in top 6 µm or so, colourless in lower part, cellular; cells subrounded, about 6 µm wide. Medulla: 50 µm thick, of loosely interwoven hyphae. Lower cortex: not well developed; medulla merges almost imperceptibly into rhizoidal hyphae. Apothecia: usually present, sessile, ±flat, 0.6 - 1.2 mm diameter. Disc: red-brown to dark brown. Thalline margin: present, persistent but becoming thin, white felted. Exciiple: present but not visible externally; in section about 25 µm wide, mostly colourless, very pale yellow-brown near surface, of broad radiating hyphae that appear cellular. Epithecium: very pale yellow brown, K-, pigment not soluble in K. Hymenium: 110 µm tall, colourless, I+ blue, slowly turning blue-green in places. Hypothecium: 80 µm tall, colourless. Paraphyses: 1.5 - 2 µm wide at base, 3 µm at apex, sometimes slightly capitulate, septa clearly visible at least in K. Asci: clavate, 60 - 70 x 22 µm, wall weakly KI+ blue, apical plug strongly KI+ blue. Ascospores: colourless, ellipsoid, 13 - 17 x 8 - 12 µm, ends rounded, without ornamentation, often uniseriate, 8 per ascus. Chemistry: thallus C-, K-, KC-, P-, UV-. Photobiont: blue-green (said to be Nostoc); cells globose, 6 - 10 µm diameter, not in chains, forming large clusters, each cluster being a single thallus granule; there is no photobiont layer in the usual sense.

Smith et al (2009) state that the paraphyses are simple, but branched paraphyses were not uncommon in the Greek collection seen.

The combination of an I+ blue-green (not pure blue) hymenium, a granular thallus, and rather small ascospores is diagnostic. Vahlilla atlantica is isidiate and has much larger ascospores. The morphologically similar Gregorella humida (not yet reported for Greece) has an I- hymenium. Protopannaria pezizoides has an I+ blue (not blue-green) hymenium, larger ascospores, and does not usually occur directly on soil.

Island of Alonisos, and a small area in Macedonia and Thrace directly north of Alonisos, on soil, bryophytes and granite rock at altitudes 50 - 1285 m.

Throughout much of Europe. Also Macaronesia, central Asia (southern Siberia, Mongolia), Africa (Morocco, Algeria, S. Africa), N. America (California, Idaho, Massachusetts).

Fuscopannaria olivacea (P. M. Jørg.) P. M. Jørg. (1994)


Thallus: squamulose. Squamules: olive brown, with white felted margins, 0.4 - 1.0 mm wide, usually ±adpressed, sometimes with ascending margins; margins crenulate. Hypothallus: usually present and well developed, but may appear inconspicuous on some types of bark, blue-black to black. Isidia and soralia: absent. Upper cortex: 30 µm thick, pale yellow in top 6 µm or so, colourless in lower part, cellular; cells subrounded, about 6 µm wide. Medulla: 50 µm thick, of loosely interwoven hyphae. Lower cortex: not well developed; medulla merges almost imperceptibly into rhizoidal hyphae. Apothecia: usually present, sessile, ±flat, 0.6 - 1.2 mm diameter. Disc: red-brown to dark brown. Thalline margin: present, persistent but becoming thin, white felted. Exciiple: present but not visible externally; in section about 25 µm wide, mostly colourless, very pale yellow-brown near surface, of broad radiating hyphae that appear cellular. Epithecium: very pale yellow brown, K-, pigment not soluble in K. Hymenium: 110 µm tall, colourless, I+ blue, slowly turning blue-green in places. Hypothecium: 80 µm tall, colourless. Paraphyses: 1.5 - 2 µm wide at base, 3 µm at apex, sometimes slightly capitulate, septa clearly visible at least in K. Asci: clavate, 60 - 70 x 22 µm, wall weakly KI+ blue, apical plug strongly KI+ blue. Ascospores: colourless, ellipsoid, 13 - 17 x 8 - 12 µm, ends rounded, without ornamentation, often uniseriate, 8 per ascus. Chemistry: thallus C-, K-, KC-, P-, UV-. Photobiont: blue-green, cells not in chains; photobiont layer 50 - 100 µm thick.

Fairly easily recognised by the white-felted margins of the squamules and the absence of soralia.

Throughout Greece. On bark of a wide range of phorophytes from sea level to about 2000 m, once on wood of Cupressus sempervirens. The commonest species of the genus in Greece.

Southern Europe from Portugal to Cyprus. Also Macaronesia (Madeira), western Asia (Turkey, Syria), N. Africa (Morocco, Algeria, Tunisia). A Mediterranean / Macaronesian species.

Gloeoheppia Gyeln. (1935)


Five species, two of which occur in Europe. There are very few Greek reports.

11 Thallus inflated. Surface smooth. (G. turgida)
1 Thallus not inflated. Surface rough. G. erosa

Gloeoheppia erosa (J. Steiner) Marton (1981)


Islands of Amorgos, Iraklia and Karpathos, on calcareous rock at altitudes 12 - 300 m.

In Europe, only known from Greece. (Reports for "Spain" refer to the Canary Is.) Also Macaronesia (widespread in Canary Is), western Asia (Israel, widespread in Arabian Peninsula), Africa (Algeria, Tunisia, Socotra).
Graphis Adans. (1763)


Literature: Most literature on *Graphis* deals with the tropical species, and is not relevant to Europe. The two widespread European species are treated in all the standard floras.

As traditionally circumscribed, this is a large genus of about 500, mainly tropical, species. It is heterogeneous, and is being subdivided. About a dozen species occur in Europe, but only one is likely to occur in Greece.

*Graphis scripta* (L.) Ach. (1809)


More than 50 infra-specific taxa have been described within this species, but probably none has taxonomic value.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Rare and scattered, on the mainland and Corfu. On bark at altitudes 0 - 1500 m. Recorded from: *Fagus sylvatica*, *Quercus* sp., and *Robinia pseudacacia*.

Widespread in Europe outside arctic and Mediterranean environments. Also Macaronesia, Asia (widespread), Malesia (Philippines, PNG), Africa (widespread), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda, Guadeloupe), C. America (Mexico), S. America (widespread), Pacific (widespread). Reports for Australasia are incorrect. Some reports may be unreliable, owing to confusion with other species.

Gyalecta Ach. (1808)


Literature: The best introduction for southern Europe is Egea et al. (2004), but Clauzade & Roux (1985) and Smith et al. (2009) between them cover all the European species except for a few poorly known ones. Nimis & Martellos (2004) is also useful.

The genus is characterised by a crustose thallus with photobiont *Trentepohlia*, apothecia that are usually concave and rather pale in colour, without a thalline exciple, and ascospores that are multi-septate to muriform.

About 57 names at species rank are presently referred to *Gyalecta*, but several are poorly known and may not be good taxa. About 26 names refer to European taxa. The genus is widely distributed outside the tropics, and occurs on a wide range of substrates, but is nowhere very common. Five species are known for Greece, but two have been reported only for Mt. Olympus and the others are uncommon.

11 Apothecia deeply immersed, resembling perithecia. Hymenium, at least in lower part, with orange-yellow oil droplets.

22 Ascospores 65 - 115 x 4.5 - 4 µm. Thallus areolate. (G. mediterranea)

2 Ascospores 40 - 60 x 6 - 12 µm. Thallus powdery granular. (G. nidarosiensis)

1 Apothecia immersed or not, but not resembling perithecia. Hymenium without orange-yellow oil droplets.

22 Ascospores septate, without any longitudinal septa.

33 Ascospores 3-septate.

44 Disc red, sometimes white pruinose. Ascospores 16 - 23 µm long. Usually on bark. Not restricted to high altitudes. **G. ulmi**

4 Disc orange to brown, not pruinose. Ascospores 9 - 14 µm long. Usually terricolous. If present in Greece, probably restricted to high altitudes (above tree line). (G. geoida)

3 Ascospores with more than 3 septa.

44 On bark. Ascospores 12 - 30 µm long. **G. derivata**

4 On rock. Ascospores 30 - 37 µm long. **G. leucaspis**

2 Ascospores muriform or submuriform, with at least some longitudinal septa.

33 Paraphyses not or scarcely broadening above. Usually on rock, occasionally on other substrates.

44 Hypothecium more than 100 µm tall. Disc pale orange-pink. **G. jenensis**. Two varieties are sometimes recognised; neither has been explicitly reported for Greece.

55 Lower part of hymenium colourless or very pale yellow, without oil droplets. (var. jenensis)

5 Lower part of hymenium clearly yellow, with oil droplets. (var. montenegrina)

4 Hypothecium about 50 µm tall. Disc brown or yellow-brown. (G. schisticola)

3 Paraphyses distinctly broadening above. On bark or wood.

44 Ascospores ± lemon shaped, with both ends distinctly pointed, 12 - 18 x 8 - 12 µm. (G. liguriensis)

4 Ascospores ellipsoid to elongated, without two distinctly pointed ends.
55 Ascospores 10 - 18 x 6 - 10 μm, muriform, with all septa oblique. (G. flotovii)
5 Ascospores (10) 17 - 32 x 5 - 9 μm, submuriform, with some or all transverse septa not oblique.
66 Ascospores submuriform. G. truncigena
6 Ascospores multi-septate with occasional longitudinal septa. G. derivata

Gyalecta derivata (Nyl.) H. Olivier (1911)

Thallus: crustose, green-grey, ±continuous, slightly warty, thin, sometimes inconspicuous, without vegetative propagules. Apothecia: 0.25 - 0.3 mm diameter, urceolate when young, becoming flat later, immersed in substrate but disc above level of substrate in mature apothecia, not pruinose. Disc: brown. Thalline margin: ±absent, but fragments of thallus may adhere to margin of mature apothecia. Exciple: present, persistent, brown, 0.07 mm wide; in section: colourless, of broad hyphae with elongated lumina, not appearing cellular. Epithecium: brown, K-, pigment soluble in K. Hymenium: 120 - 125 μm tall, colourless. Hypothecium: 50 - 70 μm tall, colourless. Paraphyses: simple, 1 μm wide at base, 1.5 - 3 μm at apex, sometimes capitate. Asci: 80 x 13 μm, cylindrical. Ascospores: colourless, 5 - 8 -septate, occasionally with a longitudinal septum, transverse septa usually regular (rarely oblique), 20 - 30 x 5 - 6 μm, ±ellipsoid to almost fusiform, 8 per ascus. Photobiont: Trentepohlia.

The distinctly urceolate apothecia without a thalline exciple, and the Trentepohlia photobiont make the genus easy to recognise. G. derivata could be confused with G. truncigena, but that species has more distinctly submuriform ascospores.

Scattered in regions with a ± humid climate, never very far from the sea. On bark of Platanus orientalis and Quercus spp. at altitudes 10 - 850 m.
Scattered in Europe to as far north as southern Scandinavia. Also western Asia (Turkey), N. Africa (Morocco).

Gyalecta jenensis (Batsch) Zahlbr. (1924)
Cat. Lich. Univ. 2: 720; Peziza jenensis Batsch (1783), Elench. Fung. 123; Gyalecta cupularis (Hedw.) Fr.
Descriptions: Clauzade & Roux (1985); Egea et al (2004); Smith et al. (2009).
Mt Olympus, on calcareous rock at altitudes above 1000 m.
Throughout Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (Turkey, Russia, northern India), N. America (widespread), perhaps C. America, S. America (JF), Australasia (Tasmania).

Gyalecta leucaspis (Kremp.) Kremp. (1861)
Mt. Olympus, on calcareous rock at altitudes above 1000 m.
Central Europe and the Alps, to the mountains of southern Europe. Absent from British I and Nordic countries. I have not seen any reports for other continents.

Gyalecta truncigena (Ach.) Hepp (1853)
Flecht. Eur. no. 27; Gyalecta wahlenbergiana B G. (= var.) truncigena Ach. (1810), Lichenogr. Universalis 152.
Descriptions: Clauzade & Roux (1985); Egea et al (2004); Smith et al. (2009).
Scattered, usually in localities not very far from the sea. On bark of Platanus and Quercus at altitudes 0 - 900 m.
Widespread in Europe to southern Scandinavia. In southern Europe, commoner in the mountains than at lower altitudes. Also Macaronesia, Asia (Turkey, Syria, Iran, southern Siberia), N. Africa (Tunisia), N. America (widespread), perhaps C. America, Australasia (NZS).

Gyalecta ulmi (Sw.) Zahlbr. (1890)
Annln k. k. naturhist. Hofmus., Wien 5: 43; Lichen ulmi Sw. (1784), Nova Actae Regiae Soc. Sci. Upsal. 4: 247; Secoliga ulmi (Sw.) Szatala.
Descriptions: Clauzade & Roux (1985); Egea et al (2004); Smith et al. (2009).
Mt. Olympus and island of Samothraki, on bark at altitudes 600 - 1200 m. Reported from Acer sp. and Quercus pubescens.
Widespread, reaching Arctic Circle in coastal Norway. South of the Alps probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia), N. Africa (Algeria, Tunisia), perhaps N. America.
Haematomma A. Massal. (1852)


Literature: The genus was monographed by Staiger & Kalb in Biblioth. Lichenol. 59: 1-198. 1995 [not seen]. Otherwise, information is scattered. Smith et al. (2009) is as good a starting point as any. For H. fenzlianum see Nash et al. (2004).

About 40 species, 5 of which occur in Europe. The genus is not common in Greece.

1 Thallus ±entirely leprose, usually delimited by a white, cottony prothallus. Ascospores 3 - 7 -septate. Paraphyses richly branched, especially in upper part of hymenium. On bark or siliceous rock. H. ochroleucum s. lat.

2 Thallus pale yellow-green to yellow-grey, with usnic acid. H. ochroleucum var. ochroleucum

11 Thallus with delimited soralia; prothallus absent or thin and grey. Ascospores 8 - 14 -septate. Paraphyses simple. On bark. (H. sorediatum)

1 Thallus without soralia. Ascospores 3 - 7 -septate. On siliceous rock.

22 Aпотhecia immersed, at least when young. (H. fenzlianum)

2 Aпотhecia subsessile to sessile. H. nemetzii

Haematomma nemetzii J. Steiner (1900)


Thallus: crustose, to 15 cm diameter, without vegetative propagules, not pruinose; medulla light brown; areolate, to 550 µm thick, outer part white, continuous to cracked, often with elongated radiating cracks but not marginal lobes, 100 - 150 µm thick. Arealles: 0.5 - 1.5 mm wide, ±flat overall but surface irregular. Prothallus: white, 0.4 - 1 mm wide. Cortex: 30 - 50 µm thick, colourless to very pale brown, of rather randomly oriented hyphae (best seen in K). Medulla: white. Aпотhecia: subsessile, to sessile, flat when young, sometimes slightly convex later, 0.7 - 1.6 mm later, not pruinose but disc, especially outer parts, sometimes with patches of prothallus-like hyphae that can be mistaken for pruina. Disc: red-orange, sometimes bright. Thalline margin: present, persistent, 0.1 - 0.15 mm wide, with rather soft granular texture; in section: 25 - 150 µm wide, upper part with few algal cells. Exciple: not visible externally; in section: 25 - 50 µm wide, same colour as hymenium, of ±vertical hyphae. Epithecium: orange-brown, K+ purple-red. Hymenium: 170 µm tall, not sharply delimited from hypothecium, very pale orange-brown to orange-brown, rarely entirely colourless, K+ purple-red where pigmented, KI+ blue. Hypothecium: 150 µm tall, colourless or almost. Paraphyses: anastomosed, 1 µm wide at base, 1.5 µm at apex, not capitate or moniliform. Ascii: 100 x 22 µm when mature, narrower when immature, clavate, KI+ blue in a broad arch at top. Ascospores: colourless, 3 - 7 -septate, fusiform, 35 - 50 x 5 - 7 µm when mature (immature ones, before septa develop, may be as small as 25 x 2.5 µm), often curved, sometimes sigmoid, 8 per ascus. Pycnidia: common, appearing externally as bright red-orange dots 0.1 - 0.15 mm diameter, initially with a point-like ostiole, but soon developing 2 - 4 radial cracks and ostiole then broadening substantially; in section: at first 100% immersed and globose to subglobose, later sometimes partly emergent and almost cup-shaped, 170 - 300 µm tall, 210 - 230 µm wide, orange-brown at surface, colourless elsewhere, without distinct wall; larger ones apparently multi-chambered (though as there are no distinct walls this is not very clear). Conidia: colourless, curved, 15 - 22 x 1.5 µm. Chemistry: apothecia and pycnidia K+ dark purple, sometimes so dark as to appear black; medulla K-, C-, KC-, P-, 1-; thallus K+ yellow, C-, P-, UV+ orange. Photobiont: green, cells globose to subglobose, 8 - 13 µm diameter. Photobiont layer: 40 - 75 µm thick, slightly irregular, sometimes slightly discontinuous.

H. nemetzii is distinctive, and can not be confused with any other Greek species. H. fenzlianum A. Massal., reported once for Europe (Minorca, as H. subpuniceum), has slightly smaller apothecia and ascosporas. To avoid confusion, measurements should be made only on mature ascospores, in which septa are clearly visible, as immature ascospores of H. nemetzii are sometimes much smaller than mature ones.

Most of Greece except for the westernmost parts, at altitudes 0 - 1000 m, occasionally higher. Usually on siliceous rock but reported once from bark of Ficus carica.

Only SE Europe (Croatia, Bulgaria, Greece, European Turkey, Cyprus) and western Asia (Turkey).

Haematomma ochroleucum (Neck.) J. R. Laundon (1970) var. ochroleucum

Lichenologist 4(4): 299; Lichen ochroleucus Neck. (1771), Meth. Musc. 52; Lecanora haematomma Ach., nom. superfl.

Description: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the Aegean, including Crete, on limestone at altitudes 300 - 1100 m.

Widespread in western Europe, but much rarer eastwards. Also Macaronesia, western Asia (Turkey, Kazakhstan, Russia). Reports of H. ochroleucum for the Americas probably refer to var. porphyrium.
Haematomma ochroleucum var. porphyrium (Pers.) J. R. Laundon (1970)


Description: Clauzade & Roux (1985); Smith et al. (2009).

Epiros on bark of *Platanus*, and Santorini on lava, at altitudes below 250 m.

Similar distribution in Europe to var. ochroleucum. Also Macaronesia, N. America (western half).

Halecania M. Mayrhofer (1987)


Literature: van den Boom & Elix (2005) give a key to all species then known. Clauzade & Roux (1985) and Smith et al. (2009) give more details of the European species.

About 21 species, 13 of which occur in Europe. It is very rare in Greece.

11 Soredia present. **H. giraltiae**

1 Soredia absent.

22 Epithecium greenish, N+ reddish. On acidic rock. (H. spodomela)

2 Epithecium brown, N-. On calcareous rock. (H. alpivaga). Greek reports probably incorrect.

Halecania giraltiae van den Boom & Etayo (2001)

*Lichenologist* 33(2): 103-106.

Description: See the protologue.

Known with certainty only from a single site in Epiros, on siliceous rock at an altitude of 1580 m. The report of *H. alpivaga* for Attica, which might belong here, was from siliceous rock at an altitude of 850 m.

Only Portugal, Spain and Greece.

Halospora (Zschacke) Tomas. & Cif. (1952)


Literature: A good starting point is the key to species of *Merismatium* in Roux, Gueidan & Navarro-Rosinés (2002). Four species of lichenicolous fungi, all of which occur in Europe. Until recently they were treated in *Merismatium*. They are generally restricted to cold regions. Only one species is known for Greece, where it is rare.

11 Ascospores generally more than 20 µm long. **H. deminuta**

1 Ascospores generally less than 20 µm long. (H. discrepans), (H. scamnoeca)

Halospora deminuta (Arnold) Tomas. & Cif. (1952)


The combination *Strickeria dissidens* was made in Steiner (1898:185) from *Polyblastia dissidens* Arnold. Steiner described a Greek collection, which was parasitic on an endolithic calcareous lichen, cited as *Lecidea enteroleuca* (probably *Lecidella stigmatea*). Steiner's description suggests a species close to *H. deminuta*, though the perithecial diameter of 0.1 - 0.2 mm quoted by Steiner is rather small for that species. However, *Polyblastia dissidens* itself is otherwise known only from the type collection, from Germany, and it was not described as lichenicolous in Arnold's protologue. It will be necessary to examine Steiner's collection to clarify what he meant by the name.

Descriptions: Clauzade, Diederich & Roux (1989); Clauzade & Roux (1985) both as *Polyblastia deminuta*; Smith et al. (2009) as *Merismatium deminutum*.

Northern half of mainland Greece at altitudes 1100 m and above. On limestone or parasitic on "*Lecidea enteroleuca*".

Scattered, mainly in northern Europe and the Alps. I have not seen any reports for other continents.

Heppia Nägeli ex A. Massal. (1854)

Geneac. Lich. 7-8. Type: *H. adglutinata* A. Massal., the only species originally included. Family: *Lichinaceae*.

Literature: Egea (1989) treats the European species, though often under synonyms. He incorrectly regards *H. adglutinata* and *H. lutosa* as synonyms. For a more modern treatment of some of these species, see Ahti et al. (2007) and Nash et al. (2002).
About 27 names at species rank are presently referred here, but many denote poorly known taxa. There may be fewer than 10 good species. About 6 species occur in Europe. The genus is rare in Greece.

*H. lobatoplicata* (de Lesd.) ined. is not included in the key, as I have insufficient information.

11 Squamules with many spines. *(H. echinulata)*
1 Squamules without spines.
22 Upper surface of squamules reticulate and densely white pruinose. **H. solorinoides**
2 Upper surface not as above.
33 Thallus homoiomerous, lacking a cortex or with a rudimentary cortex at the margins. *(H. lutosa)*
3 Thallus heteromerous, with a distinct upper or lower cortex.
44 Upper cortex poorly developed. Lower cortex distinct, of ±horizontal hyphae. Hymenium I+ reddish. **H. adglutinata**
4 Upper cortex distinct, cellular. Lower cortex absent, or limited to margins of squamules. Hymenium mostly I+ blue, but reddish above tips of asci. *(H. despreauxii)*

**Heppia adglutinata** A. Massal. (1854)

*Lecanora adglutinata* Kremp. (1851) is homotypic, but a later homonym and illegitimate.

It is unclear whether Massalongo's name was published before or after Nylander's *Pannaria adglutinata* in *Mém. Soc. Sci. Nat. Cherbourg* 2: 324, 1854. If after, Nylander's name would be the basionym and authorship of *Heppia adglutinata* would be (Nyl.) A. Massal.

Descriptions: Ahti et al. (2007); Nash et al. (2002); Nimis & Martellos (2004).

Kalimnos, on soil at 100 m altitude.

Mostly central Europe and the Alps, with outliers in southern Sweden, Italy and Greece. Also Macaronesia, Asia (Bahrain, southern Siberia), Africa (Socotra, Namibia, S. Africa), N. America (widespread), C. America (Mexico).

**Heppia lobatoplicata** (de Lesd.) ined.
Grube et al. (2001) ascribed the combination to Timdal, but it does not appear to have been formally published.; *Psora lobatoplicata* de Lesd. (1936), *Bull. Soc. Bot. Fr.* 83: 6.

Nimis (2016) considered the name to be a synonym of *H. despreauxii*, but for the moment I prefer to reserve judgment.

Crete, at altitudes 0 - 900 m. The substrate was not stated.

The Cretan reports are the only ones that I have seen.

**Heppia solorinoides** (Nyl.) Nyl. (1858)


Crete and islands of the southern Aegean, on calcareous soil and rock at altitudes 100 - 1000 m.

Southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (widespread as far east as southern Siberia), Africa (Morocco, Algeria, Tunisia, Socotra).

**Hertelidea Printzen & Kantvilas (2004)**

*H. botryosa* (Fr.) Printzen & Kantvilas. Family: Stereocaulaceae.


Literature: Smith et al (2009) treat the only European species.

The genus has 5 species, but only one occurs in Europe.

**Hertelidea botryosa** (Fr.) Printzen & Kantvilas (2004)


Descriptions: Nash et al. (2004); Smith et al. (2004).

Athos Peninsula, on wood at an altitude of 800 m. Not recorded in Greece since 1941.

Widespread, though not common, in central and northern Europe, but very rare south of the Alps. Also Macaronesia, Asia (Russia, Mongolia), N. America (widespread ).
**Heterocephalacria Berthier (1980)**

*Mycotaxon* 12(1): 114. Type: *H. solida* Berthier, which is not lichenicolous. Family: *Carcinomycetaceae*.

- Literature: Diederich (1996), as *Syzygospora*.
- Four species of basidiomycetes, two of which are lichenicolous. There is only a single Greek report.

- 11 Basidia 10 - 18 µm long, with 1 - 2 basidiospores. On Parmeliaceae. (*Syzygospora parmeiliicola*).
- 1 Basidia at least 24 µm long, with 2 - 4 basidiospores. On other hosts.
- 22 Basidia 24 - 55 µm long. On Physciaceae. **H. physciacearum**
- 2 Basidia 50 - 90 µm long. On Cladonia. (*H. bachmannii*)

**Heterocephalacria physciacearum** (Diederich) Millanes & Wedin (2015)


- Description: Diederich (1996), as *Syzygospora physciacearum*.
- Epiros, on *Physcia leptalea* at an altitude of 830 m.
- Middle latitudes of Europe, to southern Scandinavia in the north. In the south, probably restricted to the uplands. Also Macaronesia, Malesia (PNG), Africa (Ethiopia, Malawi, Rwanda), N. America (widespread), S. America (Colombia, Ecuador).

**Heterodermia Trevis. (1869)**


- Literature: Clauzade & Roux (1985) treat briefly the few species that might occur in Greece. For more extensive descriptions of some of them see: Nash et al. (2002); Smith et al. (2009).
- About 110 species, only 8 of which occur in Europe. Some are much too oceanic to occur in Greece, and Greece is at the limit of the range of the others.

- 11 Thallus dichotomously branched. Lobes long and narrow, with marginal cilia. **H. leucomelos**
  - 1 Thallus irregularly branched. Lobes broad, without marginal cilia (but rhizines may project beyond lobe margins).
  - 22 Lower cortex present. Lower surface pale brown to dark brown, K+ yellow. Marginal rhizines few or absent. (*H. speciosa*) Greek report needs confirmation.
  - 2 Lower cortex absent. Lower surface felted with yellow to rusty-brown pigment, K+ violet. Marginal rhizines present. (*H. obscurata*)

**Heterodermia leucomelos** (L.) Poelt (1965)


- Description: Nash et al. (2002); Smith et al. (2009).
- There are two poorly localised, 19th century reports for Sterea Ellada., on bark.
- Mainly parts of Europe with oceanic climate, rare in subcontinental climates (southern Germany, Switzerland, Ukraine). Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (widespread), N. America (widespread), Caribbean (widespread), C. America (widespread), S. America (widespread), Australasia (Queensland, NZN, NZS), Pacific (Hawaii, Tahiti).

**Heteroplacidium Breuss (1996)**


- Literature: The best starting point is probably Prieto et al. (2010).
- A segregate from *Catapyrenium s. lat.*, characterised by the cellular texture of the medulla. The very well developed thallus distinguishes *Heteroplacidium* from most species of *Verrucaria*. There are 12 species, mostly saxicolous or terricolous, or parasitic on lichens on those substrates. Nine species occur in Europe. The genus is uncommon in Greece.
11 Thallus ±squamulose.
22 Lower surface of squamules with rhizohyphae (Note 1).
  33 Squamules wart-like. Rhizoidal hyphae not in fascicles. Cells of upper cortex 5 - 8 µm diameter. Lower surface pale brown. (H. contumescens)
33 Squamules not wart-like, overlapping. Other characters various.
  44 Squamules densely overlapping, 150 - 400 µm thick. Perithecia pyriform or subglobose, to 0.35 mm diameter. **H. imbricatum**
  4 Squamules only slightly overlapping, 100 - 200 µm thick Perithecia subglobose, to 0.5 mm diameter. (H. divisum)
3 Squamules not wart-like, not overlapping. Other characters various. (H. acervatum), (H. congestum), (H. phaeocarpoides)
2 Rhizohyphae poorly developed or absent. (H. endocarpoides)
1 Thallus crustose to squamulose-areolate.
22 Parasitic on Circinaria calcarea, at least when young. Conidia 3 - 5 µm long. Ascospores 9 - 14 µm long, with ±thick wall about 1 µm wide. Medulla with some distinct cylindrical hyphae. Areoles to 1.5 mm wide. **H. fusculum**
2 Sometimes overgrowing other lichens, but not truly parasitic. Conidia 5 - 7 µm long. Ascospores 11 - 18 µm long, with thin wall. Medulla ±cellular. Areoles to 4 mm wide; margin sometimes crenulate or lobed. **H. compactum**

(1) Rhizohyphae are clearly visible in a thin section, but may not be apparent otherwise.

**Heteroplacidium compactum** (A. Massal.) Gueidan & Cl. Roux (2008)
  Descriptions: Clauzade & Roux (1985); Nash et al. (2007) - both as **Verrucaria compacta**; Prieto et al. (2010).
  It has been debated whether **H. compactum** is distinct from **H. fusculum** (see Moberg et al. 2017: 28), but the numerous reported differences between the two, as listed in the key above, suggest that they are distinct.
  All modern reports are from the islands of the southern Aegean, at altitudes 0 - 200 m, but there is a 19th century reports for the mountains of the northern Peloponnesse. On calcareous or siliceous rock.
  Southern and central Europe, to as far north as Belgium. Also Asia (Turkey, Israel, Iran, Mongolia), Africa (Algeria, S. Africa), N. America (widespread), C. America (Mexico), Australasia (S. Australia, NZS).

**Heteroplacidium fusculum** (Nyl.) Gueidan & Cl. Roux (2007)
in Gueidan et al., **Mycol. Res.** 111: 1157; **Verrucaria fuscula** Nyl. (1853), Bot. Notiser 1853: 161; **Dermatocarpon insulare** (A. Massal.) Mig.; **Verrucaria insularis** var. major Zehet.
  Thallus: crustose-areolate to almost subsquamulose, dark brown, not pruinose, usually forming small patches to 1 cm diameter on the host, sometimes entirely overgrowing it, without vegetative propagules. Areoles: 0.25 - 1.5 mm wide, usually flat, sometimes slightly convex, 400 µm thick. Perithecia: black, 0.07 - 0.2 mm diameter; in section: 100% immersed, ±globose, 180 - 250 µm diameter. Exciple: continuous below, brown to black in upper half, sometimes paler in lower half. Involucrellum: absent. Ascii: 43 x 15 µm. Ascospores: colourless, simple, subglobose to broadly ellipsoid, 9 - 11 x 6 - 9 µm, 8 per ascus.
  Fairly easily recognised by the dark brown areoles parasitic on **Circinaria calcarea**.
  Scattered in the southern half of Greece at altitudes 50 - 1300 m. Parasitic on **Circinaria calcarea**, at least when young, but may entirely overgrow the host and may then appear (and perhaps is) free-living.
  Scattered in southern and central Europe to as far north as southern Sweden. Also Macaronesia, Asia (Turkey, Syria, Iran, southern Siberia), N. Africa (Morocco, Algeria, Tunisia).

**Heteroplacidium imbricatum** (Nyl.) Breuss (1996)
  Thallus: squamulose, to 2.5 cm diameter, without vegetative propagules. Squamules: brown, sometimes white pruinose at tips, ±rounded to slightly elongate, 1 - 2.5 mm long, 0.7 - 2 mm wide, weakly adpressed to ±erect, overlapping, concave to convex, 150 - 300 µm thick, increasing to 500 µm near perithecia. Lower surface: white at margin, attached by rhizohyphae. Cortex: 30 - 60 µm thick, brown in outer part, colourless in inner part, distinctly cellular throughout; cells subrounded to angular, 5 - 12 µm diameter; sometimes overlain by structureless epinecral layer to 10 µm thick. Medulla: white, distinctly cellular. Lower cortex: poorly developed, scarcely differentiated from medulla except for presence of some brown pigment. Perithecia: laminal, appearing as dark brown to black dots, darker than squamule, 0.12 - 0.15 mm diameter; in section: 100% immersed, subglobose, 250 - 380 µm tall, 200 - 300 µm wide.

Differs from the other Greek species of the genus in having a distinctly squamulose thallus.

Known from two sites in western Greece, on limestone at altitudes 50 - 250 m.

Southern Europe, from Portugal to Greece. Also Macaronesia, Asia (Turkey, Tibet, NW China, Mongolia), N. Africa (Algeria).

Hydropunctaria Keller, Gueidan & Thüüs (2009)


Literature: For a discussion of the genus, see the protologue. Orange (2012) is also helpful. Its species are discussed under *Verrucaria* in most Floras.

*Hydropunctaria* has nine 9 species, all present in Europe. The genus is rare in Greece.

The poorly known *H. ligurica*, reported from Liguria and Corsica, is not included in the key. It may be synonymous with *H. adriatica* or *H. maura*.

11 On freshwater rocks. *(H. scabra)*
1 On marine rocks.

22 Thallus cracked to areolate. Perithecia 0.2 - 0.4 mm diameter. On calcareous or non-calcareous rock.
33 Dark tissue in thallus usually in the form of small dots, sometimes small ridges, 20 - 90 x 20 - 40 μm, sometimes reaching thallus surface. Apex of perithecia ±rounded. *(H. maura)* Greek reports doubtful.
3 Dark tissue in the form of distinctly elongated bars, 40 - 400 x 40 - 60 μm, always reaching surface. Apex of perithecia flat or wavy, not rounded. *(H. amphibia)*
2 Thallus continuous or with fine cracks. Perithecia 0.4 - 1 mm diameter. On calcareous rock. *H. adriatica*

Hydropunctaria adriatica (Zahlbr.) Orange (2012)

*Lichenologist* 44(3): 305 (A 2009 combination by Keller & Gueidan was not validly published); *Dermatocarpon adriaticum* Zahlbr. (1904), *Annls Mycol*. 2: 267; *Verrucaria adriatica* (Zahlbr.) Zahlbr. ex J. Steiner

Thallus: crustose, to several cm diameter, very dark brown to black, black dots often visible in paler parts, usually continuous, sometimes with a few cracks, thin (80 - 120 μm); in section with prominent black inclusions of a wide range of shapes and sizes but typically 30 - 80 μm in extent. Cortex: poorly developed; layer above photobiont cells 5 - 20 μm thick, colourless except where interrupted by black inclusions, without distinct structure, K-. Perithecia: absent over large areas, conspicuous when present, black, ±sessile, globose, 0.4 mm diameter, centrum 225 x 225 μm. Exciple: colourless in lower half of perithecia; in upper half not distinguishable from involucrellum. Involuteum: 600 μm diameter, with flat top and rather steep sides, not separating from centrum. Photobiont: green; cells globose, 5 - 7 μm diameter. Photobiont layer: 15 - 40 μm thick, ±regular but often interrupted by black inclusions.

The continuous thallus with black inclusions, and the unusual ecology are distinctive, and this species can be recognised even when sterile. Fertile collections are even more distinctive, as the almost sessile, globose perithecia are unusual for *Verrucariaceae*. *H. maura*, doubtfully reported for Greece, has a thicker areolate thallus. *Wahlenbergiella striatula*, not reported for Greece, usually has a green tinge and distinct black ridges on the thallus surface.

Alonisos, Corfu and Crete, on calcareous rock at sea level in the zone submerged by wave action. Greek reports of *H. maura*, from Rhodes and Thessaly, may also belong here.

Southern Europe, from Portugal to Greece and Ukraine. Also Asia (Turkey).

Hymenelia Kremp. (1852)


Literature: Lutzoni & Brodo (1995) discuss the circumscription of the genus. For accounts of individual species Clauzade & Roux (1985) is probably the best starting point.

About 19 species, about 13 of which occur in Europe. Most are restricted to cold regions. All are saxicolous, and most show a clear preference for wet, or at least moist rock. The genus is uncommon in Greece, where only 4 species have been reliably reported.
11 Photobiont Trentepohlia.

22 Apothecia pale pink or pale brown. Hymenium colourless. Ascospores 13 - 22 x 5 - 12 µm. Epithecium N-. **H. epulotica**


1 Photobiont chlorococcoid.

22 Epithecium blue, N+ purple. Ascospores 6 - 15 x 5 - 11 µm. (H. coerulea) Greek reports probably incorrect.

2 Epithecium yellowish, N-. Ascospores 14 - 25 µm long.


**Hymenelia epulotica** (Ach.) F. Lutzoni (1995)

Descriptions: Clauzade & Roux (1985) as *Ionaspis epulotica*; Smith et al. (2009). Crete and Mt. Olympus, on calcareous rock at altitudes 0 to about 2000 m. Fairly widely distributed in Europe. Also Asia (Russia, Taiwan), N. America (widespread).

**Hymenelia melanocarpa** (Kremp.) Arnold (1869)
*Flora* 52: 255; *Hymenelia prevostii* ß (= f.) *melanocarpa* Kremp. (1852), *Flora* 35: 25; *Ionaspis melanocarpa* (Kremp.) Arnold.

Thallus: crustose, white, almost entirely endolithic, forming (in the only collection seen) a small patch 2 x 1.5 cm. Prothallus: faint, black, 0.05 mm wide. Apothecia: immersed in pits in substrate, irregular, often rather angular, 0.35 - 0.5 mm diam. Disc: black, sometimes white pruinose. Thalline margin: poorly developed. Epithecium: pale green-blue, K-, some pigment soluble in K, N+ red. Hymenium: 85 - 125 µm tall, colourless in lower part, upper part with some green-blue pigment. Hypothecium: colourless. Ascospores: colourless, simple, ellipsoid, 11 - 16 x 7 - 10 µm. Chemistry: thallus C-. Photobiont: Trentepohlia.

The immersed apothecia and blue epithelial pigment are diagnostic.

Mt. Killini region and Mt. Athens. On calcareous rock at altitudes 1700 m and above. Fairly widely distributed, but south of the Alps restricted to high mountains. Also Asia (Russia), N. America (Alaska, northern Canada).

**Hymenelia prevostii** (Duby) Kremp. (1852)
*Flora* 35(2): 25; *Urecolaria prevostii* Duby (1830), Bot. Gall. 2: 671; *Hymenelia affinis* A. Massal.; *Ionaspis prevostii* (Duby) Arnold; *Lecanora prevostii var. affinis* A. Massal.; *Lecidea prevostii* (Duby) Schauer.

Descriptions: Clauzade & Roux (1985); Smith et al (2009). Reliably reported for Chios, on limestone at an altitude of 375 m. There are also old reports for western Greece, but their status is uncertain.

Throughout Europe. Also western Asia (widespread, but no further east than Oman and Urals), N Africa (Algeria).

**Hymenelia similis** (A. Massal.) M. Choisy (1949)

Description: Clauzade & Roux (1985).

Chios and Mt. Olympus, on calcareous rock at altitude 880 - 1000 m. Southern and central Europe. I have not seen any reports for other continents.

**Hyperphyscia Müll. Arg.** (1894)

Literature: The only European species is treated in Smith et al. (2009). *Hyperphyscia* has 21 species, only one of which occurs in Europe.

Thallus: foliose, to about 1 cm diameter, green-grey, not pruinose. Lobes: 0.5 - 1.5 x 0.1 - 0.3 mm, strongly adpressed, 90 - 100 µm thick. Soralia: usually abundant, green; initially rounded, delimiting and usually marginal, later sometimes coalescing or expanding to lobe margins. Upper cortex: 15 µm thick, colourless, obscurely cellular. Medulla: white. Lower cortex: 10 µm thick, colourless, hyphal, clearly developed near tips of lobes but elsewhere absent or scarcely distinguishable from medulla. Chemistry: soralia K-; thallus K-, UV-. Photobiont: green, cells 8 - 12 µm diameter, forming a continuous, regular layer 25 - 30 µm thick.

Easily recognised by the small, strongly adpressed, sorediate lobes. Could be confused with some species of *Phaeophyscia*, but they have a well developed, dark coloured, cellular lower cortex.

Scattered, mainly in the northern half of Greece, but present as far south Crete, generally avoiding strongly inland localities. On bark at altitudes 0 - 930 m. Recorded from numerous phorophytes, with no clear preference.

Cosmopolitan outside cold regions. Throughout Europe except for the far north. Also Macaronesia, Asia (widespread), Maleasia (PNG), Africa (widespread), N. America (widespread), Caribbean (DR, PR, St Croix, perhaps Bahamas), C. America (CR, Guatemala, Mexico, Nicaragua), S. America (widespread), Australasia (widespread), Pacific (Hawaii, New Caledonia).

**Hypocenomyce M. Choisy (1951)**


Literature: The only European species is treated in all the standard floras.

A small genus of three species, two of which are restricted to the southern Hemisphere.

**Hypocenomyce scalaris (Ach.) M. Choisy (1951)**


Thallus: squamulose. Squamules: not adpressed, attached along one edge only, 0.2 - 1.7 mm wide along side where attached, 250 - 400 µm thick. Upper surface: pale brown, not pruinose. Lower surface: white. Soralia: present on free margin of squamules, often extending onto lower surface. Upper cortex: 20 µm thick, brown in upper half, colourless in lower half, structure indistinct; K-, pigment soluble in K. Medulla: white; in section: of randomly oriented hyphae 2 - 5 µm wide. Apothecia: infrequent, sessile, flat, 0.45 - 0.8 mm diameter. Disc: black. Thalline margin: absent. Exciple: black, sometimes slightly white pruinose, persistent; in section: 50 µm wide, dark brown, of radiating hyphae. Epithecium: blue-black to green-blue, K-, pigment not soluble in K. Hymenium: 55 µm tall, colourless or with epithelial pigment in upper part. Hypothecium: brown to dark grey. Paraphyses: usually simple, 1.5 - 2 µm wide, not capitulate or moniliform, without visible septa. Chemistry: soralia and upper surface of thallus C+ red. Photobiont: green, of globe or subglobe cells 10 - 13 µm diameter, forming a continuous, regular layer 50 - 60 µm thick.

The pale brown, sorediate squamules reacting C+ red can not be confused with any other species.

Scattered in mainland Greece and Corfu, on wood or acidic bark, usually at altitudes 800 - 1250 m, rarely lower. The lichenicolous fungus *Clypeococcus hypocenomycis* has been reported once on this host.

Throughout Europe except for the high arctic, but nowhere very common. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (CR, Mexico), S. America (Colombia), Australasia (widespread).

**Hypogymnia (Nyl.) Nyl. (1896)**


Differs from Parmelia in having hollow and ±swollen lobes, and in lacking rhizines.

About 98 species worldwide, with a centre of distribution being North America and eastern Asia. Rather poorly represented in Europe, where only 10 species occur. Most species occur on ±acidic bark or wood, occasionally rock, in cool to cold habitats. In Greece, Hypogymnia is restricted to upland regions. Six species have been reported for Greece, but reports of two of them are doubtful or in need of confirmation.

111 Thallus without soralia, isidia or surface folds. (H. vittata) Greek reports need confirmation.
11 Thallus with delimited marginal soralia, but without laminal soralia or surface folds.
22 Soralia capitate. Medulla P-. H. tubulosa
2 Soralia lip-shaped on upturned lobe ends. Medulla P+ orange to red. H. physodes
1 Thallus with laminal soralia and/or surface folds.
22 Upper surface of lobes dark brown. Soralia forming by gradual dissolution of upper cortex. (H. bitteri) Greek report needs confirmation.
2 Upper surface of lobes grey. Soralia developing along cracks in cortex.
33 Lobes strongly overlapping. Medulla P+ orange-red or P-. If present in Greece, probably restricted to sites with suboceanic microclimate. (H. bryophila)
3 Lobes not overlapping, or not much. Medulla P-
44 Thallus to 5 cm diameter. Lobes 1 - 3 mm wide, closely adpressed. Soralia not strongly rugose. H. farinacea
4 Thallus 4 - 10 cm diameter. Lobes 2 - 5 mm wide, loosely adpressed and becoming free at margins. Soralia strongly rugose. Note 1. H. laminisorediata

(1) Juvenile or poorly developed specimens of H. laminisorediata may be impossible to separate from H. farinacea.

**Hypogymnia farinacea** Zopf (1907)
*Justus Liebig's AnnIn Chem.* 352:42; Hypogymnia bitteriana (Zahlbr.) Räsänen; Parmelia farinacea Bitter.

Description: Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Scattered, at altitudes 600 to over 2000 m. Usually on bark, rarely on siliceous rock. Most corticolous records are from Pinus, but reported once from Sorbus terminalis. H. farinacea can be confused with H. laminisorediata, and some reports may refer to the latter.

Present in most cool regions of Europe, but absent from truly arctic habitats; in southern Europe usually confined to the mountains. Also Asia (widespread), perhaps N. Africa (Morocco), N. America (widespread), perhaps C. America.

**Hypogymnia laminisorediata** D. Hawksw. & Poelt (1973)

Thallus: foliose, to 9 cm diameter. Lobes: hollow, elongate, 11 - 15 x 2 - 5 (8) mm wide, flat to slightly convex, not or only weakly adpressed, strongly rugose in central part of thallus; margins often wavy, often with small indentations. Upper surface: pale grey to blue-grey, sometimes slightly shiny near tips of lobes, not pruinose. Lower surface: dark brown to black, usually rather wrinkled, without rhizines. Soralia: usually present in central parts of thallus but often not well developed, laminal. Upper cortex: 25 - 50 µm thick, colourless to pale brown or pale orange-brown, with a rather weak cellular structure; cells rounded, about 6 µm diameter. Medulla: present on both upper and lower inside surfaces of hollow lobes, white; of loosely interwoven, broad hyphae, 3 - 5 µm wide, densely encrusted with fine crystals less than 1 µm diameter. Lower cortex: present. Apothecia: often present, laminal, usually on a hollow stalk up to 2 mm long, concave, 1.5 - 5 mm diameter, not pruinose. Disc: pale brown to dark brown, slightly shiny. Thalline margin: present, thin but persistent; in section 110 - 130 µm thick. Exciple: not visible externally, poorly developed in section. Epithecium: pale orange brown, K-; some pigment soluble in K. Hymenium: 45 µm tall, colourless. Hypothecium: 100 µm tall, colourless, of two distinct layers; upper layer 25 µm tall, with hyphae parallel to surface of disc; lower layer with more randomly oriented hyphae. Asci: ±Lecanora type. Ascospores: colourless, simple, ellipsoid, 6 - 7 x 4 µm, with distinct wall a little under 1 µm thick, 8 per ascus. Pycnidia: often present, especially near tips of the lobes, laminal, appearing externally as black dots 0.05 mm diameter; in section: 100% immersed, subglobose, 130 - 160 µm tall, 100 - 130 µm wide; wall dark brown everywhere, thin (and so may appear pale brown or even colourless if not properly in focus), about 5 µm thick. Conidia: colourless, bifusiform, 5 x 0.5 µm. Chemistry: cortex K+ yellow, C-, KC-, P-, UV-; medulla K-; C, KC+ pink > orange, P-, UV-. Photobiont: green, cells globose, 10 - 12 µm diameter, forming a continuous layer to 150 µm thick.

This species has not received much attention since its original description, and is not well known. It could only be confused with *H. farinacea*, which is chemically (Zeybek et al., 1993) and morphologically similar, but *H.*
*laminisorediata* is a distinctly larger and more robust species, although juvenile material may be difficult to place. It might be better regarded as a subspecies of *H. farinacea* that is restricted to Mediterranean and Macaronesian mountains.

Montane forests of Peloponnese and Attica, at altitudes 980 - 1230 m, on bark, usually of conifers but recorded once from *Quercus coccifera*, or on wood of *Juniperus oxycedrus*.

In Europe, only southern Italy, Serbia and Greece. Also Macaronesia (Canary Is), western Asia (Turkey), N. Africa (Morocco).

**Hypogymnia physodes** (L.) Nyl. (1896)


Description: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Widely distributed, at all altitudes, but absent from Peloponnese and Crete. Usually on bark, especially of conifers, rarely on siliceous rock.

Present in most of Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread). Reports for Caribbean (Bermuda), C. America (CR), S. America (Argentina) and Australasia seem doubtful to me.

**Hypogymnia tubulosa** (Schaer.) Hav. (1918)


Thallus: foliose, to 7 cm diameter. Lobes: 1 - 3 mm wide, hollow, flat to convex, usually smooth, occasionally slightly wrinkled, dichotomously branched, 0.7 mm thick near tips, to 2 mm thick when mature, most of the thickness being the central cavity. Upper surface: grey, not pruinose. Lower surface: black, attached directly to substrate in central part of thallus, elsewhere unattached, without rhizines. Soralia: always present, on slightly expanded apices of the lobe, circular or globose, 1.2 - 4 mm diameter. Upper cortex: 25 µm thick, very pale brown, with weakly cellular texture of rather rounded cells; K-, pigment soluble in K. Lower cortex: pale brown, weakly cellular. Apothecia: very rare, on short stalks 1 - 2 mm tall, concave to flat, 3 - 5.5 mm diameter. Disc: dark brown, slightly shiny, not pruinose. Thalline margin: present, persistent slightly crenulate. Exciple: not visible externally. Chemistry: medulla K-, C-, KC+ briefly purple-pink then fading to ±permanent orange, P-, I-; soralia K+ yellow, C-, KC+ brown-orange, P-, UV+ whitish; thallus K+ yellow, C-, KC-, P-, UV-. Photobiont: green, trebouxioid; cells globose, 10 - 12 µm diameter, forming a layer 80 - 100 µm thick.

The only apothecia seen appeared well developed externally, but in section they lacked well-developed anatomical structures.

Could only be confused with *H. physodes*, but the two species differ clearly in the morphology of the soralia.

Almost throughout Greece, but absent from Crete. Usually on bark, especially of conifers, occasionally on wood. At all altitudes above 150 m where there are suitable substrates, but commonest in montane forests at 1000 - 1500 m. Most of Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Kenya), N. America (widespread), C. America (Mexico).

**Immersaria** Rambold & Pietschm. (1989)


Literature: Calatayud & Rambold (1998) give an overview of the genus, but their paper is not a monograph and does not have descriptions of all species.

Nine species, 5 of which occur in Europe. The genus is not common in Greece.

11 Thallus olive (caused by blue-green pigment in cortex), C-. Medulla I-. Ascospores 9 - 14 x 4 - 7 µm. Conidia clavate to pyriform. (I. olivacea)

1 Thallus some shade of brown, C- or C+ pink. Medulla usually I+ violet (but sometimes I- in I. cupreoatra). Ascospores various. Conidia clavate or bacilliform.

22 Disc black, ±white-pruinose.

33 Thallus brown to yellow-brown, C-. Hypotheicum brown in lower part. Ascospores 14 - 17 (19) x 8 - 11 µm. *I. athroocarpa*

3 Thallus olive-brown, C+ pink. Hypotheicum colourless. Ascospores 13 - 22 x 7 - 14 µm. (I. usbekica)

2 Disc dark brown to black, not pruinose.
33 Thallus brown, C+ pink. Conidia bacilliform. Pycnidia opening by a simple pore. **I. cupreoatra**

3 Thallus brown to red-brown, C-. Conidia mostly clavate, rarely bacilliform. Pycnidia opening by ±radiating, winding cracks. (I. iranica)

**Immersaria athroocarpa** (Ach.) Rambold & Pietschm. (1989)
in Rambold, Biblioth. Lichenol. 34: 240; *Lichen athroocarpus* Ach. (1799), Lichenogr. Svec. Prodr. 77 as athroocarpus, but in later works Acharius used athroocarpus.

Unfortunately, *Lichen athroocarpus* Ach. is a superfluous name for *Verrucaria fassiculata* Hoffm. (1796). Conservation is desirable. Here I treat Acharius's name as though it were already conserved, and thus legitimate.

Description: Clauzade & Roux (1985) as *Amygdalaria athroocarpa*; Nash et al. (2004); Smith et al. (2009). Islands of the Aegean, at altitudes 490 -1070 m, usually on siliceous rock, once parasitic on *Aspicilia intermutans*.

Subcosmopolitan. Widespread in Europe. Also Macaronesia, Asia (widespread), Malesia (Sabah), Africa (S. Africa), N. America (Newfoundland, Arizona, Michigan), Australasia (widespread in temperate parts), Antarctica (Macquarie Is, Antarctic Peninsula).

**Immersaria cupreoatra** (Nyl.) Calatayud & Rambold (1998)*Lichenologist* 30(3): 232; *Lecanora cupreoatra* Nyl. (1866), Lich. Lapp. Or. 181; *Aspicilia cupreoatra* (Nyl.) Arnold; *Aspicilia olivacea* Bagl. & Car. (non *Immersaria olivacea* Calatayud & Rambold); *Bellemerea cupreoatra* (Nyl.) Clauzade & Cl. Roux; *Lecanora olivacea* (Bagl. & Car.) J. Steiner.

The earliest name is *Aspicilia olivacea* Bagl. & Car. (1864), but the epithet is not available in *Immersaria*.

Descriptions: Calatayud & Rambold (1998); Clauzade & Roux (1985) as *Bellemerea cupreoatra*.

Scattered throughout Greece, on siliceous rock at altitudes from 130 m to alpine levels. Reports from low altitude are surprising, but they are modern ones made by an experienced lichenologist.

Scattered in northern Europe and the Alps, uncommon in the south. Also Asia (widespread), perhaps N. America.


Literature: Nash et al. (2004) is the most convenient starting point.

The genus contains a single species.


Description: Clauzade & Roux (1985) as *Diploschistes bisporus*; Nash et al. (2004).

Aegean and adjacent coasts of the mainland, at altitudes 250 - 1100 m. On siliceous rock or parasitic on *Aspicilia intermutans*. The lichenicolous fungus *Karschia talchophila* has been reported once from this host.

Widespread in southern Europe and the Alps, though not very common. Also Macaronesia, Asia (Turkey, Iran, Nepal, Japan), Africa (S. Africa), N. America (California), S. America (Argentina, Chile, Uruguay, Brazil), Australasia (warm temperate parts).


Literature: The best starting point is Hawksworth & Cole (2002).

Four species of lichenicolous hyphomycetes, all present in Greece, though there are very few records.

111 Conidia 2- or more -septate or submuriform. **I. lichenicola**

11 Conidia mostly 1-septate, at least eventually.

22 Conidia 5 - 8 x 4 - 6 µm. **I. christiansenii**

2 Conidia 8.5 - 12 x 7 - 9.5 µm. **I. baccisporus**

1 Conidia mostly simple. **I. lichenenum**


Description: See the protologue.
Known from a single site in Macedonia, where it occurred on *Caloplaca holocarpa* at an altitude of 1740 m. Scattered in NW and central Europe, but also reported for Sicily and Greece. Also Asia (Turkey), N. America (Nova Scotia, California, Nebraska).


Crete and Attica, at altitudes 20 - 1870 m. Hosts were *Candelariella antennaria*, and a *Lecanora* sp.

Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), N. America (widespread), C. America (Mexico). This appears to be a common species, but according to Nash et al. (2004) it may be heterogeneous.


Crete, at an altitude of 1970 m, on *Candelariella* sp.

Widespread in central and northern Europe, rare south of the Alps and Pyrenees. Also Macaronesia, Asia (Turkey, Russia), N. America (California), S. America (southern Chile).

**Intralichen lichenenum** (Diederich) D. Hawksw. & M. S. Cole (2002)


Description: See the protologue.

Crete, at an altitude of 1500 m, on *Candelariella unilocularis*.

Widespread in central and northern Europe, rare south of the Alps and Pyrenees. Also Asia (Turkey), Malesia (PNG), N. America (Alaska, Minnesota).

**Ionaspis** Th. Fr. (1871)


Literature: There is no convenient monograph. The best staring point is probably Smith et al. (2009). A rather poorly known genus, with about 17 species, though the status of some is uncertain. Most occur on siliceous rock. Eight species are reported for Europe. The genus is very rare in Greece.

11 On periodically submerged siliceous rock. **I. lacustris**

1 Not aquatic. **I. cerea**

**Ionaspis cerea** (Arnold) Jatta (1910)


Known from a single site in western Macedonia, where it occurred on sandstone at an altitude of 1740 m. Scattered in northern and central Europe, very rare south of the Alps. Also Macaronesia (Azores), Asia (Turkey, Siberia, Taiwan), N. Africa (Morocco), N. America (New Brunswick, Newfoundland).

**Ionaspis heteromorpha** var. *regelii* Rässänen (1944)

*Hedwigia* 81: 233.

This variety was described from Attica, on limestone, but the application of the name is not clear. The type, and only, collection needs to be studied.

**Ionaspis lacustris** (With.) F. Lutzoni (1995)


Description: Smith et al (2009).

Reliably reported for Chios, where it occurred on periodically wet siliceous rock at an altitude of 420 m. There is an early 19th century report of what might be this species from Tinos.
Throughout northern and central Europe, very rare south of the Alps and Pyrenees. Also Macaronesia, Asia (widespread), N America (widespread), S America (Brazil), Australasia (widespread).

**Jamesiella Lücking, Sérus. & Vězda (2005)**

*Lichenologist* 37(2): 165. Type: *J. anastomosans*. Family: *Gomphillaceae*.

Literature: The European species are treated in Smith et al. (2009).

*Jamesiella* was segregated from the large, and mostly tropical genus *Gyalideopsis*. It contains four species, two of which occur in Europe. One of those is northern and will not occur in Greece. For the other there is a single Greek report.

**Jamesiella anastomosans (P. James & Vězda) Lücking, Sérus. & Vězda (2005)**


Descriptions: Clauzade & Roux (1985); Nash et al. (2004) both as *Gyalideopsis anastomosans*; Smith et al. (2009). Naxos, on bark at an altitude of about 540 m.

NW Europe as far north as southern Scandinavia, and central Europe as far east as Ukraine; rare south of the Alps. Also Macaronesia, N. America (widespread), Australasia (NZN, NZS).

**Julella Fabre (1879)**


Literature: Between them, Clauzade & Roux (1985) (under *Polyblastiopsis*) and Nash et al. (2002) treat the four species in the key below.

About 17 species of corticolous ascomycetes, 8 of which occur in Europe. Though not lichenised, they are often encountered by lichenologists and are sometimes studied by them. The genus is very rare in Greece.

11 Ascospores 2 - 6 per ascus. (*J. lactea*)
1 Ascospores 8 per ascus.
22 Most ascospores less than 20 µm long. (*J. sericea*)
2 Most ascospores more than 20 µm long.
33 Perithecia 0.2 - 0.3 mm diameter. (*J. myrticola*)
3 Perithecia 0.5 - 1 mm diameter. *J. vitrispora*

**Julella vitrispora (Cooke & Harkn.) M. E. Barr (1986)**

*Sydowia* 38: 13; *Pleospora vitrispora* Cooke & Harkn. (1881), *Grevillea* 9(51): 86; *Polyblastia sublactea* (Nyl.) Arnold; *Verrucaria sublactea* Nyl.

Description: Nash et al. (2002).

Corfu, on bark of *Olea europaea* at close to sea level. Not reported for Greece since the 19th Century.

Southern Europe, from Portugal to Greece. Also eastern Asia (HK), Malesia (PNG), N. America (California, Florida, Louisiana), Caribbean (PR), C. America (Mexico), S. America (Guyana), Pacific (Hawaii).

**Karschia Körb. (1865)**


Literature: Clauzade, Diederich & Roux (1989) treat all but one of the well-defined European species. The other will not occur in Greece.

About 9 names at species rank have been referred to this genus of lichenicolous fungi, but some denote poorly known taxa and others may not belong to *Karschia* sensu stricto. Five species are recorded for Europe. Two are known from Greece, but there are no recent reports.

11 Paraphyses simple or only occasionally branched. (These species do not belong to *Karschia* sensu stricto.)
22 Hypothecium pale.
33 Apothecia initially immersed within thallus of host, eventually becoming sessile. *K. sordidae*
3 Apothecia remaining at least partly immersed in thallus of host. (*K. anziana*)
2 Hypothecium dark brown.

33 Apothecia 0.1 - 0.2 mm diameter. On Squamarina cartilaginea (K. crassaria)

3 Apothecia 0.2 - 0.8 mm diameter. On various hosts.

44 Epithecium blueish. Ascospores 16 - 20 x 8 - 9 µm. On Lecidella carpathica. (K. latypizae)

4 Epithecium brown. Ascospores 10 - 15 x 6 - 8 µm. On various saxicolous lichens. See Buellia badia

1 Paraphyses branched or anastomosing.

22 Hymenium I+ orange-red. On Porpidia. (K. santessonii)

2 Hymenium I-. On Diploschistes. K. talcophila

Karschia sordidae J. Steiner (1898)


Description: See the protologue.

Sterea Ellada, at about 900 m on Lecanora rupicola.

Known only from the type collection and another collection made with it. Its status needs to be clarified.

Karschia talcophila (Ach.) Körb. (1865)

Parerga Lichenol. 460; Lecidea talcophila Ach. (1810), Lichenogr. Universalis 183-184.

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004).

Attica, at about 1100 m on Ingvariella bispora. Not recorded since 1893.

Widespread in Europe. Also Asia (China), N. Africa (Morocco), N. America (Arizona), C. America (Guatemala, Mexico), S. America (Colombia), Australasia (Australia).

Koerberia A. Massal. (1854)

Geneac. Lich. 5-6. Type: K. biformis A. Massal., the only species originally included. Family: Koerberiaceae.

Literature: Burgaz (2011) is best. Clauzade & Roux (1985) treat the two European species under 'Koerbera'.

The genus contains two species, both of which occur in Europe. Only one has been reported for Greece.

11 Isidia present. Ascospores spirally twisted in ascus. On bark. K. biformis

1 Isidia absent. Ascospores not spirally twisted in ascus. On rock. (K. sonomensis)

Koerberia biformis A. Massal. (1854)

Geneac. Lich. 6; 'Koerbera biformis auct.


Scattered in the western half of Greece, on bark at altitudes 200 - 1000 m. Recorded from: Platanus orientalis, Prunus sp. and Quercus pubescens.

Southern Europe, from Portugal to Greece. Also Asia (Turkey, southern Siberia), N. Africa (Morocco), western N. America (Arizona, California, Washington).

Labrocarpon Etayo & Pérez-Ortega (2010)


Literature: See the protologue.

The genus has a single, rather poorly-known species that is parasitic on Pertusaria.

Labrocarpon canariense (D. Hawksw.) Etayo & Pérez-Ortega (2010)


Description: Clauzade, Diederich & Roux (1989) as Melaspilea canariensis, or see the protologue of Melaspilea canariensis.

Naxos, at an altitude of 820 m, on a corticolous species of Pertusaria pertusa.

Southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Turkey), S. America (Brazil).
Lambiella Hertel (1984)


About 7 species, all of which occur in Europe. The genus is distinctly northern in Europe, and is rare in Greece.

11 Parasitic on lichens on siliceous rock. Ascospores no more than 16 µm long.

22 Thallus dark brown to black. Ascospores 12 - 16 x 7 - 9 µm. On various lichens. **L. furvella**

2 Thallus pale brown. Ascospores 7 - 14 x 5 - 7 µm. On Lecanora rupicola s. lat. **L. insularis**

1 Not parasitic. Ascospores 16 - 28 x 8 - 14 µm. (Rimularia gibbosa) Greek reports need confirmation.

**Lambiella furvella** (Nyl. ex Mudd) M. Westberg & Resl (2015)

Descriptions: Clauzade & Roux (1985) as *Lecidea furvella*; Hertel & Rambold (1990); Smith et al. (2009) both as *Rimularia furvella*.

Scattered in Macedonia, at altitudes 200 - 1860 m, on *Lecidea fuscoatra* and *Rhizocarpon geographicum*. Widespread in northern and central Europe, rare south of the Alps. Also western Asia (Syria), Malesia (Sabah), N. America (Alaska, Nova Scotia, Colorado).

**Lambiella insularis** (Nyl.) T. Sprib. (2014)

Descriptions: Clauzade & Roux (1985) as *Lecidea insularis*; Hertel (1990); Nash et al. (2004); Smith et al (2009), the last three as *Rimularia insularis*.

Scattered, with no clear pattern, at altitudes 600 - 2100 m. An obligate parasite of *Lecanora rupicola*. A report from rock (schist) may be incorrect, or perhaps the host was overlooked.

Predominantly northern in Europe; in the south it is quite widespread but sporadic. Also Macaronesia, Asia (Turkey, Syria, Iran, Russia), N. America (widespread), C. America (Mexico), S. America (Chile), Australasia (SE Australia, NZS).

Lasallia Mérat (1821)


About 16 species, on siliceous rocks. Five occur in Europe but two have very restricted European ranges and will not occur in Greece.

11 Thallus 5 - 20 cm diameter. Isidia abundant, papillate or coralloid. Apothecia often absent. **L. pustulata**

1 Thallus 3 - 5 cm diameter. Isidia sometimes few, squamiform. Apothecia usually present.

22 Lower surface black. (L. brigantium)

2 Lower surface grey to dark brown. (L. hispanica)

Lasallia pustulata (L.) Mérat (1821)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, mainly in the north but with a disjunct report for Crete. On siliceous rock at altitudes 500 -1800 m. Throughout Europe except the far north, though in the south commonest in the uplands. Also Macaronesia, Asia (widespread), Africa (widespread). Reports for N. and C. America are probably incorrect.

Lathagrium (Ach.) Gray (1821)


Literature: Ahti et al. (2007), Carvalho (2012), and Smith et al. (2009) treat the Greek species, under *Collema*.
Thallus: foliose, homoiomerous, brown to black, without a cortex. Lobes: without ridges or pustules. Isidia: often present, globose. Apothecia: sessile on lobes, slightly concave to ±flat, 0.5 - 2.5 mm diameter, not pruinose. Disc: brown to dull red-brown. Thalline margin: present. Exciple: in section distinctly cellular. Epithecium: orange-brown to brown, K-.

Hymenium: colourless to pale orange-brown. Hypothecium: colourless to pale orange-brown, sometimes distinctly cellular. Paraphyses: simple, not capitate. Ascii: Collema type. Ascospores: colourless, submuriform or muriform, ellipsoidal, sometimes slightly rhomboid, ends sometimes slightly pointed, 20 - 35 x 8 - 15 µm, (4) 8 per ascus. Photobiont: Nostoc; cells globose or broadly ellipsoidal, 4 - 6 µm diameter (heterocysts to 7.5 µm), in chains of up to 24 cells; sometimes more abundant near upper and lower surfaces of lobes than in centre, but thallus not truly stratified.

Lathagrium is a segregate from Collema s. lat. for a group of species that usually occur on calcareous rock or soil and in which the lobes are not swollen. At present, 10 species are recognised, 6 of them in Europe. Five species are reported for Greece. Some are widespread and common.

11 Isidia present.

22 Mature isidia distinctly squamulose (Note 1). L. latzeli

2 Mature isidia ±globose (Notes 1 and 2).

33 Lobes linear and ±deeply channelled, ±narrow, to 3 mm wide; margins sinuose. Ascospores submuriform. Usually on calcareous rock. L. cristatum

3 Lobes rounded or linear, but not deeply channelled. Ascospores septate or submuriform. On various substrates. 44 Thallus swelling when wet to 200 - 500 µm thick (most easily observed in thin section). Lobes brownish, not pustulate but often finely striated, often distinctly paler than isidia. Ascospores submuriform. Usually on bryophytes on calcareous rock, sometimes directly on calcareous rock; rarely on bark and then usually associated with bryophytes. L. auriforme

4 Thallus to about 200 µm thick when wet. Lobes mostly blackish (may be brownish near margins), concolourous with isidia or not. Ascospores septate or submuriform. Usually directly on calcareous rock. 55 Ascospores 3-septate, linear-oblong. Lobes usually ±smooth, not pustulate at margins, concave, undulate, curled and ascending, often overlapping, to 3 mm wide. Isidia ±concolourous with lobes. Confined to the uplands. L. undulatum var. granulosum

5 Ascospores submuriform, ellipsoidal with pointed ends. Lobes sometimes slightly pustulate at margins, to 5 mm wide; margins ascending and undulate. Isidia sometimes darker than lobes. At all altitudes. L. fuscovirens

1 Isidia absent.

22 Ascospores with only transverse septa. L. undulatum var. undulatum

2 Ascospores submuriform or muriform.

33 Apothecia usually more than 1 mm diameter. Ascospores ellipsoid. L. cristatum

3 Apothecia to 1 mm diameter. Ascospores oval-subglobose or ±cuboid. L. latzeli

(1) Examine mature isidia at the centre of mature lobes. Others are usually globose.

(2) These species can be difficult to separate, especially when sterile, which they often are. Well-developed sterile specimens can often be determined, if careful attention is paid to morphology of the lobes, but scanty or juvenile material generally can not.

Lathagrium auriforme (With.) Otálora, P. M. Jorg. & Wedin (2013)

Fungal Diversity 64(1): 287; Riccia auriformis With. (1776), Bot. Arr. Veg. Gr. Brit. 704; Collema auriculatum Hoffm.; (?) Collema auriculatum f. adspersum (Kremp.) Szatala (as 'adspersa'); (?) Collema auriculatum f. papulosum auct. graec.; Collema auriforme (With.) Coppens & J. R. Laundon; Collema granosum (Weber) DC.; Collema pulposum C. (= var.) granulosum (Ach.) Ach.; Collema tenax f. papulosum (A. Massal.) Degel.; Collema tenax f. vulgaris Degel.

Thallus: foliose, to 2.5 cm diameter, homoiomerous, becoming distinctly pulpy when wet. Lobes: 4-5 mm wide, rounded, without ridges but sometimes with fine striations, not adpressed, 150 µm thick when dry, 330 - 450 µm when wet. Upper surface: brown to dark brown, not pruinose. Lower surface: grey, without rhizines or hairs. Isidia: black, noticeably darker than lobes, globose, 0.08 - 0.15 mm diameter, mostly laminal, a few marginal. Upper and lower cortex: absent; in section lobes colourless in central part, orange-brown in top 25-40 µm and bottom 30-60 µm (measured when wet); hyphae 3 µm wide, often with visible septa. Photobiont: Nostoc; cells globose to broadly ellipsoidal, 4-6 µm diameter, in long chains, not forming a distinct layer.

The brownish colour, the large rounded lobes without ridges or pustules and which are not swollen at the tips, and the ecology are usually enough to separate L. auriforme from other species.

Fairly common, and probably present throughout Greece. Usually associated with bryophytes, whatever the
substrate. Most commonly encountered on limestone, but sometimes terricolous or corticolous. At altitudes from sea level to at least 2300 m.

Throughout much of Europe except for the far north. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia, Egypt), N. America (widespread), perhaps S. America (Argentina).

Lathagrium cristatum (L.) Otálora, P. M. Jorg. & Wedin (2013)
Fungal Diversity 64(1): 287; Lichen cristasus L. (1753), Sp. Pl. 1143. (The name has a conserved type.); Collema cristatum Hoffm.; Collema cristatum (L.) F. H. Wigg.; Collema cristatum var. jacobaeaeolium (Schrank) ined. (as 'jacobaeaeolium'); Collema cristatum var. marginale (Huds.) Degel.; Collema cristatum subf. papulosum (Ach.) Degel.; Collema granuliferum Nyl.; Collema melaenum (Ach.) Ach.; Collema melaenum γ C. (= var. jacobaeaeolium (Schrank) Ach.; Collema multifidum (Scop.) Rabenh.; Collema multifidum c. (= var.) complicatum (Schaer.) Rabenh.; Collema multifidum (letter) f. (= var.) jacobaeaeolium (Schrank) Rabenh.; Collema multifidum f. marginale (Huds.) J. Steiner; Collema multifidum d. (= var.) marginale (Huds.) Rabenh.

Two varieties are sometimes recognised:

11 Lobes short and broad, ±overlapping. Isidia absent. var. cristatum
1 Lobes linear and elongated. Isidia sometimes present. var. marginale

Both varieties can be recognised in Greek collections, but intermediates are common.

Thallus: foliose, to 4 cm diameter, homoiomerous. Lobes: very variable: to 3 (5.5) mm wide but often less, rounded or distinctly linear and elongate, concave, often distinctly channeled especially when elongate, without ridges, 80 - 150 µm thick when dry (100 - 500 µm when wet), sometimes ascending at margins. Lobe margins: very variable: not or slightly swollen, smooth to incised, sometimes bearing ±globose lobules. Upper surface: usually black, occasionally with a brown tinge. Isidia: sometimes present, globose, 0.1 - 0.2 mm diameter, laminal or marginal, occasionally also on thalline margin, often not very distinct from lobules. Rhizines: sometimes present, white, fasciculate. Upper and lower cortex: absent; thallus of very loosely interwoven, often anastomosed hyphae, 2 - 4 ± µm wide, often with visible septa. Apothecia: usually present, though sometimes few in number, sessile, slightly concave or ±flat, (0.5) 0.65 - 1.7 (2.3) mm diameter, not pruinose. Disc: usually brown, occasionally dull red-brown. Thalline margin: present, persistent; in section: 80 - 180 µm wide. Exciple: not usually visible externally; in section: 25 - 40 µm wide, distinctly cellular, cells typically 6 - 7 µm wide. Epithecium: orange-brown to brown, K-, pigment not soluble in K. Hymenium: 85 - 130 µm tall , colourless, sometimes pale orange-brown in upper part. Subhymenium: 30 - 35 µm tall, very pale yellow-brown to pale brown, of small cells about 3 ± µm diameter . Hypothecium: 30 - 115 ± µm tall, colourless, of large angular cells 7 - 12 (19) µm wide, clearly continuous with exciple. Paraphyses: simple, 2 - 3 ± µm wide at base, 3 ± µm at apex, not capitulate, often with visible septa. Asci: 90 - 100 x 15 - 25 µm, subcylindrical, Collema type. Ascospores: colourless, submuriform (usually with 3 transverse septa), usually ±ellipsoid, one or both ends sometimes slightly pointed, 19 - 30 x 8 - 13 (15) µm, (4) 8 per ascus. Photobiont: Nostoc; cells globose, 4 - 5 ± µm diameter, in chains, not forming a distinct layer.

The narrow, linear, concave, distinctly channeled lobes, without ridges or pustules, that are characteristic of this species make many collections easy to determine. However, L. cristatum is variable. Fertile specimens can be separated unambiguously from other common species that grow directly on limestone by the strongly cellular exciple. Sterile specimens corresponding to var. marginale can usually be recognised by the elongate, concave, strongly channeled lobes, but other sterile specimens may be difficult to determine reliably.

Throughout Greece. Nearly always on calcareous rock, but it has been reliably reported from calcareous soil and from bark. At all altitudes.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, perhaps elsewhere), N. America (widespread), C. America (Mexico).

Lathagrium fusovirens (With.) Otálora, P. M. Jorg. & Wedin (2013)
Fungal Diversity 64(1): 287; Lichen fusovirens With. (1776), Bot. Arr. Veg. Gr. Brit. 717; Collema furvum (Ach.) DC.; Collema fusovirens (With.) J. R. Laundon; Collema tunaeforme (Ach.) Ach. (often as ‘tunaeforme’).

The earliest name is Lichen pulcher Leers (1775), but Withering’s name has been proposed for conservation.

Thallus: foliose, to 2 cm diameter, homoiomerous. Lobes: 2 - 5 ± mm wide, elongate or rounded, not channeled, not adpressed, without ridges but sometimes with acicular (not longitudinal) pustules about 0.5 ± mm diameter especially near margins, 100 ± µm thick when dry, 120 - 170 ± µm when wet; margins not swollen, often wavy. Upper surface: brown to black, not pruinose. Lower surface: green-black to black, with clumps of white, hair-like rhizines. Isidia: abundant, often contiguous, globose, (0.05) 0.1 - 0.2 ± mm diameter, black, often darker than lobes, laminal. Rhizines: white, 0.5 mm long, forming tufts in which individual hairs not clearly separated. Upper and lower cortex: absent; in section lobes colourless in central part, pale yellow-brown to yellow-brown in top and bottom parts. Photobiont: Nostoc; cells globose
or subglobose, 3 - 6 µm diameter, in chains, not confined to a distinct layer.

Easily separated from the common *Collema subflaccidum* by its narrower, less adpressed and much less 'tidy' lobes, by its much coarser isidia, and usually also by its substrate. Could be confused with *L. auriforme* and *Collema* subsp. *corcyrense*, but they have a thallus that swells markedly when wet. *L. cristatum*, which occurs in the same habitat, has much more obviously channelled lobes. Sterile specimens can be difficult to separate from *L. undulatum* var. *granulosum*.

Scattered thinly throughout Greece. Usually on calcareous rock, sometimes overgrowing bryophytes on rock, once on bark of *Juglans*. At all altitudes. Present in much of Europe. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa; also Socotra), N. America (widespread). Old reports for Australasia and the Pacific seem doubtful to me.

*Lathagrium latzelii* (Zahlbr.) Otálora, P. M. Jörg. & Wedin (2013)


Descriptions: Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009), all as *Collema latzelii*.

Very scattered, and most of the few reports were said by their authors to be tentative. On calcareous rock at altitudes 0 - 1200 m.

Southern Europe, plus a disjunct report for SW England (Cornwall). Also Asia (Turkey, Japan), N. Africa (Morocco, Tunisia). Except for the disjunct report for Japan (by Degelius) this appears to be basically a circum-Mediterranean taxon.

*Lathagrium undulatum* (Laurer ex Flot.) Poetsch (1872) var. *undulatum*


Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009), all as *Collema undulatum*.

Scattered on the mainland and larger islands, on calcareous rock at altitudes 30 - 2000 m. Most reports are from altitudes above 1000 m, and those from lower altitudes are unconfirmed or tentative.

Present in much of Europe, but in the south probably mainly in the uplands. Also Asia (widespread), perhaps N. Africa, N. America (widespread).


As with many other taxa which have a fertile morph lacking vegetative propagules and an infertile morph with them, there may be little justification for regarding the two morphs of *L. undulatum* as distinct taxa. However, the matter does not appear to have been investigated critically, and for the moment I distinguish them.

Descriptions: Ahti et al. (2007); Nash et al. (2004); Smith et al. (2009), all as *Collema undulatum* var. *granulosum*.

Northern Greece, and perhaps Evia. On rock or bryophytes on rock. The reports for northern Greece were from altitudes 1650 - 2000 m.

In Europe, var *granulosum* seems to have a similar distribution to var. *undulatum*, but it is less common. Also Asia (Turkey, Tajikistan, China), N. America (widespread).

*Lecania* A. Massal. (1853)


Family: *Ramalinaceae*.


Thallus: crustose, usually rather small and often poorly developed. Vegetative propagules: present in a few species. Apothecia: small in most species, not often exceeding 0.5 mm diameter, flat to convex. Disc: usually some shade of brown, pruinose in some species. Thalline margin: present in most species, but usually rather thin. Exciple: often not visible externally; in section: of radiating hyphae, sometimes with visible lumina, brown at surface, colourless elsewhere. Epithecium: usually some shade of brown, sometimes with additional reddish pigment, often not sharply differentiated from upper part of hymenium. Hymenium: colourless. Hypothecium: colourless. Paraphyses: simple, clavate to slightly capitately, apical cell without internal pigment. Asci: small, clavate, Biatora type. Ascospores: colourless, 1-septate in most species, 3-septate in some, often remaining simple until fully mature, usually narrowly ellipsoid, fairly small (10 - 20 µm long), 8 per ascus in most species. Photobiont: green, trebouxioid.
Could sometimes be confused with Bacidia, but species of Bacidia lack a thalline exciple, and the ascospores are usually multi-septate, longer, and with ends that are more pointed. Species of Lecania with immature (i.e. simple) ascospores could be confused with Lecanora, but ascospores in Lecanora usually have a distinct wall, about 1 µm wide, that is not present in Lecania; the two genera also have different ascus type. Catillaria species have a very different ascus type, always lack a thalline exciple, and have a black disc.

About 100 species, in cold to warm-temperate regions, mainly in the Northern Hemisphere. They usually occur on bark or rock, less commonly on bryophytes, but are not terricolous. The genus is not especially well known, and new species continue to be described. There are about 50 species in Europe. Lecania is difficult to study in Greece as most species are inconspicuous and not often collected.

Key to Lecania main groups

11 On bryophytes. Ascospores 0-1-septate. (L. pusilla)
11 On bark or wood. Group 1.
1 On rock, or parasitic on lichens on rock. Group 2.

Key to Lecania group 1: On bark or wood

11 Mature ascospores mostly 3-septate.
 22 Apothecia with a thalline margin that may become thin but is usually ±persistent. L. fuscella
 2 Apothecia usually without a thalline margin (no algae in section).
 33 Thallus powdery, often indistinct. L. koerberiana
 3 Thallus smooth, thin. L. naegelii

1 Mature ascospores mostly 1-septate (immature ones may be simple, an occasional mature one may be 3-septate).
 22 Minute hairs present on thalline margin and, less commonly, on granules of thallus.
 33 Ascospores distinctly constricted at septum. Exciple cellular. (L. sipmanii)
 3 Ascospores not, or only slightly, constricted at septum. Exciple hyphal. (L. poeltii)
 2 Hairs absent.
 33 Soredia present. (L. croatica)
 3 Soredia absent.
 44 Hypothecium red-brown. (L. lesdainii)
 4 Hypothecium ±colourless.
 55 Ascospores 2-3 (4) µm wide, straight (or almost). Apothecia 0.1-0.25 mm diameter. L. cyrtellina
 5 Ascospores (3) 4-5 µm wide, straight or curved. Apothecia (0.15) 0.25-0.5 mm diameter.
 66 Ascospores very curved when mature. L. dubitans
 6 Ascospores sometimes bent when mature, but not very curved.
 77 Asci with 8 ascospores. L. cyrtella
 7 Asci with 16 ascospores. (L. sambucina)

Key to Lecania group 2: On rock.

11 Ascospores 3-septate.
 22 Apothecia not pruinose. Thalline margin absent. L. cuprea
 2 Apothecia pruinose. Thalline margin present.
 33 Cortex of thalline margin cellular. L. suavis
 3 Cortex of thalline margin containing a network of narrow hyphae. (L. nylanderiana)
 1 Ascospores 1-septate.
 22 Thallus verrucose-squamulose, with placodioid margin. L. spadicea
 2 Thallus crustose.
 333 Thallus and apothecial margin with minute hairs (x20). Ascospores 9-12 x 4-5 µm, often slightly constricted at septum. Probably restricted to ±calcareous rock in coastal areas. (L. poeltii)
 33 Thallus and apothecial margin without hairs but with with blastidia (0.05-0.1 mm diameter). Ascospores 9-16 x 3-5 µm. In nutrient enriched habitats. L. erysibe
 3 Thallus and apothecial margin without hairs or blastidia. Ascospores and ecology various.
 44 Paraphyses not strongly coherent. Ascospores 8-12 x 4-5 µm. Paraphyses strongly capitate, with pigmented apex. L. polycycela
 4 Paraphyses coherent. Ascospores generally longer. Paraphyses capitate or not, apex pigmented or not.
Apothecia convex and ±immarginate almost from the beginning; few algal cells present in section.

77 Apothecia brown to black-brown, to 0.8 mm diameter. Thallus usually immersed, sometimes thinly superficial and granular. **L. heterocarpa** (Note 1.)

7 Apothecia orange to dark brown, translucent when wet. Thallus usually immersed or superficial. **L. sylvestris** s. lat.

68 Thallus superficial, smooth or areolate. Apothecia 0.3 - 0.8 mm diameter. **L. sylvestris** var. *sylvestris*

8 Thallus immersed or thin and granular. Apothecia 0.3 - 0.4 mm diameter. **L. sylvestris** var. *umbrotica*

On non-calcareous rock. Thallus superficial, wide-spreading, continuous, smooth or cracked-areolate. Apothecia pink-yellow to dark brown, or piebald, not translucent when wet. (L. *hutchinsiae*)

5 Apothecia with distinct thalline margin, at least when young; many algal cells present in section.

66 Thallus pale; white, whiteish, white-grey or pale brown.

77 Disc white pruinose, red-brown to black below pruina. **L. turicensis**

7 Disc not pruinose, red-brown to dark brown.

68 Thalline margin ±persistent. On calcareous or siliceous rock. **L. olivacella**. Note 2.

6 Thallus dark; dark brown, grey-brown or black.

77 Areoles smooth, rather regular and angular, not minutely papillose. Apothecia ±regularly distributed, not normally deformed by compression, often white pruinose. Ascospores 10 - 13 µm long. **L. rabenhorstii**

6 Areoles poorly developed, nodular, minutely papillose. Apothecia in groups, sometimes crowded and deformed by compression, usually not pruinose. Ascospores 12 - 18 µm long. **L. inundata**

(1) **L. heterocarpa** is a poorly known species. I cannot guarantee that it is placed correctly in the key.

(2) **L. arenaria**, a doubtful species, would also key out here. It is said to have dark brown to black apothecia, whereas apothecia in **L. olivacella** are paler brown.

**Lecania arenaria** (Anzi) Flagey (1895)


Description: Clauzade & Roux (1985). A rather poorly known species, perhaps synonymous with **L. olivacella**.

The two reports to date are from the southern half of Greece. On limestone at altitudes 100 - 275 m.

France (Paris), Iberian Peninsula, Italy, Greece. Also Africa (Algeria, S. Africa).

**Lecania cuprea** (A. Massal.) van den Boom & Coppins (1992)

in van den Boom, *Nova Hedwigia* 54: 234; *Bilimbia cuprea* A. Massal. (1856), *Lotos* 6: 77 and Sched. Crit. Fasc. 5-6: 122. It is not known which was published first.

Description: Nash et al. (2004); Smith et al. (2009).

Chios, on limestone at an altitude of 5 m.

Throughout Europe, to as far north as southern Scandinavia. Also Macaronesia (Azores), Asia (Turkey, Israel, Siberia, India), northern Africa (Morocco, Mauretania), N Africa (widespread), C America (Mexico).

**Lecania cyrtella** (Ach.) Th. Fr. (1871)

Lichenogr. Scand. 294; *Lecidea cyrtella* Ach. (1803), Methodus 67-68.

Thallus: crustose, inconspicuous, almost immersed, without hairs or vegetative propagules. Apothecia: subsessile, flat to convex, (0.15) 0.2 - 0.5 mm diam, sometimes slightly white pruinose. Disc: grey-brown to dark grey-brown, matt. Thalline margin: sometimes obscurely present. Exciple: present, thin, paler than disc, sometimes becoming excluded; in section: 10 - 35 µm wide, colourless to pale yellow in inner part, sometimes brown at surface, formed of hyphae parallel to paraphyses, sometimes with elongated lumina. Epithecium: often not well differentiated from hymenium, colourless to brown or pale grey, K-, pigment soluble in K. Hymenium: 40 - 70 µm tall, colourless in lower part, upper part generally with epiphytic pigment. Hypothecium: 40 - 70 µm tall, colourless to very pale yellow. Paraphyses: occasionally branched, 1 - 2 µm wide at base, 2.5 - 4 µm at apex, not capitulate. Asci: 37 - 40 x 12 - 14 µm. Clavate. Ascospores: colourless, (0) 1 (3) -septate, ±ellipsoid but sometimes slightly curved, 10 - 12.5 x 3 - 4 µm, 8 per ascus. Conidia: colourless, 10 x 1 µm, usually curved. Photobiont: green, cells globose 13 - 23 x 10 - 23 µm.

**L. cyrtellina** is very similar but has smaller apothecia and narrower ascospores. The occasional 3-septate ascospore in **L. cyrtellina** should not cause confusion with **L. naegelii**, in which most mature ascospores are (at least) 3-septate; they are also, at least on average, longer than those of **L. cyrtella**.
Lecania cyrtellina (Nyl.) Zahlbr. (1928)
Cat. Lich. Univ. 5: 721; Lecanora cyrtellina Nyl. (1873), Flora 56: 18; Lecidea albokyalina auct. graec.
Thallus: crustose, green-grey, not pruinose, continuous, slightly granular in central part, forming a small patch 1 cm diameter (in only collection seen), without hairs or vegetative propagules. Apothecia: 0.15 - 0.25 mm diameter, flat when young, becoming moderately convex later, not pruinose. Disc: dark brown. Thalline margin: sometimes present (algae sometimes present in section), pale brown, much paler than disc, becoming excluded. Exciple: sometimes visible externally, pale brown, very thin; in section: rather poorly developed, outer part with brown pigment, K+ purple-brown. Epitheciun: not well differentiated from hymenium, pale brown to red-brown. Hymenium: 40 - 45 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, apex to 4 µm, ±apicilate, sometimes moniliform. Asci: 33 x 11 µm, clavate. Ascospores: colourless, 0 - 1 -septate, ellipsoid, straight, 10.5 - 12 (15) x 3 µm, 8 per ascus. Photobiont: green.

For separation from L. cyrtella, see under that species.

Lecania dubitans (Nyl.) A. L. Sm. (1918)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered in Macedonia, at altitudes 400 - 1800 m. On bark. The only phorophyte reported was Fagus.

Widespread in central and northern Europe to as far north as mid Scandinavia, but very rare south of the Alps. Also Asia (Iran, Russia, Kazakhstan), N. Africa (Morocco, N. America (Colorado).

Lecania erysibe (Ach.) Mudd (1861)

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), perhaps S. America, Australasia (SE Australia, NZN, NZS).

Lecania fuscella (Schae.) A. Massal. (1853)
Description: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Chios, on bark of Olea europaea at an altitude of 250 m.

Throughout Europe. Also Asia (widespread as far east as Kashmir), N Africa (Morocco, Algeria), N America (widespread).

Lecania heterocarpa Zahlbr. (1905)
Description: See the protologue.
Corfu, on limestone at an altitude of 500 m.

Probably throughout Greece. Perhaps more common than reports suggest, as it is easily overlooked. On basic, or at least not strongly acidic, bark at altitudes 100 - 1300 m. Recorded from a wide range of phorophytes.

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), perhaps S. America, Australasia (SE Australia, NZN, NZS).

Lecania erysibe (Ach.) Mudd (1861)

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), perhaps S. America, Australasia (SE Australia, NZN, NZS).
Only Croatia and Greece.

**Lecania inundata** (Hepp ex Körb.) M. Mayrhofer (1987)

- Descriptions: Clauzade & Roux (1989); Nash et al. (2004); Smith et al. (2009).
- Islands of the Aegean. On siliceous or, less commonly, calcareous rock at altitudes 5 - 230 m.
- Southern and central Europe. It reaches British Is but not Baltic States or Nordic Countries. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia), N. America (California), Australasia (SE Australia, NZN, NZS).

**Lecania koerberiana** J. Lahm ex Körb. (1859)

- Description: Clauzade & Roux (1985); Wasser & Nevo (2005).
- Scattered, with no clear pattern. On bark at altitudes 0 - 1400 m. The only phorophyte explicitly mentioned was *Pinus*.
- Scattered to as far north as southern Scandinavia. Also Asia (widespread as far east as NW China), N. Africa (Morocco), perhaps S. America (Argentina).

**Lecania naegelii** (Hepp) Diederich & van den Boom (1994)

- Thallus: crustose, white to grey, very thin, inconspicuous. Apothecia: sessile, flat when young, becoming convex later, 0.3 - 0.7 mm diam, not pruinose. Disc: black. Thalline margin: absent, even in section. Exciple: black, becoming almost excluded; in section: 60 µm wide, dark brown in outer part, colourless to pale brown in inner part, pigment K-, not soluble in K. Epithecium: green-grey, K+ slightly purple in places, N+ red everywhere. Hymenium: 50 - 70 µm tall, pale yellow-brown, KI+ blue. Hypothecium: 200 µm tall, pale yellow-brown. Paraphyses: simple, 1.5 µm wide at base, 3 µm at apex, sometimes slightly capitate, apical cell pigmented. Asci: 45 x 10 µm, clavate, *Biatora* type. Ascospores: colourless, 3-septate (when mature, but long appearing simple), narrowly ellipsoid, straight, 17 - 27 x 4 µm, 8 per ascus.

- Unlikely to be confused with other Greek species, provided that mature ascospores are seen. For separation from *L. cyrtella*, see under that species.
- Fairly common throughout Greece. On nutrient rich bark at altitudes 0 - 1100 m. Recorded on a wide range of phorophytes.
- Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), Australasia (NZN).

**Lecania olivacella** (Nyl.) Zahlbr. (1928)

- Description: Clauzade & Roux (1989, 1989); Smith et al. (2009).
- Only known from a single collection in the SE Peloponnese, where it occurred on rock at an altitude of 40 m. The other collection cited in Abbott (2009) was incorrectly determined.
- A rare species of western and Mediterranean Europe. Also western Asia (Turkey), N. Africa (Tunisia).

**Lecania polyccyla** (Anzi) Lettau (1912)


- Thallus: crustose, cracked to areolate, pale brown, not pruinose. Apothecia: subsessile, ± flat, 0.2 - 0.35 mm diam, not pruinose. Disc: black. Thalline margin: present, persistent. Epithecium: red-purple, K-, pigment dissolving in K leaving only the black pigment within tips of paraphyses. Hymenium: 45 µm, colourless, KI+ blue. Hypothecium: 50 µm, colourless. Paraphyses: not coherent, 1.5 µm wide at base, capitale, apical cell 5 µm with internal black pigment in upper half. Asci: apex KI+ blue, ± *Biatora* [or ? *Bacidia*] type. Ascospores: colourless, (0) 1-septate, ellipsoid but often constricted slightly at septum, 8 per ascus, 10 x 5 µm. Photobiont: green.

- The poorly coherent, distinctly capitate paraphyses are characteristic.
- SE Peloponnese, on limestone at an altitude of 150 m. The single collection was only 3 mm in diameter and had only three apothecia, so could not be studied thoroughly without destroying it. Although the determination seems reliable, it is desirable to confirm the presence of this species in Greece from a well-developed collection.
- Scattered in southern and central Europe. Also Asia (Turkey), N. Africa (Algeria), N. America (Arizona).
**Lecania ravenhorstii** (Hepp) Arnold (1884)

*Flora* 67: 403; *Patellaria ravenhorstii* Hepp (1853), Flecht. Eur. no. 75; *Lecania erysibe* var. *proteiformis* auct. graec.; *Lecania erysibe* var. *ravenhorstii* (Hepp) H. Olivier; *Lecania ravenhorstii* var. *ceramonea* (A. Massal.) J. Steiner; *Lecania ravenhorstii* f. *syntrophica* J. Steiner.

Thallus: crustose, dark brown, sometimes green when fresh, not pruinose, to about 2 cm diameter, well developed and of contiguous small areoles (to 0.4 mm wide), to poorly developed and discontinuous. Apothecia: sessile to sessile, flat to convex, 0.4 - 0.55 mm diameter, sometimes blue-white pruinose. Disc: brown. Thalline margin: present, white, becoming excluded in convex apothecia; in section: 50 µm wide. Excipula: not visible externally; in section: 25 - 100 µm wide, pale brown to orange-brown at surface, colourless elsewhere, of radiating hyphae, often with small, rounded to elongate lumina. Epithecium: mostly brown, in a few places with a pink or red tinge, brown pigment K-, soluble in K, reddish pigment K+ slightly violet, not soluble in K. Hymenium: 55 - 65 µm tall, mostly colourless, sometimes with epitecial pigment in upper part. Hypotheicum: 110 µm tall, colourless. Paraphyses: simple, 1 µm wide at base, not to slightly capitate, apical cell 2 - 5 µm wide, without pigment. Ascii: 35 x 11 µm, clavate. Ascospores: colourless, 1-septate (when mature), narrowly ellipsoid, 9 - 14 x 4 - 5 µm, 8 per ascus. Photobiont: green.

The thin, dark brown, areolate but often discontinuous thallus seems to be characteristic. Fairly common in the south of Greece, rare in the north. On calcareous rock. Reported from all altitudes, but two thirds of reports are from below 200 m altitude.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Syria, Russia), N. Africa (Morocco, Algeria), N. America (California, perhaps elsewhere), Australasia (ACT, NZN, NZS).

**Lecania spadicea** (Flot.) Zahlbr. (1916)


Thallus: crustose to (at least at margins) subsquamulose, brown-green, green-brown or dark brown, sometimes blue-white pruinose, without vegetative propagules, 250 - 300 µm thick. Squamules: flat to convex, adpressed, rounded, to 2 mm diameter, never strongly radiating. Cortex: 40 - 45 µm thick, swelling in K to 50 - 60 µm, mostly colourless, sometimes brown in top 5 - 8 µm, formed of branched hyphae oriented predominantly vertically, K-, C-; sometimes overlain by a colourless, structureless layer 3 - 5 µm thick, without hyphae. Lower cortex: absent. Apothecia: sessile, flat when young, sometimes convex later, 0.4 - 1.1 mm diameter, sometimes white or white-blue pruinose on disc or exciple when young. Disc: brown to dark brown, sometimes orange-brown in young apothecia. Thalline margin: present in some collections, sometimes persistent; in section: 150 - 250 µm wide. Excipula: brown, paler than disc, persistent or not; in section: 25 - 50 µm wide, colourless to pale brown, K-. Hypotheicum: brown to grey-brown, K- or patchily K+ purple-red, some pigment soluble in K. Hymenium: 40 - 65 µm tall, colourless to brown. Hypothecium: 55 - 100 µm tall, colourless to pale brown, upper part sometimes obscurely differentiated into a subhymenium. Paraphyses: not coherent, simple or sparingly branched, 1.5 µm wide at base, to 3 µm at apex, sometimes with visible septa, not to slightly capitate, apical cell with some internal brown pigment not soluble in K. Asci: 45 x 10 - 12 µm, ±cylindrical to narrowly clavate, ±Bacidia type though with rather broad ocular chamber. Ascospores: colourless, (0) 1 (2) -septate, septum thin, ellipsoid to narrowly ellipsoid, ends sometimes slightly pointed, 7.5 - 13 x 3 - 5 µm, 8 per ascus. Pycnidia: sometimes present, black, 0.07 mm diameter, 100% immersed in slight depressions in squamules; in section: multichambered, 200 µm tall, 230 µm wide, mostly colourless, wall in upper part sometimes grey. Conidia: colourless, 15 - 20 x 3 µm, straight to slightly curved. Chemistry: thallus K-, C-, KC-, P-, UV- (or almost); medulla K-, C-, KC-, P-, I-. Photobiont: green, cells globose, 8 - 11 µm diameter, forming a continuous, regular layer 50 - 60 µm thick.

Easily separated from other species of the genus by the subsquamulose margin of the thallus. Could be confused with species of *Tominia* but lacks the strongly capitate paraphyses of that genus.

Widespread and fairly common in coastal sites with a maritime climate, mainly in the southern half of Greece. On rock, usually calcareous; reported once from calcareous soil. At altitudes 0 - 600 m, but 80% of reports are from below 200 m.

Southern Europe from Iberian Peninsula to Cyprus, and southernmost part of C. Europe. Also Macaronesia, Asia (Syria, Russia, perhaps Thailand), N. Africa (Morocco, Tunisia, Egypt).

**Lecania suavis** (Müll. Arg.) Mig. (1926)


Descriptions: Clauzade & Roux (1989); Smith et al. (2009).

Island of Samothraki, on siliceous rock at an altitude of 10 m.

Throughout northern and central Europe, but rare south of the Alps. Apparently endemic to Europe.

**Lecania sylvestris** (Arnold) Arnold (1884) var. *sylvestris*

Islands of the Aegean, including Crete, on limestone at altitudes 5 - 500 m.
Most reports do not indicate which variety is concerned. *L. sylvestris* s. lat. is widespread in Europe to as far north as southern Scandinavia. Also western Asia (Turkey), N. Africa (Morocco) and, surprisingly, Australasia (Western Australia).

**Lecania sylvestris** var. *umbratica* (Nyl.) M. Mayrhofer (1987)
Islands of the southern Aegean, including Crete, on calcareous rock at altitudes 0 - 500 m.
Var. *umbratica* has a more southerly distribution than var. *sylvestris*, and is known from no further north than France and Austria. I have not seen any reports for other continents.

**Lecania turicensis** (Hepp) Müll. Arg. (1862)

Thallus: crustose, pale grey to pale brown, poorly developed and discontinuous (in only collection seen), of scattered, rounded areoles. Apothecia: subsessile, flat, 0.35 mm diam, white pruinose when young, mature apothecia generally not pruinose. Disc: dark brown. Thalline margin: present; in section: 50 µm wide. Exciple: in section: of small cells, 2 - 3 µm diameter. Epithecium: dark brown to red-brown, developing a slightly purple-brown tinge in K. Hymenium: 60 µm tall, colourless. Hypothecium: 60 µm tall, colourless. Paraphyses: 1 µm wide at base, 3 - 5 µm at apical cell, clavate or slightly capitate. Ascospores: colourless, 0 - 1 -septate, ellipsoid, 11 - 13 x 5 µm, 8 per ascus. Photobiont: green.

Mainly southern half of Greece. On calcareous rock, usually at altitudes below 400 m, though there are scattered reports up to 1500 m.
Widespread in Europe to as far north as British Is and Baltic States, but rare in the more continental parts of eastern Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), Africa (Morocco, Tunisia, Egypt, perhaps Zimbabwe), N. America (scattered in USA), C. America (Mexico, Guatemala), Australasia (scattered).

**Lecanographa Egea & Torrente (1994)**

Literature: Egea & Torrente (1994) monograph the genus. Many of the species that are likely to occur in Greece are also treated in Clauzade & Roux (1985) under *Lecanactis* or *Opegrapha*, or in Smith et al. (2009).

About 36 species of which 11 occur in Europe. Five of the European species will certainly not occur in Greece. The genus is not common in Greece.

11 Ascospores asymmetric, narrower at one end than the other, with one central cell larger than the others. Ascospores 3 (-5) -septate.
22 Thallus C+ red, or parasitic on lichens (Dirina or Roccella) with thallus C+ red or C+ pink. *L. grumulosa*
2 Thallus C-. On rock, not parasitic. (L. subgrumulosa)

1 Ascospores symmetric, all cells similar. Ascospores septation various.
22 On bark. Thallus C-. 33 Ascospores 3 (5) -septate, 17 - 25 x 3 - 3.5 µm. (L. amylacea)
23 Ascospores 7 - 8 (12) -septate, 21 - 30 x 3 - 4.5 µm. *L. lynceae*
2 On rock. Thallus C- or C+ pink.
33 Ascospores 5 - 7 -septate. Thallus C-. (L. farinosa)
3 Ascospores 8 - 12 -septate. Thallus C+ pink. *L. werneri*

**Lecanographa grumulosa** (Dufour) Egea & Torrente (1994)

Descriptions: Clauzade & Roux (1985) as *Lecanactis monstrosa*; Egea & Torrente (1994); Nash et al. (2004); Smith et al. (2009).
Islands of the southern Aegean, including Crete; also Corfu, at altitudes 0 - 350 m. Always very close to the sea.
Not reported from the mainland, and obviously requiring a maritime climate. Most commonly on rock (calcareous or siliceous), but also reported from bark of *Ceratonia siliqua* and parasitic on *Roccella phycopsis*.

Southern and central Europe; it reaches Scotland, but absent from Baltic States and Nordic countries. Also Macaronesia, western Asia (Turkey, Israel), Africa (widespread), perhaps N. America (old reports), Caribbean, C. America (Mexico).

**Lecanographa lynea** (Sm.) Egea & Torrente (1994)

*Biblioth. Lichenol.* 54: 142; *Lichen lycneus* Sm. (1801) in Smith & Sowerby, Engl. Bot. 12, tab. 809; *Lecanactis lycnea* (Sm.) Fr.; *Opegrapha lycnea* (Sm.) G. Mey.

Descriptions: Clauzade & Roux (1985) as *Lecanactis lycnea*; Egea & Torrente (1994); Nash et al. (2004); Smith et al. (2009).

Corfu, on bark and wood of *Olea europea*, at altitudes 0 - 20 m.

Widespread in Europe, to as far north as Scotland and southern Sweden. Also western Asia (Syria, Yemen), Africa (widespread), N. America (California), C. America (Mexico), S. America (Chile, Galapagos Is).

**Lecanographa werneri** (Faurel, Ozenda & Schotter) Egea & Torrente (1994)


Description: Egea & Torrente (1994).

Santorini, on lava at altitudes 200 - 330 m.

Circum-Mediterranean. Southern Europe, from Portugal to Greece, and N. Africa (Morocco, Algeria, Tunisia).

**Lecanora** Ach. (1809)


The precise application of the name is uncertain, as its type is a Dillenian illustration, but it is close to *L. allophana*, *L. chlorotera* and *L. horiza*, so it is clear enough what constitutes the core of *Lecanora*, and there is no need for a conserved type. Family: *Lecanoraceae*.

Literature: There is no monograph. Floras containing good introductions to the genus as a whole, as well as discussions of a large number of species (including many European species) include: McCarthy & Mallett (2004); Nash et al. (2004); Smith et al. (2009). Useful treatments of some parts of the genus, including some material relevant to Europe include: Dickhäuser et al. (1995) (the subcarnea group); Guderley & Lumbsch (1999) (species with multi-spored asci); Lumbsch, Plümpner et al. (1997) (corticolous species with pruinose discs); Printzen (2001) (corticolous species with usnic or isousnic acid); van den Boom & Brand (2008) (the saligna group).

The name *Lecanora* has been used in a very broad sense, but as various well-defined groups have been segregated it has become more narrowly circumscribed. Some segregates, such as *Protoparmelia*, are now well established and others, including *Protoparmeliopsis* and *Myriolecis* seem sufficiently well founded that I accept them in this Flora. Although *Lecanora* in the sense used here remains heterogeneous, I prefer not to rush to accept all suggested segregates. Because of the heterogeneity, a detailed description would be inappropriate, and the following description just notes characters common to all, or almost all, species.

Thallus: crustose, varying from poorly developed and immersed to very well developed. Vegetative propagules: usually absent, but a few species with soralia. Apothecia: small to medium sized, rounded, usually with a thalline exciple at least when young. Asci: Lecanora type. Ascospores: colourless, simple, ellipsoid, usually 8 per ascus, small to medium sized (typically 8 - 15 µm long), often with a distinct wall. Pycnidia: not common. Chemistry: various. Photobiont: green, trebouxiod.

Species of *Lecanora* occur mainly on bark, wood and rock. The genus is well represented in Greece, and some species are very common.

**L. configurata** Nyl., *L. dispersella* J. Steiner and *L. rechingeri* Szatala are not included in the keys as I have insufficient information.

**Key to Lecanora main groups**

11 Thallus subsquamulose or with lobed margin. Group 1
1 Thallus crustose, margin not lobed.
22 Soredia present. Group 2
2 Soredia absent.
33 Thallus, thalline margin or disc C+ yellow, orange or red. Group 3.
3 Thallus, thalline margin and disc C-.
44 Thallus and thalline margin K+ yellow > red (norstictic acid). (Note 1). Group 4.
4 Thallus and thalline margin K- or K+ yellow (atranorin).
55 Thallus grey, green-grey, green-white or white, rarely with a yellow tinge.
66 Thallus and thalline margin K+ yellow (atranorin) (Note 2). Group 5.
77 On soil or on decaying vegetation on the ground, at high altitude. L. epibryon
7 On bark, wood or rock.
88 Disc distinctly pruinose. Group 5A.
8 Disc not, or only very slightly, pruinose.
99 On bark or wood. Group 5B.
9 On rock. Group 5C.
6 Thallus and thalline margin K- (Note 2). Group 6.
5 Thallus ±green or brown. Group 7.

(1) If norstictic acid is present in low concentration, a spot test may yield an orange or yellow colour, or may even appear negative. Norstictic acid is easier to detect in a thin section. When testing a thin section use as little K as possible.

(2) This couplet can be difficult, as atranorin reacts only faintly with K. If the thallus is thin, spot tests may give clearer results on the thalline margin. If spot tests do not give an obvious positive reaction, test a thin section using as little K as possible. If atranorin is present a yellow pigment will diffuse into solution. (Using a lot of K dilutes the pigment, making it unobservable.)

Key to Lecanora group 1: Thallus with marginal lobes.

Some green species of Squamaria could cause confusion, but they are distinctly squamulose, at least in places.

11 Soredia present. See (Coscinocladium gadinatunum)
1 Soredia absent.
2222 Thallus C+ red. (L. chaffiniana), (L. negevensis)
222 Thallus C+ orange.
33 Medulla P+ yellow. L. cerebellina
3 Medulla P- See Myriolecis
22 Thallus C+ yellow. (L. sphalera)
2 Thallus C-.
33 Thallus green, attached to substrate by very long, prominent rhizines. (L. rhizinata)
3 Thallus variously coloured, without rhizines.
44 Thallus green. Disc ±same colour as thalline margin and thallus. On non-calcareous rock. If present in Greece, probably restricted to alpine levels. (L. concolor)
4 Thallus variously coloured. Disc not same colour as thalline margin and thallus. On calcareous or siliceous rock. Not restricted to alpine or subalpine level.
55 Thallus ±densely white pruinose everywhere, P-. Apothecia green to brown. (L. valesiaca)
5 Thallus not densely white pruinose everywhere, though some white pruina may be present. P- or P+ yellow.
Disc usually brown. See Protoparmeliopsis

Key to Lecanora group 2: Thallus without marginal lobes; soralia present.

11 Thallus C+ orange.
22 On bark or wood. Thallus not always entirely sorediate. Apothecia fairly common. L. expallens
2 On calcareous rock. Thallus leprarioid, sorediate everywhere. Apothecia unknown. (L. rouxii)
1 Thallus C-.
222 Apothecia absent. Consider L. compallens which is not known fertile.
22 Asci with more than 8 (usually 16) ascospores. (L. strobilinoides)
2 Asci with 8 ascospores.
333 Terricolous on on decaying vegetation on the ground. At subalpine levels or above. L. epibryon
33 On bark or wood.
44 Soredia in well-defined, confluent soralia. L. impudens
4 Thallus granular rather than truly sorediate, without confluent soralia. L. strobilina
3 On rock.
44 Disc C+ yellow. **L. rupicola var. efflorens**
4 Disc C-.
55 Soralia arising from margins of areoles. (L. orosthea) Greek report incorrect.
5 Soralia not arising from margins of areoles. **L. umbrosa**

**Key to Lecanora group 3**: Thallus without marginal lobes or soralia; some part C+

111 Thallus or thalline margin C+ red.
   22 On bark or wood. **L. lividocinerea**
   2 On rock.
      33 Thallus well developed, subsquamulose. On inland siliceous rock. (L. chaffiniana)
   3 Thallus well developed or not, but not subsquamulose. On coastal rock. See **Myriolecis**

11 Thallus or thalline margin, C+ orange or very yellow.
   2222 On bark or wood.
      33 Apothecia 0.3 - 1.5 mm diameter, convex from an early stage. **L. symmicta**
   3 Apothecia 0.2 - 0.4 mm diameter, flat or slightly convex. **L. conizella**
   22 On calcareous rock with runoff from siliceous rock, or vice versa. (Myriolecis antiqua)
   22 On calcareous rock.
      33 Thallus well developed, C+ yellow or red. **L. conferta**
   3 Thallus poorly developed, immersed or forming small patches around some apothecia, C-. See **Myriolecis semipallida**
   2 On siliceous rock.
      33 Exciple forming a distinct blackish ring. Probably strictly montane in Greece. **L. bicincta**
   3 Exciple not forming a blackish ring. Not confined to montane regions.
   44 Disc P+ orange. See **Myriolecis fugiens**
   4 Disc P-.
      55 Thallus well developed.
         66 Apothecia at first immersed but becoming subpedicellate and easily detached. Epithecium colourless to olive-green. **L. swartzii**
   6 Apothecia immersed to sessile. Epithecium brown to brown-grey.
      77 Thallus granular. On coastal rock. See (Myriolecis oyensis)
   7 Thallus continuous or areolate, not granular. Not restricted to coastal sites.
      88 Thallus grey or white. **L. rupicola subsp. subplanata**
   8 Thallus yellow-green. **L. rupicola subsp. sulphurata**
      5 Thallus rather poorly developed. See (Myriolecis invadens) Greek reports need confirmation.

1 Thallus and thalline margin C-, but disc C+ orange or yellow.
   22 On bark or wood.
      33 Thalline margin of apothecia with a true cortex (Note 1), 30 - 75 µm wide, containing crystals that are readily soluble in K. **L. carpinea**
   3 Thalline margin with a pseudocortex, width various, containing crystals insoluble, only partly soluble, or slowly soluble, in K.
   44 Apothecia sessile, 0.2 - 1.0 mm diameter. Thallus and thalline margin without psoromic acid, P-. Thalline margin typical in size for Lecanora. Pseudocortex of thalline margin 25 - 60 (90) µm wide, algal-containing part 30 - 50 µm wide. White-grey prothallus sometimes present (Note 2). **L. leptyrodes**
   4 Apothecia subimmersed to sessile, 0.3 - 2.0 mm diameter. Thallus and thalline margin with psoromic acid (P+ yellow if concentration high enough, but often P-). Thalline margin sometimes more robust that usual for Lecanora (more like Ochrolechia). Pseudocortex and algal-containing part generally wider, on average, though there is much overlap. Prothallus absent. **L. subcarpinea**

2 On rock.
   33 Thallus poorly developed. Apothecia not or only slightly pruinose. On ±calcareous rock. See **Myriolecis semipallida**
   3 Thallus well developed. Apothecia strongly white pruinose. On non-calcareous rock. **L. rupicola subsp. rupicola**

(1) Hyphae are oriented predominantly perpendicular to the surface, though there may be many anastomoses. They are often visible in water mounts and always clearly visible in K.
(2) In external view the prothallus may look very similar to the thallus, so examine a thin section. The prothallus lacks photobiont cells over large areas, though there may be patches of photobiont cells here and there where a true thallus is starting to form. In contrast, the thallus has photobiont cells over most of its area, though the photobiont layer may be discontinuous in places.

**Key to Lecanora group 4**: Thallus without marginal lobes or soralia; all parts C-; thallus with norstictic acid.

11 On bark or wood. (L. cadubriae) Greek report doubtful.
1 On siliceous rock.
22 Epithecium N+ purple or red, K- or K+ green.
33 Epithecium green to brown-green. Prothallus absent. (L. herteliana)
3 Epithecium brown to olive. Prominent white prothallus generally present. **L. cenisia**
2 Epithecium N-, K- or K+ red (norstictic acid).
33 Prominent white prothallus generally present. Disc pink-brown to grey-brown. Apothecia often strongly convex. (L. ochroidea)
3 Prothallus absent or poorly developed. Disc various. Apothecia flat to slightly convex.
44 Disc pale brown to black, colour sometimes varying within a single apothecium. Aspect ratio of ascospores 1.5 - 2. **L. praepostera**
4 Disc brown-yellow to red-orange, uniformly coloured. Aspect ratio of ascospores about 2. **L. rhodi**

**Key to Lecanora group 5A**: Thallus without marginal lobes or soralia; all parts C-, without norstictic acid; thallus grey to white, with atranorin; discs pruinose.

11 On bark. Thalline margin and disc P+ yellow or red. **L. albella**
1 On non-calcareous rock (Note 1).
22 Thalline margin persistent. **L. cenisia**
2 Thalline margin excluded very early. **L. formosa**

(1) If a prominent white prothallus is present, consider L. subcarnea, which usually has a K- thallus.

**Key to Lecanora group 5B**: Thallus without marginal lobes or soralia; all parts C-, without norstictic acid; thallus grey to white, with atranorin; discs not pruinose; on bark or wood.

111 Epithecium with large grains, K+ red (norstictic acid). Probably restricted to sites with a warm, maritime climate. **L. rubicunda**
11 Epithecium without norstictic acid, but with with crystals or granules that rotate the plane of polarisation of light.
22 Medulla of thalline margin with large crystals not soluble in K. (Small crystals soluble in K may also be present, especially in cortex.)
33 Epithecium with coarse crystals, typically 1 - 2 μm diameter. Thallus P- (or almost).
44 Disc pale brown, medium brown or red-brown (Note 1).
55 Thalline margin distinctly warty and irregular. Thallus distinctly warty. Apothecia often exceeding 1 mm diameter. **L. rugosella**
5 Thallus margin smooth to slightly crenulate. Thallus smooth to moderately warty. Apothecia only occasionally exceeding 1 mm diameter.
66 Epithelial crustals not descending into hymenium. **L. chlarotera**
6 Epithelial crystals clearly descending into upper part of hymenium, often slightly yellowish in colour. **L. hybocarpa**
4 Disc usually dark brown to black (Note 1). **L. meridionalis**
3 Epithecium with only fine crystals or granules generally less than 1 μm diameter (though they may aggregate to form larger clumps). Thallus P- or P+.
44 Cortex of thalline margin very wide, to 80 μm. Thallus P-. Disc brown, dark brown or black. Ascospores 11.5 - 17.5 x 7.5 - 10 μm. At subalpine or alpine levels. (L. circumborealis)
4 Cortex of thalline margin not usually exceeding 40 μm wide. Thallus P- or P+. Disc and ascospores various. Not restricted to (sub)alpine levels.
55 Thallus and thalline margin distinctly P+. Usually (but not exclusively) on bark of conifers or on wood.
66 Thallus P+ red. Most apothecia less than 1 mm diameter. **L. pulicaris**
6 Thallus P+ yellow-orange. Most apothecia more than 1.5 mm diameter. (L. paramerae)
5 Thallus and thalline margin P- or almost (may be faintly yellow if atranorin present in high concentration). Usually on deciduous trees. L. hybocarpa

2 Thalline margin with only small crystals soluble in K (Note 2).

33 Thallus or thalline margin P+ red, orange, pale orange or yellow-orange. L. intumescens

3 Thallus and thalline margin P- or almost (may be faintly yellow if atranorin present in high concentration). L. strobilina

1 Epitheciun without large grains or polarising crystals or granules.

22 Pycnidia usually present, containing two types of conidia. (L. quercicola)

2 Pycnidia usually absent.

33 Thalline margin with large crystals not soluble in K (some small soluble ones may also be present). L. argentata

3 Thalline margin with only small crystals soluble in K (Note 2).

44 Cortex of thalline margin 15 - 40 µm wide, sometimes to 50 µm in lower part, clearly separated from medulla by a crystal-free zone. Disc sometimes slightly shiny, remaining ± flat. Apothecia 0.4 - 1 (1.25) mm diameter. Ascospores 11 - 17 x 6 - 8 µm. L. horiza. Note 3.

4 Cortex of thalline margin 30 - 100 µm wide, not clearly separated from medulla by a crystal-free zone. Disc not shiny, concave to convex. Apothecia 0.5 - 2.5 mm diameter. Ascospores various.

55 Apothecia 1 - 2.5 mm diameter, concave, constricted at base. Ascospores 12 - 20 µm long. Thallus continuous or verrucose-areolate. L. allophana

5 Apothecia 0.5 - 1.7 mm diameter, flat to convex, not constricted at base. Ascospores 9.5 - 13 µm long. Thallus thin, continuous. L. glabrata

(1) Lecanora chlorotera usually has a pale brown disc, but it may have a darker brown (but not very dark brown) disc, perhaps in response to environmental factors. Occasionally the disc in L. meridionalis may be medium brown (perhaps a response to shading), but most discs are almost black.

(2) Before concluding that large insoluble crystals are absent, examine more than one section. The large crystals are sometimes not abundant.

(3) The poorly known (L. elapheia), said to occur in Mediterranean regions of Eurasia, would probably key out here. It has a P+ pale orange thallus and thalline margin, whereas L. horiza is P-.

Key to Lecanora group 5C: Thallus without marginal lobes or soralia; all parts C-, without norstictic acid; thallus grey to white, with atranorin; discs not pruinose; on rock.

11 Epitheciun some shade of brown.

22 Epitheciun with crystalline granules.

33 Apothecia 0.2 - 0.6 mm diameter. L. ripartii

3 Apothecia mostly more than 1 mm diameter. L. cenisia

2 Epitheciun without crystalline granules.

33 Thallus coarsely granular, but usually inapparent; not delimited. Thalline margin often excluded early. (L. lecideoides)

3 Thallus ± areolate or continuous, apparent, fairly clearly delimited.

44 Medulla, especially of thalline margin, with large crystals or large crystal aggregates. (Small crystals may also be present.) On siliceous rock.

55 Ascospores 8 - 12 x 4 - 6 µm. Prothallus absent. Thallus sometimes becoming subsquamulose when well developed. (L. pseudistera)

5 Ascospores 12 - 15 x 8 - 9 µm, often 4 per ascus. Prothallus often present. Epitheciun yellow-brown, the pigment dissolving in K producing a yellow effluent. L. ochica

4 Medulla of thallus and thalline margin with only many small crystals. On calcareous or siliceous rock.

55 On calcareous rock or slightly basic siliceous rock, never on strongly acidic rock. Prothallus often present. Thallus not subsquamulose. Ascospores 10 - 15 x 6 - 8 µm. L. campesiris. Note 1.

5 On ± horizontal siliceous rock, often weathered and near the soil. Disc remaining concave for a long time. Apothecia often with blackened margin. L. puniceofusca. Note 2.

1 Epitheciun not brown.

22 Epitheciun soon becoming excluded. Thallus often with a yellow tinge.

33 Epitheciun yellow-green to green black. On calcareous rock at alpine levels. L. atromarginata

3 Epitheciun blue-black. Disc black. L. marginata.

2 Thalline margin persistent. Thallus without a yellow tinge. Epitheciun green or or brown-green, K+ green, N+
purple-red. Disc black. **L. gangaleoides.**

(1) If a prothallus is absent (or almost absent) and the discs of young apothecia are shiny, consider **L. horiza**, which has been reported on rock in the British Isles.

(2) **L. puniceofusca** is not well known, and I have not seen a comprehensive description. Its placement in the key may not be reliable.

**Key to Lecanora group 6:** Thallus without marginal lobes or soralia; all parts C-, without norstictic acid; thallus grey to white, without atranorin.

111 On bark or wood.

22 Apothecia not pruinose, disk black, or darkening with age and eventually becoming ± black.

33 Apothecia soon becoming convex, without algal cells in section or with algal cells present only in basal parts. Cortex of lower part of thalline margin with many black granules. Epithecium brown to yellow-brown.

44 Hymenium 25 - 40 µm tall. Asci Catillaria type. Ascospores 3 - 4 µm wide. **L. hypopta**

4 Hymenium 55 - 75 µm tall. Asci Lecanora type. Ascospores 4.5 - 5.5 µm wide. **L. aitema**

3 Apothecia remaining ± flat, with algal cells throughout in section. Cortex of thalline margin without black granules. Epithecium green-brown, dark brown or almost black. (L. hypoptoides) Greek reports tentative, but discussed below.

2 Apothecia either pruinose, or disk not black; colour of disc not varying much with age.

33 Asci with 16 - 32 ascospores. See **Myriolecis sambuci**

3 Asci with 8 ascospores.

44 Thalline margin very thick, persistent. **L. aff. populicola**, non L. populicola (DC.) Duby

4 Thalline margin thin, eventually almost excluded.

55 Epithecium with few to many polarising granules (Note 1).

66 Thallus with a slight yellow tinge (isosuninic acid). This is the saligna group.

777 Ascospores 6 - 8.5 x 2.5 - 3.5 µm. **L. subinbricata**

77 Ascospores 3.5 - 5 µm wide, mostly more than 8 µm long.

88 Margin of apothecia usually persistent. Epithecium yellow-brown to olive-brown, N+ . Abundant macroconidia usually present, curved, 6 - 8 x 2 - 2.4 µm, not septate. **L. saligna**

8 Margin of apothecia often excluded. Epithecium brown, N+ red-violet. Macroconidia absent or not as above. (L. pseudosarcolipoides), (L. subsaligna)

7 Many ascospores more than 5 µm wide. (L. calabriaca), (L. laxa)

6 Thallus white or grey, without any yellow tinge, or entirely immersed. See **Myriolecis**

5 Epithecium entirely without granules. **L. horiza**

11 On calcareous rock (or on other lichens on calcareous rock). See **Myriolecis**

1 On siliceous rock.

22 Apothecia sessile, even when young.

33 Prominent white prothallus usually present. Thallus well-developed, areolate. **L. subcarnea**

3 Prothallus absent. Thallus poorly developed or not areolate. See **Myriolecis**

2 Apothecia ± immersed, at least when young. (L. helicopis) Greek report doubtful.

(1) In collections with many crystals in the thalline margin but rather few in the epithecium, the epithecium may appear by contrast to lack granules at a first glance. Be sure to observe carefully!

**Key to Lecanora group 7:** Thallus without marginal lobes or soralia; all parts C-, without norstictic acid; thallus green.

11 Disc dark brown, sometimes shiny. On various substrates, but not bark or wood. If present in Greece probably restricted to high mountains. (L. argopholis)

1 Disc greenish, yellowish or reddish, in some species becoming black eventually, not shiny. On various substrates. At all altitudes.

22 On wood or, less commonly, bark.

33 Thalline margin only apparent in section; apothecia soon becoming convex and immarginate. **L. symmicta**

3 Thalline margin visible externally, at least in young apothecia. Apothecia ± flat at least when young.

44 Thallus and thalline margin P+ yellow or orange-red. Cortex of thalline margin well developed, thickening towards the base.
55 Thallus well developed, warted-areolate.
66 Margin of apothecia appearing two layered from above; inner part matt, grey-white; outer part glossy, brownish. Cortex of thalline margin to 100 µm wide near base. Usually on wood of conifers. **L. varia**
6 Margin of apothecia not (or not distinctly) two layered. Cortex of thalline margin 25 - 65 µm wide near base. Usually on twigs of conifers. **(L. densa)**
5 Thallus ± immersed, or of dispersed warts. On fallen pine cones and branches. **(L. burgaziae)**
4 Thallus and thalline margin P- or slightly + reddish. Cortex of thalline margin various.
55 Disc eventually becoming black or blackish. Tips of paraphyses often black, N+ violet. Apothecia 0.35 - 0.65 mm diameter. **L. mughicola**
5 Disc not becoming black or blackish eventually. Tips of paraphyses colourless to brown, N-. Apothecia diameter various.
66 Thallus UV+ faintly orange. Thalline margin without a distinct cortex, of loosely entangled hyphae with scattered groups of algae. Apothecia not or scarcely pruinose. **L. strobilina**
6 Thallus UV-. Thalline margin usually with a distinct cortex (though it may be thin). Apothecia usually pruinose.
77 Cortex of thalline margin distinctly thickening towards base. **(L. coniferarum)**, **(L. laxa)**
7 Cortex of thalline margin (if present) not thickening towards base.
88 Ascospores 2.5 - 4 µm wide. Apothecia pale brown to orange-brown. Usually on bark. **L. albellula** s. lat.
99 Macroconidia 7 - 10.5 µm long, 1 (3) - septate. **L. albellula var. albellula**
9 Macroconidia 12.4 - 14 µm long, 1 - 3 - septate. **(L. albellula var. macroconidiata)**
8 Ascospores 4 - 5 µm wide. Apothecia pale red-brown. Usually on wood. **L. saligna**

On rock, usually siliceous.
33 Thalline margin P+ yellow. **L. eminens**
3 Thalline margin P-.
44 Prominent black hypothallus visible between the well-developed areoles. Disc pale brown to brown, without a green tinge. Apothecia sessile. See **Protoparmeliopsis laatokkaensis**
4 Black hypothallus absent or not prominent. Disc usually some shade of green, sometimes blackening, only rarely pure brown. Apothecia sessile or immersed.
555 Thallus of well-developed flattened areoles with distinct indented darker rim. Black hypothallus sometimes present. Apothecia mostly immersed, sometimes sessile. Disc green, green-black or green-brown. **L. intricata**
55 Thallus usually of small, dispersed rounded areoles; less commonly entirely immersed or of well-developed areoles. Black hypothallus sometimes present. Apothecia sessile. Disc usually greenish, sometimes grey-green but never blackening, only rarely brownish. **L. polytropa**
5 Thallus of well-developed, ± contiguous areoles. Hypothallus absent. Apothecia immersed at first, sometimes subsessile later. Disc often with a blackish tinge. Usually on slightly nutrient-enriched rock. **L. sulphurea**

**Lecanora aitema** (Ach.) Hepp (1853)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Crete, on bark at an altitude of about 1970 m.
Mainly western Europe and the Mediterranean mountains. Also Asia (Turkey, scattered in Russia). Reports for N. America are incorrect.

**Lecanora albella** (Pers.) Ach. (1810)
The earliest name is **Lichen pallidus** Schreb. (1771) but Rabenhorst's 1845 combination of that name into **Lecanora** is not legitimate because of the earlier **Lecanora pallida** Chev. (1826).
Descriptions: Lumbsch, Plümer et al. (1997); Nash et al. (2004); Smith et al. (2009).
Scattered on the mainland. On bark of **Pinus** and **Quercus** at altitudes 400 to about 1500 m.
Throughout Europe except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa, perhaps elsewhere), N. America (widespread), C. America (Mexico), S. America (Brazil, Chile), perhaps Pacific (Hawaii). Reports for Australasia are incorrect.
Lecanora albellula (Nyl.) Th. Fr. (1871)

Lichenogr. Scand. 266; Lecidea albellula Nyl. (1866), Lich. Lapp. Or. 147; Lecanora pinipenda Körb.; (?) Lecanora pinipenda var. subcarnea Körb.

Lecanora pinipenda Körb. (1859) may be synonymous, and has priority if legitimate, which in my opinion it is, though some authors have claimed otherwise.

Descriptions: Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern, on bark of conifers or on wood at altitudes 700 - 1700 m. A report for Evia, from an altitude of just 25m, seems doubtful to me.

Most of Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread), C. America (Mexico).

Lecanora allophana (Ach.) Nyl. (1872)

Flora 55: 250; Lecanoni subfuscus g. (= f.) allophana Ach. (1814), Syn. Meth. Lich. 158; (?) Lecanora allophana f. subvirescens J. Steiner; Lecanora chlorona f. geographica (A. Massal.) Zahlbr.; Lecanora subfuscata f. geographica (Flagey) Szatala.

The nomenclatural situation is complicated. The two earliest names were published by Hoffmann in 1796, but at an indefinite infra-specific rank and so have no nomenclatural priority. The next three are Parmelia subfusca var. flexuosa Ach., P. subfusca var. pallida Ach. and P. subfusca var. pellaeas Ach., all of which date from (1803). Next, we may have Lecanora leucopsis Ach. (1810), but application of this name is disputed.

When, in 1810, Acharius published the name Lecanora subfuscus var. allophana he cited in synonymy the three varietal names that he had published in 1803. The 1810 name is thus superfluous name and illegitimate. (Acharius also cited earlier names at species rank, but as none of those earlier names had at the time been combined at the rank of variety they are not relevant here.) Lecanora subfuscus var. allophana is typified by "the type of the name that ought to have been adopted" (Article 7.5), i.e. by the type of one of the three 1803 varieties. The Code does not specify which of those three names are to be chosen, and we are at liberty to choose provided that a choice has not already been published. Brodo & Vitikainen (1984 :284) suggested that Parmelia subfuscus var. flexuosa Ach. is the most natural choice to make, although they themselves did not designate a type and the name appears to be untypified.

Regardless of how one typifies Lecanora subfuscus var. allophana, the homotypic name Lecanora subfuscus f. allophana Ach. (1814) is legitimate, because of the change in rank. Brodo & Vitikainen (1984) were incorrect in asserting that Nylander's 1872 name could be taken as new; Nylander introduced the name as L. allophana (Ach.), and as there is a legitimate basionym available, namely Lecanora subfuscus f. allophana Ach., Nylander's name must be cited as L. allophana (Ach.) Nyl. So far as I can determine, none of the three 1803 varieties has ever been combined at the rank of species, so Nylander's name is legitimate.


Scattered, with no clear pattern but commoner in northern Greece. On bark at altitudes 20 to over 2000 m. Reported from a wide range of phorophytes, with no marked preference but avoiding strongly acidic bark.

Most of Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa, perhaps elsewhere), N. America (widespread), C. America (Mexico, perhaps elsewhere), perhaps Pacific (Hawaii, Tahiti, Tuamotu, perhaps elsewhere). Reports for S. America may be unreliable; those for Australasia are incorrect.

Lecanora argentata (Ach.) Malme (1897)

Lich. Suec. Exs., no. 5. (Sayre, 1969, implies that new combinations in Malme's exsiccatea are validly published.); Parmelia subfuscus f. argentata Ach. (1803), Methodus 169; Lecanora subfuscata H. Magn.; (?) Lecanora subfuscata f. melanarca (Harm.) Szatala; Lecanora subrugosa Nyl.

Acharius's epithet has priority at species rank only from 1897. The name Lecanora subrugosa Nyl. (1875) is considered to be synonymous, and has priority.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Fairly common in some parts of Greece, but curiously absent from the mainland of central and southern Greece. On bark at altitudes 0 to about 2000 m. Reported from a wide range of phorophytes, with no marked preference but avoiding strongly acidic bark.

Throughout Europe to about Arctic Circle. Also Macaronesia, Asia (widespread), perhaps Malesia (old report), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), perhaps Caribbean (old report), C. America (Mexico, Guatemala, perhaps elsewhere), S. America (widespread), Australasia (eastern Australia, NZN).

Lecanora atromarginata (H. Magn.) Hertel & Rambold (1997)
Description: Smith et al. (2009).
Known from a single site in northern Epiros, where it occurred on calcareous rock at an altitude of 2100 m.

Northern Europe and the Alps. The Greek report is a substantial range extension. Also Asia (Russia), N. America (Alberta, Nunavut, Montana, Washington), Antarctica (S. Shetland Is, Antarctic Peninsula).

Lecanora bicincta Ramond (1827)
Northern Peloponnese, on siliceous rock at about 2000 m altitude. Not reported since 1894.

Widespread in Europe to as far north as mid Scandinavia, though south of the Alps restricted to high mountains. Also Asia (widespread), Africa (Algeria, S. Africa, perhaps elsewhere, N. America (widespread), C. America (Mexico), S. America (Argentina, Bolivia), Australasia (NSW, NZS).

Lecanora campestris (Schaer.) Hue (1888)
Bull. Soc. Bot. Fr. 35: 47; Parmelia subfuscus θ (= var.) campestris Schae. (1839), Lich. Helv. Spic. 8: 391; Lecanora subfuscus f. campestris (Schaer.) Nyl.: Lecanora subfuscus h. (= var.) campestris (Schaer.) Rabenh.

Thallus: crustose, white to pale grey, continuous to areolate, sometimes slightly warted, to several cm diameter, without vegetative propagules. Prothallus: sometimes present, white, 0.5 - 0.8 mm wide. Apothecia: always abundant, sessile, flat to slightly convex, usually rounded, sometimes becoming irregular when old, 0.55 - 1.4 mm diameter, not pruinose. Disc: brown to dark brown, sometimes with a slight reddish tinge. Thalline margin: present, 0.05 - 0.1 mm wide, usually persistent, smooth to (in old apothecia) rather crenulate; in section: 40 - 110 µm wide, of which cortex 10 - 20 µm; with abundant small crystals. Exciple: not visible externally; in section: 10 - 15 µm wide, colourless except at surface. Epithecium: brown to orange-brown, without crystals. Hymenium: 50 - 80 µm tall, colourless, or with some epithelial pigment in upper part. Hypothecium: 50 - 100 µm tall (including a subhymenium that is sometimes developed), colourless. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 16 x 4 - 8 µm. Chemistry: disc C-; thallus and thalline exciple K+ yellow, C-, P-.

Easily recognised by the absence of crystals in the epithecium, the absence of large crystals in the exciple, and the saxicolous habit. Other species with a similar arrangement of crystals are corticolous.

Scattered throughout Greece, usually not very far from the sea. On calcareous rock or moderately basic siliceous rock at altitudes 0 - 920 m.

Widespread in Europe to about Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), C. America (Mexico, perhaps elsewhere), perhaps S. America (Uruguay). Reports for Australasia, Pacific are incorrect.

Lecanora carpinea (L.) Vain. (1888)

Thallus: crustose, white, continuous to slightly cracked, forming small patches to 1 cm diameter when on a broad expanse of bark, when on small twigs sometimes extending several cm along the twig, thin, without vegetative propagules. Apothecia: always abundant, sessile, flat to moderately convex, 0.3 - 0.9 mm diameter, with abundant white pruina on disc. Thalline margin: present, persistent but sometimes becoming very thin; in section: 70 - 80 µm wide, with true cortex 35 - 60 µm wide that is mostly colourless but sometimes pale brown in outer part; crystals: abundant throughout cortex, small, soluble in K. Exciple: not visible externally; in section: 10 - 15 µm wide, colourless except at surface, of anastomosed hypothecium on an overall radiating trend. Epithecium: brown, K-, with abundant small crystalline granules soluble in K. Hymenium: 60 - 80 µm tall, colourless, KI+ blue. Hypothecium: 40 - 65 µm tall (including a rather poorly developed subhymenium), colourless. Paraphyses: simple to sparingly anastomosed, 1 µm wide at base, 1 - 1.5 µm at apex. Ascii: 50 - 55 x 12 - 13 µm, narrowly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 12 x 6 - 8 µm, with distinct Lecanora type wall, 8 per ascus. Chemistry: pruina of disc C+ persistent yellow, orange or dark orange, P-; thalline exciple C+ orange, P+ yellow; thallus K+ faintly yellow, C-, P- or almost, UV+ faintly orange. Photobiont: green, cells globose, 8 - 13 µm diameter.

The group of species consisting of L. carpinea, L. leptyrodes and L. subcarpinea is easily recognised by the white pruinose lecanorine apothecia reacting C+ orange and the corticolous habit. Separation of species within this group requires careful microscopic examination. L. carpinea is distinguished by its thalline exciple having a true cortex, not pseudocortex, and the greater solubility in K of the crystals in the thalline exciple.

According to published reports this species is widespread and common throughout Greece, where it occurs on bark, predominantly of deciduous trees, at all altitudes. It avoids strongly basic and strongly acidic bark. However, some reports, especially older ones, may be unreliable owing to confusion with L. leptyrodes and L. subcarpinea. Some Peloponnesian reports of Abbott (2009) were based on field observations, and some may be errors for L. leptyrodes.
Subcosmopolitan outside the tropics.

**Lecanora cenisea** Ach. (1810)

Lichenogr. Universalis 361-362; *Lecanora transcendens* (Nyl.) Hayek.

The epithet is not *cenisea*, as sometimes written.

**Description:** Nash et al. (2004); Roux (2007); Smith et al. (2009). The description in Clauzade & Roux (1985) is misleading, and should not be used.

Scattered, with no clear pattern. On bark or siliceous rock, at altitudes 420s - 2150 m. The only phorophyte explicitly reported was *Pinus heldreichii*.

Throughout Europe, though south of the Alps restricted to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), perhaps S. America (Argentina, Chile). Reports for Australasia (NZ) are incorrect.

**Lecanora cerebellina** Poelt (1958)


**Description:** Clauzade & Roux (1985), or see the protologue.

Reported from a single site in Attica, at an altitude of about 250 m. No substrate was reported.

Otherwise only known from Bulgaria and Yugoslavian Macedonia.

**Lecanora chlarotera** Nyl. (1872)


**Thallus:** crustose, white to grey, smooth to slightly warty, without vegetative propagules. **Apothecia:** sessile, flat to slightly convex, 0.35 - 1.0 (1.6) mm diameter, usually not pruinose. **Disc:** pale brown, brown or orange-brown, only occasionally darker brown. **Medulla:** with large crystals, (5) 10 - 50 µm wide, slowly soluble in N but not soluble in K; small crystals also present, especially in cortex, soluble in K.

**Exciple:** not visible externally; in section: 15 µm wide, formed of thin hyphae ±parallel to paraphyses. **Epithecium:** brown or dark brown, K-, pigment soluble in K; with abundant coarse crystals, usually 1 - 2 µm wide, sometimes smaller, usually forming a distinct layer above paraphyses, sometimes also present in upper part of hymenium, soluble in K but not, or scarcely, in N (though N may cause some crystals to detach and float away). **Hymenium:** 50 - 75 (90) µm tall, colourless, KI+ blue. **Hypothecium:** 60 - 100 µm tall, colourless. **Paraphyses:** usually simple, 1.5 µm wide at base, 2 - 5 µm at apex, not to slightly capitate. **Asci:** 50 - 63 x (12) 17 - 23 µm, ±cylindrical to clavate, apex KI+ blue. **Ascospores:** colourless, simple, ellipsoid, 11 - 14 x 5 - 8 (9) µm, with distinct Lecanora-type wall, 8 per ascus.

**Chemistry:** disc C-, P-; thallus and thalline exciple K+ yellow (reaction sometimes faint), C-, KC-, P-, UV- or UV+ faintly white. **Photobiont:** green.

The epithecial crystals do not dissolve in 50% N, or they dissolve so slowly that they will be observed as insoluble. According to Smith et al. (2009) they dissolve in nitric acid, but they may be referring to concentrated acid. I have not been able to make observations using concentrated acid.

The common *L. horiza* lacks polarising crystals in the epithecum. *L. meridionalis* has much darker discs. For separation from *L. hybocarpa* see under that species.

Very common throughout Greece, at all altitudes where there are suitable substrates. Nearly always on bark, but once on wood of *Cupressus sempervirens*. On a wide range of phorophytes with no marked preference. A common pioneer species on twigs, but not restricted to them. The lichenicolous fungus *Stigmidium congestum* has been reported several times from this host and *Vouauxiella lichenicola* has been reported once.

**Lecanora compallens** van Herk & Aptroot (1999)


**Description:** Smith et al. (2009); or see the protologue.

This species has never been found with apothecia or pycnidia, and its determination requires the use of chromatography. It is not adequately included in the keys in this Flora.

Chios, on bark at altitudes 430 - 740 m.

Widespread in Europe. Also Asia (Turkey, Armenia), Africa (St. Helena).

**Lecanora conferta** (Duby) Grognot (1863)

According to Laundon (2010) the name has been misapplied. Here I use the name in the traditional, but incorrect, sense. Conservation is desirable.

Description: Clauzade & Roux (1985); Smith et al. (2009).
Scattered, with no clear pattern. On siliceous rock at altitudes 0 to at least 1200 m.
Southern and central Europe to as far north as Denmark. Also Asia (Turkey, Iran), N. Africa (Morocco, Algeria).

**Lecanora configurata** Nyl. (1884)

Description: Poelt & Vězda (1977); unfortunately, the description is not very detailed. The protologue is also insufficiently detailed for modern needs. This is a greenish species with marginal lobes (like *L. muralis*), but small and with immersed apothecia.

Very scattered, with no clear pattern. On siliceous rock at altitudes 50 - 670 m. Also tentatively reported for Epiros, on limestone at an altitude of 2150 m.
SE Europe: Romania, Bulgaria, Ukraine, Greece. Also Asia (Azerbaijan, Russia, Kazakhstan).

**Lecanora conizella** Nyl. (1875)
*Flora* 58: 104.

Thallus: crustose, pale grey, forming irregular patches to a few cm diameter, very thin (to 80 µm when well-developed, but usually much less), without vegetative propagules. Apothecia: sessile, flat to moderately convex, 0.2 - 0.25 mm diameter, not pruinose. Disc: pale brown to brown. Thalline margin: absent, even in section. Exciple: sometimes visible externally, thin, dark brown (darker than disc), excluded early; in section: 20 µm wide, pale brown, sometimes colourless in inner part, of radiating hyphae. Epithecium: orange-brown, K-, pigment between paraphyses soluble in K; crystals apparently absent (though there is some polarisation in upper part of hymenium below epithecium). Hymenium: 40 - 45 µm tall, colourless, KI+ blue. Hypothecium: colourless. Paraphyses: occasionally branched, 2 µm wide, not capitate, with internal green-back pigment cap; this pigment not soluble in K. Ascii: 50 x 13 µm, subcylindrical, apex KI+ blue. Ascospores: colourless, simple, usually ellipsoid, but rather variable in shape, 10 x 5 µm, 8 per ascus. Chemistry: thallus K- (or almost), C+ persistent orange, P-, UV- (or almost).

Well characterised by the C+ orange thallus and very small, almost immarginate apothecia.
Western Peloponnese, near the sea. On wood at an altitude of 20 m.
Iberian Peninsula, France and Greece. Also N. Africa (Morocco).

**Lecanora dispersella** J. Steiner (1905)

Description: See the protologue, though unfortunately it is not adequate for modern needs. This species is close to *L. dispersa*, but its precise placement is uncertain.

Delos, on schist near sea level.
Southern Europe, from Iberian Peninsula to Crimea. Also Asia (widespread in a band from Turkey to Tajikistan).

**Lecanora eminens** Asta, Clauzade & Cl. Roux (1975)

Description: Clauzade & Roux (1985).
Chios, on siliceous rock, sometimes metal-rich, at altitudes 525 - 670 m.
Otherwise apparently only known from the Alps and Pyrenees.

**Lecanora epibryon** (Ach.) Ach. (1810)
Lichenogr. Universalis 396; *Lichen epibryon* Ach. (1799), Lichenogr. Svec. Prodr. 79. The basionym is a nomen novum for *Lichen hypnorum* Wulf. (1791) nom illeg. (later homonym).

Description: Clauzade & Roux (1985); Smith et al. (2009).
Known from a single site in Epiros, where it occurred on calcareous soil at an altitude of 2100 m.
Widespread in northern and central Europe; rare in the mountains of the south. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan, Mongolia., Malesia (PNG), N. America (widespread), perhaps S. America (Argentina, Falkland Is, perhaps elsewhere), Australasia (cooler parts of Australia), Antarctica (subantarctic islands, Antarctic Peninsula).

**Lecanora expallens** Ach. (1810)
Lichenogr. Universalis 374-375; (?) *Lecanora smaragdophora* Harm.

Greek material seen fits published descriptions of *L. expallens*, but is sterile. In view of the difficulties of working with sterile crustose lichens in a poorly known region, and the risk of errors of determination, I prefer not to provide a description. For a published description see Smith et al. (2009).
Scattered rather thinly throughout Greece at altitudes 0 - 1700 m. On bark, usually of conifers, less commonly on wood. Throughout Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (Mexico), perhaps S. America (old reports), Australasia (NZN), Pacific (Hawaii, perhaps New Caledonia).

**Lecanora formosa** (Bagl. & Car.) Knoph & Leuckert (2000)


Description: Smith et al. (2009).

Known from a single site in Epiros, where it occurred on calcareous rock at an altitude of 2100 m. Northern and alpine Europe. The Greek report represents a considerable range extension. Also Asia (Russia, Nepal, Japan), perhaps N. America.

**Lecanora gangaleoides** Nyl. (1872)


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Islands of the Aegean, including Crete; occasionally on the mainland. On siliceous rock at altitudes 10 - 1750 m, but usually below 1000 m. Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (western half), C. America (Mexico), S. America (Chile), Australasia (NSW).

**Lecanora glabrata** (Ach.) Nyl. (1872)


Description: Clauzade & Roux (1985).

Scattered, mostly in the northern half of Greece, at altitudes 0 - 1500 m. Usually on bark, occasionally on wood. Reported bark of from _Abies, Fagus, Ficus, Olea_ and on wood of _Pinus._

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread, but not continental interior), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), perhaps S. America (old reports), perhaps Pacific (New Caledonia - old report).

**Lecanora horiza** (Ach.) Linds. (1869)


Thallus: crustose, white to pale grey or pale green-grey, not pruinose, continuous to slightly cracked, smooth to slightly warty, forming small patches usually less than 2 cm diameter, usually thin, less commonly ± well developed to 250 µm thick, without vegetative propagules. Cortex: true cortex absent; layer above algal cells colourless, usually thin, without distinct structure. Medulla: poorly developed. Apothecia: usually abundant, sessile, usually ± flat, sometimes slightly convex, (0.3) 0.4 - 1 (1.25) mm diameter, not pruinose. Disc: brown to dark brown, sometimes slightly shiny. Thalline margin: prominent, persistent, usually smooth except sometimes in very old apothecia, 0.05 - 0.1 mm wide; in section: 50 - 150 µm wide, of which cortex 12 - 30 µm in upper part of apothecium, sometimes as much as 40 - 50 µm in lower part, formed of a network of hyphae (best seen in K); abundant small crystals present especially in cortex, sometimes also in medulla but generally not in algal layer, those in cortex soluble in K, those in medulla not soluble in K. Exciple: usually not visible externally; in section: thin, 12 - 20 µm wide, poorly developed, with epiphytic pigment in outermost part, colourless elsewhere, formed of hyphae ± parallel to paraphyses. Hypothecium: brown-orange to orange-brown, without crystals. K-, pigment mostly soluble in K. Hymenium: 60 - 85 (100) µm tall, colourless, KI+ blue. Subhymenium: sometimes present, colourless, 25 µm tall, of ± vertical hyphae. Hypothecium: 50 - 130 µm tall, colourless, of randomly oriented hyphae. Paraphyses: simple, 1 µm wide at base, 2 - 3 µm at apex, not or slightly capitate. Ascii: 55 - 65 x 17 -23 µm, clavate. Ascospores: colourless, simple, ellipsoid, (10) 11 - 17 x 6 - 8 (9) µm, with distinct Lecanora-type wall, 8 per ascus. Chemistry: disc K-, C-, P-; thallus and thalline exciple K+ yellow (reaction sometimes faint), C-, P-, UV- or almost. Photobiont: green, cells globose, 8 - 11 µm diameter. Photobiont layer: continuous, often occupying much of thallus, upper boundary very irregular.

Often recognisable even in the field by the slightly shiny brown discs, which are usually darker than those of _Lecanora chlorotera._ Easily recognised microscopically as, at least in southern Greece, it is the only common species in this group that lacks epiphytic crystals.

Throughout Greece. Recorded from sea level to 1550 m, but commonest at low altitudes: about 70% of reports are from below 500 m. Nearly always on bark, and recorded from a wide range of phorophytes, but apparently always avoiding _Pinus._ There are also a few records from wood. The lichenicolous fungus _Vouauxiella verrucosa_ has been
reported several times from this lichen and Vouauxiella lichenicolata has been reported once.

Southern and central Europe, just reaching British Is but absent from Baltic States and Nordic Countries. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (scattered in USA), C. America (Mexico, perhaps elsewhere). Reports for S. America seem doubtful to me.

**Lecanora hybocarpa** (Tuck.) Brodo (1984)


Said to differ from *L. chlarotera* in having small polarising granules between the paraphyses, whereas *L. chlarotera* is said to have slightly larger (1 - 2 µm diameter) polarising crystals between and above the paraphyses. For published descriptions see Nash et al. (2004) and Smith et al. (2009), but note that these disagree on whether the polarising granules or crystals in the epithecium do or do not dissolve in K. Nash et al. claim that they do dissolve, whereas Smith et al. state that they do not. The disc in *L. chlarotera* is not pruinose, whereas it is said to be lightly pruinose in *L. hybocarpa*.

I have referred a few Greek collections here, but only tentatively. Some published Greek reports might be misinterpretations of *L. chlarotera*. In some collections of that species the crystals in the upper part of the hymenium can be prominent, and the layer of crystals overlying the paraphyses can be poorly developed. This could lead to confusion with *L. hybocarpa*.

Scattered, mainly in the southern half of Greece, never very far from the sea, on bark at altitudes of 0 - 500 m. Reported from a wide range of phorophytes, with no clear preference.

Southern and western Europe to as far north as Scotland. Also Macaronesia, Asia (Turkey), N. America (widespread).

**Lecanora hypopta** (Ach.) Vain. (1899)


Thallus: crustose, thin, inconspicuous, smooth, pale grey to pale brown, to 1.5 cm diameter, without vegetative propagules. Apothecia: abundant, sometimes crowded, sessile, slightly concave to flat when young, becoming strongly convex later, 0.2 - 0.3 mm diameter, not pruinose. Disc: black. Thalline margin: sometimes obscurely present in external view; in section: sometimes present, 0 - 95 µm wide. Exciple: brown, becoming excluded; in section: 25 - 40 µm wide, colourless in inner part, orange-brown in outer part, of radiating hyphae, without obvious crystals (though there is some polarising effect). Epithecium: orange-brown to brown, without crystals. Hymenium: 45 µm tall, colourless or with some epiphytic pigment in upper part. Hypothecium: 50 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, 3 µm at apex, clavate to slightly capitulate. Ascii: said to be Catillaria type. Ascospores: colourless, simple, 10 - 3 - 4 µm, 8 per ascus. Chemistry: thallus K-, C-, P-. Photobiont: green.

This species does not belong in *Lecanora* and its true affinities are uncertain. I treat it here for convenience, because in my single collection a thalline exciple is weakly present in some apothecia, and the first impression is of a species close to *Lecanora*.

SE Peloponnese, on wood of *Castanea sativa* at an altitude of 900 m. The site has a long-established woodland of *C. sativa* (and other uncommon species of lichens are also present). This is consistent with the ecology of this species in Sardinia (Zedda, 2002).

Widespread in cool regions of the Northern Hemisphere. Rare and scattered in the Mediterranean.

**Lecanora aff. hypoptoides** (Nyl.) Nyl. (1872)


A species that keys out here occurs in the Peloponnese on wood of *Pinus* at altitudes 1200 - 1500 m, but it differs from some published descriptions of *L. hypoptoides* (it has crystals in the upper part of the hymenium). The epithecium reacts K+ dull green, N- (or almost; there may be an obscure N+ violet reaction but it is hard to be sure in the material I have seen). Crystals (or polarising granules) are present in the epithecium and the thalline exciple, and are soluble in K but not in N. For a published description of *L. hypoptoides* see Clauzade & Roux (1985). The description in Nash et al. (2004) may refer to a different species.

The only other Greek report, also tentative, was from Crete on wood at an altitude of 900 m. *L. hypoptoides* s. str. is widespread but scattered in central and northern Europe, and it does appear to be present south of the Alps. Also N. America (apparently widespread, but some reports may refer to other species).

**Lecanora impudens** Degel. (1944)

*Sv. Bot. Tidskr.* 38(1): 50. It is a nomen novum for *Pertusaria farinacea* H. Magn., Magnusson's epithet being unavailable in *Lecanora* because of the earlier *L. farinacea* Fée (1825). Another earlier synonym is *Pertusaria maculata* Erichsen (1936), but that epithet is also unavailable in *Lecanora*, because of *L. maculata* H. Magn.

Lecanora intricata (Ach.) Ach. (1810)
Lichenogr. universalis 380; Parmelia intricata Ach. (1803), Methodus 178.
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Chios, on siliceous rock at an altitude of 490 m.
Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Algeria, Algeria), N. America (widespread), S. America (Argentina, Bolivia, Colombia), Australasia (widespread outside drier parts), Antarctica (S. Shetland Is).

Lecanora intumescens (Rebent.) Rabenh. (1845)
Deutschl. Krypt.-Fl. 2(1): 34; Parmelia intumescens Rebent. (1804), Prodr. Fl. Neomarch. 301; Lecanora intumescens var. glaucorufa (Mart.) Arnold; (?) Lecanora intumescens var. ochrocarpa Zahlbr.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered on Crete and the mainland, with no clear pattern. On bark of Fagus, Quercus coccifera and Q. frainetto at altitudes 400 - 1600 m.
Throughout Europe, though south of the Alps predominantly an upland species. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (BC), Australasia (NZN).

Lecanora leptyrodes (Nyl.) Degel. (1931)
Thallus: crustose, white to white-grey, sometimes slightly cracked, forming small patches to 1.5 cm diameter, thin (30 - 70 µm), without vegetative propagules. Prothallus: sometimes present, appearing very similar to thallus but slightly whiter, to 1 mm wide. Cortex: true cortex absent; pseudocortex: 5 - 35 µm thick, colourless, without distinct structure. Medulla: absent. Apothecia: usually abundant, subsessile to sessile, flat to convex, 0.4 - 1 mm diameter, usually with dense white pruina. Disc: brown (below pruina). Thalline margin: present, smooth, 0.05 mm wide, slightly whitish, to 1 mm wide. Cortex: true cortex absent; pseudocortex: 5 - 35 µm thick, without distinct structure. Exciple: sometimes visible externally as a very thin ring ±concolourous with disc; in section: 12 µm wide, of radiating hyphae. Epithecium: brown to grey, K-, pigment soluble in K; with abundant small crystals soluble in K. Hymenium: 60 - 70 µm tall, colourless, KI+ blue. Hypothecium: 50 µm tall, colourless. Paraphyses: usually simple, sometimes sparingly Anastomosed, 1 µm wide at base, 2 µm at apex, not capititate. Asci: 50 - 55 x 13 - 15 µm, clavate. Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 12 x 5.5 - 7.5 µm, with Lecanora-type wall about 1 µm wide, 8 per ascus. Chemistry: disc C+ persistent yellow to orange-yellow; thalline exciple K+ yellow, C-, P-; thallus K+ yellow, C-, P-, UV-. Photobiont: green, cells globose, 10 - 12 µm diameter Photobiont layer: ±regular but sometimes discontinuous, 20 - 50 µm thick.

For separation from L. carpinea and L. subcarpinea see under those species.
Scattered throughout Greece at altitudes of 200 m and above. On bark of a wide range of phorophytes, with no clear preference. Very common on twigs. Probably more common than records suggest, as some reports of L. carpinea probably belong here. In the Peloponnese this is the commonest species in the L. carpinea-leptyrodes-subcarpinea group.

Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (Turkey, Israel, Russia), N. Africa (Algeria).

Lecanora lividocinerea Bagl. (1879)

Thallus: crustose, white to white-grey, smooth, continuous, to several cm diameter, thin (50 - 100 µm), without vegetative propagules. Apothecia: abundant, sessile, flat to slightly convex, 0.35 - 0.7 mm diameter, not pruinose. Disc: brown to dark brown, sometimes almost black. Thalline margin: prominent, persistent, smooth; in section: 60 µm wide, cortex 12 µm wide; large crystals present, not soluble in K. Exciple: sometimes visible externally as a very thin ring ±concolourous with disc; in section: 12 µm wide, of radiating hyphae. Epithecium: brown to green-brown or green-black, K-, pigment between paraphyses (but not internal pigment) soluble in K; with small crystals soluble in K. Hymenium: 50 - 60 µm tall, colourless, KI+ blue. Hypothecium: to 130 µm tall at centre of apothecia, colourless. Paraphyses: simple to sparingly Anastomosed, 1.5 µm wide at base, 2.5 µm at apex, sometimes slightly capititate, apical cell with thin crescent of internal pigment. Ascii: 40 - 50 x 10 µm, narrowly clavate, apex KI+ blue. Ascospores: colourless, simple, ellipsoid, 12 - 14 x 4 - 5 µm, with Lecanora-type wall, 8 per ascus. Chemistry: disc K-, C-, P-; thallus and thalline exciple K- or K+ yellow, C+ red or pink-red, P-, UV+ orange. Photobiont: green.
This species is said to react P+ orange, but I have not been able to observe that. The K reaction is variable in spot tests, which suggests that lichen substances are sometimes present only in small amounts.

Easily recognised by the C+ thallus and the corticolous habit.

Rare and scattered in humid parts of the southern half of Greece, never very far from the sea. Usually on bark occasionally on wood, at altitudes 10 - 700 m.

Southern Europe, from Portugal to Greece. Also N. Africa (Morocco) and, surprisingly, Australasia (western Australia).

_Lecanora marginata_ (Schaer.) Hertel & Rambold (1985)


Descriptions: Clauzade & Roux (1985) as _Lecidea marginata_; Nash et al. (2004); Smith et al. (2009).

Rare in northern Greece. On rock at altitudes 1900 - 2150 m.

Throughout Europe, though south of the Alps restricted to high mountains. Also Macaronesia (if _L. sulphurella_ is synonymous), Asia (widespread), Africa (Socotra; Ascension Is), N. America (widespread), perhaps S. America (Falkland Is), Australasia (eastern Australia).

_Lecanora meridionalis_ H. Magn. (1932)


The name _Lecanora subfusca_ var. _meridionalis_ Arnold (1868) may be synonymous. I have not seen Magnusson’s protologue, so do not know whether he referred to Arnold’s name.

Similar to _L. chlarotera_ but apothecia with dark brown to black discs. For published descriptions see: Clauzade & Roux (1985) as _Lecanora chlarotera_ subsp. _meridionalis_; Nash et al. (2004).

Scattered rather thinly throughout Greece at altitudes 0 - 1300 m. Usually on bark, sometimes on wood. Reported from a wide range of phorophytes with no marked preference.

Southern Europe, from Iberian Peninsula to Cyprus, with a very few reports from the Alps and regions just northwards. Also Macaronesia, Asia (Turkey, Russia, Mongolia), N. America (widespread).

_Lecanora mughicola_ Nyl. (1872)

_Flora_ 55: 248. (It is a nomen novum for _Lecanora varia_ var. _alpina_ Kremp. (1861), _Denkschr. k. bayer. bot. Ges. Regensburg_ 4(2): 153, the epithet _alpina_ not being available at species rank owing to the earlier _Lecanora alpina_ Sommerf. 1826.)

Descriptions: Clauzade & Roux (1985, 1989); Nash et al. (2004); Smith et al. (2009).

Northern Greece, especially near Mt. Olympus. On bark and wood of conifers at altitudes 275 - 1800 m. Reported from _Pinus heldreichii_ and _Juniperus oxycedrus_.

Widespread in central Europe, occasional further north (Scotland, Norway). Rare south of the Alps and mostly confined to the mountains. Also Macaronesia, Asia (Turkey, Russia, Mongolia), N. America (western half).

_Lecanora ochica_ Sipman (2007)


Description: See the protologue. According to D. H. J. M. Sipman (pers. comm.) this species is close to _L. cenisia_. It may prove to be merely an extreme morph of that species.

Evia and adjacent coast of the mainland. On siliceous rock at altitudes 950 - 1350 m.

Known only from Greece.

_Lecanora polytropa_ (Hoffm.) Rabenh. (1845)


Thallus: crustose, poorly developed, of scattered, grey-green areoles on a black prothallus that extends far beyond the areoles, not pruinose, without vegetative propagules, forming small patches 1 - 2 cm diameter. Areoles: ±rounded, 0.1 - 0.25 mm wide, flat to slightly convex, to 200 µm thick. Cortex: 30 - 40 µm thick, mostly colourless, sometimes very pale brown in outer part, of randomly oriented hyphae; K-, pigment soluble in K. Medulla: poorly developed. Apothecia: sessile, flat, 0.25 - 0.55 mm diameter, not pruinose. Disc: green. Thalline margin: not visible externally (in Greek collections seen); in section: present on lower surface of apothecia, 50 - 70 µm wide. Exciple: pale green, paler than disc, persistent, sometimes crenulate in old apothecia; in section: 40 - 50 µm wide, pale grey to pale brown, of radiating hyphae, K-, pigment soluble in K. Hypothecium: brown, K-, pigment soluble in K. Hymenium: 45 - 55 µm tall, colourless. Hypothecium: usually about 50 µm tall, but at centre of apothecia sometimes with a deep 'root' to 150 µm, colourless. Paraphyses: simple, 1.5 µm wide at base, 2 - 2.5 µm at apex, not capitate or moniliform. Ascii: 35 - 40 x 14 -
15 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 12 x 6 µm, 8 per ascus. Chemistry: thallus K- (or almost), C-, KC-. Photobiont: green, cells globose to subglobose, 10 - 12.5 µm diameter. Photobiont layer: 50 - 80 µm thick, not continuous, cells tending to form large clumps.

Scattered throughout Greece. On rock, usually siliceous, at altitudes 0 to at least 2150 m. The lichenicolous fungi Carbonea supersparsa, Cerdidosponia epipolytropa and Nesolechia oxysporiza have each been reported once from this lichen.

Subcosmopolitan outside tropical regions, though not reported for Africa.

**Lecanora aff. populicola**

I use this name for a taxon that is distinctive and well defined, and which keys out as *L. populicola*, but which almost certainly is not *L. populicola* (DC.) Duby, a species that is said to be restricted to bark of *Populus*. It has large flat apothecia that become markedly contorted when old, and an unusually well-developed, prominent and persistent thalline exciple (which would appear to exclude *L. hypoptoides*), but at present its identity is uncertain.

Uplands of the Peloponnese at altitudes 1200 - 1300 m. On bark or wood of *Pinus nigra* and bark of *Juniperus foetidissima*.

**Lecanora praepostera** Nyl. (1873)

*Flora* 56: 19; *Lecanora pomensis* Zahlbr.; *Lecanora sardoa* Bagl.; *Lecanora schistina* (Nyl.) Arnold.

Thallus: crustose, pale grey, warty, without vegetative propagules, to several cm. diameter, 1.5 mm thick. Cortex: true cortex absent; pseudocortex 35 - 50 µm thick, colourless, poorly structured; with abundant small crystals, about 1 µm wide, soluble in K. Medulla: white, chalky, rather friable; in section: with dense mass of crystals, the smaller ones like those in the pseudocortex, dissolving in K to reveal many larger crystals 5 - 8 µm diameter not (or only slowly) soluble in K. Apothecia: sessile, flat when young, often becoming ±convex later, 0.8 - 2.1 mm diameter, usually not pruinose, occasionally with slight white pruina. Disc: brown in young apothecia, generally black in old ones, some apothecia with patches of both colours. Thalline margin: pale grey, persistent but becoming very thin; in section: 125 - 150 µm wide in upper part of apothecium. Proper exciple: not visible externally; in section: 15 - 25 µm wide, colourless in inner part, orange-brown at surface, hyphal. Epithecium: orange-brown, pigment soluble in K; K- (see note below), diffusing a yellow pigment into solution. Hymenium: 70 - 90 µm tall, colourless. Hypothecium: 50 - 100 µm tall, ±colourless. Paraphyses: 1 µm wide at base, 1 - 1.5 µm at apex, anastomosed, not capitate or moniliform, without visible septa. Ascii: 50 x 11 - 12 µm, ±cylindrical to narrowly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 9.5 - 10 x 5.5 - 7 µm, with Lecanora type wall, 8 per ascus. Chemistry: medulla K+ faintly yellow in spot tests, norstictic acid present in section (see note below); thallus K+ pale orange, C-, P+ faintly yellow, UV-. Photobiont: green; cells globose, 7 - 12 µm diameter; forming a ±regular but sometimes discontinuous layer 50 - 70 µm thick.

In Greek material seen, the thallus contains norstictic acid but it is patchily distributed; clumps of dense concentration are separated by gaps, sometimes large, without norstictic acid. Norstictic acid can be demonstrated in the epithecium of about one apothecium in three, but is present at low concentration and very few crystals are formed. In the other apothecia norstictic acid is absent, or present at concentrations too low to be detected.

Scattered in the eastern half of Greece, usually close to the sea. On siliceous rock at altitudes 10 - 920 m, but more than three quarters of reports are from below 200 m. Mediterranean (Spain to Greece) and Atlantic (to as far north as SW British Is) part of Europe. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Tunisia).

**Lecanora pulicaris** (Pers.) Ach. (1814)


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern, at altitudes 0 to over 2000 m. Usually on bark of conifers, once on *Quercus frainetto*; less commonly on wood.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Malesia (Philippines, PNG), Africa (widespread), N. America (widespread), perhaps Pacific (W. Samoa). Reports for C. America, S. America and the Pacific may be unreliable and those for Australasia are incorrect.

**Lecanora punicofusca** Bagl. (1879)


Islands of the southern Aegean, on siliceous rock at altitudes 25 - 50 m.
Only Italy and Greece.

**Lecanora rechingeri Szatala (1943)**


Description: See the protologue. This taxon belongs in *Protoparmelia*. It seems close to *P. montagnei*, except that the thallus was described as *granular*-areolate (emphasis mine).

Rhodes and Athos, on wood at altitudes 700 - 1200 m.

Known only from Greece.

**Lecanora rhodi Szatala (1943)**


Description: Dickhäuser et al. (1995), or see the protologue. This taxon is close to *L. cenisia*. It has a well-developed, yellow-white thallus containing atranorin and norstictic acid. Apothecia are sessile, 0.4 - 2 mm diameter, with red-orange discs and a heavy white pruina. The amphithectum has numerous small crystals soluble in K. The epithecium is grey-brown, granular, with small crystals. Ascospores 10 - 13.5 x 5 - 7 µm.

Scattered in the islands of the southern Aegean. On siliceous rock at altitudes 500 - 800 m.

France, Germany, Portugal, Sardinia and Greece. Perhaps also North America (Tennessee).

**Lecanora ripartii Lamy ex Nyl. (1879)**

*Flora* 62: 202-203 as riparti. (The etymology of the epithet is not clear to me, but I have assumed that it commemorates someone called Ripart.)

Description: Clauzade & Roux (1985).

Macedonia, on rock (unspecified) at an altitude of 100 m.

A poorly understood taxon of southern and south-central Europe. Also Macaronesia, Asia (Turkey).

**Lecanora rubicunda Bagl. (1879)**


Description: Clauzade & Roux (1985).

Corfu, on bark of *Olea europaea* at an altitude of 20 m.

Probably circum-Mediterranean/Macaronesian. Southern Europe from Portugal to Greece. Also Macaronesia, N. Africa (Morocco). Reports for elsewhere appear to be unconfirmed.

**Lecanora rugosella Zahlbr. (1928)**

Cat. Lich. Univ. 5: 524; *Lecanora chlarotera f. rugosella* (Zahlbr.) Poelt; *Lecanora subfusca* var. *rugosa* (Nyl.) Th. Fr.

Similar to *L. chlarotera*, but with a generally more warted thallus, more robust thalline exciple, and larger apothecia (to 2 mm diameter). However, *L. rugosella* is difficult to circumscribe. Intermediates are quite common, and for this reason some authors do not recognise this species. My own view is that at least some of the collections that I have referred here differ so much from typical *L. chlarotera* that they can not possibly be the same species. The situation is likely to remain unclear pending a revision of the *chlarotera* group in SE Europe.

Scattered throughout Greece, but less common than *L. chlarotera*. On bark of a wide range of phorophytes, with no clear preference, at altitudes 0 - 1400 m. There is also a single report from wood of *Cupressus sempervirens*.

Widespread in Europe to as far north as mid Scandinavia. Also Asia (widespread), N. America (widespread).

**Lecanora rupicola (L.) Zahlbr. (1928) var. rupicola**


Thallus: crustose, areolate to warted-areolate, white, pale grey or pale yellow-grey, to several cm diameter, 0.4 - 0.8 mm thick, without vegetative propagules. Areoles: 0.5 - 1.5 mm wide, flat, surrounded to angular. Prothallus: occasionally present, white, 0.5 - 1.5 mm wide, less commonly black to 0.5 mm wide. Cortex: true cortex absent; pseudocortex: 15 - 80 µm thick, colourless, with abundant small crystals about 1 µm diameter, partly soluble in K. Medulla: white, upper part loosely packed, often with voids, individual hyphae often clearly visible; lower part densely packed, individual hyphae not easily seen; strongly polarising almost everywhere but individual crystals not easily seen. Apothecia: usually present, subimmersed to subsessile, usually flat, sometimes convex, 0.5 - 1.3 mm diameter. Disc: pale pink-orange, brown or black, usually obscured by dense white pruina. Thalline margin: present, persistent, rather thin in external view, often slightly wavy or crenulate; in section: best developed on lower surface of apothecia, 150 µm thick, without obvious cortex, with abundant fine crystals everywhere, soluble in K. Exciple: not visible externally; in section: 25 - 40 µm wide, colourless except in thin brown surface layer, of radiating hyphae, without crystals.
Epithecium: brown-grey, K-, pigment soluble in K. Hymenium: 60 - 65 \( \mu \)m tall, colourless, KI+ blue. Hypothecium: 100 \( \mu \)m tall, colourless. Paraphyses: simple (said to be sparingly branched sometimes), cylindrical, 1 \( \mu \)m wide, not capitate or moniliform. Ascii: 50 x 20 \( \mu \)m, clavate, Lecanora type. Ascospores: colourless, simple, usually ellipsoid, occasionally dacyriform, 11 - 15 x 4.5 - 8 \( \mu \)m, with Lecanora-type wall, 8 per ascus. Chemistry: pruina of disc C+ persistent yellow, orange-yellow or orange; medulla K-, C-, KC-, P-, I-; thallus K+ faintly yellow (diffusing yellow pigment in solution), C-, KC- or remaining yellow, P-, UV+ faintly orange. Photobiont: green, cells globose, 10 - 12 \( \mu \)m diameter. Photobiont layer: 50 - 70 \( \mu \)m thick, continuous, upper surface regular but lower surface often rather irregular.

The well developed thallus, robust apothecia with dense white, C+ orange pruina, and the siliceous substrate make this species easy to recognise. It is unlikely to be confused with any other.

Throughout Greece, on siliceous rock at all altitudes. Several lichenicolous taxa have been recorded from this lichen, including Arthonia varians many times, Lambiella insularis three times and, once each, Caloplaca inconnexa, Karschia sordida and Rinodina insularis.

Subcosmopolitan outside the tropics.

**Lecanora rupicola var. efflorens** Leuckert & Poelt (1989)
*Nova Hedwigia* 49(1-2): 151.

Description: Smith et al. (2009).

Epiros, on serpentinite at an altitude of 1100 m.

Scattered in western and southern Europe. Also Asia (Turkey).

**Lecanora rupicola subsp. subplanata** (Nyl.) Leuckert & Poelt (1989)
*Nova Hedwigia* 49(1-2): 152; Lecanora subplanata Nyl. (1881), *Flora* 64: 530; Lecanora subradiosa (Nyl.) Nyl.

The name *Lecanora glaucoma* subsp. *subradiosa* Nyl. (1872) is thought to be synonymous, and the epithet *subradiosa* has priority at the rank of subspecies.

Like subsp. *rupicola*, but thallus C+ orange.

Very scattered, with no clear pattern but never very far from the sea. On siliceous rock at altitudes 0 - 1000 m.

Western and southern Europe; absent from those parts of eastern Europe with a continental climate. Also western Asia (widespread as far east as Kazakhstan), N. Africa (Algeria), perhaps N. America (Yukon).

**Lecanora rupicola subsp. sulphurata** (Nyl.) Leuckert & Poelt (1989)
*Nova Hedwigia* 49(1-2): 156; Lecanora sulphurata Nyl. (1873), *Flora* 56: 69; Lecanora sulphurata f. decussata (Bagl.) Zahlbr.; Lecanora sulphurata f. flavescens (Bagl.) Zahlbr.; (?) Lecanora sulphurata f. variolosa J. Steiner.

Description: Clauzade & Roux (1985) as *Lecanora rupicola* var. *sulphurata*.

Common in the Aegean and nearby parts of the mainland, but absent from western parts of the country. On siliceous rock at altitudes 0 to about 1000 m.

Southern and south-central Europe. Also Macaronesia, western Asia (Turkey, Syria), N. Africa (Tunisia).

**Lecanora saligna** (Schrad.) Zahlbr. (1928)

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern though usually not very far from the sea, at altitudes 0 - 1340 m. Usually on wood, once on bark of *Juniperus drupacea*.

Throughout Europe except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), Australasia (scattered in Australia).

**Lecanora strobilina** (Spreng.) Kieff. (1895)

Thallus: crustose, pale green-grey, of scattered granules 0.05 - 0.2 mm wide. Apothecia: frequent, sessile, flat to slightly convex, 0.3 - 0.5 mm diameter. Disc: pale brown in young apothecia, darker later. Thalline margin: rather obscurely present on lower surface of apothecia; in section: outer part with abundant small crystals, soluble in K. Excipule: smooth, becoming excluded; in section: 25 \( \mu \)m wide, colourless in inner part, brown in outer part, of radiating hyphae. Epithecium: brown to pale grey-brown, K-, pigment soluble in K; with abundant small crystals soluble in K. Hymenium: 45 \( \mu \)m tall, colourless. Hypothecium: 35 \( \mu \)m tall, colourless. Paraphyses: 1 \( \mu \)m wide at base, 2 \( \mu \)m at apex, slightly capitata. Ascospores: colourless, simple, ellipsoid or slightly curved, 10 x 3 \( \mu \)m, 8 per ascus. Chemistry: disc and exciple K-, C-, KC-, P- in spot tests; thallus K-, C-, KC-, P-, UV+ faintly orange. Photobiont: green, cells globose,
12 - 23 µm diameter.

Scattered in the southern half of Greece, with no clear pattern. On bark, especially of *Pinus*, or wood at altitudes 25 - 1300 m. The lichenicolous fungus *Vouauxiella lichenicola* has been reported once from this lichen.

Much of Europe to as far north as southern Scandinavia, but avoiding regions with distinctly continental climate. Also Macaronesia, Asia (Turkey, southern Siberia, S. Korea), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico), S. America (Bolivia, Ecuador, perhaps Chile). Reports for Australasia are incorrect.

**Lecanora subcarnea (Lilj.) Ach. (1810)**

*Lichenogr. Universalis* 365; *Lichen subcarneus* Lilj. (1792), Utkast Sv. Fl. 327.

Thallus: crustose, pale green-grey, not pruinose but surface sometimes appearing slightly crystalline, slightly warted, sometimes weakly areolate, to 5 cm diameter, 250 - 400 µm thick, without vegetative propagules. Areoles: (when present) 0.2 - 0.5 mm wide. Prothallus: often present, white, cottony, to 1 mm wide. Cortex: poorly developed, almost a pseudocortex, 12 - 25 µm thick, ±colourless, without distinct structure in water, sometimes with weak cellular texture in K; K-. Medulla: white. Apothece: 0.3 - 0.7 mm diameter, flat, sessile, often with narrow base. Disc: pale brown, usually obscured by white pruina. Thalline margin: when to pale brown, persistent; in section: 50 - 100 µm wide, pale brown, formed of radiating hyphae that broaden outwards (best seen in K), photobiont cells often but not always present. Excipte: not visible externally; in section: 10 µm wide, colourless except at surface which is brown, formed of parallel hyphae, continuous with lower part of hypothecium. Epithecium: brown, K-, some pigment dissolving in K leaving a greyish residue (?pruina). Hymenium: 50 - 70 µm tall, colourless, KI+ blue. Hypothecium: 55 - 80 µm tall, colourless. Paraphyses: simple, 1.5 µm wide. Asci: 50 - 52 x 10 - 18 µm, cylindrical to clavate, or bulging in the middle, Lecanora type. Ascospores: colourless, simple, ellipsoid, 12.5 - 13 x 6 - 7.5 µm, often with 2 locules, 8 per ascus. Chemistry: disc C-; medulla K-, P-, I-; thallus K-, KC-, P+ orange, UV+ faintly orange in short wave UV (only). Photobiont: green. Photobiont layer: 30 - 80 µm thick, sometimes discontinuous, sometimes irregular.

The combination of C- apothecia with a narrow base, and a prominent white prothallus is distinctive, and this lichen is unlikely to be confused with any other. In *Lecanora rupicola*, which occurs in similar habitats, apothecia are C+ yellow or orange, and usually subsessile to subimmersed.

Rare and scattered in the southern half of Greece. On siliceous rock at altitudes 500 - 920 m. The Peloponnesian collection was from a site with long ecological continuity that had several other lichens that are uncommon in Greece.

Throughout Europe to as far north as southern Scandinavia, but scarce in parts of eastern Europe. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan), N. America (California), C. America (Mexico), perhaps S. America (Brazil), perhaps Pacific (Marquesas). Reports for Africa and Australasia are incorrect.

**Lecanora subcarnea Szat. (1954)**


Abbott (2009) reported this species for Greece only tentatively. It is definitely present, on the basis of two collections now determined with certainty. (Two others are referred here tentatively.)

Thallus: crustose, white, slightly cracked, forming small patches 0.8 - 2.5 cm diameter, without vegetative propagules. Prothallus: absent. Apothece: abundant, sub sessile to sessile, flat to slightly convex, 0.7 - 2 mm diameter, strongly white pruinose. Disc: pale brown to pale pink-brown (below pruina). Thalline margin: present, persistent; in section: 80 - 170 µm wide, pseudocortex 40 - 100 µm wide, algal-containing part 40 - 50 µm wide; crystals abundant in pseudocortex, small, mostly not soluble in K. Excipte: not visible externally; in section: 15 µm wide, poorly developed and scarcely distinguishable from hymenium, colourless except right at surface. Epithecium: brown, K-, pigment soluble in K; with abundant small crystals soluble in K. Hymenium: 100 µm tall, colourless, KI+ blue. Hypothecium: 50 - 60 µm tall, colourless. Paraphyses: usually simple, sometimes anastomosed, 1 µm wide at base, 1 - 2 µm at apex. Asci: 52 - 70 x 12 - 13 µm subcylindrical to narrowly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 12 - 13 x 5.5 - 7 µm, with Lecanora type wall, 8 per ascus. Chemistry: pruina of disc C+ persistent orange-yellow; thalline exciple P- (in material seen); thallus K+ yellow, C-, P- (or almost, in material seen), UV+ faintly orange. Photobiont: green.

When well-developed, resembles a rather large, robust *Lecanora carpinea*, but separated from that species by the absence of a true cortex in the thalline exciple. Sometimes difficult to separate from *L. leptyrodes*, but the characters in the key, when taken together, will usually suffice if sufficient material is available. *Ochrolechia pallescens* has much larger ascospores.

Northern Peloponnesse. The two confirmed collections were from bark of *Quercus coccifera* and *Q. frainetto* at altitudes of 950 - 1050 m.

Mainly central Europe to as far north as Estonia. Rare south of the Alps and Pyrenees. Also Asia (Turkey, southern Siberia), N. Africa (Algeria).
**Lecanora subintransita (Nyl.) Th. Fr. (1871)**


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Known from two localities in northern Greece, Mt. Olympus, on wood at altitudes 1540 m and above.

Widespread in Europe from Alps to Arctic Circle. In the south probably only in the highest mountains: a report for Cyprus seems doubtful to me. Also Asia (Turkey, Russia, Kazakhstan, Japan), N. Africa (Morocco, Algeria), N. America (widespread).

**Lecanora sulphurea (Hoffm.) Ach. (1810)**


The name usually cited as basionym, *Lichen sulphureus* Hoffm. (1784) in Enum. Lich. 32-33, is not legitimate, being a later homonym of *L. sulphureus* Retz. (1769) and *L. sulphureus* J. König (1772).

Thallus: crustose, areolate, pale green, not pruinose, to several cm diameter, 350 µm thick, without vegetative propagules. Cortex: with abundant fine polarising granules. Medulla: white, with abundant fine polarising granules. Apothecia: submersed to subsessile, flat to convex, 0.4 - 2 mm diameter, sometimes slightly white pruinose when young. Disc: pale yellow-brown to black. Thalline margin: absent or poorly developed; if present soon excluded, or present only as thin ring of thalline tissue on lower surface of some apothecia, sometimes with large crystals (like those in hypothecium) in outermost part, not soluble in K. Exciple: not visible externally; in section: 25 - 40 µm wide, colourless to pale blue-green in inner part, brown in outer part, of branched or sometimes anastomosed hyphae on an overall radiating trend; with abundant fine polarising granules soluble in K. Hymenium: 50 - 60 µm tall, colourless, KI+ blue. Hypothecium: 100 - 150 µm tall, colourless, KI+ brown-purple > slowly blue; with abundant coarse crystals 1 - 5 µm wide, not soluble in K. Paraphyses: usually simple, sometimes sparingly branched or anastomosed, 1 µm wide at base, 1.5 - 2 µm at apex, not capitate, apex surrounded by thin, dull greenish pigment hood. Ascii: Lecanora type. Ascospores: colourless, simple, narrowly ellipsoid, 10 - 13 x 4 - 5 µm, 8 per ascus. Pycnidia: visible externally as black dots, 0.05 - 0.1 mm diameter; in section: 100% immersed, 100 - 125 µm tall, 90 - 120 µm wide, flask-shape to cup-shaped, brown in a layer at surface, colourless elsewhere. Conidia: colourless, 8 - 10 x 1 µm, sometimes curved. Chemistry: disc C-; medulla K- or K+ slightly brownish, C-, KC-, P-, I-, UV+ whiteish; thallus K-, C-, KC-, P-, UV-. Photobiont: green.

The well-developed, pale green thallus and submersed black apothecia ± without a thalline exciple make this species easy to recognise. *Rhizocarpon geographicum* is a much greener species, having different ascospores, and occurs only on nutrient-poor siliceous rock.

Fairly widely distributed in the southern half of Greece, less common in the north. On siliceous rock, especially when slightly nutrient enriched, at altitudes 0 - 1400 m. Once reported (Servit, 1933) overgrowing, and apparently parasitic on, *Tephromela atra*.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (Nunavut), perhaps S. America (Argentina). Reports for Australasia are incorrect.

**Lecanora swartzii (Ach.) Ach. (1810)**


Description: Nash et al. (2004); Smith et al. (2009). Three subspecies are sometimes recognised, but the single Greek report did not indicate which subspecies was involved.

Known from a single site in northern Macedonia, where it occurred on gneiss rock at an altitude of 1200 m.

Widespread in northern and central Europe, but south of the Alps and Pyrenees rare and restricted to the mountains. Also Macaronesia, Asia (Turkey, Armenia, Russia as far east as southern Siberia), North America (Alaska, Arizona), Australasia (widespread).

**Lecanora symmicta (Ach.) Ach. (1814)**


The Peloponnesian collection of Abbott, cited in Abbott (2009), was incorrectly determined and belongs to *L. strobilina*. I have another collection that may belong here, but prefer not to provide a description yet. For published descriptions see: Nash et al. (2004); Smith et al. (2009).

Scattered throughout Greece, never very far from the sea. On bark or, less commonly, wood. At all altitudes, but
most reports are from below 1200 m.

Throughout Europe except for high arctic. Also Macaronesia, Asia (widespread), N. Africa (Morocco, perhaps elsewhere), N. America (widespread), perhaps Caribbean (Bermuda), C. America (Mexico), Australasia (widespread), perhaps Pacific (Hawaii, New Caledonia), Antarctica (subantarctic islands).

**Lecanora umbrosa** Degel. (1943)


Athos, on bark of *Quercus* at an altitude of 400 m.

Widespread from Alps northwards. Present but rare in Balkans and a few parts of southern Europe. Also N. America (scattered in cold regions).

**Lecanora varia** (Hoffm.) Ach. (1810)


Thallus: crustose, areolate, pale green, not pruinose, to several cm diameter, 100 - 150 µm thick, without vegetative propagules. Apothecia: subimmersed when young, becoming sessile later, concave to flat, 0.6 - 0.95 mm diameter, sometimes slightly white pruinose. Disc: brown, matt. Thalline margin: present, prominent, persistent, regular, 0.08 mm wide, often with thin white inner rim [?'pruina] contrasting with outer part which is concolourous with thallus; in section: 150 µm wide, of which well-developed cortex 50 µm, with abundant small polarising granules. Exciple: not visible externally; in section: poorly developed, 15 µm wide. Epithecium: dark brown, with abundant small polarising granules. Hymenium: 65 µm tall, colourless. Hypothecium: 95 µm tall, colourless. Ascospores: colourless, simple, ellipsoid, 10 x 5 µm, with distinct Lecanora type wall, 8 per ascus. Chemistry: disc C-; thallus and thalline exciple K+ faintly yellow, C-; P+ yellow, UV- (or almost). Photobiont: green.

In the single Greek collection seen, the thallus is not at all granular. The material might not be conspecific with *L. varia* of western European authors. Additional collections are needed to clarify the matter.

Fairly well characterised by the green thallus, the P+ yellow reaction and the substrate.

Scattered thinly throughout Greece. On wood, especially of conifers, sometimes on acidic bark, at altitudes 300 m and above.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, perhaps S. Africa). Its status in N. America is disputed, so reports for Caribbean, C. America and S. America may also be unreliable. Reports for Australasia and Antarctica are incorrect. I am sceptical of an old report for Pacific (New Caledonia).

**Lecidea** Ach. (1803)


Litterature: Information is scattered. All the well-known species are treated in Smith et al. (2009) or Clauzade & Roux (1985), though sometimes under synonyms. For *L. aegaeica*, *L. fuscuta*, *L. graeca*, *L. halaczyi*, *L. separanda*, *L. tessellata* var. *caesia*, and *L. tringiana* there is little alternative to consulting the protologues.

Because the genus is still heterogeneous, a detailed description would not be appropriate. However, the main characters are as follows.


*Lecidea* was at one time used as a 'dustbin' for lichens with a crustose thallus, green photobiont, apothecioid ascomata lacking a thalline exciple, usually 8-spored asci, and small to medium sized, colourless, simple ascospores. It then included over 1000 species. Many have since been placed elsewhere, but about 660 names at species rank remain in *Lecidea*, of which 210 denote European species. Some denote poorly known taxa and others do not belong in *Lecidea*. *Lecidea* sensu strictu contains perhaps 100 - 150 species; it appears to be restricted to siliceous rocks in temperate and cool climates.

*L. fuscuta*, *L. graeca*, *L. separanda* and *L. tringiana* are not included in the key, as I have insufficient information.
44 On lichens on calcareous rock.  **L. tessellata v. tessellata**
4 On lichens on siliceous rock.  **L. tessellata v. caesia**
2 On Rhizocarpon geographicum.  **L. halacysyi**

1111 On soil or bryophytes.

22 Thallus C+ red.  **(L. gypsicola)**
2 Thallus C-.
33 Thallus slightly squamulose, pale brown or yellow-brown, P+ orange to red. Hypothecium brown.
   Ascospores 7-10 x 3-5 µm.  **(L. coacervata)**
3 Thallus crustose, chalk white, P-. Hypothecium colourless. Ascospores 10-13 x 6-9 µm.  **(L. circinarioides)**

11 On bark or wood.

222 Thallus C+ red. Apothecia black.  **L. aegaeica**  Note 2.
2 Thallus C-, KC-.
33 Thallus glose or subglobose, 4-7 µm diameter.
44 Soralia present.  **L. nylanderi**
4 Soralia absent.  **(L. globulispora)**
3 Ascospores distinctly ellipsoid.
44 Hypothecium dark brown.  **(L. machadoi)**
4 Hypothecium ±colourless.
55 Thallus minutely squamulose. Exciple of radiating hyphae with ±cylindrical lumina and scattered rounded cells with thick gelatinous sheaths.  **(L. holopola)**
5 Thallus strictly crustose. Exciple without rounded cells with thick gelatinous sheaths.
66 Epithecium with minute pale granules, giving apothecia a pruinose appearance when wet; granules soluble in K.  **L. turgidula**
6 Epithecium without minute granules.  **L. erythrophaea**

11 On calcareous rock.

22 Hypothecium colourless or pale brown.  **L. tessellata v. caesia**

22 Medulla I+ blue. Thallus C-, KC-.
33 Thallus some shade of brown.
44 Ascospores mostly 6.5-10 x 3-5 µm.  **L. atrobrunnea**
4 Ascospores mostly 9-15 x 5-8 µm.  **L. praenubila**
3 Thallus some shade of grey.
44 Hypothecium almost colourless.
55 Thallus thick, grey. Apothecia sometimes partly immersed. Exciple soon excluded. Ascospores 6-13 x 4-6 µm.  **L. tessellata var. tessellata**
5 Thallus thin, white, pale grey or blue-grey, sometimes rust-coloured. Apothecia not immersed. Exciple persistent. Ascospores 9-15 x 7-7 µm.
66 Thallus ±absent.  **L. ecrustacea**
6 Thallus moderately well developed.
77 Thallus K+ red (norstictic acid).  **L. lapicida v. pantherina**
7 Thallus K+ yellow (norstictic acid absent, or almost).  **L. lapicida v. lapicida**
4 Hypothecium pale brown to dark brown, clearly distinct from exciple.
55 Exciple C+ red in section. Thallus usually poorly developed.  **L. diducens**
5 Exciple C-. Thallus poorly developed or well developed.
66 Ascospores 5-8 µm wide.  **(L. confluens)** Greek report probably incorrect.
6 Ascospores 3-4.5 µm wide.
77 Thallus absent or poorly developed.  **L. promiscens**
7 Thallus well developed, thick, white.  **L. promiscua**

2 Medulla I-. Thallus reactions various.

33 Thallus C+ or KC+. Hypothecium dark brown. Black prothallus usually present.
44 Thallus very poorly developed. Apothecia 0.15-0.35 mm diameter.  **(L. confluens)**
4 Thallus well developed. Apothecia (0.2) 0.4-2 mm diameter.
55 Thallus areolate everywhere; brown (Note 5).  **L. fuscoatra**
5 Thallus continuous in marginal parts, sometimes cracked in central part but not strongly areolate there; white,
grey or pale brown-grey. **L. grisella**

3 Thallus C-, KC-. Hypothecium dark or pale.

44 Thallus dark (brown, dark grey or blackish).

55 Epithecium dark brown. **L. fuliginosa**

5 Epithecium green-black. (L. ob luridata)

4 Thallus pale (white or pale grey) or entirely endolithic.

55 Hypothecium colourless or pale brown.

66 Ascospores 2.5 - 5 µm wide. Thallus immersed or superficial; if superficial then grey, not white.

77 Thallus immersed. Apothecia 0.6 - 1.4 mm diameter. **L. laboriosa**

7 Thallus immersed or superficial. Apothecia only occasionally exceeding 0.5 mm diameter. (L. plana)

6 Ascospores 5 - 6 µm wide. Thallus superficial, well developed, white. (L. lithophila)

5 Hypothecium dark brown to black.

66 Outer part of exciple K+ purple. **L. sarcogynoides**

6 Exciple K-. (L. paratropoides)

(1) Several lichenicolous species formerly in Lecidea have since been referred to other genera. In case of difficulty, consult the key to Lecidea s. lat. in Clauzade, Diederich & Roux (1989).

(2) Rare lignicolous collections of L. grisella would also key out here.

(3) L. praenubila could also key out here, but is usually on siliceous rock.

(4) L. graeca and L. tringiana belong in this branch but are not included in the key.

(5) Occasional collections of L. fuscoatra have enough white pruina to appear white at a first glance.

**Lecidea aegaeica** Szatala (1943)


Description: See the protologue. According to Şenkardeşler et al. (2014), who lectotypified the name, this species belongs in *Lecidella*, close to *L. elaeochroma*.

The Dodecanese islands of Rhodes and Symi only. On wood of *Cupressus* and *Juniperus* at altitudes 700 - 1200 m. Only Greece and Ukraine.

**Lecidea atrobrunnea** (DC.) Schaed. (1828)


Scattered on the mainland and on Crete. Commonest in northern Greece. On siliceous rock at altitudes from 200 to about 2150 m, but usually above 1000 m. The lichenicolous fungus *Sphaerellothecium abditum* has been reported from this host.

Throughout central and northern Europe; rare south of the Alps. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), S. America (Chile), Australasia (SE Australia), Pacific (Hawaii), Antarctica (widespread).

**Lecidea diducens** Nyl. (1865)

*Flora* 48: 148; *Lecidea auriculata* β (= var.) *diducens* (Nyl.) Th. Fr.

Descriptions: Nash et al. (2004); Smith et al. (2009).

Crete and Macedonia. On rock (of unspecified type) at altitudes 600 - 1400 m.

Throughout central and northern Europe, but rare south of the Alps. Also Asia (Turkey, Russia, Nepal, Japan), N. America (widespread), S. America (Chile), Australasia (SE Australia, NZS).

**Lecidea ecrustacea** (Anzi ex Arnold) Arnold (1876)


Description: Clauzade & Roux (1985) as *Lecidea lactea* var. *ecrustacea*.

Thessaly, on schist at about 1400 m altitude. Not recorded since the 19th Century.

Most reports of this rather poorly known species are from the Alps northwards, but it is present in Sardinia. Also Asia (Russia), N. America (Alaska).

**Lecidea erythrophaea** Flörke ex Sommerf. (1826)

*Suppl. Fl. lapp.* 163-164.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Amorgos and Kos, on bark at altitudes 650 - 850 m.
Throughout Europe, but in the south mostly in the uplands. Also Macaronesia, Asia (Russia, Kazakhstan, Japan, Taiwan), N. America (widespread).

**Lecidea fuliginosa** Taylor (1836)
in Flotow, Lichenen, vors. Lecidea grisella Fl.
Otherwise, the basionym is in Flotow, Lichenen, vors. Lecidea grisella Fl.
Developed ascospores ("sporae nunquam evolutae"), so the name is of uncertain application.

**Lecidea grisella** Flörke (1830)
in Flotow, Lichenen, vorsūglich in Schlesien, nos. 141 - 142. (It is claimed that the 1830 name is not a nomen nudum. Otherwise, the basionym is Lecidea fuliginosa δ (= var.) grisella Flörke ex Schäer. (1850), Enum. Crit. lich. Eur. 110, and the combination at species rank was made by Nylander in Lich. Lapp. Or. 160. 1866); Biatora fumosa var. grisella (Flörke) Flot.; Lecidea fuscoatra var. grisella (Flörke) Nyl.

**Lecidea fuscata** (Lam.) Ach. (1810)
Lichenogr. Universalis 211; Lichen fuscatus Lam. (1792), Encycl. 3: 478.
Descriptions: Acharius (1810, 1814a).
Athos Peninsula. No substrate or altitude was stated. Not collected in Greece since the 18th Century.
The only other reports that I have seen are for France. This name does not appear to have been mentioned in the literature since the early 19th century, and is of uncertain application.

**Lecidea fuscoatra** (L.) Ach. (1803)
Methodus 44 (as fusco-atra); Lichen fuscoater L. (1753), Sp. Pl. 1140 (as fusco-ater); Biatora fumosa var. nitida (Schaer.) Hepp; Lecidea fumosa (Hoffm.) Ach.; Lecidea fumosa var. fuscoatra (L.) Nyl. ex Lamy; (? Lecidea fuscoatra f. cechumenoides Vain.; Lecidea fuscoatra var. fumosa (Hoffm.) Fr.; Lecidea fuscoatra f. mosigii (Ach.) Nyl.; Lecidea fuscoatra f. opaca (Schaer.) Vain.; (? Lecidea fuscoatra f. subcontiguella Vain.; Lecidea ocellulata (Schaer.) Th. Fr.

Thallus: crustose, areolate, usually pale brown, sometimes green-grey or brown-grey, usually not pruinose, sometimes with a little white pruina. Areoles: usually subrounded, 0.3 - 1.3 mm wide (larger ones usually nearer margin of thallus), central ones usually flat, marginal ones sometimes slightly convex, 250 - 550 µm thick. Prothallus: absent. Cortex: 30 - 35 µm thick, very pale brown, of rounded cells 3 µm diameter, K-, pigment soluble in K; cortex overlain by a colourless, structureless (?epinecral) layer 2 - 8 µm thick, swelling to 10 - 20 µm in K. Medulla: white, I-, of loosely interwoven, randomly oriented hyphae 2 - 2.5 µm wide, without visible septa. Apothecia: subimmersed to subsessile, rarely sessile, flat to moderately convex, 0.4 - 1.6 mm diameter, usually not pruinose, sometimes with a little white pruina. Disc: black. Thalline margin: absent. Exciple: black, persistent but becoming very thin; in section: 30 - 50 µm wide, brown, almost opaque. Epithecium: grey to grey-green, basically K- but green tinge accentuated in K, N+ purple-red. Hymenium: 75 - 100 µm tall, usually colourless, upper part sometimes with epithelial pigment, KI+ blue. Hypothecium: 125 µm tall, dark brown. Paraphyses: simple, coherent. Asci: Lecidea type. Ascospores: colourless, simple, ellipsoid, 15 x 5 µm, 8 per ascus. Chemistry:thallus K-, C+ red (reaction often faint), KC+ red (reaction usually distinct). Photobiont: green, cells ±globose, 10 µm diameter, forming a continuous, regular layer 25 - 40 µm thick.

This species has been confused with L. grisella but that species is not strongly areolate and is generally paler in colour, without a brown tinge.
Throughout Greece On siliceous rock at altitudes 0 - 1750 m. The few reports for calcareous rock probably refer to other species. The lichenicolous lichen Lambiella furvella has been reported once from this host.
Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), C. America (Mexico), perhaps S. America (Argentina, Bolivia), Pacific (Hawaii).

**Lecidea graeca** J. Steiner (1893)
Description: See the protologue. Steiner's description is quite comprehensive, but his material lacked properly developed ascospores ("sporae nunquam evolutae"), so the name is of uncertain application.
Mt. Pendeli in Attica, at about 1100 m. The substrate was not stated but was probably rock.
Known only from the type collection.

**Lecidea grisella** Flörke (1830)
in Flotow, Lichenen, vorsūglich in Schlesien, nos. 141 - 142. (It is claimed that the 1830 name is not a nomen nudum. Otherwise, the basionym is Lecidea fuliginosa δ (= var.) grisella Flörke ex Schäer. (1850), Enum. Crit. lich. Eur. 110, and the combination at species rank was made by Nylander in Lich. Lapp. Or. 160. 1866); Biatora fumosa var. grisella (Flörke) Flot.; Lecidea fuscoatra var. grisella (Flörke) Nyl.
Thallus: crustose, to many cm diameter, continuous in marginal parts, cracked (not areolate) in central parts, pale grey to very pale brown, to 300 µm thick. Cortex: 30 - 40 µm thick, colourless, weakly cellular in lower part. Medulla: white. Apothecia: submersed, flat, 0.6 - 1.4 mm diameter. Disc: black, moderately white pruinose. Thalline margin: absent. Exciple: black, thin, persistent, sometimes crenulate or irregular in older apothecia; in section: 30 - 100 µm wide, mostly dark brown, sometimes colourless in innermost part, mostly of radiating hyphae but outermost part sometimes of small (3 µm diameter) cells. Epitheicum: grey to green-grey, basically K- but green tinge accentuated, N+ slowly red. Hymenium: 90 µm tall, colourless, K+ blue. Hypothecium: dark brown. Paraphyses: simple, 1 - 1.5 µm wide at base, 2 µm at apex, without visible septa, not capitate or moniliform. Ascii: 60 x 14 µm, narrowly clavate. Ascospores: colourless, simple, ellipsoid, 12 x 7 µm, 8 per ascus. Chemistry: medulla K-, C+ red in places (not everywhere), KC+ red (everywhere), I-. Photobiont: green, of globose cells 10 - 12 µm diameter, forming a ±regular, but sometimes discontinuous, layer 25 - 50 µm thick.

L. grisella is close to L. fuscoatra but, unlike that species, is never distinctly areolate. It is also generally whiter in colour, but colour alone cannot be relied on to separate the two species.

Scattered, in the southern half of Greece, on siliceous rock at altitudes 50 - 1100 m.

Distribution unclear, owing to confusion with L. fuscoatra. Most reports are from temperate latitudes of Europe to as far north as Denmark. There are a few reports for south of the Alps. Also western Asia (Turkey, Syria), N. Africa (Morocco, Algeria), perhaps N. America (California).

Lecidea halacsi J. Steiner (1894)

Description: Hafellner (2006), or see Steiner's protologue. According to Hafellner (2006) this species does not belong either in Lecidea or in Carbonea.

Scattered on the mainland, above 2000 m altitude, on Rhizocarpon geographicum.

The only reliable reports appear to be those for Greece and perhaps France. Reports of Carbonea halacsi for the Iberian Peninsula refer to Carbonea intrudens.

Lecidea laboriosa Müll. Arg. (1874)
Flora 57: 187-188; Lecidea leptoboloides Nyl.


Attica at about 200 m altitude; substrate not stated.

A rather poorly known species known from a few countries scattered across Europe. Also Asia (Turkey, Kazakhstan, Nepal, Mongolia), N. America (scattered in western half), C. America (Mexico), S. America (Chile).

Lecidea lapicida (Ach.) Ach. (1803) var. lapicida
Methodus 37; Lichen lapicida Ach. (1799), Lichenogr. Svec. Prodr. 61; Lecidea declinascens Nyl.

Unfortunately, Lichen lapicida Ach. is a superfluous name for Lichen petraeus Wulf. Conservation is required.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered thinly throughout Greece, but commonest in the north. On siliceous rock at altitudes above 1800 m, though there is one anomalous, and perhaps incorrect, report from 20 m altitude. The lichenicolous fungus Muellerella pygmaea has been reported once from this lichen.

Throughout central and northern Europe; in the south confined to high mountains. Also Macaronesia, Asia (widespread), Maleisia (PNG), Africa (Morocco, S. Africa), N. America (widespread), S. America (widespread), Australasia (montane SE Australia, NZS), Antarctica (widespread). Reports for C. America and Pacific seem doubtful to me.

Lecidea lapicida var. pantherina (Hoffm.) Ach. (1808)

If Lecidea lapicida var. cyanea Ach. (1803) is synonymous, as some authors have suggested, it would provide the correct epithet for this taxon at the rank of variety.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as Lecidea lactea.

Very scattered, though most reports are from northern Greece. On siliceous rock at altitudes 300 - 2150 m.

European distribution as for var. lapicida. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), Australasia (SE Australia, NZS). The status of reports for S. America is disputed.
Lecidea nylanderi (Anzi) Th. Fr. (1874)
Descriptions: Nash et al. (2004), Smith et al. (2009).
Known from a single site in Macedonia, near the Bulgarian border, on Pinus sylvestris at an altitude of 1350 m. Northern and central Europe. Also Asia (Turkey, Russia, Mongolia), North America (widespread).

Lecidea praenubila Nyl. (1873)
Flora 56: 21; Lecidea paupercula Th. Fr.
Descriptions: Clauzade & Roux (1985), Smith et al. (2009), both as Lecidea paupercula.
Rare and scattered in northern Greece. On rock at altitudes around 2100 m. Mostly northern Europe, with scattered reports southwards to the Alps; very rare south of the Alps. Also Asia (Russia, Japan), N. America (widespread). I am sceptical of a report for Pacific (Hawaii).

Lecidea promiscens Nyl. (1872)
Epithecium: very dark brown, often with green tinge, basically K- but green tinge enhanced in K. Hymenium: 50 - 65 µm, colourless, sometimes with epithecial pigment in upper part, KI+ blue. Hypothecium: brown. Paraphyses: 2 µm wide at base, 2.5 at apex, apex pigmented. Asc: 40 x 12 µm, clavate, Lecidea type. Ascospores: colourless, usually simple (occasionally appearing 1-septate with very thin septum), 8 - 12 x 3 µm, 8 per ascus. Photobiont: green, of globose cells 7 - 10 µm diameter, forming a continuous, ±regular layer 40 - 50 µm thick.
L. promiscua is fairly well characterised by the I+ blue medulla, grey thallus and dark hypothecium. However, it belongs to a group of species that are said to be difficult to separate.
 Mostly temperate latitudes, rare further north; south of the Alps confined to high mountains. Also Asia (widespread), N. Africa (Morocco), N. America (Arizona, California, Colorado, perhaps elsewhere), southern S. America (Argentina, Chile), Australasia (SE Australia).

Lecidea sarcogynoides Körb. (1855)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Islands of the Aegae, on siliceous rock at altitudes 100 - 2000 m. A report for the Peloponnese, on calcareous rock, is doubtful.
Widespread to as far north as southern Sweden, but avoiding regions with true Mediterranean climate; in southern Europe probably confined to uplands. Also Asia (Turkey), Africa (Algeria, Angola, S. Africa, perhaps elsewhere), S. America (Chile, Bolivia, Venezuela), Australasia (widespread).

Lecidea separanda J. Steiner (1898)
Description: See the protologue. It was said to be identical to Lecidea tringiana expect for having shorter, broader conidiophores ("sterigmata") and shorter conidia. Possibly both names refer to a single, variable species, or to a single species with dimorphic conidia. However, since the identity of L. tringiana is uncertain, that of L. separanda is also uncertain, though presumably it too belongs somewhere in the group of species close to Lecidea auriculata, L. promiscens and L. promiscua.
Mt. Panachaiko in the Peloponnese, on siliceous rock.
Known only from the type collection.

**Lecidea tessellata Flörke (1819)**
Deutsche Lichenen, Fasc. 4, page 5, no. 64.

Thallus: crustose, areolate, slightly zoned, mostly grey, outermost 1 mm white, 1150 µm thick. Areoles: ±angular, 0.5 - 1 mm diameter, marginal ones very slightly radiating. Prothallus: present but inconspicuous, blue-black to black.

Cortex: true cortex probably absent; pseudocortex: 15 - 20 µm thick, ±colourless, structureless, with much crystalline debris. Medulla: mostly white, but with prominent vertical brown streaks. Apothecia: immersed, 0.25 - 0.45 (0.7) mm diameter, slightly concave to flat, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, persistent; in section: 30 µm wide, sometimes dark brown in outer part and colourless in inner part, other sections with only epithecial pigment.

Epithecium: blue-green, K-, N+ purple. Hymenium: 75 µm tall, mostly colourless, upper part sometimes with epithecial pigment. Hypothecium: 75 µm tall, colourless to very pale brown, N-. Ascospores: colourless, simple, ellipsoid, 8 - 12 x 5 µm, with distinct wall about 0.7 µm thick, 8 per ascus. Chemistry: medulla K-, C-, I+ blue; thallus K-, C-, KC-, P-. Photobiont: green, of globose cells 10 - 15 µm diameter, forming a continuous, ±regular layer 100 - 125 µm thick.

My only collection is heavily parasitised by an undetermined species of *Buellia* (s. lat.) and, perhaps as a result, there are very few ascospores and no mature asci. For published descriptions see Clauzade & Roux (1985), or Nash et al. (2004).

Scattered on the mainland, on siliceous and calcareous rock at altitudes 1000 m and above. Widespread in Europe, but south of the Alps confined to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), S. America (widespread).

**Lecidea tessellata var. caesia "(Anzi) Arnold (1889)"

The supposed basionym is a later homonym, and illegitimate. The earliest name at the rank of variety is *Lecidea azurea* Kremp. (1857) var. azurea (1857) in Flora 40: 373 (automatic autonym). The correct name appears to be *L. tessellata* var. azurea (Kremp.) ined.

Description: Wirth et al. (2013a).
Peloponnese, on limestone at about 2200 m altitude.

Similar distribution in Europe to var. *tessellata*, but less frequently reported. Also Asia (Afghanistan, Japan), N. Africa (Morocco), perhaps N. America.

**Lecidea tringiana** J. Steiner (1898)

Description: See the protologue. Steiner's description is fairly detailed, and it suggests a lichen close to *Lecidea auriculata*, *L. promiscens* or *L. promiscua*. The first of these has never been reported for Greece. Steiner never cited *L. promiscens* or *L. promiscua* from among his many Greek collections from upland siliceous rock, and he may have been unfamiliar with those taxa. *L. tringiana* may perhaps be referable to one or other of those species. However, at present the precise application of the name is uncertain.

Thessaly, on siliceous rock at about 2200 m.

Known only from the type collection.

**Lecidea turgidula** Fr. (1824)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Mt. Olympus, on wood at altitudes 1200 - 2300 m, and at a single site in Epiros, on bark at 980 m.

Widespread in central and northern parts of Europe; south of the Alps confined to the uplands. Also Macaronesia, Asia (Turkey, Russia, Mongolia, Japan), N. Africa (Morocco), N. America (widespread), Australasia (Tasmania).

**Lecidella Körb.** (1855)


Family: *Lecanoraceae*.

Literature: There is no convenient summary of the European taxa in English, but Clauzade & Roux (1985), Nash et al. (2004), and Smith et al. (2009) are all helpful. There are several important papers and monographs in German.

Thallus: crustose, thin to well-developed, continuous to areolate, white, grey, brownish or greenish. Vegetative propagules present in a few species. Apothecia: without a thalline margin; disc and exciple usually black. Epithecium:
usually with a characteristic blue-green-back pigment. Asci: close to Lecanora type, but central KI-region conical in shape and not or scarcely open above (sometimes distinguished as Lecidella type). Ascospores: colourless, simple, ellipsoid, small to medium sized (typically 10 - 18 µm long), 8 per ascus. Chemistry: variable, but many species C+ orange. Photobiont: green, trebouxioïd.

About 57 species, mostly outside the tropics, of which about 33 occur in Europe. Lecidella is quite well represented in Greece, and some species are common. Most species occur on bark or rock. L. arosanguinea (Hoffm.) R. Sant., a poorly known saxicolous taxon that is doubtfully reported for Greece, is not included in the key, as published descriptions are inadequate.

1111 Parasitic on other lichens. (L. vorax)
111 On bryophytes or plant remains. (L. wulfenii)
11 On bark or wood.

222 Blastidia present, K+ yellow, C+ orange. Apothecia common. Usually on wood, not bark. L. pulveracea
22 Blastidia absent, but soredia present. Reactions various. Apothecia common or not.

33 Soralia continuous; thallus ± leprose. Thallus K+ yellow, C-. L. alba
3 Soralia discrete at least initially; thallus never leprose when young. Thallus K-.

44 Thallus grey-green. Apothecia nearly always present. Soralia bright yellow-green, remaining discrete, UV+ yellow. L. elaeochroma f. soralifera
4 Thallus grey-white. Apothecia often absent. Soralia green, sometimes becoming confluent, UV+ orange. L. flavosorediata

2 Blastidia and soredia absent.

33 Hypothecium colourless. L. xylophila Note 1.
3 Hypothecium orange-brown.

44 Thallus C+ and KC+ orange (Note 2), UV+ orange.
55 Thallus white, grey or olive-green. L. elaeochroma f. elaeochroma
5 Thallus yellow or yellow-green. L. elaeochroma var. flavicans

4 Thallus C-, KC- (Note 2), UV-.
55 Thallus K+ yellow. L. euphorea
5 Thallus K-.

66 Ascospores 10 - 18 x 6 - 10 µm. L. laureri
6 Ascospores 9 - 14 x 5.5 - 7.5 µm. (L. tumidula)

1 On rock.

22 Thallus with delimited soralia. L. scabra
2 Thallus without soralia.

33 Hypothecium colourless or almost.

44 Hymenium with oil droplets. Exciple with crystals. L. patavina
4 Hymenium without oil droplets. Exciple with or without crystals.

55 Hypothecium partly strongly filled with crystals. L. granulosula
5 No part of hypothecium strongly filled with crystals.

66 Exciple blue-green, green-black, or black-green. On calcareous or siliceous rock. L. stigmatia (Note 1)
6 Exciple brown, green-brown or grey-green. On siliceous rock.

77 Thallus C+ orange. Apothecia 0.2 - 0.3 mm diameter. L. viridans
7 Thallus C-. Apothecia 0.4 - 0.7 mm diameter. L. anomaloides

3 Hypothecium some shade of brown, at least in lower part.

44 Thallus C+ or at least KC+ orange or red. On non-calcareous rock.

55 Thallus white to pale grey, sometimes with a green tinge, surface sometimes rough (resembling pruina). Thallus C+ and KC+ fleeting red changing to persistent orange (either reaction, but not both, may be absent). Probably confined to low altitudes within a few km of the sea. L. aegaea
5 Thallus greenish or brownish, areolate, surface not rough. Thallus C+ and KC+ persistent orange. Not geographically restricted.

66 Areoles with blister-like swellings. Exciple mostly darker than hypothecium. Apothecia 0.4 - 1.0 mm diameter. (L. effugiens)
6 Areoles concave to flat, without swellings. Exciple paler than hypothecium. Apothecia 0.5 - 1.5 mm diameter. L. asea s. lat.
77 Thallus greenish. L. asea var. asea
7 Thallus pale brownish. L. asea var. elaeochromoides
4 Thallus C-, KC-. On calcareous or non-calcareous rock.
5 Hymenium ±without oil droplets. On calcareous, or at least slightly basic, rock. Asci Lecidella type (central KI- part convergent towards apex, not open above). L. carpathica

(1) The poorly known L. latypiza, not reliably reported for Greece, would key out here.
(2) The common L. elaeochroma reacts C+ and (usually more strongly) KC+ orange, but both reactions can be faint. Both can be patchy, demonstrable in only some parts of a thallus. I only determine a collection as L. euphorea if it reacts KC- in several different places.

Lecidella aegaea Knoph & Sipman (1999)
Mycotaxon 72: 74–76.
Thallus: crustose, white, cracked, with rough surface that may superficially resemble pruina, to 5 cm diameter, 0.5 mm thick, without vegetative propagules. Apothecia: immersed, flat to slightly convex, 0.55–0.8 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: thin, black; in section: 15 µm wide, brown. Epithecium: blue-black, K-, pigment soluble in K. Hymenium: 80 µm tall, colourless in lower part, upper part often with epithecial pigment. Hypothecium: 80 µm tall, dark brown in lower part, pale brown in upper part. Paraphyses: sometimes branched in upper part. Ascospores: colourless, simple, ellipsoid, 13 x 5.5 µm, 8 per ascus. Chemistry: thallus K-, C-or almost (in material seen; said to be C+ orange), KC+ persistent orange, often preceded by a fleeting KC+ red reaction. Photobiont: green.

Some collections have characters that seem intermediate between L. aegaea and L. asema (var. asema). The description is based only on collections that clearly belong here.
Islands of the Aegean and adjacent parts of the mainland (Methana Peninsula), on siliceous rock at altitudes 5 - 250 m. Possibly up to 600 m on Methana, but those collections are ambiguous.
Known only from Greece.

Lecidella alba (Hepp) Hertel (1981)
Description: Clauzade & Roux (1985).
Corfu, on bark of Olea europea close to sea level, and mountains of northern Peloponnese on Pinus at high altitude. Not reported for Greece since the 19th century.
Alps and nearby regions (Austria, Switzerland, southern Germany, Czech Republic, Slovenia) and Greece only.

Lecidella anomaloides (A. Massal.) Hertel & H. Kilias (1980)
in Hawksworth et al., Lichenologist 12(1): 107; Lecidea anomaloides A. Massal. (1852), Ric. Auton. Lich. Crost. 72; Catillaria anomaloides (A. Massal.) Lettai; Lecidea enteroleuca f. pungens (Körb.) J. Steiner; Lecidea goniophila (Flörke) Schauer.; Lecidea goniophila f. pungens (Körb.) de Lesd.; Lecidea pungens (Körb.) Nyl.
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Scattered on the mainland and the two large islands, with no clear pattern. On calcareous or siliceous rock at all altitudes.
Widespread in Europe, but not common south of the Alps. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan, Tajikistan), N. America (widespread). Reports for C. America (Mexico), S. America (Argentina, Venezuela), Pacific (New Caledonia) seem doubtful to me.

Lecidella asema (Nyl.) Knoph & Hertel (1990) var. asema
Descriptions: Nash et al. (2004); Smith et al. (2009).
Abbott (2009) cited several Peloponnesian collections here. The two from inland localities belong in Lecidea. Of those from the Methana Peninsula, some are L. aegaea; the remainder are either L. aegaea or L. asema (var. asema) but are difficult to place. For the moment, the presence of L. asema in the Peloponnese is in need of confirmation.
Scattered, mainly around the Aegean. On siliceous rock at altitudes 0 - 2150 m, but usually below 800 m.
Throughout much of Europe, but absent from those parts of eastern Europe with distinctly continental climate. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), A. America (Brazil), Australasia (Victoria, Western Australia).
Lecidella asema var. elaeochromoides (Nyl.) Nimis & Tretiach (1996)
in Nimis et al., Bull. Mus. Reg. Sci. Nat. Torino 14(1): 128; Lecidea parasema var. elaeochromoides Nyl. (1873), Flora 56: 201 and in Bull. Soc. Linn. Normandie II, 6(2): 310 (It is not known which was published first); Lecidella 
subcongrua var. elaeochromoides (Nyl.) Hertel & Leuckert.

Description: Clauzade & Roux (1985) as Lecidella subcongrua var. elaeochromoides; Smith et al. (2009); Wasser & Nevo (2005).

Islands of the Aegean and adjacent coasts of the mainland. On silicic rock at altitudes 0 - 450 m, but usually below 200 m.

Spain to Cyprus, and along Atlantic margin to as far north as British Is. Also Macaronesia, Asia (widespread, but absent from continental interior), N. Africa (Morocco, Algeria), perhaps N. America.

Lecidella carpathica Körb. (1861)
Parerga Lichenol. 212; Lecidea carpathica (Körb.) Szatala; (? Lecidea latypizella auct. grae.

Thallus: crustose, pale grey to grey, not pruinose, areolate, often warted, without vegetative propagules, 0.5 - 1 mm thick. Areoles: 4-8 mm wide, flat to slightly convex. Cortex: 25 - 50 µm thick (including epicortex), colourless, usually acellular; cells small, subrounded, 2 - 4 µm diameter; over lain by colourless, structureless epithecium 5 - 8 (20) µm thick. Medulla: white. Apothecia: subsessile to sessile, flat at first, sometimes convex later, 0.25 - 1.25 mm diameter, not pruinose. Disc: black, matt. Thalline margin: absent. Exciple: black, sometimes shiny, sometimes becoming excluded; in section: 15 - 85 µm wide, brown to dark brown at least in inner part, outer part blue-green or at least with trace of blue-green pigment, K+ purple-brown. Epithecium: blue-black, blue-green, green-blue, or green-black, some brown pigment sometimes also present, usually K-, sometimes K+ violet, pigments scarcely soluble in K. Hymenium: 70 - 100 µm tall, colourless or with some epithecial pigment in upper part; oil droplets absent or very few; sometimes underlain by poorly developed subhymenium, 30 µm tall, colourless. Hypothecium: 250 µm tall, mostly brown to dark brown, sometimes purple-brown at least in lower part. Paraphyses: simple to branched, 1.5 - 2 µm wide at base, 2.5 - 3 µm at apex, not to slightly capitate, apical cell with external pigment cap. Asci: 60 x 15 µm, narrowly clavate, Lecidella type. Ascospores: colourless, simple, ellipsoid, 10 - 15 x 6 - 7.5 µm, sometimes with Lecanora type wall when mature, 8 per ascus. Chemistry: medulla K-, C-, KC-, I-; thallus K+ faintly brown to dark brown, sometimes colourless in upper part, K+ purple-brown at least in lower part. Hymenium: 70 - 100 µm tall, mostly yellow, C-, KC- (or almost), UV- (or almost). Photobiont: green, cells globose, 8 - 11 µm diameter. Photobiont layer: 30 - 180 µm thick, sometimes discontinuous, sometimes irregular.

Material in which the epithecium reacts K+ violet is sometimes distinguished as var. latypizella.

Easily separated from L. stipitata, the other common saxicolous species, by its pigmented hypothecium. L. asema has a green or brown, not grey, thallus. Some collections that seem to belong here have a very few oil droplets in the hymenium or hypothecium, which suggests that separation from Carbonnea latypizella might sometimes be difficult.

Throughout Greece. On calcareous or base-rich siliceous rock at all altitudes.

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, Egypt, Madagascar), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Brazil, Venezuela), Australasia (widespread), Pacific (Hawaii).

Lecidella elaeochroma (Ach.) M. Choisy (1950) f. elaeochroma

Bull. Mens. Soc. Linn. Lyon 19: 19; Lecidea parasema β (= var.) elaeochroma Ach. (1803), Methodus 36; Lecidea elaeochroma (Ach.) A. Massal. var. subincongrua (corticolous); Lecidea enteroleuca var. rugulosa (Ach.) W. Krause & Klem., nom. inval.; Lecidea goniothilifera f. enteroleuca auct. grae.; Lecidea olivacea (Hoffm.) A. Massal., nom. illeg.; Lecidea olivacea f. euphoreoides (Vain.) Vain.; Lecidea olivacea var. euphoreoides (Vain.) Vain.; Lecidea parasema auct. (=? Lecidea parasema f. athallina (H. Olivier) Sandst.; Lecidea parasema f. atrorubens (Fr.) Arnold; Lecidea parasema f. limitata (Scop.) Vain.; Lecidea parasema f. rugulosa (Ach.) Ach.; Lecidea parasema var. rugulosa Ach.; (? Lecidea parasema var. zonata (H. Olivier) Szatala; Lecidella achristotera (Nyl.) Hertel & Leuckert; Lecidella olivacea (Hoffm.) Arnold.

The nomenclatural history is complicated. The epithet elaeochroma has priority at species rank from 1814, when Acharius made the combination Lecidea elaeochroma (Ach.) Ach. Earlier names that do, may, or have been suggested to, refer to this taxon are discussed in chronological order. (1) Lichen limitatus Scop. (1772). Reports in the literature under the epithet limitata generally refer to Lecidella elaeochroma. However, as pointed out by Hawksworth (1972c), Scopoli's name can not be satisfactorily typified, as no authentic material appears to exist. Scopoli's description is too vague to be helpful. (2) Sphaeria lichenoides var. anastomosans Weigel (1772). The epithet has never been used at species rank. (3) Verrucaria punctata [indefinite rank] olivacea Hoffm. (1796). Priority of the epithet at species rank dates from 1858. (4) Lichen parasemus Ach. (1799) is a superfluous name for Lichen limitatus Scop. (5) Patellaria leucoplaca DC. (1805). The synonym is uncertain. (6) Lecidea enteroleuca Ach. (1810) has often been regarded as synonymous, in which case the correct name for Lecidella elaeochroma would be Lecidella enteroleuca (Ach.) Körb.
However, the name has not been typified, and the synonymy has not been confirmed. (7) Lecidea parasema var. rugulosa Ach. (1810). Priority of the epithet at species rank dates from 1852.

The status of infra-specific enteroleuca combinations under Lecidea goniophila is confused, and requires explanation. They "ought" to be based on L. enteroleuca Ach., as is L. goniophila subsp. enteroleuca (Ach.) Sandst. (1912). However, when Vainio published the name L. goniophila f. enteroleuca, in Acta Soc. Fauna Fl. Fenn. 57(2): 260, 1934, he explicitly excluded the name L. enteroleuca Ach., and must be regarded as introducing a new taxon; its type is from Finland. Vainio also referred to Nylander's discussion of L. enteroleuca in Flora 64: 187. 1881, but that must be regarded as a sensu citation, as Nylander did not there introduce a new taxon. Vainio's name seems to be of uncertain application. Szatala's Greek report of Lecidea goniophila f. enteroleuca referred to Vainio's name, but I must presume that Szatala's lichen was Lecidella elaeochroma.

Thallus: crustose, usually green-grey, sometimes white or pale grey, smooth to slightly warted, continuous to cracked, occasionally almost areolate, often forming small patches in lichen mosaics, sometimes larger to about 4 cm diameter, to 300 µm thick. Vegetative propagules: absent. Prothallus: sometimes present at margin of thallus, black to blue-black, to 0.25 mm wide. Cortex: poorly developed; layer above algal cells 5 - 20 µm thick, colourless, without distinct structure, K-. Medulla: white. Apothecia: sessile, concave to flat when young, often convex later, 0.2 - 1.1 mm diameter, not pruinose. Disc: usually black, matt. Thalline margin: absent. Exciple: black, often shiny especially in young apothecia, 0.05 - 0.07 mm wide in young apothecia, ±persistent but becoming thin in older apothecia, only becoming excluded in very convex apothecia; in section: 45 - 60 µm wide, outer part blue-black, blue-green or green-black, inner part usually colourless to brown, all pigments K-, of rather coarse radiating hyphae that broaden outwards; inner part sometimes with crystals soluble in N but not in K. Epithecium: usually blue-green, green-blue, green-black or blue-black, less commonly a brown pigment sometimes also present, K-, pigment(s) mostly or entirely soluble in K, of rather coarse radiating hyphae that become excluded in very convex apothecia. Hypothecium: 60 - 100 (120) µm thick, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, mostly colourless, upper part sometimes with epithecial pigment, sometimes with oil droplets especially in lower part.

Usually easily recognised by the slightly greenish thallus, often delimited by a black hypothallus, and the distinctive shiny exciple of at least the young apothecia. The C and KC reactions may vary greatly in intensity, even within the same thallus, and separation from L. euphorea can be difficult.

I have seen what appeared to be a clone of this species in which the apothecia had lost the ability to produce the usual blue-green-black pigment. The epithecium was orange-brown, and the disc also appeared brown rather than black. Piebald apothecia, which are occasionally reported, may be a less extreme version of the same phenomenon.

Very common throughout Greece, at all altitudes. Usually on bark (95% of records), sometimes on wood. Recorded from a wide range of phorophytes with no obvious preference. A common pioneer species on twigs, but not black. Piebald apothecia, which are occasionally reported, may be a less extreme version of the same phenomenon.

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Lecidella elaeochroma var. flavicans (Ach.) Nimis (1993)


Description: Claudez & Roux (1985).

Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On bark at altitudes 5 - 1200 m. The only phorophyte explicitly cited was Acer creticum.

France and Southern Europe, from Iberian Peninsula to Greece. Also Asia (Turkey), Africa (Tunisia, S. Africa), perhaps N. America.

Lecidella elaeochroma f. soralifera (Erichsen) D. Hawksw. (1972)


Differs from f. elaeochroma, with which it usually grows, only in having soralia. My only confirmed collection, which is too scanty to allow a full description, was fertile. The soralia were yellow-green, slightly convex, delimited though with some tendency to become confluent, 0.25 mm diameter, and reacted K- C+ orange, KC+ orange, P-.

Rare and scattered, on the mainland, with no clear pattern. On bark at altitudes 0 - 1500 m.

Scattered throughout Europe, but commoner in northern regions. Also Asia (Turkey).
**Lecidella euphorea** (Flörke) Kremp. (1861)


Very similar to *L. elaeochroma* f. *elaeochroma*, but reacting K+ yellow, C-, KC-, P-, UV-. Because lichen substance in *L. elaeochroma* are sometimes present in low concentration and/or are patchily distributed in the thallus, I have been reluctant to refer collections to *L. euphorea* until I have observed a negative C and KC reaction in several places. In the experience of Mr. S. N. Christensen (pers. comm.), *L. euphorea* has a grey thallus and a preference for (but is not restricted to) acidic bark of conifers and other trees with rough, leached bark, whereas *L. elaeochroma* has an olive coloured thallus and a preference for (but is not restricted to) smooth bark of deciduous trees in nutrient enriched places.

*L. euphorea* has the same distribution and ecology in Greece as *L. elaeochroma* f. *elaeochroma*, but is less common. Almost throughout Europe. Also Macaronesia. Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), C. America (Mexico), S. America (Argentina, Uruguay).

**Lecidella flavosorediata** (Vězda) Hertel & Leuckert (1969)


Description: Smith et al. (2009); Tønsberg (1992a).

Epiros, on bark at altitudes 940 - 1210 m.

Northern and central Europe, rare in the south. Also Asia (Turkey, India), perhaps N. America.

**Lecidella granulosula** (Nyl.) Knoph & Leuckert (2000)


Islands of the southern Aegean, on siliceous rock at altitudes 5 - 250 m.

Portugal, Italy and Greece. Also perhaps Asia (Turkey), Africa (S. Africa; Ascension Is, St Helena), N. America (Arizona, California, Colorado), C. America (Mexico), S. America (Chile, Brazil, Peru, Venezuela), Australasia (widespread).

**Lecidella laureri** (Hepp) Körb. (1855)


Description: Foucard (1990).

Known from a single locality in Macedonia, where it occurred on bark of *Platanus orientalis* at 340 m altitude.

Throughout Europe, but rare in Mediterranean regions. Also Asia (Turkey, Russia, Tajikistan), N. Africa (Morocco), N. America (BC).

**Lecidella patavina** (A. Massal.) Heufl. (1871)


Descriptions: Nash et al. (2004); Smith et al. (2009).

Crete and Mt. Olympus, on calcareous rock at altitudes over 2000 m.

Throughout Europe, but south of the Alps restricted to high mountains. Also Asia (widespread), perhaps Africa, N. America (widespread), C. America (Mexico), perhaps S. America (Argentina, Brazil, Venezuela), Antarctica (S. Orkney Is, continental Antarctica).

**Lecidella pulveracea** (Schaer.) P. Syd. (1887)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Island of Samothraki, on bark of *Quercus pubescens* at an altitude of 890 m. Perhaps also Peloponnese, on bark of *Juniperus drupacea* at an altitude of 1000 m.

Temperate Europe, extending north to Sweden and south to the Alps. Absent from arctic regions and truly mediterranean regions. Also Macaronesia (Tenerife), perhaps N. America.

**Lecidella scabra** (Taylor) Hertel & Leuckert (1969)

*Willdenowia* 5(3): 375; *Lecidea scabra* Taylor (1836) in Mackay, Fl. Hibern. 2: 121; *Lecidea protrusa* Fr.
Thallus: crustose, thin, rather inconspicuous, of scattered areoles, blue-grey when fresh, becoming pale grey in herbarium, 4 cm diameter. Soralia: bright green (when fresh), 0.2 - 0.3 mm diameter, delimited; soredia 20 - 30 µm diameter. Apothecia: absent (in material seen). Chemistry: soralia K-, C+ persistent orange, P-, UV-. Photobiont: green.

Scattered, mainly in the southern half of Greece, never very far from the sea. Usually on slightly nutrient-enriched siliceous rock, occasionally on calcareous rock or calcareous soil, at altitudes 0 - 1100, but commonest below 200 m. The lichenic fungus Endococcus stigma has been reported from this host.

Widespread in Europe to as far north as the Arctic Circle. Also Macaronesia, Asia (Turkey, southern Siberia), N. Africa (Morocco), N. America (Nova Scotia, California, Colorado), perhaps S. America (Argentina).

**Lecidella stigmatea** (Ach.) Hertel & Leuckert (1969)


Thallus: crustose, inconspicuous and immersed to well developed, to a few cm diameter; continuous, cracked or areolate, pale green-grey, without vegetative propagules. Apothecia: subimmersed to sessile, usually flat, sometimes convex, 0.2 - 1.2 mm diameter, rarely with slight white pruina. Disc: usually black, sometimes very dark red-brown or red-black, matt. Thalline margin: absent. Exciple: black, sometimes slightly shiny, 0.05 - 0.1 mm wide, persistent or sometimes becoming included in very convex apothecia; in section: 40 - 70 µm wide, outer part blue-black, blue-green or dark brown, inner part paler (colourless, pale brown or pale blue-green), of ± radiating hymata, without crystals. Epithecium: blue-green, blue-black or green-black, a brown pigment sometimes also present, K+ purple-black, blue-green-black pigment soluble in K, brown pigment (if present) not soluble in K, N+ violet, without crystals. Hymenium: 40 - 100 µm tall, colourless or with some epithelial pigment in upper part, without oil droplets or crystals. Hypothecium: 50 - 75 µm tall, usually colourless, sometimes very pale brown, without crystals. Paraphyses: sparingly branched, 1 - 2 µm wide at base, 2.5 - 3 µm at apex, sometimes with visible septa, usually not capitate. Ascospores: colourless, simple, ellipsoid, 9 - 17 x 5 - 10 µm, with Lecanora type wall, 8 per ascus. Chemistry: medulla C-, I-; thallus K- (or almost), C-, KC-. Photobiont: green.

*L. carpathica*, the other common saxicolous species of the genus, has a distinctly brown hypothecium.

Scattered throughout uplands of the mainland and the two large islands; not reported from the small islands. On calcareous rock at all altitudes, but commonest above 1000 m.

Subcosmopolitan outside the tropics.

**Lecidella viridans** (Flot.) Körb. (1855)


Description: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009). Islands of the Aegean, on siliceous rock at altitudes around 450 m. Southern and central Europe, reaching British Is but not Baltic States or the Nordic Countries. Also western Asia (Turkey), perhaps Africa (S. Africa), N. America (Labrador, Arizona, Colorado, New Mexico; perhaps elsewhere), C. America (Mexico), S. America (Chile, Venezuela, perhaps elsewhere).

**Lecidella xylophila** (Th. Fr.) Knoph & Leuckert (1997)

*Biblioth. Lichenol.* 68: 131; *Lecidea xylophila* Th. Fr. (1874) in Falck, Om östra Blekinges lafflora 16.

Description: Clauzade & Roux (1985) as *Lecidea xylophila*.

Western Crete at an altitude of 1100 m. No substrate was reported. Sweden, Germany, Switzerland, mountains of central Italy, Russian Caucasus, and Crete. Perhaps Asia (Taiwan).

**Lemmopsis** (Vain.) Zahlbr. (1906)


Literature: The genus was monographed by Ellis (1981). The only widespread species, *L. arnoldiana*, is treated in all the standard Floras.
Three species, all of which occur in Europe, though two have a rather restricted distributions. They occur on rock or soil. Like most groups in Lichinaceae, the genus is not very well known.

11 On rock. Disc remaining pore-like. Thallus ± crustose. L. arnoldiana

Lemmopsis arnoldiana (Hepp) Zahlbr. (1906)
in Engler-Prantl, Die natürlichen Pflanzenfamilien 1(1): 171; Physma arnoldianum Hepp (1858) in Arnold, Flora 41: 94.

Thallus: crustose, black, areolate, not well delimited, not stratified, 180 µm thick. Areoles: 0.3 - 0.6 mm wide, contiguous, often slightly concave, subrounded to subangular. Apothecia: not common, immersed in thallus, slightly concave, 0.2 mm diameter, 1 per areole, not pruinose. Disc: dark brown-black to black. Thalline margin: absent. Exciplle: black; in section: 30 - 50 µm wide, dark brown, structure obscured by pigment (even in K). Epithecium: pale orange-brown, K-; pigment not soluble in K. Hymenium: 90 µm tall, usually colourless, sometimes pale orange-brown in upper part, KI+ blue. Hypothecium: 25 - 35 µm tall, colourless to pale orange-brown. Paraphyses: simple, 1 µm wide at base, 1 - 2.5 µm at apex, usually not capitate. Asci: 50 x 12 µm, wall scarcely thickened at apex, outermost part of wall KI+ slightly blue. Ascospores: colourless, simple, 14 - 15 x 7 - 7.5 µm, ellipsoid but with slightly pointed ends, with thin (<1 µm) but distinct wall, 8 per ascus, often uniseriate in ascus. Photobiont: blue-green (not Nostoc), cells globose, 6 - 7 µm diameter (a few isolated cells to 10 µm diameter), forming compact, well delimited clusters to about 25 µm diameter; clusters eventually reach a diameter of about 60 µm but by that stage are diffuse and tending to disintegrate.

SW Peloponnese, on limestone at altitudes 245 - 850 m altitude. A report from the island of Ikaria, on rock at an altitude of 245 m, is tentative, as the material was scanty. Perhaps more common than these records suggest, since in the field it could be overlooked as Verrucaria nigrescens.

Most reports are from middle latitudes of Europe, but present as far north as the Arctic Circle. Very rare in southern Europe. Also Asia (Turkey, Taiwan), N. America (Arizona), perhaps C. America.

Lempholemma Körb. (1855)


Literature: The best starting point is Jorgensen, in Ahti et al (2007), which is an excellent treatment of 9 of the European species. It can be supplemented by Clauzade & Roux (1985), Nash et al. (2004), and Smith et al. (2009).

A rather poorly known genus with 22 species, of which 14 occur in Europe. Few are likely to occur in Greece, where the genus is very rare.

11 Thallus umbilicate. On calcareous rock with periodic water seepage. (L. elveoideum)
1 Thallus crustose, often granular. On various substrates.
222 Ascospores 7 - 9 x 5 - 7 µm. Thallus granular, not more than 0.5 cm diameter. On calcareous rock with periodic water seepage, or in water filled depressions. L. botryosum
22 Ascospores 20 - 33 x 10 - 13 µm, ellipsoid. On soil, bryophytes or plant debris over calcareous substrates. (L. chalazanum)
2 Ascospores mostly 10 - 20 µm long.
3 On bark. L. corticola
3 On soil, bryophytes or plant debris over calcareous substrates. L. polyanthes

Lempholemma botryosum (A. Massal.) Zahlbr. (1924)
Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).
Thessaly, at about 500 m altitude. The substrate was not recorded.
Widespread north of the Alps, to Arctic Circle; rare in southern Europe. Also Macaronesia, western Asia (Turkey, Syria, Yemen), N. Africa (Algeria), N. America (BC, California).

in Lumbsch et al., Phytotaxa 18: 80-81.
Description: See the protologue.
Crete, on bark at altitudes 250 - 350 m. The only phorophyte explicitly mentioned was Platanus orientalis.
Known only from Crete.
Lepmoehlemma polyanthes (Bernh. ex Schrad.) Malme (1924)
Sched. ad Lich Suec Exs. no. 883; Lichen polyanthes Bernh. ex Schrad. (1797), Annln Bot. (Usteri) 22: 82.

Descriptions: Ahti et al. (2007); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).

Crete, at an altitude of 500 m. The substrate was not recorded.

Widespread in Europe, but never common. Also Macaronesia, Asia (widespread), N. Africa (Tunisia), N. America (widespread), S. America (Chile) Australasia (SE Australia).

Lepra Scop. (1777)


Literature: The species are included in all the standard Floras, under Pertusaria.

This segregate from Pertusaria s. lat. has about 18 species, of which 17 occur in Europe.

Species are keyed out under Pertusaria.

Lepra albescens (Huds.) Hafellner (2016)
in Hafellner & Türk, Stafia 104(1): 171; Lichen albescens Huds. (1762), Fl. Angl. 444; Pertusaria albescens (Huds.) M. Choisy & Werner; Pertusaria albescens var. globulifera (Turner) Poelt; Pertusaria dacica Erichsen; Pertusaria discoidea (Pers.) Wedd.; Pertusaria discoidea var. albida Erichsen; (? Pertusaria discoidea f. minor Erichsen; Pertusaria globulifera (Turner) A. Massal.; Pertusaria globulifera var. euboica Erichsen; (?) Pertusaria globulifera var. simulans Erichsen; Pertusaria orbicularis auct.; Variolaria discoidea Pers.; Variolaria globulifera Turner.

Thallus: crustose, well developed, to several cm diameter, white to pale grey, often cracked but surface smooth between cracks, 200 - 350 µm thick, margin often zoned. Prothallus: usually well developed, white, 1 - 3 mm wide, often zoned. Isidia: absent. Soralia: always present, white (whiter than thallus), usually ±circular, well delimited, usually slightly concave to flat, less commonly slightly convex, (0.5) 1 - 4.2 mm diameter, with coarse soredia 0.05 - 0.1 mm diameter. Cortex: 20 - 35 µm thick, colourless, formed of horizontal hyphae. Medulla: white. Chemistry: thallus, medulla and soralia K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: 45 - 70 µm thick, ±continuous but slightly irregular, as cells show some tendency to form clumps.

Typical material is easily recognised by the very large, white, well-delimited, usually slightly excavate soralia with coarse soredia, the negative spot test reactions, and the usually corticolous habit. Var. corallina has less well delimited, and generally smaller soralia. Ochrolechia alboflavescens has smaller soralia.

Throughout Greece. At all altitudes. On bark, less commonly wood, rarely on rock. Reported from a wide range of phorophytes, with no clear preference.

L. albescens s. lat. is present throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (scattered), C. America (Mexico), S. America (Colombia, perhaps elsewhere).

Lepra albescens var. corallina (Zahlbr.) ined.


Thallus: crustose, to many cm diameter, grey-white, pale grey or slightly green-grey, not pruinose, usually with a few cracks, 180 - 300 µm thick. Isidia: abundant, soft, fragile, rather irregularly globose, 0.1 - 0.3 mm diameter, occasionally developing into soralia. Soralia: often absent; when present large (to 8 mm diameter), white, paler than thallus, slightly convex (in material seen). Cortex: 50 µm thick, mostly colourless, sometimes pale brown in upper part, formed of ±horizontal hyphae, K-. Medulla: white. Chemistry: all parts K-, C-, KC-, P-; thallus UV- or almost. Photobiont: green, cells globose, 9 - 12 µm diameter. Photobiont layer: 30 - 50 µm thick, regular and continuous where there are no isidia).

Fairly well characterised by the abundant development of small, soft, rather irregular isidia that have only a weak tendency to develop into soralia. Pertusaria coccodes has more regular isidia and is K+ red. Var. albescens has well-developed soralia and lacks isidia.

Probably throughout Greece, though less common than var. albescens. On bark of a fairly wide range of phorophytes, with no marked preference. at altitudes 350 - 1400 m.

Widespread, but slightly more southern than var. albescens. Its northern limit is Scotland and southern Scandinavia, whereas var. albescens reaches the Arctic Circle. Also N. Africa (Morocco).

Lepra amara (Ach.) Hafellner (2016)
**Pertusaria amara** (Ach.) Nyl.; *Pertusaria amara f. ecrustacea* Erichsen; (?) *Pertusaria amara f. macrosora* Erichsen; (?) *Pertusaria communis f. effusa* Hepp; *Pertusaria faginea* (L.) Tuck.; (?) *Pertusaria orbiculata var. albida* Erichsen; *Variofaria faginea* (L.) Pers.

Thallus: crustose, to at least 7 cm diameter, pale-grey, not pruinose, usually warty, weakly areolate, 200 - 600 µm thick. Prothallus: present, grey, 0.3 - 1 mm wide, distinctly zoned. Isidia: absent, but soralia sometimes with coarse papillae that vaguely resemble soft isidia. Soralia: abundant, white, paler than thallus, 0.5 - 1.8 mm diameter, at first flat, soon markedly convex, at first delimiting, sometimes confluent later, with a distinct bitter taste. Cortex: 50 - 70 µm thick, swelling to 80 - 120 µm in K, colourless, formed of randomly oriented hyphae with distinct elongated lumina; crystals: abundant (but vertical crystal-free zones 15 - 30 µm wide sometimes present), colourless, 2 - 10 µm wide, rather squareish, not soluble in K. Medulla: white. Chemistry: medulla K-, C-, KC- or almost, P+ orange, I-; soralia K-, C-, KC+ fleeting violet, P+ orange, UV-; thallus K-, C-, KC-, P+ faintly yellow (probably just medulla reaction showing through), UV-. Photobiont: green, cells globose, 6 - 12 µm diameter. Photobiont layer: 50 - 70 µm thick, ±continuous, sometimes irregular as cells often form large clumps 40 - 70 µm wide.

The prominent white soralia, reacting KC+ violet, are distinctive, but this species is most easily recognised by the bitter taste of the soralia.

Widespread in the northern half of Greece, less common in the south. At all altitudes. Usually on bark (85% of records), and reported from a wide range of phorophytes, but avoiding strongly acidic bark; occasionally on non-calcareous rock or wood.

Throughout Europe though avoiding localities with distinctly Mediterranean climate. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), C. America (Mexico), perhaps S. America.

**Lepra aspergilla** (Ach.) Hafellner (2016)


Descriptions: Clauzade & Roux (1985) as *Pertusaria dealbescens*; Smith et al. (2009) as *Pertusaria aspergilla*.

Rare and scattered, with no clear pattern. On bark or siliceous rock at altitudes 200 - 700 m.

Widespread north of the Alps, rare in southern Europe. Also Macaronesia, Asia (Turkey, Russia, Mongolia, perhaps China), N. Africa (Algeria), S. America (Colombia, perhaps elsewhere).

**Lepra corallina** (L.) Hafellner (2016)

in Hafellner & Türk, *Stapfia* 104(1): 172; *Lichen corallinus* L. (1767), Mant. Pl. 131; *Pertusaria corallina* (L.) Arnold; *Pertusaria subdubia* Nyl.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as *Pertusaria corallina*.

Mountains of northern Greece, at altitudes 1400 m and above. The only substrate definitely reported is wood, which is an unusual, but not unknown, substrate for this lichen.

Throughout Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (Turkey, Russia, China, Japan).

**Lepra leucosora** (Nyl.) Hafellner (2016)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as *Pertusaria leucosora*.

Islands of the southern half of the Aegean (Chios, Crete and Kos). On siliceous rock at altitudes 500 - 800 m.

Southern and central Europe, just reaching British Is. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa).

**Lepra mammosa** (Harm.) Hafellner (2016)


Description: Clauzade & Roux (1985), as *Pertusaria mammosa*.

Chios, Kos and Samothraki, on siliceous rock at altitudes 200 - 700 m.

Southern Europe (Iberian Peninsula to Greece), and Macaronesia.

**Lepra monogona** (Nyl.) Hafellner (2016)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as *Pertusaria monogona*.

Islands of the Aegean, on siliceous rock at altitudes 15 - 670 m.

Southern Europe, and the Atlantic margin to Brittany and southern half of British Is. Also Macaronesia, Asia
Lepra ophthalmiza (Nyl.) Hafellner (2016)

Descriptions: Nash et al. (2002); Smith et al. (2009), both as *Pertusaria ophthalmiza*.

Chios and Ikaria, on bark. On Chios it was on bark of *Acer sempervirens* at an altitude of 880 m.

Widespread in and north of the Alps, extending well into Scandinavia. Very rare south of the Alps. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico).

Lepra pseudoparotica (Sipman) Sipman & Raus (2019)

Description: See the protologue.

Islands of the southern Aegean, on siliceous rock at altitudes 200 - 750 m.

Known only from Greece.

Lepraria Ach. (1803)

Methodus 3. The name is conserved over *Conia* Vent. and *Pulina* Adans. Type: *L. incana* (L.) Ach., listed in Appendix of the ICN. Family: *Stereocaulaceae*.

Literature: Saag et al. (2009) is a world monograph, with a key and descriptions of all species then known.

Thallus poorly structured, leprose, of groups of algal cells loosely wrapped by fungal hyphae. Ascomata and conidiomata unknown.

About 74 species worldwide, of which 31 occur in Europe. They occur on a wide range of substrates, but most species prefer shaded habitats not exposed to direct rain. Because of the scarcity of morphological characters, species are delimited mainly on chemical grounds.

Early workers did not recognise most of the species now known to be present in the genus, and a high proportion of reports before about 1985 are likely to be unreliable.

The chemistry of *Lepraria* species is best investigated by chromatography. Determinations made using spot tests alone may not always be reliable.

11 Usnic acid present. Thallus distinctly green (yellow-green or white-green), K-, KC+ golden yellow. On bark, especially of old trees. Granules to 0.5 mm diam, eroded or aggregated into consoredia, forming a compact layer over the white medulla; projecting hyphae short or absent. *L. leuckertiana*

1 Usnic acid absent. Thallus grey, blue-grey, green-grey or yellow-white, but never distinctly green, not both K- and KC+ golden yellow On various substrates.

22 Divaricatic acid present. Thallus UV+ blue-white. Granules 0.05 - 0.12 mm diameter, sometimes to 0.2 mm at margins.

33 Thallus C+ red, KC+ red. On acidic or slightly calcareous rocks below overhangs. (L. crassissima)

3 Thallus C-, KC-. On acid rock, walls, bark and soil, on surfaces sheltered from direct rain. (L. incana). Greek reports need confirmation.

2 Divaricatic acid absent. Thallus not UV+ blue-white. Other characters various.

33 Thallus C+ pink or red, KC+ pink, red or pink-violet.

44 Lecanoric acid and pannaric acid-6-methylester present. Thallus P+. On bark. Thallus green-grey, about 0.1 mm thick, granules 0.1 mm diameter. Margines lobate; marginal lobes about 1 mm wide, 1 mm long, with raised marginal rim. (L. impossibilis). Greek report needs confirmation.

4 Alectorialic acid present, sometimes with other substances. Thallus P+ yellow to orange.

55 Thallus pale blue-grey to green-white or yellow-white. Granules with soft surface. Usually on limestone or slightly calcareous siliceous rock, often overgrowing bryophytes, occasionally on ±basic bark. *L. eburnea*

5 Thallus white or pale grey. Granules with a compact surface. On moss cushions on acidic rocks and on stony ground, on unshaded rain-exposed surfaces. *L. neglecta*

3 Thallus C- and KC-, or C and/or KC yellow, dirty yellow, dull yellow-brown or dirty orange.

444 Thallus with protocetraric and/or fumarprotocetraric acid, P+ red or rust red.

55 Granules very coarse, 0.32 - 0.54 mm diameter, resembling isidia, often becoming sorediate. On calcareous soil and rock, sometimes on mosses, in shaded but well-lit places. *L. isidiata*

5 Granules 0.06 - 0.2 (0.4) mm diameter, soft in appearance. On acidic or calcareous rock; sometimes on soil or overgrowing bryophytes, on surfaces sheltered from rain. *L. nivalis*
44 Thallus P+ yellow, orange or dirty orange.
55 Thallus with distinctly lobed margin. Atranorin present in all species.
66 Thallus P+ yellowish. Granules 0.1 - 0.4 mm diameter. Thallus bone white or dirty brown. On soil. (L. xerophila)
6 Thallus P+ orange. Granules 0.03 - 0.12 mm diameter in younger parts of thallus (to 0.3 mm in older parts). In various substrates.
77 Thallus green-blue. L. finkii
7 Thallus pale grey to cream or yellowish. L. membranacea
5 Margin of thallus not distinctly lobed (diffuse, delimited or very obscurely lobed).
666 Thamnolic acid present. Thallus P+ bright yellow, without any orange tinge.
77 Thallus white to pale blue-grey. Granules 0.1 - 0.3 mm diameter, soft in appearance, often poorly defined. On slightly calcareous cliffs in light or moderate shade in woodland. (L. nylanderiana)
7 Thallus grey-green or green to dull blue-green. Granules 0.06 - 0.1 mm diameter. On shaded acidic bark and wood, less commonly on rocks and soil, on surfaces sheltered from rain. (L. umbricola)
66 Stictic and constictic acid present. Thallus K+ yellow, C-, P+ orange.
77 Granules often ill defined, especially in humid situations, 0.12 - 0.36 mm diam, comprising loose aggregations of smaller granules. Free hyphae (not associated with algae) abundant in thallus, forming a spongy network, connecting the granules and often predominating in lower part of thallus to form a ±distinct white medulla. Thallus pale green, blue-white to pale blue-grey. On all substrates sheltered from rain L. lobificans
7 Granules 0.03 - 0.12 mm diam, with a fairly firm appearance. Free hyphae not abundant. Thallus pale blue-grey to dull blue-grey. On acid rock and bark, and on soil banks. L. elobata
6 Not as above.
77 4-oxypannaric acid 2-methylester present (TLC required). Thallus K± dirty orange, C± dirty orange, P+ yellow to dirty orange. Thallus pale grey to cream, deep cream or dull yellow; rarely pale blue-grey. On calcareous or slightly calcareous substrates sheltered from rain; rarely on bark (L. diffusa)
7 Pannaric acid 6-methylester present (TLC required). Thallus K+ dirty yellow to orange, C+ dirty yellow, P+ orange to orange-yellow, UV- Thallus green-grey, blue-white to pale blue-grey, grey or pale cream. On surfaces sheltered from rain, shaded or unshaded; avoiding only very acidic substrates. L. vouauxii
4 Thallus P-.
55 Granules 0.1 - 0.2 mm diameter, with long projecting hyphae (at least 60 μm long). Thallus pale grey. On acid bark and rock, on surfaces sheltered from rain. L. rigidula
5 Granules 0.04 - 0.06 mm diameter, without very long projecting hyphae. Thallus blue-white to pale blue-grey. On acid bark, or on plant remains or moss over rock (L. jackii)

Lepraria eburnea J. R. Laundon (1992)
Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009); Tønsberg (1992a).
Scattered in NW Greece at altitudes 700 - 930 m. On bark.
Widespread in Europe, but rare south of the Alps and probably restricted to the uplands. Also Asia (Turkey, Russia, S. Korea), N. America (widespread), perhaps C. America, S. America (Chile), Australasia (widespread in cooler parts), Antarctica (Kerguelen Is).

Lepraria elobata Tønsberg (1992)
Sommerfeltia 14: 197-198.
Description: Nash et al. (2004); Smith et al. (2009); or see the protologue.
NW Greece, at altitudes 100 - 700 m. The only substrate reported explicitly was bark.
Widespread in Europe to as far north as southern Scandinavia, but avoiding regions with true Mediterranean climate. Also Asia (Turkey, Russia), N. America (widespread), perhaps C. America.

Lepraria finkii (de Lesd. ex Hue) R. C. Harris (1985)
Description: Lendemer (2013).
Epiros, on bark at an altitude of 735 m.
Widespread in central and southern Europe. Also Asia (Turkey), N. America (widespread).
Description: Saag et al. (2009).
Scattered, with no clear pattern. On calcareous soil or calcareous rock at altitudes 5 - 800 m.
Southern Europe, from Spain to Cyprus. Also Macaronesia, Asia (Iran), N. Africa (Morocco), perhaps N. America.

Lepraria leuckertiana (L. Zedda) L. Saag (2009)
Description: Saag et al. (2009); or see the protologue.
Scattered, with no clear pattern, at altitudes 5 - 900 m. On bark (60% of records), calcareous rock (30% of records), or soil.
Southern and central Europe to as far north as Netherlands. Also Asia (S. Korea), N. Africa (Morocco), S. America (Peru).

Lepraria lobificans Nyl. (1873)
Flora 56: 196; Lepraria santosii Argüello & A. Crespo.
Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009); Tønsberg (1992a).
Scattered, with no clear pattern, at altitudes below 1000 m. On all substrates, but commonest on bark.
Cosmopolitan. Throughout Europe, and reported from all continents except Antarctica.

Lepraria membranacea (Dicks.) Vain. (1921)
Descriptions: Smith et al. (2009); Tønsberg (1992a) as Leproloma membranaceum.
Scattered in the eastern half of Greece, at all altitudes. Most commonly on rock (calcareous or siliceous) or overgrowing bryophytes (? on rock), but reported once from bark of Platana orientalis.
Widespread in Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Kenya, Zimbabwe), N. America (widespread), Australasia (Tasmania, NZS). Many, perhaps all, reports for S. America are incorrect.

Lepraria neglecta (Nyl.) Erichsen (1957)
Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009); Tønsberg (1992a).
Scattered, in the northern half of Greece. Usually on siliceous rock, less commonly on saxicolous bryophytes or on bark, at altitudes 350 - 1600 m.
Widespread in Europe, though rare south of the Alps. Also Macaronesia, Asia (widespread), Malesia (PNG), N. America (widespread), C America (Mexico), S. America (widespread), Australasia (widespread in cool to temperate parts), Pacific (East Is), Antarctica (widespread).

Lepraria nivalis J. R. Laundon (1992)
Lichenologist 24(4): 327. (It is a nomen novum for Crocynia murorum de Lesd. (1948), the epithet being unavailable in Lepraria owing to the earlier Lepraria murorum Hook. 1833.); (?) Lepraria crassissima auct. gaec.
Description: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).
Scattered in the southern half of Greece. On non-calcareous soil or, less commonly, non-calcareous rock, occasionally on bark, at altitudes 0 - 1000 m, but commonest below 400 m.
Widespread in Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread in western half), C. America (Guatemala), Antarctica (subantarctic Heard Is).

Lepraria rigidula (de Lesd.) Tønsberg (1992)
Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009); Tønsberg (1992a).
Crete, overgrowing bryophytes on rock at an altitude of 1100 m, and Epiros on bark at 940 m..
Widespread in central and northern Europe, but rare south of the Alps. Also Asia (Turkey, Iran, Armenia, Russia), N. America (widespread), perhaps C. America, S. America (Chile, Bolivia), Antarctica (Alexander Is).
Lepraria vouauxii (Hue) R. C. Harris (1987)


Descriptions: Nash et al. (2004); Smith et al. (2009); Tønsberg (1992a) as Leproloma vouauxii.

Rare and scattered, with no clear pattern. On bark, or on bryophytes on bark, at altitudes 750 - 2100 m.

Throughout Europe, but rare south of the Alps. Also Asia (widespread), Malesia (PNG), Africa (Ethiopia, S. Africa), N. America (widespread), Caribbean (DR, Jamaica), C. America (Mexico, Guatemala), S. America (widespread), Australasia (SE Australia, NZS), Pacific (Hawaii), Antarctica (subantarctic islands, Antarctic Peninsula).

Leprocaulon Nyl. ex Lam. (1880)

Bull. Soc. Bot. Fr. 25: 352. Type: L. nanum (Ach.) Nyl. ex Lam, the only species originally included. Family: Leprocaulaceae.

Literature: Smith et al. (2009) treat the only widespread European species.

About 9 species. Two are present in Europe, but one has a very restricted range.


The earliest name is Lichen quisquiliaris Leers (1775), but in the interests of nomenclatural stability I decline to take up Leers's epithet.

Thallus: to several cm diameter, pale grey, bipartite; crustose part entirely leprose; fruticose part of coralloid branches, about 1 mm tall, to about 1.5 mm wide, terminating in granules resembling soralia, main stems not sorediate. Soralia (of crustose part): 0.07 - 0.15 mm diameter. Chemistry: thallus K- (sometime faintly + brownish, but this seems to be a physical effect), C-, KC-, P-, UV-.

This lichen can not be confused with any other. Its ascomata and conidiomata are not known.

Widespread, though there are few records for the NW of the country. On non-calcareous rock, or occasionally non-calcareous soil, at altitudes 10 - 1100 m. Its thallus is fragile, and so it usually occurs in places protected from direct rain, such as on the lower surface of overhangs, or in crevices.

Widespread in Europe, except for the far north. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread in western half), C. America (Mexico), S. America (Venezuela), Australasia (widespread in Australia).

Leptochidium M. Choisy (1952)


Literature: There is no monograph, but Ahti et al. (2007) discuss both species.

Two species, both of which occur in Europe. One is distinctly northern and will not occur in Greece.

Leptochidium albociliatum (Desm.) M. Choisy (1952)


Thallus: foliose, to 2.5 cm diameter. Lobes: erect, 1 - 1.7 mm wide, grey-black, not pruinose, 80 - 100 µm thick, attached by rhizines. Lobe margins: wavy to very incised, with abundant small white hairs about 0.1 mm long. Rhizines: white, 0.3 - 0.8 x 0.05 - 0.1 mm, simple, discrete or fasciculate. Isidia: sometimes present in centre of mature lobes, black, globose, 0.07 - 0.1 mm diameter. Upper cortex: 10 µm thick, pale orange-brown to orange-brown, formed of parallel, vertical hyphae with expanded luminae, giving the appearance of a cellular cortex one cell thick, K-.

Medulla: present, as a photobiont-free zone between the two photobiont layers. Lower cortex: 25 µm thick, brown in outer part, colourless, in inner part, distinctly cellular; cells 10 - 15 x 4 - 10 µm, long axis vertical; cortex more than one cell thick; K-.

Apothecia: 0.7 - 1.6 mm diameter, slightly concave to slightly convex, not pruinose. Disc: brown. Thalline margin: present, persistent but very thin, smooth; in section: 100 µm wide, with distinct cellular cortex. Exciple: sometimes visible externally as a thin ring, darker brown than disc; in section: 50 - 70 µm wide, colourless except at surface which is orange-brown, of prominent large cells, 5 - 14 x 5 - 10 µm, long axis oriented in outward direction. Epithecium: orange-brown, K-.

Hymenium: 90 - 100 µm tall, colourless, K1+ blue. Hypothecium: 50 µm tall, colourless, lower part distinctly cellular, long axis of cells horizontal, cellular layer continuous with exciple. Paraphyses: simple, with conspicuous septa, expanding gradually from 1.5 µm at base to 3 µm at apex, not capitulate, sometimes slightly moniliform. Asci: 60 x 20 µm, variable in shape, cylindrical, narrowly clavate, or bulging at the
middle, KI+ blue in a narrow arc at the tip (without obvious structure). Ascospores: colourless, 1-septate, constricted at septum, ±narrowly ellipsoid though ends sometimes slightly pointed, 25 - 30 x 8 - 10 µm, 8 per ascus. Photobiont: blue-green, cells globose, 5 - 8 µm diameter, not in chains, forming two distinct but ±identical layers separated by a layer with no or few photobiont cells. Both photobiont layers continuous and fairly regular.

Resembles a small Leptogium or Collema species, but the marginal hairs are very distinctive and this species can not be confused with any other.

Reliably known from a single site in the Peloponnese, on bryophytes over siliceous rock at an altitude of 920 m. The site is a north-facing slop in a steep valley, and probably has some degree of ecological continuity, as it is too steep ever to have been terraced. It is also the only known Peloponnesian locality for Haematomma nemetzii. A collection from another site in the Peloponnese probably belongs here, but it is scanty, in very poor condition, and the determination is tentative.

Most of the western half of Europe (though not British Isles) but rare in the east. South of the Alps probably confined to the mountains. Nowhere very common. Also Macaronesia, western Asia (Turkey, Syria), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico).

**Leptogium (Ach.) Gray (1821)**

Nat. Arr. Br. Pl. 1: 400; *Collema unranked Leptogium* Ach. (1810), Lichenogr. Universalis 654. Type: *L. lacerum* (Sw.) Gray, designated by Clements & Shear, Gen. Fung. 317. 1931. However, it has been proposed to re-typify the genus on *L. azureum* and the proposal is likely to be accepted. Family: Collemataceae.

Literature: There is no monograph of the European species, but between them Clausade & Roux (1985), Jørgensen in Ahti et al. (2007), and Smith et al. (2009) are adequate.

Around 150 species, of which 19 occur in Europe. The genus is uncommon in Greece.

111 Thallus foliose, with large lobes 1 - 20 mm wide.
22 Lower surface densely covered in white hairs.
33 Isidia present.
   44 Isidia ±granular. Surface ±smooth.
      55 Isidia ±uniformly distributed over surface of lobes. Upper surface dark green-black, smooth. Lower surface with tomentum and a few long rhizines. **L. saturninum**
      55 Isidia present only in patches. Upper surface brown or blue-grey, with transverse wrinkles. Lower surface only with short tomentum. (L. hibernicum) Greek report doubtful.
   4 Mature isidia mostly cylindrical to coralloid (young isidia may be ±granular). Surface smooth or wrinkled.
      55 Upper surface often wrinkled. Isidia brown, often with minute pit in swollen apex. **L. furfuraceum**
      55 Upper surface usually smooth, rarely with a few wrinkles near margin. Isidia slate grey, darker than lobes. (L. burnetiae)
   33 Isidia absent. (L. hildenbrandii)
22 Lower surface not densely covered in white hairs (a few scattered hairs may be present, or hairs may be present in central part only).
33 Upper surface of lobes with isidia.
   44 Upper surface with distinct ridges. Lobes often fusing.
      55 Isidia granular, brownish, contrasting with blue-grey thallus, mostly marginal, rarely spreading onto ridges of internal parts of lobes. Apothecia without paraplectenchyma directly below subhymenium. Ascospores fusiform to acicular, 40 - 65 x 3 - 8 µm. **L. brebissonii**
      55 Isidia cylindrical or coralloid, pale blue-grey, concolourous with thallus, mostly along ridges. Apothecia with paraplectenchyma directly below subhymenium. Ascospores ellipsoid, 25 - 35 x 12 - 18 µm. **L. coralloideum**
   4 Upper surface smooth or wrinkled, but without distinct ridges. Lobes discrete or overlapping, but not fusing.
   55 Thallus olive-brown. See Scytinium subaridum
   55 Thallus grey or blue-grey. **L. cyanescens**
33 Upper surface of lobes without isidia. (Some species have many marginal extensions of the lobes which may resemble isidia, but there are few or no such structures laminally.)
44 Thallus ±cushion-forming; of ±densely crowded lobes at least some of which are erect. Lobes usually red-brown, sometimes grey in sheltered situations. See Scytinium
   4 Thallus not cushion-forming; lobes adpressed or upturned, but not erect.
      55 Lobes 3 - 6 mm wide. Usually on bark, or overgrowing bryophytes on bark.
      66 Thallus with folds and pustules. Usually with many apothecia. On bark. (L. corticola) Greek reports
incorrect.

6 Thallus without folds or pustules. Apothecia usually absent. On bryophytes on bark, occasionally on rock. **L. cochleatum**

5 Lobes to 3 (4) mm wide. On rock or soil. See **Scytinium**

11 Thallus foliose, with lobes less than 1 mm wide, or thallus small-squamulose, sub-squamulose, or crustose without radiating marginal lobes. See **Scytinium**

1 Thallus ±crustose, of blackish, discrete, placoid areoles, often forming radiating patterns. On dry calcareous rocks or walls. See **Pseudoleptogium diffractum**

**Leptogium brebissonii** Mont. (1840)  
*Plantes Cellulaires Sistens* 130; *Leptogium chloromelum* auct. graec.; *Leptogium ruginosum* (Schaer.) Nyl.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Rare and scattered, with no clear pattern. On bark at altitudes 0 - 800 m. Recorded from *Araucaria*, *Carpinus* and *Quercus*. Most reports are from sites fairly close to the sea.

Fairly widespread in humid parts of southern Europe and the southern Atlantic margin. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (BC, Oregon, Washington), S. America (widespread). Reports for Australasia (NZ) are incorrect.

**Leptogium cochleatum** (Dicks.) P. M. Jørg. & P. James (1983)  

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).

Corfu and Mt. Olympus. No information is available for the former. At Mt. Olympus, overgrowing bryophytes on limestone at an altitude of 1300 m.

Suboceanic in Europe; absent from the central part of the continent. Also Macaronesia, Asia (widespread, but not western Asia), Malesia (Philippines), Africa (widespread), Caribbean (widespread), C. America (widespread), S. America (widespread), Australasia (NSW), Pacific (Hawaii, New Caledonia, Tahiti, W. Samoa). Reports for N. America are incorrect.

**Leptogium coralloideum** (Meyen & Flot.) Vain. (1915)  

Descriptions: Clauzade & Roux (1989); Nash et al. (2004); Smith et al. (2009).

Epiros and southern Peloponnese, on bark of *Olea europaea* and *Quercus coccifera* at altitudes 300 - 400 m.

Basically a southern species, but reaching British Is. Also Macaronesia, Asia (India, Thailand), Malesia (Philippines, PNG), Africa (widespread, but not N. Africa), N. America (Arizona), Caribbean (Guadeloupe, St Lucia), C. America (CR, Mexico, Panama), S. America (widespread), Australasia (eastern Australia, NZN, NZS), Pacific (Tahiti).

**Leptogium cyanescens** (Ach.) Körb. (1855)  

The basionym is often cited as "*Collema cyanescens* Rabenh.", but Rabenhorst's name is a combination from Acharius's name. The confusion arose because Jørgensen & James (1983) incorrectly regarded *Collema tremelloides* b. *cyanescens* Ach. and *Collema tremelloides* β *caesium* Ach. as having the same rank.

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Rare and scattered, with no clear pattern. On bark, or overgrowing bryophytes on bark or rock, at altitudes 25 - 930 m.

Present throughout those regions of Europe with a ±humid climate. Subcosmopolitan where the climate is suitable.

**Leptogium furfuraceum** (Harm.) Sierk (1964)  

Thallus: foliose, homoiomerous. Lobes: 4 - 6 mm wide, rounded, ±smooth or (near margins) sometimes with network of fine striations. Upper surface: red-brown, often slightly shiny near lobe margins. Hairs: abundant on lower surface, white, initially formed of a single hypha, later of several loosely joined hyphae, to 125 µm long; individual hyphae colourless, 4 - 5 µm wide, with frequent and distinct septa. Isidia: laminal, initially globose, 0.05 mm diameter, later cylindrical to coralloid, 0.2 x 0.05 mm, with distinct pit in apex, brown in lower part, dark brown to black towards apex. Upper and lower cortex: present, 1 cell thick; hyphae in centre of lobes about 2 µm wide. Photobiont: Nostoc; cells subglobose to globose, 3 - 5 µm diameter, in chains, not forming a distinct layer.
The unusual form of the isidia easily distinguish this species from others in the genus. Crete and SW Peloponnese, a altitudes of 500 - 850 m. On bark of *Quercus pubescens* and overgrowing bryophytes and a *Lepraria* sp. on bark of *Platanus orientalis*.

Scattered, mostly in southern Europe from Portugal to Greece. Also Macaronesia, Asia (southern Siberia, India, Yunnan), E. Africa (Ethiopia, Kenya, Tanzania), N. America (scattered in western half), C. America (CR, Mexico), S. America (Venezuela).

**Leptogium hibernicum** M. E. Mitch. ex P. M. Jörg.
Reported for Greece in Muggia et al. (2018), but that report is not accepted here. This is a strongly western species in Europe, and is not reported even for Italy. I suspect confusion with the similar, and fairly common *L saturninum*. Unfortunately, I did not receive any response to my email requesting further information on the Greek specimen.

**Leptogium saturninum** (Dicks.) Nyl. (1857)

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, but absent from the islands of the Aegean except for Crete. At altitudes 450 to about 2000 m. Usually on bark, and recorded from *Abies cephalonica*, *Fagus*, *Juglans* and *Platanus*; rarely on rock.

Present in most of parts Europe with a humid climate, though in the south restricted to the uplands. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (widespread), Caribbean, C. America (Mexico), perhaps Pacific (Hawaii). Reports for S. America (Chile), Australasia (NZ) are incorrect.

**Leptorhaphis** Körb. (1855)


Thirteen species, 11 of which occur in Europe. Most are saprophytic, but a few may be be weakly lichenised. The genus is rare in Greece.

11 Ascospores 3 - 5 -septate, 30 - 40 x 3 - 4.5 µm. *L. oleae*
1 Ascospores 1 - 3 -septate. On other phorophytes.

22 Perithecia ellipsoid, surrounded by dark basal fringe. Ascospores 1-septate, 30 - 45 µm long. (*L. parameca*)
2 Perithecia circular, not surrounded by dark basal fringe. Ascospores 1 - 3 -septate, 25 - 32 µm long. *L. atomaria*

**Leptorhaphis atomaria** (Ach.) Szatala (1927)


Corfu, on bark of *Opuntia ficus-indica* at an altitude of 50 m. Not reported for Greece since 1915.

Widespread in Europe, but rare in truly Mediterranean vegetation. Also Asia (widespread), N. Africa (Algeria), N. America (Arizona, Illinois, Michigan), perhaps S. America (Paraguay). Probably not all reports are reliable.

**Leptorhaphis oleae** (A. Massal.) Körb. (1865)
Parerga Lichenol. 386; *Sagedia oleae* A. Massal. (1855), Symm. Lich. Nov. 96 - 97.


Evia, on bark of *Quercus ilex* at an altitude of 200 m.

Only southern Europe, from Portugal to Greece, and N. Africa (Algeria, Tunisia).

**Lethariella** (Motyka) Krog (1976)


Literature: Clauzade & Roux (1985) treat the only European species.

Six species, only one of which occurs in Europe.

**Lethariella intricata** (Moris) Krog (1976)
Jatta.
   Description: Clauzade & Roux (1985).
   Very scattered, with no clear pattern but never very far from the sea. On bark of conifers or on siliceous rock, occasionally on wood, at altitudes 830 to about 2000 m.
   Southern Europe, from Iberian Peninsula to Greece and Ukraine. Also Macaronesia, western Asia (Turkey). An old report for Africa (Sierra Leone) is doubtful.

Lichenochora Hafellner (1989)


Literature: The best starting point is the key to all species then known in Etayo & Navarro-Rosinéés (2008), on which the key below is based.

About 44 species, of which about 30 occur in Europe. There are few Greek reports.

111 Ascospores simple. On Acarospora, Aspicilia, or Psora.
   22 Forming galls on Aspicilia (L. verrucicola)
   2 Not forming galls.
      33 On Psora decipiens. Ascospores 31 - 42 x 14 - 18 µm. (L. atrans)
      3 On Acarospora moenium. Ascospores 13.5 - 17.5 x 4.5 - 5.5 µm. (L. thorii)
11 Mature ascospores mostly 1-septate. On various hosts, but not Acarospora or Psora.
   22 Ascospores narrowly ellipsoid, aspect ratio 3 or more.
      33 Ascospores 4.5 - 6 µm wide. On Fuscopannaria. (L. lepidiotae)
      3 Ascospores 6 - 9 µm wide. On other hosts.
         44 On Mycobolimbia berengeriana. Asci with 4 - 8 ascospores. (L. inconspicua)
         4 On Aspicilia. Asci usually with 4 ascospores. (L. aprica)
   2 Ascospores subglobose to broadly ellipsoid, aspect ratio less than 3.
      33 Asci with 2 or 4 ascospores.
         44 Most ascospores less than 15 µm long. On Lecidella. (L. lecidellae)
         4 Most ascospores more than 15 µm long. On other hosts.
      55 Perithecia more than 200 µm diameter. On Fulgensia. _L. constrictella_
   11 Ascospores mostly 1-septate. On various hosts, but not Acarospora or Psora.
   22 Ascospores narrow ellipsoid, aspect ratio 3 or more.
      33 Ascospores 4.5 - 6 µm wide. On Fuscopannaria. (L. lepidiotae)
      3 Ascospores 6 - 9 µm wide. On other hosts.
         44 On Mycobolimbia berengeriana. Asci with 4 - 8 ascospores. (L. inconspicua)
         4 On Aspicilia. Asci usually with 4 ascospores. (L. aprica)
   2 Ascospores subglobose to broadly ellipsoid, aspect ratio less than 3.
      33 Asci with 2 or 4 ascospores.
         44 Most ascospores less than 15 µm long. On Lecidella. (L. lecidellae)
         4 Most ascospores more than 15 µm long. On other hosts.
      55 Perithecia more than 200 µm diameter. On Fulgensia. _L. constrictella_
      5 Perithecia 120 - 170 µm diameter. On Bilimbia sabuletorum (L. paucispora)
   3 Asci with 8 ascospores.
      44 Ascospores with distinct perispore, eventually becoming finely granular. On Physcia. (L. aipoliae), (L. polycoccoides)
      4 Ascospores without perispore, remaining colourless.
      55 Ascospores 10 - 12 µm long. On Physciona. _L. weillii_
   5 Ascospores 12 - 21 µm long
      66 Most ascospores 4 - 8 µm wide. Perithecia 80 - 200 x 50 - 180 µm. On various hosts.
         7777 On Trapelia coarctata. Ascospores 15 - 18 x 5 - 6 µm. (L. coarctatae)
         7777 On Phaeophyscia or (less commonly) Physcia. Ascospores 14 - 20 x 5 - 7 µm. _L. obscuroides_
         77 On Heppia. Ascospores 11 - 15 x 4 - 6 µm. (L. heppiae)
         7 On Teloschistaceae. (L. epimarmorata), (L. pyrenodesmiae), (L. sinapispermae)
      6 Most ascospores more than 8 µm wide. Perithecia (130) 200 - 320 x (95) 130 - 240 µm. On Teloschistaceae
         77 Asci 13 - 20 µm wide. Ascospores 8 - 11 µm wide. On terricolous crustose members of Teloschistaceae. (L. epidesertorum), (L. epifulgens)
         7 Asci 9 - 15 µm wide. Ascospores 9 - 15 µm wide. On saxicolous crustose members of Teloschistaceae and on Xanthoria. (L. wasseri), (L. xanthoriae)
5 Ascospores 12 - 21 µm long
   66 Most ascospores 4 - 8 µm wide. Perithecia 80 - 200 x 50 - 180 µm. On various hosts.
      7777 On Trapelia coarctata. Ascospores 15 - 18 x 5 - 6 µm. (L. coarctatae)
      7777 On Phaeophyscia or (less commonly) Physcia. Ascospores 14 - 20 x 5 - 7 µm. _L. obscuroides_
      77 On Heppia. Ascospores 11 - 15 x 4 - 6 µm. (L. heppiae)
      7 On Teloschistaceae. (L. epimarmorata), (L. pyrenodesmiae), (L. sinapispermae)
   6 Most ascospores more than 8 µm wide. Perithecia (130) 200 - 320 x (95) 130 - 240 µm. On Teloschistaceae
      77 Asci 13 - 20 µm wide. Ascospores 8 - 11 µm wide. On terricolous crustose members of Teloschistaceae. (L. epidesertorum), (L. epifulgens)
      7 Asci 9 - 15 µm wide. Ascospores 9 - 15 µm wide. On saxicolous crustose members of Teloschistaceae and on Xanthoria. (L. wasseri), (L. xanthoriae)
   1 Mature ascospores mostly 3- or more -septate. On Fuscopannaria or Squamarina.
   22 Asci with 2 ascospores. On Fuscopannaria mediterranea. (L. mediterraneae)
   2 Asci with (4) 8 ascospores. On Squamarina. _L. clauzadei_

Lichenochora clauzadei Nav.-Ros., Cl. Roux & Llimona (1994)


Corfu, on a species of _Squamarina_ at an altitude of 100 m.

Only southern France, Spain and Greece.
Lichenochora constrictella (Müll. Arg.) Hafellner (1989)


Eastern Crete, on a species of *Caloplaca*, perhaps *C. subbracteata*, at close to sea level.
Scattered, from Norway to Crete. Also Asia (Russia), N. America (Nebraska).

Lichenochora obscuroides (Linds.) Triebel & Rambold (1992)


Chios, on *Phaeophyscia orbicularis* at an altitude of 450 m, and Epiros on *Phaeophyscia ciliata* at 665 m..

Probably throughout Europe, except for arctic regions. Also Asia (Ural Mts.), N America (widespread), C America (Mexico).


Forms a small gall on host thallus, about 1 x 0.8 mm, brown, convex. Perithecia: 0.05 mm diameter, black; in section: 100% immersed, pyriform, 120 µm tall x 80 µm wide. Exciple: pale brown in lower part, brown in upper part, of hyphae parallel to outer margin of perithecium, a few long, thin lumina sometimes visible. Paraphyses: present but inconspicuous, 1 µm wide or less. Asci: cylindrical, 45 - 57 x 7.5 µm. Ascospores: colourless, 1-septate, ellipsoid but often constricted at septum, 12.5 - 13 x 7 µm, 8 per ascus, uniseriate in ascus, sometimes adhering in groups of 2 - 4 after discharge,

SE Peloponnese, on *Physconia distorta* at an altitude of 900 m.
Widespread in Europe, from arctic to Mediterranean regions. Also Macaronesia, Asia (Russia), N. Africa (Morocco), N. America (Canada), S. America (southern Chile).

Lichenoconium Petr.& Syd. (1927)
Family: *Lichenoconiaceae*.

Literature: The genus was monographed in Hawksworth (1981b). There is an updated key, including species described after 1981, in Cole & Hawksworth (2004).

About 15 species of lichenicolous coelomycetes, of which at least 11 occur in Europe. Although some are common and widespread, there is only a single Greek report and it is more than 50 years old.

11 Pycnidia mostly more than 100 µm diameter.
22 Conidia 2.5 - 3.5 x 2 - 3 µm, almost smooth. On Cladonia. (L. pyxidatae)
2 Conidia mostly more then 4 µm long, distinctly spinulose or warted. On various hosts.
33 Conidia mainly ellipsoid to ampulliform, gradually tapering. On Lobaria pulmonaria or Physcia aipolia.
44 Conidia 10.5 - 13.5 x 6.5 - 8 µm. On Lobaria pulmonaria. (L. follmannii)
4 Conidia 6 - 8 x 3 -4 µm. On Physcia aipolia. (L. lichenicola)
3 Conidia subglobose to pyriform, not gradually tapering, base sometimes abruptly truncated. On various hosts.
44 Conidia 5 - 7 x 3.5 - 5.5 µm. On various hosts, especially Ramalina and Parmeliaceae. (L. cargillianum)
4 Conidia 3 - 4.5 µm diameter. On various hosts, especially in Parmeliaceae, Physciaceae and Teloschistaceae, but most commonly on Xanthoria polycarpa. (L. xanthoriae)

1 Pycnidia mostly less than 80 µm diameter.
22 Conidia 2 - 3.5 µm diameter. (L. erodens)
2 Conidia mostly more than 3.5 µm diameter.
33 Conidiogenous cells 5 - 7 µm tall. On a wide range of hosts. *L. lecanorae*
3 Conidiogenous cells 7 - 11 µm tall.
44 Conidia 8 - 11 x 5 - 7 µm. On Ramalina fraxinea. (L. reichlingii)
4 Conidia 3 - 4.5 µm diameter, warted. On a wide range of hosts. (L. usneae)
Lichenconium lecanorae (Jaap) D. Hawksw. (1979)


Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004).

Evia, on Caloplaca pyracea, at an altitude of about 200 m.

Widespread in Europe. Also Macaronesia, Asia (widespread), N. America (widespread), perhaps C. America (Mexico), S. America (Chile, Bolivia), Antarctica (S. Shetland Is).

Lichenodiplis Dyko & D. Hawksw. (1979)


Literature: Clauzade, Diederich & Roux (1989); Hawksworth (1981b).

Lichenodiplis contains 13 species of lichenicolous coelomycetes, most of which are either uncommon or of rather restricted distribution, so far as present knowledge goes. Five are reported for Europe. By far the commonest and most widely distributed is L. lecanorae, the only species that is reported for Greece.

11 Conidia more than 9 µm long. If present in Greece, then probably montane. (L. lichenicola)

1 Conidia less than 8 µm long. Not restricted to mountains.

22 Conidia 1-septate. L. lecanorae

2 Conidia simple.

33 Pycnidia 40 - 60 µm diameter. On Opegrapha. (L. opegraphae)

3 Pycnidia 100 - 250 µm diameter. Usually on Pertusaria, occasionally on other hosts. L. pertusariicola

Lichenodiplis lecanorae (Vouaux) Dyko & D. Hawksw. (1979)


Pycnidia: black, 0.05 - 0.1 mm diameter, in apothecia of host; in section: 50 - 100% immersed, 60 - 110 µm tall, 30 - 90 µm wide, subglobose, ellipsoid or slightly pyriform, colourless to pale brown. Conidia: pale brown, 1-septate, ±ellipsoid, sometimes slightly constricted at septum, sometimes with slightly truncated base, 5 - 7 x 2 - 4 µm, arising singly (not in chains).

Easily recognised by the small, 1-septate conidia.

Scattered, with no clear pattern. Most reports to date are from the Peloponnese. At altitudes 100 - 1400 m. Most reports are from Caloplaca s. lat. (C. cerinella, C. cerinelloides, C. haematites, C. pyracea), but reported once from Lecanora hagenii.

Throughout Europe. Also Macaronesia, Asia (Turkey, Russia, Kashmir), N. Africa (Morocco), N. America (Nova Scotia), Pacific (New Caledonia).

Lichenodiplis pertusariicola (Nyl.) Diederich (2003)


Description: Clauzade, Diederich & Roux (1989) as Laeviomyces pertusariicola.

Skyros, on an undetermined species of Pertusaria at an altitude of 430 m. Probably throughout Europe, to at least as far north as Scotland. Also Macaronesia, N. Africa (Morocco), N. America (Nova Scotia), Pacific (New Caledonia).

Lichenomphalia Redhead et al. (2002)

Mycotaxon 83: 36. Type: L. hudsoniana (Jennings) Redhead et al.. Family: Tricholomataceae.

Literature: Barrasa & Rico (2001) discuss all the species that are likely to occur in Greece, under the name Omphalina.

About 10 species of lichenised basidiomycetes, 7 of which occur in Europe. All have rather northerly distributions. Except for L. hudsoniana, which has a lichenised thallus that "looks like a lichen", they are easily overlooked by lichenologists.

11 Lichenised thallus of green squamules, somewhat resembling a typical lichen. (L. hudsoniana)

1 Lichenised thallus of dark green, gelatinous globules, not at all resembling a typical lichen.
22 Hyphae in cortex of top part of mushroom with indistinct, intracellular pigment. Basidia 45 - 60 x 9 - 13 µm. Basidiospores subglobose to broadly ellipsoid, 8 - 10 x 6 - 7.5 µm. (L. umbellifera) Greek reports doubtful.

2 Hyphae in cortex of top part of mushroom with more distinct, external pigment. Basidia 16 - 30 x 4 - 7 µm. Basidiospores cylindrical or pyriform.

33 Mushroom grey-brown. Basidiospores pyriform. External pigment of cortical hyphae sometimes forming distinct stripes. (L. velutina)

3 Mushroom brown or orange, without a grey tinge. Basidiospores cylindrical. External pigment not forming stripes. **L. meridionalis**


Description: Rico & Barrasa (2011).

Skyros, on soil at an altitude of 300 m.

Only southern Europe, from Spain to Greece.

**Lichenostigma Hafellner** (1983)

*Herzogia* 6: 301. Type: L. maureri Hafellner. Family: *Phaeococcomycetaceae.*

Literature: Information is scanty and scattered. Helpful are: Calatayud & Barreno (2003), Ihlen (2004), Kocourková (2000). For several recently described species it is necessary to study the protologue.

*Lichenostigma* has 32 species, of which 18 are reported for Europe. There are few Greek records.

11 Ascomata absent. Conidiomata black, convex. **L. maureri**

1 Ascomata present.

22 Ascospores predominantly 3-septate. On Aspicilia. (L. triseptatum)

2 Ascospores 1-septate. On various hosts.

33 Ascomata cushion-like; if ascomata connected to hyphal strands then strands immersed in host. Subgenus Lichenostigma.

44 Hyphal strands absent or rare.

55 Mature ascospores with deep irregular fissures forming a rough areolate pattern. On Diploschistes. (Lichenothelia rugosa)

5 Mature ascospores finely ornamented. On many genera of ± fruticose lichens. **L. maureri**

4 Hyphal strands common; extending downwards from ascomata and mostly immersed within host. 555 On Pertusaria pertusa. (L. epiirupstre)

55 On vagrant Aspicilia species. (L. radicans)

5 On brown species of Acarospora. (L. anatolicum)

3 Ascomata globose or elongated, connected to black, simple or multi-hyphal vegetative strands growing superficially on host. Subgenus Lichenogramma.

44 Vegetative strands mostly formed by a single row of cells. Apothecia subglobose or very slightly elongated.

55 Mature ascospores brown (immature ones may be colourless).

66 Macroconidia present on hyphal strands. Ascospores 9 - 10 x 4.5 - 5 µm. On Lecanora sulphurella. (L. episulphurellum)

6 Macroconidia not present on hyphal strands. Most ascospores slightly more than 10 µm long. On other hosts.

77 On Lobothallia. Ascospores 10 - 11 x 6.6 - 6 µm. (L. iranicum)

7 On Diplotomma. Ascospores 10 - 12 x 5.5 - 7 µm. (L. epiplinum)

5 Mature ascospores mostly colourless.

66 Vegetative hyphae sunken in fissures of host thallus. On Buellia epigaea and related species. (L. semimmersum)

6 Vegetative hyphae superficial. On Xanthoparmelia. (L. cosmopolites)

4 Vegetative strands formed of several hyphae. Apothecia irregularly rounded to elongated.

55 Vegetative strands clearly radiating, at least when young.

666 On Acarospora. Ascospores 1-septate. (L. gracile)

66 On Pertusaria rupicola. Ascospores 1 - 2 (3) -septate. (L. rupicolae)

6 On Diploicia. Ascospores submuriform. (L. diploiciae)

5 Vegetative strands not radiating.
666 On Aspicilia or Lobothallia. Ascospores 1-septate. **L. elongatum**

66 On Acarospora cervina. Ascospores 1 - 2-septate. (L. svandae)

6 On Squamarina. Ascospores 1 - 3-septate. **L. rouxii**

**Lichenostigma elongatum** Nav.-Ros. & Hafellner (1996)
*Mycotaxon* 57: 213-223, as *elongata*.

Description: Nash et al. (2004), or see the protologue.

Crete, at altitudes 0 - 500 m. The hosts were reported as *Lobothallia radiosa* and *Aspicilia sp.*

Widespread in Europe to as far north as England. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Tunisia), N. America (fairly widespread in USA), C. America (Mexico), Australasia (NSW).

**Lichenostigma maureiri** Hafellner (1982)
*Herzogia* 6: 301.

Description: Clauzade, Diederich & Roux (1989); Nash et al. (2004).

Epiros, on *Pseudevernia furfuracea* at an altitude of 970 m.

Probably throughout Europe. Also Macaronesia, Asia (Turkey, Iran, Russia, Georgia), perhaps Malesia (PNG), N. America (widespread), C. America (CR), S. America (widespread), Australasia (ACT), Antarctica.

**Lichenostigma rouxii** Nav.-Ros., Calatayud & Hafellner (2002)

Description: See the protologue.

Very scattered, with no clear pattern. On *Squamarina cartilaginea* at altitudes 10 - 300 m.

Southern and south-central Europe. Also western Asia (Turkey).

**Lichina** C. Agardh (1817)

Syn. Alg. Scand. 9. The name is conserved against *Pygmaea* Stackh. Type: *L. pygmaea* (Lightf.) C. Agardh, listed in Appendix of the ICN. Family: *Lichinaceae*.

Literature: There is no monograph, but the two European species are adequately discussed in all the standard Floras.

Ten species, only 2 of which occur in Europe. One is distinctly Atlantic and will not occur in Greece.

**Lichina confinis** (O. F. Müll.) C. Agardh (1820)

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).

Crete, on siliceous rock at altitudes 35 - 40 m.

Present on most of the coast of Europe where there are hard, siliceous rocks, but probably less common in the Mediterranean than on cold Atlantic coasts. Also Macaronesia, western Asia (Turkey), N. America (Newfoundland, Nova Scotia, Massachusetts), S. America (Chile). Reports for Australasia are incorrect. The status of reports for Pacific is unclear.

**Lichina stipatula** Nyl., the only species originally included. Family: *Lichinaceae*.

Literature: Information is scanty. Clauzade & Roux (1985) treat all species included in the key below, but mostly under different names and/or in different genera. Nash et al. (2007), and Wasser & Nevo (2005) are also helpful.

About 20 species, in warm, dry habitats, though the status of some is unclear. Eight are known for Europe. Four have been reported for Greece, but there are few records. Some species have a broad range, but none are common.

The key should be used with caution, and parts may be unsatisfactory, as I have little information on some species.

1111 Thallus foliose.

22 Thallus umbilicate-foliose. Lobes more than 5 mm wide.

33 Ascii with 8 ascospores. Tiny isidia present. See **Thallinocarpon nigrilellum**

33 Ascii with 12 - 24 ascospores. Ascospores 7 - 9 µm long. Lobes of thallus not pruinose. **L. cribellifera**

3 Ascii with at least 30 ascospores. Ascospores 5 - 6 µm long. Lobes of thallus with bluish pruina. (L. heppii)

2 Thallus not umbilicate, rosette-forming or cushion-forming.

33 Lobes 2 - 5 mm wide. **L. iodopulchra**
3 Lobes 0.6 - 1.8 mm wide. (L. inflata)
111 Thallus squamulose or subfruticose.
   22 Thallus of medium sized squamules, 5 - 5 mm wide. L. iodopulchra
   2 Thallus of small squamules or sub-fruticose.
   33 Thallus to 4 mm diameter, squamulose or divided in upright lobules. Lobules to 2.5 mm tall. (L. algerica)
   3 Thallus to 1.5 cm diameter, of plate-like squamules or subfruticose. Lobules 2 - 6 mm tall. L. sinaica
11 Thallus of small granules or areoles. (L. myriospora)
   1 Thallus minutely fruticose.
   2 Ascospores ellipsoid, 5.5 - 7.5 x 2.5 µm. L. stipatula
   2 Ascospores subglobose, 4 - 5 µm diameter. (L. robusta)

Lichinella cribellifera (Nyl.) P. Moreno & Egea (1992)
Cryptog., Bryol.-Lich. 13(3): 243; Omphalaria cribellifera Nyl. (1884), Flora 67: 387-388; Gonohymenia cribellifera (Nyl.) Henssen; Rechingeria cribellifera var. kastrensis Servit.
   Islands of the Aegean, including Crete, on siliceous rock at altitudes 20 - 490 m.
   Mainly southern Europe, from Portugal to Greece; just reaching south-central Europe. Also Macaronesia, western Asia (widespread as far east as Oman), northern Africa (Morocco, Algeria, Socotra), N. America (widespread in USA), C. America (Mexico).

Lichinella iodopulchra (Croz.) P. Moreno & Egea (1992)
   Descriptions: Nash et al. (2007).
   Crete and Iraklia, plus a slightly tentative report for Thrace, on calcareous rock at altitudes 0 - 300 m.
   Widespread in southern Europe. Also Macaronesia, western Asia (widespread as far east as Iran), northern Africa (Morocco, Socotra), N. America (Arizona, perhaps elsewhere), C. America (Mexico).

Lichinella sinaica (Galun & Marton) P. Moreno & Egea (1992)
   Description: Nash et al. (2007).
   Crete, on limestone close to sea level.
   SE Spain and Greece. Also SW Asia (widespread as far east as Oman), N. Africa (Morocco, Algeria, Egypt), N. America (Arizona, Texas).

Lichinella stipatula Nyl. (1873)
Flora 56: 195 and Bull. Soc. Linn. Normandie, Sér. II, 6: 301-302. It is not known which was published first.
   Islands of the southern Aegean, including Crete, on siliceous rock at altitudes 50 - 490 m.
   Scattered in southern and central Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), Africa (widespread), N. America (widespread in western half), C. America (Mexico).

Lobaria (Schreb.) Hoffm. (1796)
   Literature: Burgaz & Martínez (2003) is best. Jørgensen, in Ahti et al. (2007) is also good. Clauzade & Roux (1985) cover all the species that are included in the key below, though only briefly. Schummm (2003) has some helpful information.
About 75 species, of which 10 occur in Europe. They are usually corticolous, but may occur on other substrates. All require fairly humid conditions.

11 Thallus coralloid fruticoso, to 1 cm tall. Blue-green morphotype (free-living cephalodia) of *L. amplissima*

1 Thallus foliose.

22 Photobiont blue-green. Soredia usually present. **L. scrobiculata**

2 Main photobiont green. Blue-green photobiont absent or confined to internal or external cephalodia. Soredia present or absent.

33 Upper surface with distinct network of ridges. Soredia present or absent. Isidia present or absent.

44 Soredia and isidia absent. Medulla K-, P-. (L. lineata) Greek reports doubtful.

4 Soredia and isidia often present, usually developing along lobe margins or ridges. Medulla K+ yellow to red, P+ yellow or orange (reactions sometimes faint). **L. pulmonaria**

3 Upper surface ±smooth, sometimes with small folds or wrinkles but without network of ridges. Soredia and isidia absent.

44 Upper surface pale green-brown when dry, without coralloid cephalodia. (L. virens) Greek report needs confirmation.

4 Upper surface pale grey-white when dry, often with dark brown coralloid cephalodia. **L. amplissima**

**L. amplissima** (Scop.) Forssell (1883)


Thallus: foliose, to 8 cm diameter. Lobes: 7 - 20 mm wide, ±rounded overall but margins strongly incised (but not lacerate or ragged), usually slightly overlapping, 450 - 530 µm thick. Upper surface: grey to blue-grey, matt, usually not pruinose, occasionally with thin white pruina near tips of lobes. Lower surface: white at margins, pale brown, brown or black near centre; tomentose at least near lobe margins. Cephalodia: sometimes present though never abundant, coralloid, like small trees, to a few mm diameter, containing cyanobacteria. Isidia: absent. Rhizines: often present but few in number, white to pale brown when young, later becoming brown, 0.5 - 1.0 x 0.1 - 0.25 mm, discrete, usually ±simple (though hyphae near apex sometimes separating giving a tufted appearance), rarely branched, in section sometimes with septate hyphae like those of the tomentum extending out horizontally. Upper cortex: 50 - 75 µm thick (including epicortex), lower half colourless, upper half pale brown, cellular, cells usually ±square to ±rectangular, 6 - 8 x 5.5 - 6 µm; cortex overlain by poorly structured epicortex, 8 - 12 µm thick. Medulla: usually 270 - 330 µm thick, sometimes thicker just above a rhizine, of loosely interwoven hyphae that are about 4 µm wide, without visible septa. Tomenatal layer: 25 - 40 µm thick, colourless to very pale brown; in section: of hyphae much more densely aggregated than in medulla; from this layer there extend numerous single hyphae or groups of conjoined hyphae to about 25 µm; these hyphae about 5 µm wide, with distinct septa about every 5 µm, and rounded lumina. Apothecia: uncommon, laminal, sessile, concave to slightly concave, not pruinose. Disc: brown, sometimes slightly shiny when young, later matt. Thalline margin: present, ±smooth, persistent; in section: about 175 µm wide; cortex 75 µm wide, distinctly cellular. Exciple: not visible externally; in section: present but not well developed, about 25 µm wide, of radiating hyphae. Epithecium: orange-brown. Hymenium: 150 µm tall, colourless. Hypothecium: 75 µm tall, colourless. Ascosporcs: colourless, clearly developing towards a septate state but distinctly septate ones not seen, 40 - 50 x 5 µm, 8 per ascus. Pycnidia: often present, laminal, in small convex warts about 0.5 - 0.7 mm diameter that are concolourous with upper surface except at the pycnidium itself, dark brown to black, 0.1 - 0.2 mm diameter; in section: 100% immersed, mostly colourless, brown near ostiole, ±globose, 730 µm tall, 660 µm wide. Conidia: colourless; usually ±rectangular, sometimes broadening at one or both ends (extreme examples can resemble a narrow triangle), 3 - 7 x 1 - 1.5 µm. Chemistry: medulla K-, C-, KC- or less commonly KC+ pink or brown-orange in thin layer at extreme base of medulla, P-; thallus K+ yellow, UV+ pale orange in short-wave UV (fluorescence often less intense after a few seconds); UV+ grey or pale orange in long-wave UV. Photobiont of cephalodia: blue-green, cells globose to subglobose, 5-8 µm diameter, with gelatinous sheath 1 µm wide, usually aggregated into clusters of 5 to many cells, not in chains. Photobiont of main thallus: green, cells globose, 6 - 11 µm diameter, usually with distinct speckly ornamentation at a scale of about 1 µm (visible at x400); photobiont later 50 - 100 µm thick, continuous, cells sometimes aggregating into clumps, upper boundary often irregular.

Differs from *L. pulmonaria* in its prominent external cephalodia, its more indented lobe margins, and in lacking isidia and ridges on upper surface of lobes.

Probably throughout Greece where there are upland forests, but not common. On bark, especially of *Abies* (one third of records), but also recorded from *Acer, Castanea* and *Quercus*. At altitudes 400 - about 1500 m, but uncommon below 800 m. Free-living cephalodia are found only rarely, in the most undisturbed habitats.
Lobaria pulmonaria (L.) Hoffm. (1796)

Deutschl. Fl. 2: 146; Lichen pulmonarius L. (1753), Sp. Pl. 1145-1146; Lobaria pulmonacea Nyl. ex Lamy; (?) Lobaria pulmonaria f. isidiosa Zahlbr.; (?) Lobaria pulmonaria var. meridionalis auct. graec.; Lobaria pulmonaria f. papillaris (Delise) Hue; Lobaria pulmonaria f. sorediata (Schae.) Zahlbr.; Sticta pulmonacea Ach.; Sticta pulmonacea var. papillaris Delise; Sticta pulmonaria (L.) Hook.; Sticta pulmonaria var. hypomela (Delise) Schae.; (?) Sticta pulmonaria f. isidiosa (Zahlbr.) Szatala; Sticta pulmonaria var. papillaris (Delise) J. Steiner; Sticta pulmonaria f. sorediata Schae.

Lobaria pulmonaria var. meridionalis (Vain.) Zahlbr. was described from the Philippines, as Lobaria meridionalis Vain., and is probably not a European taxon. Macaronesian collections that had been referred to that name were recently described as the new species L. macaronesica, but that probably does not occur in Greece. Greek collections reported under the name L. pulmonaria var. meridionalis are probably just morphs of L. pulmonaria.

Thallus: foliose, to 18 x 9 cm. Lobes: to about 10 cm long, usually 10 - 20 mm wide, 250 - 300 µm thick, sometimes dividing dichotomously, with prominent, reticulate network of ridges. Lobe margins: smooth to ± wavy, but not incised. Upper surface: green-grey. Lower surface: white to pale brown at margins and in central parts on the raised areas corresponding to depressions between ridges on upper surface, elsewhere pale brown to dark brown, tomentose except on raised areas. Isidia: usually abundant in mature thalli, often absent in young ones, green-grey in lower part, brown at tip, usually laminar and confined to ridges, sometimes marginal, rarely in depressions between ridges, cylindrical, 0.3 - 0.5 x 0.1 mm, usually simple, very rarely branched, often crowded. Rhizines: often absent; if present then sparse and usually only near tips of lobes; immature rhizines white, resembling outgrowths of tomentum, squarrose, 0.3 x 0.1 mm; mature rhizines dark brown to black, simple or with just a few white squarrose extensions near base, 0.5 x 0.1 mm. Upper cortex: 22 - 35 µm thick (including ep cortex), colourless in lower part, pale brown in upper part, ± cellular, cells 5 x 2.5 - 3 µm thick walls and rounded lumina, K-; cortex over lain by poorly structured ep cortex, 5 µm thick. Medulla: white, 150 - 160 µm thick, of loosely interwoven hyphae 2.5 - 3.5 µm wide, without visible septa. Tomental layer: 25 µm thick, pale brown, of tangled hyphae; hairs, usually formed of several conglutinated hyphae, extend about 80 - 120 µm outwards from tomental layer. Apothecia: rare, laminal, often on ridges, sessile, 0.5 - 0.8 mm diameter. Thalline margin: present. Exciele: not visible externally. Chemistry: medulla K+ yellow > orange-yellow (reaction often faint), C-, P+ faintly orange, I-; thallus K-, C-, KC-, P-, UV+ faintly dull white. Photobiont: green; cells globose, 8 - 10 µm diameter; photobiont layer 35 - 50 µm thick, continuous, with rather irregular lower boundary.

Schumm (2003) distinguished f. papillaris, with few or no soralia and (when mature) abundant longish isidia, from f. pulmonaria, with abundant soralia mixed with short isidia. Greek collections I have seen correspond to f. papillaris.

Throughout Greece, except for low-lying islands. Probably commonest in little-disturbed upland forests that are not dominated by Pinus. On bark of a wide range of phorophytes, with some preference for Abies (35% of records). Sometimes on bryophytes on bark. At altitudes from 20 to at least 1800 m, but rare below 400 m. The lichenicolous fungus Plectocarpon lichenum has been recorded once from this species. Several lichens that are not normally parasitic have been recorded "on" L. pulmonaria in Greece, but were probably merely overgrowing it.

Almost throughout Europe, but in the south restricted to upland areas. Also Macaronesia, Asia (widespread), Malesia (PNG, Philippines), Africa (widespread), N. America (widespread), C. America (Mexico, Panama, perhaps CR). Reports for S. America are doubtful and those for Australia are incorrect.

Lobaria scrobiculata (Scop.) DC. (1805)


Thallus: foliose, to 10 cm diameters. Lobes: rounded to slightly elongate, 10 - 25 mm wide, often with distinct folds, margins wavy. Upper surface: grey to yellow-green, matt. Lower surface: white, but in central parts of lobes often hidden below thick cover of brown tomentum; tomentum white to pale brown and fine at lobe margins, denser and browner towards centre of lobes, in central parts often completely absent in numerous small, ± circular patches where white lower surface is clearly exposed. Cephalodia: absent. Isidia: absent. Rhizines: usually absent; occasionally developing from tomentum. Soralia: usually present, grey to dark brown, convex, laminal and marginal; laminal ones discrete, circular or slightly elliptical, 0.6 - 1 mm diameter, often most abundant near tips of lobes; marginal ones strongly elliptical, soon becoming confluent; soredia granular. Upper cortex: 40 - 50 µm thick, colourless, cellular; cells subrounded, 6 - 10 µm diameter. Medulla: white, 110 - 140 µm thick, of loosely interwoven hyphae 2.5 - 3.5 µm wide without visible septa. Tomentum layer: 30 - 35 µm thick, colourless to pale orange-brown. Chemistry: medulla K+ yellow, C-, P+ brown-orange (reaction sometimes faint, some specimens appearing P-); thallus UV+ pale greenish.
Photobiont: blue-green, cells not in chains; in a continuous layer 50 - 60 µm thick, sometimes rather irregular as cells tend to form clumps.

Differs from *L. pulmonaria* in having a blue-green photobiont and (usually) well-developed soralia, and in lacking a distinct network of ridges on the upper surface (though folds may be present).

Throughout Greece, except for low-lying islands, but rarer than *L. pulmonaria*. Usually found in small, particularly favourable localities within the least disturbed upland forests, often together with other demanding species such as *L. amplusima* and *Peltigera collina*. On bark, or overgrowing bryophytes on bark or rock, at altitudes 400 - 1800 m. The lichenicolous fungi *Nectriopsis lecanodes* and *Plectocarpon scrobiculatae* have been reported from this host in Epiros.

Mainly oceanic parts of Europe, but occasional elsewhere. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, Kenya, S. Africa), N. America (widespread), perhaps S. America (Argentina), Australasia (SE Australia, NZN, NZS).

### Lobothallia (Clauzade & Cl. Roux) Hafellner (1991)


Literature: Clauzade & Roux (1985) treat most of the species, under *Aspicilia*. There are more detailed descriptions of some in Nash et al. (2004).

Differs from *Aspicilia* in its generally better developed thallus, sometimes with a lobed margin, and its preference for calcareous substrates. *Lobothallia* has about 17 species, of which 9 are reported for Europe. They generally prefer warm, dry regions. The genus is well represented in Greece.

In this genus, all reactions with K are best observed in thin section under the transmission microscope.

11 Thallus with distinct marginal lobes.

222 Medulla K+ yellow or orange (stictic acid). Sometimes parasitic. *L. radiosa* (stictic acid chemotype).

22 Thallus and/or medulla K+ yellow > red (norstictic acid) (Note 1); P+ yellow. On dry rock, not parasitic.

33 Marginal lobes overlapping, sometimes not very firmly attached to substrate. On siliceous rock.

44 Marginal lobes flat to moderately convex, not easily detached from substrate. Thallus usually some shade of brown when fresh. *L. praeradiosa*

4 Marginal lobes strongly convex, easily separated from substrate. Thallus usually some shade of grey when fresh (occasionally brown and sometimes developing a brown tinge in herbarium). *L. alphoplaca*

3 Marginal lobes not overlapping, firmly attached to substrate. Usually on calcareous or base-rich rock. *L. radiosa*

2 Thallus and medulla K-, P-. On rock, not parasitic.

33 On permanently wet, non-calcareous rock. If present in Greece, probably restricted to high mountains. (*L. melanaspis*)

3 On dry calcareous rock. Not restricted to high mountains. *L. radiosa*

1 Marginal lobes absent or indistinct.

22 On siliceous rock. Thallus grey. If present in Greece, then probably restricted to high altitudes. (*L. reedens*)

2 On calcareous rock. Thallus white or greyish. Not restricted to high altitude.

333 Thallus continuous to slightly cracked, to 1.5 mm thick, with papillae. Apothecia remaining immersed, 0.2 - 0.8 mm diameter, separated from thallus by thin crack. Thallus, exciple and hypothecium K-. Terpenes absent (Note 2). Cortex 30 - 90 µm thick. *L. chadefaudiana*

33 Thallus cracked to areolate, to 0.5 mm thick, with papillae or wrinkles; areoles with granular appearance. Apothecia eventually becoming asessile, 1 - 1.5 mm diameter. Thallus K-; exciple and hypothecium K+ red (norstictic acid). Terpenes present (Note 2). (*L. cernohorskyana*) Not confirmed for Greece.

3 Thallus 2cracked or areolate, at least in central part, without papillae or wrinkles; upper surface smooth or farinose. Other characters various.

44 Terpenes present (Note 2). Algal cells not forming a well-defined, continuous layer below apothecia (scattered groups of cells may be present). Thallus K+ red (norstictic acid, stictic acid or both) or K-. Cortex 10 - 50 µm thick. *L. controversa*

4 Terpenes absent (Note 2). Algal cells forming a well-defined layer below apothecia. Thallus K- or K+.

55 Thallus continuous or occasionally slightly cracked, chalk-white; surface slightly farinose. *L. farinosa*

5 Thallus with definite cracks, or areolate, white to grey; surface not farinose. *L. cheresina* s. lat.

666 Thallus K+ yellow > blood red (norstictic acid only). *L. cheresina var. microspora*

66 Thallus K+ yellow > red-brown (stictic acid; sometimes also a little norstictic acid). *L. cheresina var. justii*
6 Thallus K-.  **L. cheresina var. cheresina**

(1) The reaction tends to be restricted to upper part of the medulla and/or to hyphae in algal layer. It may be patchy, and absent in some sections. Sometimes K produces only minute red granules, not needle-like crystals; I do not know whether this is some other substance or just norstictic acid in low concentration.

(2) Chromatography required.

**Lobothallia alphonplaca** (Wahlenb. ex Ach.) Hafellner (1991)  

Thallus: placioid, areolate in central parts, 2 cm diameter, grey, not pruinose, 600 - 1200 µm thick. Areoles: flat, angular, 0.5 - 1.5 mm wide. Marginal lobes: very convex, 3 - 4.5 x 0.8 - 1.5 mm, occasionally overlapping, not or weakly adpressed. Cortex: 20 - 35 µm thick, colourless to pale brown, K-, cellular; cells subrounded, 5 - 7 µm diameter. Medulla: white. Apothecia: subsessile, flat, 1 - 1.5 mm diameter, not pruinose. Disc: very dark brown to black, slightly shiny. Thalline margin: prominent, persistent, 0.1 mm wide. Exciple: not visible externally, scarcely distinguishable in section. Epithecium: green with a little brown pigment, K- green pigment mostly soluble in K, N+ dull green. Hymenium: 70 µm tall, mostly colourless, some green pigment in uppermost part. Hypotheicum: 50 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, 5 µm tall, colourless. Medulla: white. Apothecia: immersed, flat, initially punctiform, later 0.5 - 0.7 mm diameter and often slightly irregular. Disc: black, usually slightly white pruinose. Thalline margin: not developed. Exciple: not visible externally; in section: poorly developed, 0 - 20 µm wide. Epithecium: green to orange-brown, K- some green pigment dissolves, N+ bright blue-green. Hymenium: 80 µm tall, colourless, Ki+ blue. Hypotheicum: 100 - 150 µm tall, colourless. Paraphyses: 1.5 µm wide at base, 4 - 6 µm tall, colourless to pale brown, K-, colourless. Areoles: flat, irregular, discontinuous, cells often in clumps or vertical bands. Chemistry: medulla K-, C-, KC-, UV-. Photobiont: green, present below apothecia but only as a few small clumps of cells; cells globose, 9 - 12 µm diameter. Photobiont layer: 70 - 150 µm thick, irregular, discontinuous; cells forming large clumps separated by bands of vertical hyphae.

Easily separated from *L. radiosa* by the siliceous substrate and the very convex marginal lobes that are not adpressed.

NE Peloponnesse, on siliceous rock at an altitude of 1750 m. A report from Attica on calcareous rock at 1400 m may not be reliable, as that is not the usual substrate. A 19th Century report for the Cyclades (unlocalised) may also be unreliable.

Present in most of Europe, though south of the Alps restricted to the mountains. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread, mainly in western half), C. America (Mexico), perhaps S. America (Argentina, Chile), Australasia (southern Australia, NZS).

**Lobothallia chadefaudiana** (Cl. Roux) A. Nordin, Cl. Roux & Sohrabi (2012)


Thallus: crustose, areolate, white to pale grey, 3 cm diameter (in only collection seen), 600 - 800 µm thick. Areoles: contiguous, 0.8 - 2 mm diameter, subrounded to subangular, flat to slightly convex; upper surface ± smooth when young, later becoming rough and irregular on a scale of 0.05 - 0.1 mm, sometimes developing angular papillae on the same scale. Prothallus: intermittently present, pale blue-grey, to 0.5 mm wide. Cortex: 40 - 70 µm thick, pale grey, K- Medulla: white. Apothecia: immersed, flat, initially punctiform, later 0.5 - 0.7 mm diameter and often slightly irregular. Disc: black, usually slightly white pruinose. Thalline margin: not developed. Exciple: not visible externally; in section: poorly developed, 0 - 20 µm wide. Epithecium: green to orange-brown, K- (some green pigment dissolves), N+ bright blue-green. Hymenium: 80 µm tall, colourless, Ki+ blue. Hypotheicum: 100 - 150 µm tall, colourless. Paraphyses: 1.5 µm wide at base, 4 - 6 µm tall, colourless to pale brown, K-, C-, KC-, UV-. Photobiont: green, not present below apothecia; cells globose, 6 - 12 µm diameter. Photobiont layer: 60 - 125 µm thick, irregular, discontinuous, cells often in clumps or vertical bands.

The small ascosporas, absence of photobiont cells below the apothecia and the calcareous substrate are diagnostic, but most easily recognised by the small-scale roughness of the upper surface and the rather large, subrounded, slightly convex areoles.

NE Peloponnesse. On limestone at an altitude of 60 m.

Known only from the Iberian Peninsula, France, Austria, Yugoslavia and Greece.

**Lobothallia cheresina** (Müll. Arg.) Nordin, Cl. Roux & Sohrabi (2012) var. cheresina (or no variety specified)  

Abbott (2009) referred several Peloponnesian collections here, but those collections either belong elsewhere or can not be referred to *L. cheresina* with certainty.
Description: Clauzade & Roux (1985) as Aspicilia cheresina. Scattered throughout Greece, on limestone at altitudes 100 - 1400 m. Scattered in Southern Europe. Also Asia (Turkey, Iran, Tibet, perhaps elsewhere), N. Africa (Morocco, Algeria, Egypt).

**Lobothallia cheresina var. justii (Servit) ined.**

*Lecanora justii* Servit (1935), *Feddes Rep.* 38: 441-444; *Aspicilia cheresina var. justii* (Servit) Clauzade & Cl. Roux. Description: Clauzade & Roux (1985) as *Aspicilia cheresina var. justii*. Scattered, with no clear pattern. On rock, usually calcareous, or overgrowing other lichens (*Acarospora* or *Aspicilia s. lat. spp.*) at altitudes 0 - 1000 m. Scattered in southern Europe. Also western Asia (Turkey).

**Lobothallia cheresina var. microspora (Arnold) ined.**

*Aspicilia calcarea var. microspora* Arnold (1870), *Verh. k. k. zoool.-bot. Ges. Wien* 20: 450; *Aspicilia cheresina var. microspora* (Arnold) Clauzade & Cl. Roux; *Aspicilia microspora* (Arnold) Glow.; (?) *Aspicilia platycarpa var. tincta* (J. Steiner) Szatala; *Lecanora microspora* (Arnold) Zahlbr.; (?) *Lecanora platycarpa var. tincta* J. Steiner. Description: Clauzade & Roux (1985) as *Aspicilia cheresina var. microspora*, or see the protologue. Scattered, with no clear pattern, but usually not very far inland. Usually on calcareous rock, sometimes overgrowing (?parasitic on) *Aspicilia calcarea*. At altitudes 100 - 2300 m. Widespread in south and south-central Europe. Also Asia (Turkey, Israel, Iran, Afghanistan), N. Africa (Morocco, Algeria).


Thallus: crustose, without marginal lobes, white, areolate, 1 cm diameter (in the only collection seen), 0.5 mm thick, without vegetative propagules. Areoles: contiguous, 1.5 - 2.5 mm wide, flat except near apothecia, angular to subrounded. Cortex: true cortex absent; pseudocortex: 25 - 50 µm thick, colourless, without distinct structure. Medulla: white. Apothecia: immersed in areoles, 1 - 3 per areole, 0.3 - 0.75 mm diameter, flat. Disc: black, sometimes white pruinose. Thalline margin: present, raised above level of thallus. Exciple: not visible externally; in section: not well developed, 20 - 25 µm wide, mostly colourless, brown at top, of vertical hyphae. Epithecium: brown, K-, some pigment soluble in K. Hymenium: 70 µm tall, colourless to very pale brown, K+ blue. Hypothecium: 60 µm tall, colourless to very pale brown. Paraphyses: sometimes anastomosed, 1.5 µm wide at base, 3 - 3.5 µm at apex, often moniliform. Ascii: 54 - 56 x 15 - 20 µm, narrowly clavate to clavate, KI- or almost. Ascospores: colourless, simple, ellipsoid, 12 - 13 x 7.5 - 10 µm, 8 per ascus. Chemistry: medulla K+ red (abundant norstictic acid), P+ orange. Photobiont: green, cells usually globose, occasionally broadly ellipsoid, 9 - 12 µm diameter, not present below apothecia, tending to form clumps. Photobiont layer: 15 - 75 µm thick, ±regular but discontinuous.

Island of Alonisos, on limestone at an altitude of 100 m. Southern Europe, from France to Greece. Also Asia (Russia), N. Africa (Algeria).


The basionym appears to be *U. contorta var. farinosa*, not *U. calcarea var. farinosa* as stated in the conservation proposal by Nordin & Roux (2009), though Flörke's text is not clear. Description: Clauzade & Roux (1985) as *Aspicilia farinosa*. Throughout Greece, but usually not very far from the sea. On calcareous rock at altitudes 0 - 2300 m. Widespread in south and south-central Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria, Egypt).

**Lobothallia praeradiosa** (Nyl.) Hafellner (1991)


Descriptions: Clauzade & Roux (1985) as *Aspicilia praeradiosa*; Nash et al. (2004). Rare in NW Greece, on non-calcareous rock at altitudes 1100 - 1740 m. Mainly central Europe, though recorded for Norway. South of the Alps rare and restricted to the mountains. Also Asia (widespread to as far east as Mongolia), N. Africa, N. America (widespread in western half), C. America (Mexico),
Lobothallia radios a (Hoffm.) Hafellner (1991)

Acta Bot. Malacit. 16(1): 138; Lichen radi osus Hoffm. (1784), Enum. Lich. 62; Aspicilia parasitica de Lesd.; Aspicilia radios a (Hoffm.) Poelt & Leue kert; Aspicilia subcercin a (NyI.) Coppins; Lecanora cercin a (Pers.) Ach.; Lecanora cercin a var. rauca J. Steiner; Lecanora radios a (Hoffm.) Rabenh.; Lecanora radios a a (= var.) cercin a (Pers.) Rabenh.; (? ) Lecanora radios a γ (= var.) psoralis (Ach.) Schaer.; Lecanora subcercin a Nyl.; (? ) Lecanora subcercin a f. melanaspis auct. graec.; (? ) Lecanora subcercin a var. myrhin a J. Steiner; (? ) Lecanora subcercin a var. psoralis (Ach.) J. Steiner; Placodium circin a t um (Pers.) Gray; Placodium circin a t um f (= var.) myrhin a (Ach.) Kör b.; Placodium radios a f. myrhin a (Ach.) Arnold; Placodium subcercin a (Nyl.) Glow.; Squamaria radios a (Hoffm.) Poetsch; (? ) Squamaria radios a var. albo pul verulenta (Bagl. & Car.) Sztala; Squamaria radios a var. ocell a ta (Bagl. & Car.) Sztala; Squamaria subcercin a (Nyl.) H. Olivier; Squamaria subcercin a var. myrhin a (Ach.) Sztala; (? ) Squamaria subcercin a f. subfarin o sa H. Olivier, nom. inval.; Squamaria subcercin a (Nyl.) Kiff er.

Thallus: well developed, placodioid, central parts areolate, to 6 cm diameter, usually grey to dark grey when fresh (rarely with brown tinge), sometimes becoming brown in herbarium, usually not pruinose, tips of marginal lobes sometimes slightly white pruinose, 350 - 700 µm thick. Marginal lobes: usually flat, occasionally slightly convex, adpressed, not overlapping, 2.5 - 4 x 0.3 - 1 (1.5) mm. Areoles: ± flat, angular, 0.3 - 0.9 mm wide. Prothallus: rarely present, 0.1 mm wide, blue-black. Cortex: 15 - 30 µm thick, colourless to pale brown, cellular, brown pigment K-; rarely overlain by a colourless, structureless epinecral layer 2 - 5 µm thick. Medulla: white. Apothecia: immersed to subsessile, usually flat, rarely slightly convex, 0.35 - 1.7 mm diameter, not pruinose. Disc: usually black, sometimes very dark brown. Thalline margin: present at least in mature, subsessile apothecia, persistent; in section: about 125 µm wide. Exciple: usually not visible externally; in section: not well developed, 0 - 25 µm wide, scarcely distinguishable from hymenium in structure, but recognisable when present by its continuity with hypothecium. Epithecium: usually brown, K-, N-, pigment not soluble in K or N; small amounts of Aspicilia green occasionally also present, N+ dull green. Hymenium: 50 - 120 µm tall, colourless, K+ blue. Hypothecium: 50 - 120 µm tall, colourless. Paraphyses: usually simple, rarely branched, 1.5 µm wide at base, 3 µm at apex. moniliform, septa visible septa. Asci: 55 - 70 x 16 - 22 µm, clavate, K- Ascospores: often absent or immature; when mature: colourless, simple, subglobose to ellipsoidal, 8 - 13 x 6 - 11 µm. Pycnidia: appearing externally as black dots, 0.03 mm diameter; in section: 100% immersed, aglobose or slightly flattened, colourless, 80 µm diameter. Chemistry: medulla K+ yellow > red (upper part only), C-, 1-, P+ yellow; thallus C-, UV-. Photobiont: green, present below apothecia, though often intermittently; cells globose, 11 - 17 µm diameter. Photobiont layer: 70 - 100 µm thick, irregular, discontinuous, formed of large clumps of cells typically about 100 µm diameter, clumps separated by bundles of hyphae.

The reaction with K may be faint in spot tests, but norstictic acid is always present in apothecium.

Generally easily recognised by the large, well developed, medium to dark grey, placodioid thallus with adpressed marginal lobes, and the calcareous, or at least base-rich, substrate.

Common throughout Greece. On rock, usually calcareous, at all altitudes. The lichenicolous fungi Cercidospora lobo thalliae (1 record) and Lichenostigma elongatum (4 records) have been reported from this host.

Most of Europe except for truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (Arizona, Colorado, New Mexico), Australasia (NSW, NZN, NZS).

Loxospora A. Massal. (1852)


Literature: There is no monograph, but Clauzade & Roux (1985) treat the two common European species, under Haematomma.

About 11 species in cool and temperate regions. They are usually epiphytic. Three species occur in Europe, but two are too northern to occur in Greece.

Loxospora elatina (Ach.) A. Massal. (1852)


Macedonia, on bark at an altitude of 800 m.

Widespread in central and northern Europe, rare south of the Alps. Also Macaronesia, Asia (Russia), N. America (widespread), perhaps S. America (Argentina).
Megalaria Hafellner (1984)


About 33 species, 4 of which occur in Europe. They are usually corticolous. Only one is likely to occur in Greece.

Megalaria grossa (Pers. ex Nyl.) Hafellner (1984)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Rare, in western Greece, on bark at altitudes 300 -1600 m. Reported from *Abies cephalonica* and an unspecified phorophyte.

Widespread in Europe, except the far north and strongly Mediterranean regions. Also Macaronesia, Asia (Ural Mts), N. America (Nova Scotia, perhaps elsewhere), southern S. America (Argentina, Chile), Australasia (widespread).

Megaspora (Clauzade & Cl. Roux) Hafellner & V. Wirth (1987)


Literature: *M. verrucosa* s. lat. is discussed in all the standard Floras. For var. *mutabilis* see Clauzade & Roux (1985) or Nash et al. (2007).

*Megaspora* has three species. They are corticolous or terricolous.

1 Soredia present. Apothecia uncom. (M. cretacea), (M. rimisoredata)

1 Soredia absent. Apothecia usually present.

22 Terricolous, on mosses or plant debris in alpine zone (i.e. above tree level). *M. verrucosa var. verrucosa*

2 On bark. Upland, but not alpine. *M. verrucosa var. mutabilis*

Megaspora verrucosa (Ach.) Arcadia & A. Nordin (2012) var. verrucosa


Thallus: crustose, thick, continuous, to 2.5 cm diameter, grey, strongly white pruinose everywhere. Apothecia: ±immersed in thallus, concave to ±flat, 0.7 - 0.8 mm diameter. Disc: black, not pruinose. Thalline margin: prominent, persistent, strongly pruinose; in section: 125 ±5 µm wide, cortex well developed, 60 µm wide, outermost 35 µm poorly structured, inner 25 µm of ±isodiametric cells, fairly well delimited from algal layer. Exciple: sometimes visible externally as distinct ring within thalline margin, black, not pruinose; in section: 20 - 25 µm wide, almost colourless (same colour as hypothecium), forming a thin rim to hymenium and slightly darker than it, of hyphae ±parallel to paraphyses. Epithecium: green, K-, some pigment soluble in K. Hymenium: 240 ±35 µm tall, colourless. Hypothecium: 40 ±3 µm tall, almost colourless. Paraphyses: strongly anastomosed. Ascospores: colourless, simple, ellipsoid, 45 - 50 x 30 - 33 µm, with prominent wall 6 µm thick, 8 per ascus. Chemistry: thallus K-, C-, KC- in spot tests. Photobiont: green.

*M. verrucosa* s. lat. is easily recognised by the immersed apothecia which do not resemble those of any other species. Internally, the combination of Aspicilia green pigment in the apothecia, paraphyses that are not moniliform, and rather large ascospores, is diagnostic. Var. * verrucosa* is well characterised by its ecology.

Probably scattered throughout Greece wherever there are high mountains. On bryophytes, decaying vegetation or soil at altitudes, usually above 1000 m but recorded as low as 500 m. Reports from bark probably refer to var. *mutabilis.*

Widespread in Europe, but in the south probably restricted to the uplands. Also Macaronesia, Asia (widespread), N. America (widespread), S. America (Argentina, Chile, Colombia, Venezuela), Australasia (NZS), Antarctica (subantarctic islands, Antarctic Peninsula).

Megaspora verrucosa var. mutabilis (Ach.) Nimis & Cl. Roux (1993)


The name *Parmelia verrucosa* f. *urceolaria* Fr. may be synonymous, and at the rank of variety the epithet *urceolaria* has priority over *mutabilis.*

Thallus: crustose, thick, usually continuous, sometimes slightly cracked, pale grey but generally appearing white owing to thick pruina, forming large patches to 7 cm diameter, about 700 µm thick. Cortex: 28 - 55 µm thick, with an
out the margin of 10 - 20 µm thick that is colourless to pale grey or pale brown, without distinct structure, and an inner part that is distinctly cellular; cells usually subrounded, 3 - 6 µm diameter, but sometimes distinctly elongated horizontally; pigments K-, not soluble in K. Medulla: white, chalky, structure not apparent in section (even in K). Apothecia: always abundant, immersed to submersed, rarely sessile, slightly concave to strongly urceolate, 0.5 - 1 mm diameter, not pruinose. Disc: black, sometimes almost punctiform when young, widely exposed in mature apothecia. Thalline margin: usually well developed, thick, persistent, occasionally almost absent; in section: 100 - 150 µm wide, cortex 30 - 50 µm. Exciple: sometimes visible externally as a brown to black ring within the thalline margin; in section: 25 - 100 µm wide, pale brown, sometimes with oil droplets, not sharply delimited from hymenium or thalline margin, of hyphae parallel to paraphyses. Epithecium: usually green, sometimes green-black, K-, some pigment soluble in K. Hymenium: 200 - 270 µm tall, colourless or with epithecial pigment, KI+ blue. Hypothecium: 30 - 125 µm tall, colourless to pale brown or pale brown-green, sometimes with oil droplets. Paraphyses: strongly anastomosed, 1 µm wide at base, 3 µm at apex, not capitate or moniliform. Asc: 170 x 50 µm, clavate, wall distinct and thick, 5 µm wide along sides, 8 - 30 µm in apical part, ocular chamber often visible in water mount, entire wall faintly and uniformly KI+ blue. Ascospores: colourless, simple, ellipsoid, 42 - 50 x 25 - 35 µm, with distinct wall 3 µm thick, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, KC-, P-, UV+ white to green-white. Photobiont: green, trebouxioid; cells globose, 10 - 12 µm diameter, forming ± continuous, ± regular layer 30 - 50 µm thick; photobiont cells not present below apothecia.

According to Smith et al (2009) the asci are Biatora type, but this is scarcely apparent in Greek collections seen; staining of the ascus wall in KI is both very faint and uniform.

It is unclear whether the two varieties of M. verrucosa merit taxonomic recognition.

Scattered throughout the mainland and Crete. On bark at altitudes 900 - 1600 m. About two thirds of reports are from conifers (Abies, Cupressus, Juniperus, Pinus), but also known from Fagus and Quercus. A reports from bryophytes at high altitude probably refers to var. verrucosa.

Southern and south-central Europe. Also Asia (Saudi Arabia, Kazakhstan, Tajikistan, Pakistan), N. Africa (Morocco, Algeria), N. America (widespread in USA), C. America (Mexico).

Melanelia Essl. (1978)


Literature: Smith et al. (2009), and Thell & Moberg (2011) are adequate.

Melanelia has 8 species, 4 of which occur in Europe. The genus has a rather northern distribution, Greece is too far south for most species, and there is only a single report.


1 Pseudocyphellae laminal. Medulla KC-, and either K+ brown, P+ red, or K-, P-. M. stygia

Melanelia stygia (L.) Essl. (1978)


Description: Clauzade & Roux (1985) as Parmelia stygia; Smith et al. (2009); Thell & Moberg (2011).

Known from a single site in Epiros, where it occurred on serpentine rock at an altitude of 2150 m.

Widespread in northern and central Europe, rare in the south. Also Asia (widespread), N. America (widespread).

Melanelixia O. Blanco et al. (2004)


Literature: Between them, Smith et al. (2009) and Clauzade & Roux (1985) treat all species included in the key below, some under Melanelia or Parmelia.

Thallus: foliosc, to several cm diameter, brown, sometimes green-brown in central part, matt or shiny, not pruinose. Lobes: medium sized, 5 - 8 x 1 - 5 mm, 140 - 200 µm thick. Lower surface: pale brown to black, attached by rhizines. Rhizines: often abundant, mostly pale brown to black, sometimes white at tips, simple, 0.15 - 0.3 x 0.02 - 0.05 mm. Pseudocyphellae: absent. Isidia: present in some species. Soralia: present in a few species. Cortex: 7 - 25 µm thick, colourless to brown, usually cellular at least in transverse section, K-, C-, N-. Medulla: white (rarely with a few orange patches of unknown origin), 75 - 100 µm thick, of loosely interwoven hyphae, hyphae sometimes covered in crystals not soluble in K. Lower cortex: 8 - 15 (45) µm thick, usually pale brown or brown, occasionally colourless, usually cellular. Apothecia: common in some species, rounded, sessile to slightly stalked, 2 - 4.5 mm diameter, not pruinose. Disc: brown. Thalline margin: present, persistent. Exciple: present but poorly developed. Epithecium: brown or yellow-brown. K- Hymenium: colourless, KI-. Hypothecium: colourless. Paraphyses: simple. Asc: Lecanora type.
Ascospores: colourless, simple, ellipsoid, fairly small (typically 12 - 13 x 7 - 8 µm), with Lecanora type wall, 8 per ascus. Pycnidia: sometimes present, laminal, black, 0.02 - 0.12 mm diameter; in section: 100% immersed, 120 - 170 µm tall, 110 - 160 µm wide, mostly colourless or pale grey, dark brown only near ostiole, globose or slightly pyriform with short neck. Conidia: colourless, straight, bacilliform, 5 - 8 x 0.5 - 1 µm. Chemistry: medulla K- (but orange patches, if present, K+ violet), C+ red (sometimes only in upper part). P-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, trebouxioid, cells 8 - 12 µm diameter, forming a ±continuous, ±regular layer.

Separated from other genera in Parmeliaceae by the brown cortical pigment, reacting N-, and the C+ bright red reaction of the medulla.

About 14 species, of which 6 occur in Europe. The genus is fairly common in Greece.

11 Isidia (or conical warts resembling isidia) and/or soralia present.
22 Surface of lobes pruinose. On bark or wood. **M. subargentifera**
2 Surface of lobes not pruinose. On various substrates.
33 Surface of lobes matt. On bark or wood. **M. subaurifera**
3 Surface of lobes shiny, especially near lobe tips. On various substrates.
44 Thallus brown. On bark or wood. **M. glabratula**
4 Thallus dark brown to black. On siliceous rock. **M. fuliginosa**

1 Neither isidia nor soralia present. **M. glabra**

**Melanelixia fuliginosa** (Fr. ex Duby) O. Blanco et al. (2004)


Sometime subsumed under *Melanelixia glabratula*, but the two species generally have a different appearance and are usually easy to separate. Arup & Sandler Berlin (2011) provide additional evidence that they are distinct.

Thallus: foliose, to 5 cm diameter, mostly dark brown, tips of lobes with a greenish tinge, not pruinose. Lobes: elongate, to 5 x 1.5 mm, 140 - 250 µm thick, not adpressed, usually slightly convex, often dividing at tips into ±rounded, concave to convex sublobes that are often shiny. Soralia: absent. Isidia: abundant except at tips of lobes, laminal, dark brown to black, darker than thallus, cylindrical when mature (may be globose when young), not clustered, 0.05 - 0.25 x 0.05 - 0.08 mm. Lower surface: black, attached by rhizines. Rhizines: black, simple, 0.3 x 0.05 mm; in section: formed of a rather wavy set of hyphae on a general longitudinal trend. Cortex: 7 - 17 µm thick, colourless to pale brown, cellular; cells subrounded, 3 - 5 µm diameter; K-, N-. Medulla: white, of loosely interwoven hyphae 2.5 - 5 µm wide, hyphae sometimes with external crystals. Lower cortex: 8 - 10 µm thick, dark brown, cellular; cells subangular, 4 - 6 µm diameter. Chemistry: medulla K-, C+ red, KC+ strongly red, P-, I-; thallus UV-. Photobiont: green; cells globose, 10 - 11 µm diameter, forming a continuous, ±regular layer 50 - 75 µm thick.

Could be confused with *Neofuscelia* (where saxicolous) but no species in that genus has the combination of a C+ strongly red medulla and very fine, simple, unclustered isidia.

Scattered throughout Greece, according to published reports, though less common in the southern half, at altitudes 0 - 1700 m. However, most reports are from bark, and only a few are from the expected substrate, siliceous rock. Corticolum reports may refer to *M. glabratula*. However, it is possible that *M. fuliginosa* and *M. glabratula* may not be as distinct in Greece as they are in western Europe.

Most of Europe south of the arctic. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), perhaps C. America. However, some reports may refer to *M. glabratula*.

**Melanelixia glabra** (Schaer.) O. Blanco et al. (2004)


Thallus: foliose, to 5 cm diameter. Upper surface: brown, sometimes with green tinge in central part, usually shiny at lobe margins, matt elsewhere, not pruinose, central part distinctly wrinkled, lobe margins smooth. Lower surface: mostly black, brown at extreme margin, attached by rhizines. Lobes: about 6 x 3 - 4 mm, 150 - 200 µm thick, adpressed or with ascending margins, margins crenulate. Hairs: present on lobes and thalline margin (x30), white, scarce in centre of thallus; in section: colourless, 15 - 28 µm long, 4 - 5 µm wide at base, tapering towards tip, formed of a single hypha. Isidia: absent. Soralia: absent. Rhizines: usually abundant, mostly black, often white at tips, simple, 0.3 - 0.5 x 0.03 mm. Upper cortex: 20 - 25 µm thick, colourless to pale brown, not sharply delimited below, cellular; cells small, 2 - 5 µm diameter, angular, irregularly shaped; K-, N-. Medulla: white, 75 - 100 µm thick, of loosely interwoven hyphae; hyphae 4 - 5 µm broad, without visible septa, often encrusted with colourless angular crystals 1 - 3 µm across. Lower cortex: 6 - 40 µm thick, colourless to brown, cellular; cells 2 - 7 µm diameter, angular, irregular, overall texture resembling a jigsaw puzzle; K-. Apothecia: usually present, 2 - 4.5 mm diameter, laminal, sessile to slightly stalked,
rounded when young, often distorted when mature, not pruinose. Disc: brown, shiny, strongly concave when young, usually at least slightly concave when mature. Thalline margin: present, brown, thin but persistent, smooth, 110 - 150 µm thick in section; cortex 25 - 40 µm thick; lower part of loosely spaced, unoriented, anastomosed hyphae, merging gradually with medulla; upper part a denser network of hyphae, anastomosed except near tips. Exciple: not visible externally; in section: poorly developed, 25 µm wide, colourless. Epithectum: pale yellow-brown, K-, pigment not soluble in K. Hymenium: 75 µm tall, mostly colourless, sometimes pale yellow-brown in upper part, KI-. Hypothecium: 50 µm tall, colourless. Paraphyses: simple, 3 µm wide, not capitulate or moniliform, septa sometimes visible. Asc: 33 - 40 x 15 - 20 µm, clavate, Lecanora type, ocellar chamber sometimes clearly visible in water. Ascospores: colourless, simple, 12 - 13 x 7 - 8 µm, ellipsoid, with Lecanora type wall, 8 per ascus. Pycnidia: often present, laminal, appearing as black dots, 0.07 - 0.12 mm diameter, in a slightly raised wart; in section: 100% immersed, 170 µm tall, 160 µm wide, dark brown around ostiole, colourless elsewhere. Conidia: colourless, straight, 5 - 7 x 0.5 µm. Chemistry: medulla C+ red (reaction sometimes patchy and/or confined to thin zone below upper cortex), K-, KC+ red, P-, UV-. Photobiont: green; cells globose, 8 - 12 µm diameter, in a continuous layer 25 - 40 µm thick, top of layer sometimes undulating or irregular.

This species is easily recognised by the absence of isidia or secondary lobules.

Throughout Greece, except for many of the smaller islands, at altitudes 0 - 1600 m. On bark of a wide range of trees, but usually avoiding conifers.

Southern and central Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (Arizona, California, Idaho, perhaps elsewhere).

Melanelixia glabratula (Lamy ex Nyl.) Sandler & Arup (2011)

Thallus: foliose, to 6 cm diameter. Lobes: to 8 x 5 mm, sometimes overlapping, margins weakly adpressed or slightly ascending, 0.2 mm thick. Upper surface: brown at margins, inner part often paler or with greenish tinge, shiny at least at margins, not pruinose. Lower surface: pale brown, smooth, attached by rhizines. Isidia: often abundant, sometimes almost obscuring thallus, brown to dark brown, usually darker than thallus; mostly laminal and on older parts of lobes, rarely marginal; initially simple, sometimes branched later, rounded in cross-section, erect, 0.1 - 2 x 0.05 - 0.3 mm. Rhizines: pale brown, sometimes white at tips or when immature, simple, 0.15 x 0.02 mm. Soralia: absent. Upper cortex: 8 - 15 µm thick, pale brown to brown, sharply delimited from algal layer, cellular in transverse section; cells small, 2.5 µm wide, ±square at least in outermost layer; K-, N-. Cortical hairs: not seen (in the few sections studied). Medulla: usually white, but some specimens with patches of orange pigmentation, of loosely interwoven hyphae; hyphae 3.5 - 4 µm broad, without visible septa, often clearly encrusted with colourless angular crystals 0.5 - 2 µm wide, not soluble in K. Lower cortex: 6 - 7 µm thick, brown, sharply delimited from medulla, cellular; cells square to angular, 4 µm wide. Pycnidia: sometimes present, laminal, black, 0.02 - 0.04 mm diameter; in section: 100% immersed, ±globose or with a short neck, 120 µm tall, 110 µm wide, wall colourless to pale grey except at ostiole. Conidia: colourless, bacilliform, 5 - 8 x 1 µm. Chemistry: medulla K- (but orange patches, if present, K+ strongly violet), C+ red, KC+ red, P-, I-, UV+; thallus K-, C-, KC-, P-, UV-. Photobiont: green; cells globose, 8 - 12 µm diameter, in a ±regular, sometimes slightly discontinuous, layer 25 - 30 µm thick.

The C+ and KC+ reactions are sometimes confined to the upper part of the medulla.

Easily separated from other isidiate, corticolous species of the genus by the shiny upper surface.

Present in most of Greece, though not reported from Crete. On bark of a wide range of species at altitudes 0 - 1500 m, but uncommon above 1000 m. There is also a single report from wood.

Throughout most of Europe. Also Macaronesia, western Asia (Turkey, Armenia, Mongolia), N. Africa (Morocco, Tunisia), N. America (widespread), perhaps C. America. Reports for Australasia are incorrect.

Melanelixia subargentifera (Nyl.) O. Blanco et al. (2004)

Descriptions: Clauzade & Roux (1985) as *Parmelia parvula*; Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Known from a single site in Macedonia, where it occurred on bark at an altitude of 900 m.

Widespread in northern and central Europe, rare south of the Alps. Also Asia (widespread), Africa (Kenya), N. America (widespread), perhaps C. America.

Melanelixia subaurifera (Nyl.) O. Blanco et al. (2004)

Descriptions: Clauzade & Roux (1985) as *Parmelia parvula*; Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).
Fairly common in the northern half of Greece. On bark, occasionally on wood, at altitudes 0 - 1100 m.

Widespread in Europe, but absent from areas with true Mediterranean climate. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, Kenya), N. America (widespread), perhaps C. America.

**Melanohalea O. Blanco et al. (2004)**


Literature: Smith et al. (2009) discuss all the species that have been reported for Greece.


*Melanohalea* has 22 species, 8 of which occur in Europe. Some are moderately common in Greece.

11 Isidia, or conical warts resembling isidia, present.

22 Isidia soon developing into lobules that may obscure the original lobes. **M. laciniatula**

2 Isidia or conical warts persistent, not developing into lobules.

333 Isidia hollow, usually ±flattened, often decumbent and inclined in all directions, longer than wide, abundant and often contiguous in central parts of thallus; apex without a white pseudocyphella. Lobes not adpressed. Apothecia usually absent. **M. exasperatula**

33 Isidia solid, erect, initially small and conical but soon becoming cylindrical, later branched or coralloid, much longer than wide when mature, usually forming a very dense cover that may obscure central part of thallus; apex sometimes with a ±obscure white pseudocyphella, especially in very young isidia (Note 1), but more commonly without a pseudocyphellae and then appearing dark brown. Lobes ±adpressed. Apothecia usually absent. **M. elegantula**

3 True isidia absent, conical warts present, not much longer than wide, usually frequent but always separate and well spaced, never forming a dense cover or obscuring thallus; apex with a distinct white pseudocyphella (Note 1). Lobes ±adpressed. Apothecia usually present; thalline margin strongly isidiate. **M. exasperata**

1 Isidia and warts absent.

22 Upper surface of lobes with ridges or wrinkles, at least at centre of thallus. If present in Greece then rare and strictly montane. (M. olivacea) Greek reports doubtful.

2 Upper surface of lobes without ridges or wrinkles. Thallus of many small, overlapping folioles. **M. laciniatula**

(1) In M. elegantula, isidia sometimes become abraded and then lack an apex. Such isidia appear white at the tip, owing to the exposed medulla, but this should not be confused with a white apex due to a pseudocyphella. Examination under the stereo-microscope at x40 will usually clear up any confusion.

**Melanohalea elegantula** (Zahlbr.) O. Blanco et al. (2004)


Thallus: 5 - 7 cm diameter. Upper surface: brown, often shiny at lobe tips, not pruinose. Lower surface: pale brown, darker brown at margin and there ±shiny, attached by rhizines. Lobes: 5 - 8 x 4 - 8 mm, 110 - 140 µm thick, tips incised, mostly ±adpressed, sometimes slightly ascending at margins. Isidia: always abundant and sometimes obscuring central part of thallus, initially forming as small, conical papillae, soon becoming erect and cylindrical, later branched or even coralloid, 0.2 - 0.3 x 0.05 mm when mature; lower part concolourous with lobes, upper part usually slightly darker; apex occasionally with a pseudocyphella and then appearing white (most commonly seen in young isidia that are still ±papillate). Pseudocyphellae: not seen on lobe surfaces, sometimes present at apex of isidia, especially young isidia, white, punctiform. Rhizines: mostly brown, often white at tip, simple, 0.15 - 0.35 x 0.05 mm. Soralia: absent. Upper cortex: 10 - 12 µm thick, colourless to pale brown, without crystals, K-, N-. Medulla: white, 60 - 100 µm thick, of loosely interwoven hyphae mostly oriented ±parallel to lobe surface. Lower cortex: 10 - 12 µm thick, colourless to
brown, cellular; cells subrounded, 7 - 10 µm wide; K-. Chemistry: medulla K-, P-, C-, KC-, I-; thallus UV-. Photobiont: green, cells globose, 7 - 10 µm diameter, forming a continuous layer 20 - 30 µm thick.

Can not be confused with any other species with a C- medulla, if the isidia are examined carefully.

Scattered rather thinly through much of Greece, though not yet reported for the most southerly parts. On bark of Abies and Pinus at altitudes 500 - 1600 m.

Almost throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Kenya), N. America (widespread, mainly in western half), C. America (Mexico), southern S. America (Argentina, Chile), Antarctica (S. Georgia).

Melanohalea exasperata (De Not.) O. Blanco et al. (2004)


Thallus: to 7 cm diameter. Upper surface: brown, occasionally green-brown in shade, usually matt, occasionally shiny near lobe tips, rarely slightly white pruinose. Lower surface: pale brown to black, attached by rhizines. Lobes: adpressed, often overlapping, to 8 x 4 mm, 0.08-0.12 mm thick, ends slightly incised in places. Isidia: true isidia absent but conical warts resembling isidia abundant on surface of lobes and on thalline exciple, separate and ±regularly spaced; base 0.03 - 0.1 mm diameter; apex ±flat (in section), about 0.08 mm diameter, always with a white pseudocyphella. Pseudocyphellae: on apex of isidia, never on lobes, white, punctiform, easily visible; in section, they correspond to a gap in the upper cortex, the gap being filled with a white tissue contiguous with medulla but denser, without air gaps, and without any preferred hyphal orientation. Hairs: not visible externally; in section: frequently seen projecting from upper cortex of lobe surfaces, ±erect, colourless, cylindrical, 6 - 10 x 2.5 µm, each hair a single hypha. Rhizines: basal part pale brown to brown, tip often white and occasionally broader than stem, simple, 0.2 - 0.7 x 0.05 mm. Soralia: absent. Upper cortex: 10 - 12 µm thick, brown in upper part, colourless to pale brown below; brown pigment K-, N- or N+ slightly red-brown, pigment slightly soluble in K. Medulla: white, of loosely interwoven hyphae oriented predominantly (not exclusively), horizontally. Lower cortex: 9 - 12 µm thick, sharply delimited from medulla, brown, cellular; cells angular to almost square, about 5 µm across; brown pigment K-, N- or N+ intensifying or developing a slight reddish tinge, pigment slightly soluble in K. Apothecia: usually present, sessile or shortly stalked, concave, 0.6 - 2.5 mm diameter, not pruinose. Disc: brown, shiny when young, later matt. Thalline exciple: present, persistent, with many isidia; in section 110 - 130 µm wide, of which cortex 17 - 30 µm. Exciple: not visible externally; in section 25 µm wide, colourless. Epithecium: brown, K-, swelling markedly in K, pigment not soluble in K. Hymenium: 60 µm tall, colourless, sometimes brown in upper part, KI+ blue. Hypothecium: 40 µm tall, colourless. Paraphyses: simple, 2 µm wide at base, 4 µm at apex, ±clavate or weakly capitate, coherent. Asci: 42 - 47 x 12 - 15 µm, narrowly clavate to almost cylindrical, distinct ocular chamber often visible in water, Lecanora type. Ascospores: colourless, simple, usually ellipsoid, occasionally subglobose, ends rounded to subacute, 10 - 11 x 7 - 7.5 µm, with a Lecanora type wall, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-. Photobiont: green, forming a continuous layer about 20 µm thick though scattered cells may extend deeper into medulla; present below apothecia and there forming a continuous layer 40 - 55 µm thick.

Can not be confused with any other species with a C- medulla, if the isidia are examined carefully. Present in much of Greece, though absent from most small islands. On bark of a wide range of species at altitudes 300 - 1400 m, but rare below 600 m. Often present on small twigs. There is a single report from siliceous rock.

Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread). Reports for Australasia are incorrect.

Melanohalea exasperatula (Nyl.) O. Blanco et al. (2004)

_mycologicresearch_ 108(8): 882; _Parmelia exasperatula_ Nyl. (1873), _florag₁onis_ 56: 299; _Melanelia exasperatula_ (Nyl.) Essl.

Thallus: usually small, 2 - 4 cm diameter. Upper surface: brown, shiny at lobe margins, not pruinose. Lower surface: dark brown, attached by rhizines. Lobes: 8 - 10 x 3 - 5 mm, not adpressed; margins distinctly ascending. Isidia: abundant except near lobe margins, brown, shiny, hollow, 0.35 - 0.55 x 0.15 - 0.25 mm; usually flattened in cross-section, occasionally cylindrical or clavate, occasionally almost squamule-like; usually decumbent, sometimes ±erect; without any preferred orientation overall when decumbent, but adjacent isidia tend to have similar orientation. Pseudocyphellae: absent. Rhizines: present but not abundant, simple, mostly brown, sometimes white at tips, 0.25 - 0.3 x 0.03 mm. Soralia: absent. Upper cortex: 12 µm thick, colourless to pale brown, cellular; cells ±square, 4.5 µm wide; N-. Medulla: white, of loosely interwoven hyphae oriented predominantly horizontally. Lower cortex: 8 - 15 µm thick, pale brown to brown, cellular; cells angular, 3 - 4 µm wide; N-. Chemistry: medulla K-, C-, KC-, P-. Photobiont: green, forming a continuous layer about 30 µm thick.

Can not be confused with any other species with a C- medulla, if the isidia are examined carefully. Scattered on the mainland and Crete. On bark of a wide range of species, usually at altitudes 600 - 1600 m, but...
there are reports from close to sea level. Often on small twigs. Most of Europe. Also Macaronesia, Asia (widespread), N. America (widespread), perhaps C. America.

**Melanohalea laciniatula** (Flagey ex H. Olivier) O. Blanco et al. (2004)


Thallus: foliose, to 4 cm diameter, 65 - 80 µm thick (measured at lobule, not primary lobe). Upper surface: brown, not pruinose, mostly matt, sometimes shiny at margin of lobules. Lower surface: white to pale brown (both lobes and lobules), attached by rhizines. Lobes: primary lobes to 6 mm wide, usually adpress ed, soon obscured by secondary lobules. Lobules: abundant, soon obscuring primary lobes, 0.5 - 1.5 mm wide, usually ere ct, laminal and marginal; laminal ones arising from small conical warts on surface of primary lobes, the warts soon lengthen and become flattened, briefly resembling squamiform isidia, before developing into lobules; marginal lobules do not appear to develop from conical warts. Hairs: cortical hairs sometimes present. Isidia: true isidia absent but conical warts similar to those of *M. exasperata* present on primary lobes; they do not persist but soon develop into lobules; neither isidia nor warts are present on the lobules. Pseudocyphellae: present as a white dot at apex of each conical wart. Rhizines: white to pale brown, 0.2 x 0.1 mm, simple, often with blunt or slightly swollen tip (not tapered towards tip). Soralia: absent. Upper cortex: 10 - 12 µm thick, pale brown, N-. Medulla: white, 20 µm thick, of loosely woven anastomosed hyphae; hyphae thin, about 1.5 µm wide, without crystals. Lower cortex: 10 - 15 µm thick, colourless, the outer 4 µm sometimes appearing cellular in transverse section, owing to the slightly swollen tips of the hyphae which are packed to form a neat row. Chemistry: medulla K-, C-, KC-, P-, UV-. Photobiont: green; cells globose, 8 - 13 µm diameter, forming a continuous layer 35 - 50 µm thick. This species usually has abundant secondary lobules, making it easy to recognise. Scattered, with no clear pattern. On bark at altitudes 300 - 1400 m. Commonest in temperate parts of Europe, to as far as southern Scandinavia. Quite widely distributed in the south, but restricted to upland areas. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco). Reports for N. America may be incorrect.

**Melaspidea Nyl. (1857)**


Literature: The genus is poorly known, many species appear to be known only from the type collection, and information is scattered, scanty and often inadequate. The best places to start are probably Clauzade & Roux (1985) and Smith et al. (2009).

As presently circumscribed, *Melaspidea* has about 70 species, but it is heterogeneous. About 20 species have been reported for Europe. Some species are not lichenised.

11 On calcareous rock (or perhaps parasitic on lichens thereon). *M. graeca* 1 On bark or wood. 22 Hypothecium black-brown, same colour as or contiguous with exciple. Apothecia elongated. (M. poetarum) 2 Hypothecium pale. Apothecia elongate or rounded. 33 Apothecia ±elongate. (M. bagliettoana) 3 Apothecia ±round. 44 Apothecia in groups. *M. olece* 4 Apothecia not in groups, ±regularly spread over surface of thallus. 55 Thallus mostly immersed. Ascomata 0.1 - 0.2 mm diameter. Ascospores 18 - 28 µm long. *M. proximella* 5 Thallus mostly superficial. Ascomata at least 0.3 mm diameter. Ascospores 10 - 18 µm long. *M. urceolata*

**Melaspidea graeca** Szatala (1956)


Description: See the protologue. It describes a lichen with a dark coloured epilithic thallus, round to elongate apothecia 0.15 - 0.25 mm wide, a closed exciple, an I+ blue hymenium, asci 55 - 65 x 28 - 38 µm, and 1-septate ascospores, constricted at the septum, colourless at first but becoming brown, 22 - 24.5 (26) x 9 - 11 µm. It was said to be lichenised with *Trentepohlia.* Nothing in the protologue suggests that it was parasitic. These characters do not clearly match any well-known species of *Melaspidea.* Mt. Olympus, on calcareous rock at an altitude of 1800 m. Known only from the type collection.
Melaspilea oleae J. Steiner (1894)


Description: See the protologue. Steiner stated that the apothecia resemble those of *M. megalyna*, which is a synonym of *M. gibberosula* (Ach.) Zwackh according to Faltynowics (2003). However, *M. oleae* is probably not a synonym of *M. gibberosula*. Its ascospores were said to be 19 x 7 - 9.5 µm, whereas those of *M. gibberosula* are said by Clauzade & Roux (1985) to be 10 - 17 x 4 - 7 µm. Also, *M. gibberosula* is a species of central, not southern, Europe. The identity of Steiner's lichen is unclear.

Patra in the NW Peloponnese, where it occurred on the bark of *Olea* close to sea level.

Known only from the type collection.

Melaspilea proximella (Th. Fr.) Nyl. (1873)

The basionyn is usually cited as *Arthonia proximella* Nyl. (1861) in: *Notis. Sällsk. Fauna Fl. Fenn. Förh.* 5: 269, but Nylander's 1861 name and Fries's 1860 name appear to be based on the same specimen, and so are homotypic. Although in 1861 Nylander did not refer to Fries, the 1861 name can reasonably be regarded as a presumed new combination.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009). This species is perhaps not lichenised. Very scattered, with no clear pattern. On bark of several species at altitudes 0 - 1800 m. It is unlikely that all these reports refer to the same taxon.

Scattered throughout much of Europe to as far north as northern Finland, but uncommon south of the Alps. Also Asia (southern Siberia), N. America (New Hampshire, Vermont,) perhaps S. America (Argentina), perhaps Australasia (Australia).

Melaspilea urceolata (Fr.) Almb. (1963)

Description: Clauzade & Roux (1985).

Athos Peninsula, on bark of *Olea* at an altitude of 50 m.

An uncommon species of central Europe and the northern parts of southern Europe. Also eastern Asia (Japan, perhaps China).

Melaspilea arthonioides var. hysteroides (A. Massal.) Zahlbr.


Description: *Melaspilea arthonioides* var. *hysteroides* (A. Massal.) Zahlbr.

Athos Peninsula, on bark of *Olea* at an altitude of 50 m.

An uncommon species of central Europe and the northern parts of southern Europe. Also eastern Asia (Japan, perhaps China).

Micarea Fr. (1825)

*Syst. Orb. Veg.* 1: 256-257. The name is conserved against *Micarea* Fr. published earlier the same year. Type: *M. prasina* Fr. The type is conserved. Family: *Pilocarpaceae*.

Literature: The best starting point for European taxa is still Coppins (1983a). Some new species have been described since then, but all those that are likely to occur in Greece, are discussed in Smith et al. (2009).

Thallus crustose, of goniocysts or thin and poorly developed. Apothecia: small, usually immarginate, often convex, not pruinose, pale to black. Asci: clavate, inner wall at apex *KI*+ blue. Ascospores: colourless, simple to 3-septate, ellipsoid in most species, 8 per ascus. Photobiont: green.

About 120 species, with about 76 in Europe. They usually occur on acidic substrata in cool, moist habitats, and so are uncommon in Greece.

Determination of *Micarea* collections tends to be difficult. Because the distribution of many species is not well known, this forces a compromise between perhaps omitting some that might occur in northern Greece and complicating the key unnecessarily. If a Greek collection of *Micarea* does not key out, or keys out but does not match the corresponding description, consult the publications cited above.

11 Hymenium, at least in upper part, dull greenish or brownish in water, *K*+ violet (Note 1). Hypothecium colourless or pale. Usually on bark or wood.

22 Ascospores mostly 3-septate. (*M. nitschkeana*)

2 Ascospores mostly simple or 1-septate (a few 2- or 3- septate spores may be present).

33 Thallus superficial, of very small, greenish granules. Thallus C-. Chromatography is required for definite separation of the two species below, but see Note 2.

44 Thallus with micareic acid. *M. prasina*
4 Thallus with methoxymicareic or prasinic acid. **M. micrococca**

3 Thallus immersed or of green-grey to grey granular areoles. Thallus C- or C+ red.

44 Ascospores mostly 1-septate, often curved, 9 - 16 µm long. Paraphyses numerous. Apothecia and thallus usually C+ red. **M. denigrata**

4 Ascospores mostly simple, not curved. 6.5 - 9.5 µm long. Paraphyses scanty. Apothecia and thallus usually C-. **M. misella**

1 Hymenium variously coloured or colourless, not K+ violet (if purple in K, then already so in water). Hypothecium pale or dark. On various substrates.

22 Mature ascospores 3- or more septate, mostly over 15 µm long. (M. lignaria), (M. peliocarpa)

2 Mature ascospores simple or 1-septate, length various.

33 Apothecia whitish, pale or dull reddish, without distinct pigmentation in section. Thallus C+ red (Note 3). Usually on bark or wood. (M. viridileprosa)

3 Apothecia coloured, with obvious pigmentation in section. On rock or soil.

44 Ascospores reniform, distinctly curved. **M. curvata**

4 Ascospores ± ellipsoid (occasionally tending towards fusiform), not curved.

55 Photobiont cells 5 - 12 µm diameter, or ellipsoid to 15 x 10 µm. Hypothecium colourless to pale green in upper part. See **Brianaria bauschiana**

5 Photobiont cells 4 - 8 µm diameter. Hypothecium colourless, pale yellow or pale orange-brown. **M. lithinella**

(1) Specimens with very pale apothecia may have too little apothecial pigment to give an observable K+ violet reaction. In such cases it may be necessary to try both branches, or to consult a more comprehensive key elsewhere in the literature.

(2) According to Coppins, in Smith et al. (2009), specimens with small (less than 0.2 mm diameter), whitish apothecia in secondary habitats are likely to be M. micrococca.

(3) If thallus C-, consider the possibility of shade forms of M. prasina and M. micrococca

**Micarea curvata** Coppins (1983)


Description: Smith et al. (2009).

Island of Samothraki, on rock at an altitude of 440 m.

British Isles, Benelux, Denmark, Germany, Iberian Peninsula and Greece. The Greek report is disjunct.

**Micarea denigrata** (Fr.) Hedl. (1892)


Descriptions: Coppins (1983a); Nash et al. (2007); Smith et al. (2009).

Known from two localities in northern Greece: Mt. Olympus, on wood at altitudes around 1000 - 1450 m. The report for the Peloponnesse in Abbott (2009) is incorrect; the material belonged to **M. misella**.

Widespread in Europe to as far north as Arctic Circle, but south of the Alps uncommon and probably confined to upland areas. Also Macaronesia, Asia, (Turkey, Russia, perhaps Taiwan), N. Africa (Morocco), N. America (widespread), Australasia (SE Australia, NZN).

**Micarea lithinella** (Nyl.) Hedl. (1892)


Descriptions: Coppins (1983a); Smith et al. (2009).

Ikaria, on bark at an unspecified altitude.

Alps to southern Scandinavia: the Greek record is disjunct. Also Macaronesia, perhaps Asia (Taiwan), N. America (scattered in eastern USA).

**Micarea micrococca** (Körb.) Gams ex Coppins (2002)


Descriptions: Nash et al. (2007); Smith et al. (2009).

Western Crete, on bark of *Castanea sativa* at an altitude of 500 m.

Range uncertain, owing to confusion with *M. prasina* and *M. subviridis*. Except for the Greek report, which is disjunct, all reliable modern European reports are from the Alps to southern Scandinavia. Also reliably reported for N.
America (widespread), Australasia (Tasmania, NZ). Reports for elsewhere (e.g. Taiwan, Brazil) are in need of confirmation.

**Micarea misella** (Nyl.) Hedl. (1892)


Thallus: crustose, grey to dark grey, thin, not continuous. Cortex: absent. Apothecia: common, sessile, convex, 0.15 - 0.3 (0.4) mm diameter, larger ones often tuberculate, not pruinose. Disc: black. Thalline margin: absent. Exciple: not visible externally, absent or very poorly developed in section. Epithecium: colourless to grey or brownish, K+ violet, C+ purple. Hymenium: 25 - 50 µm tall, colourless to very pale yellow-brown, C- or C+ slightly pink. Hypothecium: 50 µm tall, colourless to very pale brown. Paraphyses: anastomosed, 1 µm wide, not or scarcely broadening at apices. Asci: 25 - 40 x 11 - 12 µm, clavate, inner wall at apex KI+ blue. Ascospores: colourless, simple, ± ellipsoid, 6.5 - 10 x 3 - 3.5 µm, 8 per ascus. Chemistry: thallus C-, P-. Photobiont: green, cells 6 - 10 µm diameter.

Crete and Peloponnese, on bark or wood at altitudes 250 - 1000 m. This inconspicuous species is probably more common in Greece than the few reports suggest.

Widespread from the Alps to subarctic regions; in the south, uncommon but quite widely distributed in the uplands. Also Macaronesia, Asia (Kazakhstan, Russia, Bhutan, perhaps Taiwan), N. Africa (Morocco), N. America (widespread), S. America (Brazil).

**Micarea prasina** Fr. (1825)


Thallus: crustose, of green, granular goniocysts 75 - 150 µm diameter, without a cortex. Apothecia: subimmersed in thallus to subsessile, convex, 0.2 - 0.3 mm diameter, not pruinose. Disc: almost colourless in fresh material, becoming pale orange-brown in herbarium. Thalline margin: absent. Exciple: absent. Epithecium: almost colourless. Hymenium: 35 µm tall, colourless. Hypothecium: 35 µm tall, colourless. Paraphyses: 1 µm wide. Ascospores: colourless, simple or 1-septate, ellipsoid, 8 - 10 x 4 µm, 8 per ascus. Pycnidia: visible externally as white dots, 0.1 mm diameter; in section: 100 µm tall, 75 µm wide. Conidia: 6 x 1 µm, sometimes slightly curved. Chemistry: thallus C-. Photobiont: green, cells 6 - 8 µm diameter.

Apothecial pigments in *M. prasina* are said to react K+ purple. In the only Greek collection seen, apothecia had very little pigment, and no K+ violet reaction was observed.

Scattered, with no clear pattern. On bark of *Pinus* and *Platanus* at altitudes 10 - 900 m. Some reports may refer to *M. micrococcata*.

Distribution uncertain, owing to confusion with other species. There are reports from most of Europe, except for the high arctic and regions with a true Mediterranean climate, and from all continents except Antarctica, but some may refer to *M. micrococcata*.

**Milospium D. Hawksw. (1975)**


This genus of lichenicolous hyphomycetes has four species, three of which occur in Europe. Only one has been reported for Greece.

11 Sporodochia blackish. On squamules of Cladonia. (M. lacoizquetae)

1 Sporodochia brown. On crustose lichens with photobiont Trentepohlia. **M. graphideorum**

**Milospium graphideorum** (Nyl.) D. Hawksw. (1975)


Description: Clauzade, Diederich & Roux (1989). Hawksworth (1979) has a diagram.

Amorgos, Kos and Rhodes, at altitudes 230 - 260 m. Usually lichenicolous: the only host determined to species was *Dirina ceratoniae*. Reported once from bark.

Throughout Europe to as far north as Scotland and southern Scandinavia. Also Macaronesia, Asia (Iran), Malesia (PNG), Africa (Ascension Is, St Helena), C. America (Guatemala), S. America (Colombia, Paraguay).
Miriquidica Hertel & Rambold (1987)


About 25 species, all saxicolous. About 20 are present in Europe, but most are strongly northern and unlikely to occur in Greece.

1 Soredia present on some areoles. Apothecia few or absent. (M. nigroleprosa) Greek report doubtful.
1 Soredia absent. Apothecia usually numerous.
22 Parasitic on *Sporastatia polyspora*. (M. invadens)
2 Not parasitic.
33 Apothecia remaining ± immersed.
44 Thallus pale grey to brown-grey. *M. complanata*
4 Thallus brown. *M. deusta*
3 Apothecia becoming emergent and sessile.
44 Areoles grey-white to brown-grey, often glossy, rarely minutely lobed. (M. leucophaea var. leucophaea)
4 Areoles grey-brown to dark blue-grey, matt, often minutely lobed. (M. leucophaea var. griseoatra)

*Miriquidica complanata* (Körb.) Hertel & Rambold (1987)


Description: Clauzade & Roux (1985) as *Lecanora complanata*; Smith et al. (2009). Samothraki and Evia, on siliceous rock at altitudes 800 - 1070 m. Abbott (2009) did not accept this species onto the Greek list, but it was recently confirmed for the country.

Throughout cold and temperate Europe; absent from regions with true Mediterranean climate. Also Asia (Russia, Mongolia, China, Japan).

*Miriquidica deusta* (Stenh.) Hertel & Rambold (1987)


Description: Clauzade & Roux (1985) as *Lecidea complanata*; Smith et al. (2009). Islands of the Aegean, including Crete, on siliceous rock at altitudes 5 - 700 m. The presence of this species at low altitudes in the Greek islands is surprising, although Nimis (1993) reports it for Sardinia "in the low mountains". However, the Greek reports are recent, and were made by experienced lichenologists.

Widespread in northern and central Europe; also present in southern European mountains. Also Asia (widespread), N. America (Alaska, northern Canada, Nevada), perhaps S. America (Venezuela), Australasia (SE Australia, NZS).

Montanelia Divakar et al. (2012)


Literature: Nash et al. (2002) treat both species included in the key, under *Melanelia*.

Four species, all of which occur in Europe. They have a rather northern distribution, and Greece is too far south for most of them.

11 Medulla C+ pink. If present in Greece, then restricted to high altitude. (M. tominii)
1 Medulla C-. Not restricted to high altitude. *M. disjuncta*

Montanelia disjuncta (Erichsen) Divakar et al. (2012)


Descriptions: Clauzade & Roux (1985) as *Parmelia disjuncta*; Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011) all as *Melanelia disjuncta*.

Reliably reported for Macedonia, on gneiss at an altitude of 1450 m. Low altitude reports for Attica and Evia may not be reliable.

Widespread in northern and central Europe, rare south of the Alps. Also Asia (widespread), Africa (Kenya), N.
Muellerella Hepp ex Müll. Arg. (1862)


Literature: There is no comprehensive summary in English, but useful starting points are Clauzade, Diederich & Roux (1989), and Triebel (1989).

Perithecia: black, immersed in thallus or (less commonly) apothecia of host, fairly small (not usually exceeding 250 μm diameter). Paraphyses: disappearing early. Ascospores: brown, simple or 1-septate, ellipsoid, more than 8 per ascus (typically 16 - 32), small (usually less than 10 μm long).

The small, brown, usually 1-septate ascospores and the parasitic habit distinguish *Muellerella* from other genera of Verrucariaceae.

*Muellerella* has 13 described species of lichenicolous fungi (though two are poorly known and may not be good species), of which 11 are reported for Europe. The genus is quite common in Greece.

111 Mature ascospores simple. Probably only at high altitude.

222 Ascospores globose or subglobose, 2 - 3 x 2 - 4 μm. (*M. hospitans*)

22 Ascospores 5 - 7 x 2 - 4 μm. (*M. polyspora*)

2 Ascospores subglobose, 5 - 7 μm diameter, or ellipsoid, 9 - 14 x 5 - 6 μm. **M. dilatata**

11 Mature ascospores mostly 1-septate. Not restricted to high altitude.

22 Perithecia (70) 100 - 120 (150) μm diameter. Paraphyses to 15 μm long. Hymenium I+ blue. Asci with more than 64 ascospores. On apothecia, more rarely thalli, of many species, but with a preference for Physciaceae and Teloschistaceae. **M. lichenicola**

2 Perithecia (100) 150 - 250 (400) μm diameter. Paraphyses to 40 μm long. Hymenium I- or slightly I+ reddish. Asci with at most 64 ascospores. On thalli, more rarely apothecia, of a wide range of lichens, especially crustose saxicolous species.

33 Ascospores slightly warted, medium brown to dark brown, mostly 8 - 10 x 4 - 5 μm, 20 - 32 per ascus. **M. pygmaea**

3 Ascospores smooth-walled, pale brown to dark brown, mostly 6 - 8.5 x 3 - 5.5 μm, 32 - 64 per ascus.

44 Ascospores ellipsoid to ovoid, mostly 3 - 4.5 μm wide, 32 - 64 per ascus. Perithecia (100) 125 - 200 (250) μm diameter. **M. erratica**

4 Ascospores broadly ovoid, mostly 4 - 5.5 μm wide, 32 (64) per ascus. Perithecia (175) 200 - 250 (400) μm diameter. **M. ventosicola**

1 Mature ascospores mostly 3-septate. See (*Capronia triseptata*)

**Muellerella dilatata** J. Steiner (1894)


Description: See the protologue, or Steiner (1898).

Mountains of northern Peloponnese, at subalpine levels, on *Aspicilia trachytica*.

Known only from Greece.

**Muellerella erratica** (A. Massal.) Hafellner & V. John (2006)


Perithecia: black, 0.07 mm diameter, 50% immersed in thallus of host; in section: 190 - 200 μm tall, 170 μm wide, rather flat-topped. Paraphyses: disappearing early. Ascospores: brown, 1-septate, about 32 per ascus, 7.5 x 3 μm, not warted.

Difficult to separate from *M. pygmaea*, though the latter has slightly larger ascospores on average, slightly warted ascospores, and its asci may have fewer than 32 ascospores.

Scattered on the mainland and Corfu, at all altitudes. Reported hosts include species of *Aspicilia, Caloplaca, Cetraria, Lecidea, Lecidella* and *Verrucaria*.

Widespread in Europe. Also Macaronesia, Asia (widespread), N. Africa (Algeria), N. America (widespread), C. America (Mexico), S. America (Chile, Bolivia, Colombia, Peru), Australasia (NSW).

**Muellerella lichenicola** (Sommerf.) D. Hawksw. (1979)

Muellerella pygmaea (Körb.) D. Hawksw. (1979)


Muellerella pygmaea var. ecatonsporum (Anzi) G. Winter; 

Tichothecium pygmaeum f. ecatonsporum (Anzi) Arnold; 

Tichothecium pygmaeum var. grandiusculum (Arnold) Arnold; 

Tichothecium pygmaeum f. grandiusculum (Arnold) Arnold; 

Tichothecium pygmaeum var. grandiusculum Arnold.

Perithecia: dark brown to black, 0.05 - 0.2 mm diameter, 50 - 100% immersed in thallus of host, less commonly in apothecia; in section: 150 - 300 µm tall, 100 - 210 µm wide, pyriform. Exciple: dark brown to black throughout. Hymenium: I- (or almost). Paraphyses: simple, disappearing at septum, ends rounded, 12 - 32 per ascus, (6) 7 - 10 x (3) 4 - 7 µm.

Ascospores are said to be slightly warded, but in practice this is hard to observe. For comparison with M. erratica, see under that species.

Fairly common on the mainland and Crete. At altitudes 300 m and above, but rare below 650 m. On a very wide range of crustose lichens. Some reports may refer to M. erratica throughout Europe. Also Macaronesia, Asia (widespread in cool and temperate regions), N. Africa (Morocco, Algeria), N. America (widespread, mainly in western half), perhaps C. America (Mexico), perhaps S. America (Chile, Bolivia), Australasia (NZS), Antarctica (S. Georgia, continental Antarctica).


Lichenologist 35(3): 212; 


Muellerella pygmaea var. ventosicola (Mudd) Triebel.

Descriptions: Nash et al. (2004); Triebel (1989), both as Muellerella pygmaea var. ventosicola.

Reported from a single unidentified locality in Macedonia, at an altitude of about 2000 m, on Rhizocarpon distinctum and R. geographicum. 

Widespread in central and northern Europe, rare south of Alps and Pyrenees. Also Asia (Turkey, Iran, Russia), N. America (widespread), S. America (Bolivia).

Mycobilimbia Rehm (1889)


Literature: The delimitation of the genus has varied greatly over the years and information is very scattered. Smith et al. (2009) is a good starting point.

Mycobilimbia s. str. contains between 4 and 6 species which occur on decaying substrates in moist, temperate regions. All are rather inconspicuous. The genus is poorly represented in Greece.

11 Ascospores 0 - 1 (3) septate.

22 Apices of paraphyses to 5 - 6 µm wide. Ascospores simple.

33 Thallus small squamulose. Hymenium without blue granules. (M. parvilobulosa)

3 Thallus crustose, granular. Hymenium with or without blue granules. M. berengeriana

2 Apices of paraphyses to 3 µm wide. Ascospores simple or septate. See (Biatora sphaeroides). Greek report doubtful.

1 Ascospores 3-septate.

22 Apothecia pale, without pigment in section. (M. carnealbida)

2 Apothecia dark, with red-brown pigment in section. M. tetramera

Mycobilimbia berengeriana (A. Massal.) Hafellner & V. Wirth (1987)

in Wirth, Die Flechten Baden-Württembergs 511; 


This species does not belong in Mycobilimbia s. str., but as it has often been discussed under this genus, and its correct placement is uncertain, it is retained here for convenience.
Thallus: crustose, of grey granules 0.05 - 0.08 (0.2) mm diameter. Apothecia: sessile, flat to convex, 0.35 - 0.55 mm diameter, not pruinose. Disc: dark brown. Thalline margin: absent. Exciple: brown, paler than disc, sometimes slightly shiny, becoming excluded; in section: colourless to pale brown in outer part, brown in inner part. Hypo- 
phae developing distinct lumina towards exterior, lumina sometimes almost circular in outermost part. Epithe-

cium: very pale yellow-brown, K-. Hymenium: 75 µm tall, colourless. Hypothecium: dark orange-brown in upper 50 µm, pale orange-brown in lower 150 µm, K-. Paraphyses: simple, apparently of two types in material seen (? parasymbiont present); narrow type 1 µm wide in lower part, 2 µm at apex, without visible septa; broad ones: 5 - 7 µm at apex, often capitate, sometimes ±moniliform, with visible septa. Asci: Porpidia type. Ascospores: colourless, simple, narrowly ellipsoid, one end often slightly pointed, 10 - 13 x 4 - 5 µm, with warted perispore, 8 per ascus, sometimes ±uniseriate. Chemistry: thallus K-, C-, KC-. Photobiont: green. Scattered on the mainland, with no clear pattern. Overgrowing bryophytes on bark or soil, at altitudes 200 - 1500 m. Reported for much of Europe, though in Mediterranean regions probably confined to the uplands. However, the Mediterranean taxon may not be conspecific with that of northern Europe. Also Asia (Turkey, Russia, China, Japan), N. America (widespread). Mycobilimbia tetramera (De Not.) Vitik. et al ex Hafellner & Türk (2001) Stapfia 76: 154; Bilimbia tetramera De Not. (1846), Giorn. Bot. Ital. ann. 2, 1(1): 191; Bilimbia obscura f. fusca (A. Massal.) Vain.; Bilimbia obscura f. rhypara (Vain.) Szatala. Descriptions: Nash et al. (2004); Smith et al. (2009). Scattered, in northern Greece. Overgrowing bryophytes or decaying vegetation, usually at altitudes above 1000 m, though there is a single report for just 200 m. There are reports from many parts of Europe. Also Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps C. America. Mycocalicium Vain. (1895) Jahrh. wiss. Bot. 28: 84. Type: M. parietinum (Ach.) Vain.. Family: Sphinctrinaceae. Literature: Tibell (1987) has good descriptions of all European species, except the recently described M. llimonae, for which see Muñiz & Hladun (2007). Ahti et al. (1999), Muñiz & Hladun (2011); Nash et al. (2007) and Smith et al. (2009) are also helpful. The genus is not lichenised. Many species are saprobic. However the 18 or so species that occur on bark or wood superficially resemble many lichenised and lichenicolous taxa that occur in the same habitats, and have often been studied by lichenologists. 11 Central part of stalk colourless in section. 22 Apothecia 0.8 - 1.8 mm tall. Head 100 - 400 µm wide. Stalk shining black, 80 - 100 µm wide; in section reddish in outer part. (M. victoriae) 2 Apothecia to 0.4 mm tall. Head 25 - 200 µm wide. Stalk brown to white, to 50 µm wide; in section ±colourless everywhere. (M. llimonae) I Central part of stalk dark greenish to dark brownish in section. 22 Base of exciple with large (8 - 13 µm), thin walled, isodiametric cells. M. albonigrum 2 Base of exciple of 3 - 4 layers of periclinal, sclerotized hyphae (or cellular with rather small, 4-6 µm, cylindrical or isodiametric cells with thickened walls). M. subtile Mycocalicium albonigrum (Nyl.) Fink (1935) Lich. Fl. U.S. 72; Calicium parietinum * C. (= subsp.) albonigrum Nyl. (1860), Syn. Meth. Lich. 1(2): 159. Thallus: absent. Ascomata: ±mazaedia. Stalk: 0.2 x 0.05 - 0.75 mm, black; in squash: dark brown, of hyphae ±parallel to axis. Head: 0.1 - 0.15 mm diameter, black. Exicle: black; in squash: dark brown, lower part with large, thin walled, isodiametric cells, 6 - 10 µm diameter. Ascii: 40 x 8 m, cylindrical, somewhat persistent. Ascospores: brown, simple, ellipsoid, 7 - 9 x 3.5 - 4 µm, without distinct ornamentation (at x400), 8 per ascus, distinctly uniseriate. Photobiont: absent. Corfu and NW Sterea Elada, on wood of Olea europea at altitudes 20 - 50 m. A species of warm-temperate to subtropical regions. Apoarently very rare in Europe (only Greece, Ukraine and Russian Caucasus) but easily confused with M. subtile and perhaps overlooked. Also Asia (Japan), Malesia (PNG), N. America (widespread), C. America (CR, Guatemala, Mexico), S. America (Brazil, Venezuela), Australasia (widespread).
Myccocalicium subtile (Pers.) Szatala (1925)


Descriptions: Ahti et al. (1999); Muñiz & Hladun (2011); Nash et al. (2007); Smith et al. (2009); Tibell (1987).

Scattered, with no clear pattern. On wood, less commonly bark, at altitudes 0 to about 2000 m. Some reports may refer to *M. albignum*.

Widespread in Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread), C. America (Guatemala, Mexico), S. America (Brazil), Australasia (widespread).

Myriolecis Clem. (1909)

in: Gen. Fung. 79. Type: *M. sambuci* (Pers.) Clem., the only species originally included. Family: *Lecanoraceae*.

Literature: Most species are treated in the standard Floras, under *Lecanora*. Sliwa (2007a) is helpful.

A recently resurrected segregate from *Lecanora* s.lat. Species of *Myriolecis* lack atranorin.

Thallus: crustose, inconspicuous to well developed, white or grey in most species, without vegetative propagules.

Cortex: true cortex absent; pseudocortex present, often with crystals. Medulla: white (if present). Apothecia: usually present, immersed to sessile, rounded, slightly concave to slightly convex, 0.25 - 0.8 (1.1) mm diameter, pruinose or not. Disc: usually pale brown to dark brown; green-brown in some species, K-, C- or C+ orange. Thalline margin: present, usually white. Excipule: not visible externally, usually poorly developed in section. Epithecium: brown, orange-brown or grey-brown, sometimes with crystals, K+, most pigment soluble in K. Hymenium: 40 - 90 µm tall, colourless or almost, KI+ blue. Hypothecium: 25 - 125 µm tall, colourless. Paraphyses: usually simple in most species, in others branched and occasionally anastomosed in upper part, 1 - 2 µm wide at base, 1 - 3 µm at apex, occasionally slightly capitate, not moniliform. Asci: usually clavate, sometimes ±cylindrical or ±globose, Lecanora type. Ascospores: colourless, simple, ellipsoid, sometimes with distinct Lecanora type wall, 8 - 13 x 5 - 8 µm, usually 8 per ascus. Chemistry: medulla K-, C+ or C+ yellow, orange or red-orange, P-, I-; thallus and thalline margin K-, C- or C+ yellow, orange or red-orange, P- or almost, UV- or UV+ orange. Photobiont: green.

About 28 species, of which 27 occur in Europe. Most occur on calcareous rock, a few on bark or siliceous rock. The genus is fairly common in Greece, but some species are difficult to separate.

11 Thallus with lobed margin.

22 Marginal lobes distinctly convex. Thallus usually no more than 1 cm diameter (but adjacent thalli may coalesce), yellow-white to pale salmon-pink below pruina, K+ orange-yellow. Probably restricted to the uplands. *M. reuteri*

2 Marginal lobes flat to slightly convex. Thallus to 3 cm diameter (though collections with small thalli are common), white to yellow-green below pruina, K+ pale yellow. Not restricted to uplands. *M. pruinosa*

1 Margin of thallus not lobed.

22 Thallus or thalline margin C+ red, orange or very yellow. On rock.

33 On calcareous rock.

44 Epithecial granules not soluble in K. Usually associated with runoff from siliceous rock. (M. antiqua)

4 Epithecial granules soluble in K. Not associated with runoff from siliceous rock. *M. congesta*

3 On siliceous rock.

44 Disc P+ orange. *M. fugiens*

4 Disc P-. 55 Thallus well developed, granular. Hypothecium with large yellow or pale orange crystals). On coastal rock. *M. oyensis*

5 Thallus rather poorly developed. Hypothecium without large crystals. (M. invadens) Greek reports need confirmation.

2 Thallus and thalline margin C- or C+ faintly yellow. On bark, wood or rock.

333 On bark or wood.

44 Asci with 16 - 32 ascospores. *M. sambuci*

4 Asci with 8 ascospores.

55 Epithecial granules not soluble in N. Disc usually pruinose. Thalline margin paler than disc. (M. juniperina)

5 Epithecial granules soluble in N.

66 Disc not pruinose (rarely slightly pruinose). Thalline margin dark grey, not contrasting strongly with disc, and not distinctly raised above level of disc. Young apothecia often in groups of 2 or 3. *M. persimilis*
6 Disc usually (but not always) pruinose. Thalline margin white-grey, contrasting strongly with disc, and distinctly raised above level of disc. Apothecia evenly distributed, not in groups. **M. hagenii**

33 On calcareous rock, or on other lichens on calcareous rock.

44 Apothecia sessile, even when young.

55 Apothecia not pruinose, disk black, or darkening with age and eventually becoming ± black. **M. prominens**

5 Apothecia not pruinose, or disc not black; colour of disc not varying much with age.

66 Thalline margin regularly and even crenulate; crenulations separated by distinct radial striations.

Disc usually pruinose. Thallus immersed to thinly superficial. Epithecial granules coarse. **M. crenulata**

6 Thalline margin not or only slightly crenulate, without distinct, regular radial striations (though there may be some fine radial gaps, illustrated in Figure 39 in Sliwa, 2007a). Disc pruinose or not. Thallus immersed to well developed.

7 Thallus superficial, usually well developed, forming small patches, ± areolate.

88 Thallus patches to about 1 cm diameter. Areoles often discrete, pruinose, thin (to 0.3 mm), not hard. **M. albescens**

8 Thallus to 4 cm diameter. Areoles contiguous, chalky but not pruinose, thick (0.5 - 1 mm), hard. **M. prophetae-eliae**

7 Thallus immersed or poorly developed (Note 1).

88 Thallus UV-. Epithecial granules not soluble in K. **M. dispersa**

8 Thallus UV+ yellow or orange. Epithecial granules soluble in K. **M. semipallida**

4 Apothecia ± immersed, at least when young.

55 Apothecia black, even when young.

66 Apothecia remaining immersed. **M. agardhiana** subsp. **agardhiana**

6 Apothecia eventually becoming raised above level of thallus. (M. agardhiana subsp. catalaunica)

5 Apothecia pale, at least when young.

66 Apothecia ± immersed even when mature. **M. bandolensis**

6 Mature apothecia not immersed. **M. poeltiana**

3 On siliceous rock.

44 Thallus of dispersed, rounded granules. (M. salina)

4 Thallus usually inconspicuous. **M. hagenii**

(1) Neither species in this branch has a well-developed thallus, but both may be parasitic on other lichens that do have a well-developed thallus, which can cause confusion.


Descriptions: Clauzade & Roux (1985); Sliwa (2007a); Smith et al. (2009), all as *Lecanora agardhiana*.

Reliably reported from the islands of Amorgos, Chios and Ikaria. There are reports from many parts of Greece, on calcareous rock at all altitudes, but most are old and some may be unreliable because the name may have been misapplied to black-fruited species of *Caloplaca*. The lichenicolous fungi *Arthonia apotheciorum* and *Muellerella pygmaea* have each been recorded once on this lichen.

Widespread to as far north as British Is and Baltic States. Also western Asia (widespread to as far east as Iran), N. Africa (Morocco, Algeria, Egypt), N. America (Oklahoma), Australasia (Campbell Is).

**Myriolecis albescens** (Hoffm.) Sliwa, Z. Xin & Lumbsch (2016) in Xin et al., *Fungal Diversity* 78: 300; *Psora albescens* Hoffm. (1796), Deutschl. Fl. 2: 165; *Lecanora albescens* (Hoffm.) Branth & Rostrup; *Lecanora galactina* Ach.; *Lecanora urbana* (Nyl.) Leight.

Thallus: crustose, forming small circular patches to about 1 cm diameter, white, pruinose, areolate, without vegetative propagules. Areoles: discrete, sometimes scattered, flat to slightly convex, subrounded, 0.25 - 0.5 mm wide, about 0.25 mm thick. Cortex: true cortex absent; pseudocortex: opaque, filled with very fine polarising granules, individual crystals not visible except for surface pruina. Medulla: crystals as for cortex. Apothecia: subimmersed to subsessile, flat, 0.4 - 0.6 mm diameter, not to slightly pruinose. Disc: pale brown. Thalline margin: thick, persistent, regular (not crenulate); in section: 100 - 110 µm wide, with a fine polarising effect everywhere but individual crystals only visible at surface pruina, polarising effect persisting in K. Exciple: not visible externally, poorly developed in

The small rounded patches with ± discrete areoles are distinctive, and this species is unlikely to be confused with any other. *M. pruinosa* has a continuous, thicker thallus and reacts C+ orange.

Common in the southern half of Greece, less so in the north. Usually near the sea. On rock, usually calcareous. Recorded from all altitudes, but two-thirds of reports are from below 400 m.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread), S. America (Argentina), Australasia (NZ, NZS).

**Myriolecis bandolensis** (de Lesd.) M. Bertrand, Cl. Roux & Nimis (2016)


Description: Clauzade & Roux (1989) as *Lecanora bandolensis*.

Islands of the Aegean, on calcareous rock at altitudes 0 - 200 m.

A rarely recorded species of southern Europe, from Spain to Greece. Not reported for other continents.

**Myriolecis congesta** (Clauzade & Vězda) M. Bertrand & Cl. Roux (2016)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as *Lecanora congesta*.

Chios, on coastal limestone at an altitude of about 5 m.

Ireland, France (Provence), Spain (Catalonia), Italy and Greece only.

**Myriolecis crenulata** (Hook.) Śliwa, Z. Xin & Lumbsch (2016)


Description: Śliwa (2007a) is best; or see Nash et al. (2004); Smith et al. (2009); all as *Lecanora crenulata*.

Scattered throughout Greece. On calcareous rock at all altitudes.

Widespread as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread, mainly in western half), C. America (Mexico), Australasia (NZ, perhaps Australia). Reports for S. America may be unreliable.

**Myriolecis dispersa** (Pers.) Śliwa, Z. Xin & Lumbsch (2016)

*Fungal Diversity* 78: 300; *Lichen dispersus* Pers. (1794), Ann. Bot. Usteri 7: 27; *Lecanora albescens* f. deminuta (Stenh.) Th. Fr.; *Lecanora albescens* var. deminuta (Stenh.) J. Steiner; *Lecanora crenulata* f. dispersa (Pers.) Arnold; *Lecanora dispersa* (Pers.) Flörke; *Lecanora dispersa* var. pruinosa Anzi ex Arnold; *Lecanora hagenii* var. lithophila (Wallr.) Flörke.; *Lecanora hagenii* var. saxigena J. Steiner.

Descriptions: Śliwa (2007a), Smith et al. (2009), both as *Lecanora dispersa*.

Collections in which the thalline exciple has radial cracks could be confused with *L. crenulata*, but that species has an obviously crenulate thalline exciple. In *M. dispersa*, apart from the cracks the exciple is regular (or at most slightly wavy in very old apothecia). Also, *M. crenulata* usually has a more pruinose disc.

Throughout Greece, at all altitudes. Usually directly on calcareous rock, sometimes overgrowing (?) parasitic on other lichens on calcareous rock. Much less commonly on bark or base-rich siliceous rock, and recorded once on an old bone. The lichenicolous fungi *Arthonia apotheciorum*, *Muellerella pygmaea* and *Zwackhiomyces inconspicuus* have each been reported once from this lichen.

Subcosmopolitan outside the tropics.

**Myriolecis fugiens** (Nyl.) Śliwa, Z. Xin & Lumbsch (2016)

*Fungal Diversity* 78: 301; *Lecanora fugiens* Nyl. (1873), Flora 56: 289.

Descriptions: Clauzade & Roux (1985); Śliwa (2007a); Smith et al. (2009), all as *Lecanora fugiens*.

Chios on siliceous rock at an altitude of 110 m.

Throughout Europe where there are coastal siliceous rocks. Also Macaronesia, North America (widespread), C America (Mexico), S America (Argentina).

**Myriolecis hagenii** (Ach.) Śliwa, Z. Xin & Lumbsch (2016)

Thallus: crustose, inconspicuous to immersed, without vegetative propagules. Apothecia: subsessile, flat, 0.45 - 0.75 mm diameter. Disc: brown, slightly white pruinose on disc. Thalline margin: present, white, persistent, 0.1 mm wide, slightly irregular but not crenulate; in section: 90 - 105 µm wide, of which pseudocortex 40 - 50 µm wide; pseudocortex with abundant small crystals 1 - 2 µm wide. Excurrent: not visible externally, poorly developed in section. Epithecium: pale brown, with fine polarising granules, K-, pigment partly soluble in K. Hymenium: 50 - 60 µm tall, colourless. Hypothecium: 50 - 80 µm tall, colourless. Ascospores: colourless, simple, ellipsoid, 10 - 11 x 5 - 7 µm, with Lecanora-type wall, 8 per ascus. Chemistry: disc C-, thalline exciple K-, C-, P-. Photobiont: green, cells globose, 8 - 15 µm wide, slightly irregular but not crenulate; in section: 90 - 105 µm diameter.

Corticolous or lichenicolous collections, at least, are not very likely to be confused with other species provided that attention is paid to the details in the key. Epruinose collections could perhaps be confused with *M. persimilis*, but on present information that species is restricted to northern Greece.

Throughout Greece, at all altitudes. Usually on bark, occasionally on wood or rock. Reported from a wide range of phorophytes, with no marked preference. The lichenicolous fungus *Lichenodiplis lecanora* has been reported once on this lichen.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Bolivia, Colombia), Australasia (NZS), Antarctica (S. Shetland Is).

**Myriolecis oyensis** (M. Bertrand & Cl. Roux) M. Bertrand & Cl. Roux (2016)

Thallus: crustose, forming small patches to 1 cm diameter, occasionally well developed but more usually very thin and inconspicuous or almost white, without vegetative propagules. Apothecia: abundant, sessile, slightly concave to slightly convex, 0.25 - 0.6 mm diameter, not or only slightly pruinose, scattered to contiguous. Disc: pale brown to brown. Thalline margin: white, smooth, persistent, often rather narrow; in section: 50 µm wide. Excurrent: not visible externally; in section: 25 µm wide, poorly developed, scarcely distinguishable from hymenium. Epithecium: brown to orange-brown, K-, pigment soluble in K; with many granular crystals not soluble in K. Hymenium: 50 - 55 µm tall, colourless or with some pigmentation in upper part, KI+ blue. Hypothecium: colourless. Paraphyses: simple, or branched in upper part, occasionally anastomosed, sometimes slightly capitate or slightly moniliform. Ascii: 40 - 45 x 21 - 24 µm, clavate to subglobose, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 - 12 x 5 - 6 µm, without prominent wall, 8 per ascus. Chemistry: thalline exciple K- (or almost), C+ persistent red, KC+ red, P- (or almost). Photobiont: green, cells globose, 8 - 15 µm diameter.

The poorly developed thallus and thin thalline exciple make K and P spot tests difficult to interpret. However, the C+ red reaction is unmistakable. That and the saxicolous substrate ensure that this species is unlikely to be confused with any other.

Southern Peloponnese, on coastal siliceous rock.

Only France, Italy and Greece.

**Myriolecis persimilis** (Th. Fr.) Sliwa, Z. Xin & Lumbsch (2016)
*Fungal Diversity* 78: 301; *Lecanora hagenii* *L.* (= *subsp.*) *persimilis* Th. Fr. (1871), Lichenogr. Scand. 251-252; *Lecanora persimilis* (Th. Fr.) Arnold.

Descriptions: Sliwa (2007a); Smith et al. (2009), both as *Lecanora persimilis*.

Northern half of Greece, on bark at altitudes 0 - 1100 m.

Widespread in Europe to about Arctic Circle. Also Macaronesia, Asia (Turkey, Russia), N. America (widespread), S. America (Argentina).

**Myriolecis poeltiana** (Clauzade & Cl. Roux) Sliwa, Z. Xin & Lumbsch (2016)

Similar to *M. albscescens*, but with apothecia that are at first immersed in the thallus. They become subsessile later.

Collections with only mature apothecia can not be separated *L. albscescens*.

Islands of the Aegean, on calcareous rock at altitudes 0 - 300 m. It is said to be restricted to sites that receive salt spray, so is strictly coastal.

Only Mediterranean Europe, from Spain to Greece.

**Myriolecis prominens** (Clauzade & Vězda) Cl. Roux & Nimis (2016)

Description: Clauzade & Roux (1985) as *Lecanora prominens*.

Islands of the Aegean, including Crete. On calcareous, or at least basic rock at altitudes 0 - 1280 m.

Southern Europe, from Spain to Greece. Also Asia (Turkey).
**Myriolecis prophetae-eliae** (Sipman) Sipman & Cl. Roux (2016)


Description: See the protologue.

Islands of the southern Aegean, including southern Evia, on calcareous rock at altitudes 300 - 500 m.

Only Greece and Asiatic Turkey.

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**Myriolecis pruinosa** (Chaub.) Sliwa, Z. Xin & Lumbsch (2016)

*Fungal Diversity* 78: 301; *Lecanora pruinosa* Chaub. (1821) in Saint-Amans, Fl. Agen. 495; *Lecanora lagostana* Zahlbr.; *Lecanora sulphurella* (Körb.) Zahlbr. nom. inval (non Th. Fr.); *Squamarina pruinosa* (Chaub.) Duby; *Squamarina sulphurella* (Körb.) H. Olivier; *Squamarina sulphurella* (Körb.) H. Kleing, nom. inval.

Thallus: placodioid, white to green-grey, ±pruinose, almost cottony, to 4 cm diameter, 0.7 mm thick, without vegetative propagules. Marginal lobes: 1 - 1.5 x 0.2 - 0.6 mm, flat to slightly convex, not overlapping. Cortex: true cortex absent; pseudocortex 40 - 120 µm thick, colourless, without distinct structure, with abundant crystals not soluble in K or N. Medulla: white, chalky. Apothecia: subsessile to sessile, flat to slightly convex, rounded at first, sometimes contorted later, 0.3 - 1.1 mm diameter. Disc: pale brown to dark brown, sometimes almost black, often slightly white pruinose. Thalline margin: prominent, 0.12 mm wide, usually persistent, sometimes almost excluded in old apothecia; in places with crystals. Exciple: not visible externally in section: rather poorly developed, 15 - 20 µm wide, not very different from paraphyses, colourless, in places with crystals. Epithecium: brown, K-, N-, without crystals (except for overlying pruina). Hymenium: 25 - 75 µm tall, usually colourless, sometimes very pale brown. Paraphyses: simple, 1.5 µm wide at base, 1.5 - 2 µm at apex, sometimes with visible septa. Asc: 55 - 60 x 8 - 10 µm, ±cylindrical, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 - 12 (15) x 4 - 7 (8) µm, wall thin and not prominent, 8 per ascus, often uniseriate. Chemistry: thallus K-, C+ orange, KC+ more strongly orange, P-, I-, UV+ orange. Photobiont: green; cells globose, 8 - 15 µm diameter. Photobiont layer: 30 - 70 µm thick, ±regular but often discontinuous, cells sometimes forming well-separated clumps. Apothecial crystals are mostly soluble in K and insoluble in N. Those in the hymenium form vertical bands that seem to be related to individual paraphyses or groups of paraphyses.

This species can not be confused with any other. The thick, white, rather chalky or cottony placodioid thallus reacting C+ orange is distinctive. *Diploicia canescens* is not cottony, usually lacks apothecia, and reacts C+ reddish rather than orange.

Widespread and common in the southern half of Greece, scattered in the north. On calcareous rock from sea level to 1200 m, but commonest at low altitudes.

Mainly southern Europe, with scattered occurrences to as far north as England. Also Asia (widespread as far east as Tajikistan and southern Siberia), Africa (Algeria, Tunisia, Socotra), Australsasia (NZS). Reports for N. America may be incorrect.

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**Myriolecis reuteri** (Schae.) Sliwa, Z. Xin & Lumbsch (2016)


Descriptions: Clauzade & Roux (1985); Poelt & Vézda (1977), both as *Lecanora reuteri*.

Crete and Macedonia, on calcareous rock. The report from Crete and one of the reports from Macedonia were from low altitude, and may be unreliable. More plausible is Szatala's report from Mt. Olympus, at altitudes 1700 - 2400 m.

Southern and central Europe. Also Asia (Turkey, Tajikistan), N. Africa (Morocco, Algeria).

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**Myriolecis sambuci** (Pers.) Clem. (1909)


Descriptions: Clauzade & Roux (1985); Sliwa (2007a); Smith et al. (2009), all as *Lecanora sambuci*.

Rare and scattered, with no clear pattern. On bark at altitudes 350 - 800 m.

Widespread to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Lebanon, Russia, India), N. Africa (Morocco, Algeria), N. America (widespread).

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**Myriolecis semipallida** (H. Magn.) Sliwa, Z. Xin & Lumbsch (2016)


Thallus: crustose, usually inconspicuous, only well developed in small patches around some apothecia, white, to 3 cm diameter (inferred from distribution of apothecia). Apothecia: sessile, ±flat, 0.4 - 0.6 mm diameter, not pruinose. Disc: brown to olive-brown. Thalline margin: prominent, white, persistent; in section: 75 - 100 µm wide; alga-free outer part 35 - 60 µm wide, with abundant fine crystals forming a ±continuous mass, crystals not soluble in K, structure of

The C+ reaction makes this a fairly distinctive member of the genus. However, the reaction may be faint. The species is also well characterised by the brown crystalline granules, soluble in K, in the epithecium. Scattered, with no clear pattern.. On calcareous rock at altitudes 50 - 1300 m.

Distribution not well known, but seems to be present in much of Europe. Also Macaronesia, Asia (widespread), N. America (widespread), S. America (Argentina, Bolivia, Peru), Australasia (Australia, NZ), Antarctica.

Myriospora Nägeli ex Uloth (1861)


Myriospora smaragdula (Wahlenb. ex Ach.) Nägeli ex Uloth (1861)

Flora 44: 618; Endocarpon smaragdulum Wahlenb. ex Ach. (1803), Methodus (Suppl.) 29-30; Acarospora fuscata var. smaragdula (Wahlenb. ex Ach.) Stein; Acarospora smaragdula (Wahlenb. ex Ach.) A. Massal.

Myriospora smaragdula (Wahlenb. ex Ach.) Nägeli ex Uloth (1861)

Flora 44: 618; Endocarpon smaragdulum Wahlenb. ex Ach. (1803), Methodus (Suppl.) 29-30; Acarospora fuscata var. smaragdula (Wahlenb. ex Ach.) Stein; Acarospora smaragdula (Wahlenb. ex Ach.) A. Massal.

Myriospora smaragdula (Wahlenb. ex Ach.) Nägeli ex Uloth (1861)

Flora 44: 618; Endocarpon smaragdulum Wahlenb. ex Ach. (1803), Methodus (Suppl.) 29-30; Acarospora fuscata var. smaragdula (Wahlenb. ex Ach.) Stein; Acarospora smaragdula (Wahlenb. ex Ach.) A. Massal.

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Myriospora smaragdula (Wahlenb. ex Ach.) Nägeli ex Uloth (1861)

Flora 44: 618; Endocarpon smaragdulum Wahlenb. ex Ach. (1803), Methodus (Suppl.) 29-30; Acarospora fuscata var. smaragdula (Wahlenb. ex Ach.) Stein; Acarospora smaragdula (Wahlenb. ex Ach.) A. Massal.
This segregate from *Catapyrenium* s. lat. has 5 species, of which 4 occur in Europe. There are few Greek records.

11 Lower surface and rhizines black. **N. rhizinum**

1 Lower surface, and rhizines if present, pale.

22 Squamules attached to substrate by elongated basal ends. Rhizines absent. (N. cladonioideum)

2 Squamules attached to surface by pale rhizines. **N. latzelii**

**Neocatapyrenium latzelii** (Zahlbr.) Breuss (1996)


Kalimnos, on limestone and calcareous soil at an altitude of 80 m.

A rare species known only for Spain, Croatia, Serbia and Greece.

**Neocatapyrenium rhizinum** (Muell. Arg.) Breuss (1996)


Islands of the southern Aegean, and also Mt. Olympus. On calcareous soil at altitudes 0 - 2300 m.

In Europe, only Greece and Russia (Caucasus). Also western Asia (widespread as far east as Tajikistan).

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**Neofuscelia Essl.** (1978)


Literature: The nearest thing to a monograph is Elix (1977b), but it emphasises chemistry. Clauzade & Roux (1985) (under *Parmelia*), and Smith et al. (2009) (under *Xanthoparmelia*) are helpful, though both have a broad concept of some species and will be of limited use for those who wish to apply narrower species concepts.

Thallus: foliose, heteromerous, to several cm diameter. Lobes: to a few mm wide, usually adpressed, flat to moderately convex, not strongly convex, central part sometimes wrinkled, contorted, warty or crinkled, marginal part usually smooth. Upper surface: brown to dark brown, often green-brown at margins and occasionally elsewhere, usually matt except at margins which are often shiny, rarely with faint white pruina at extreme tips of lobes. Lower surface: dark brown to black in most species, paler brown in some, sometimes paler at margin, smooth, attached by rhizines. Isidia: present in some species. Pseudocyphellae: absent. Rhizines: simple, brown to black when mature, often white, or at least white at tips, when young. Sororia: absent. Upper cortex: to about 25 µm thick, orange-brown or brown, sometimes colourless in lower part, distinctly cellular at least in upper part; K-; C+ blue-green, N+ blue-green > (in some specimens) permanent dull mauve. Medulla: white, of loosely interwoven hyphae; hyphae 2.5 - 4 µm wide, usually without visible septa, in many species covered in small, colourless, angular crystals. Lower cortex: to about 25 µm thick, usually rather dark brown, distinctly cellular in outer part; K-; C-, N-. Apothecia: sessile to slightly stalked, rounded, concave when young, concave to flat when mature, large (to 5.5 mm diameter in some species), not pruinose. Disc: brown to dark brown, sometimes shiny when young. Thalline margin: present, smooth, thin but persistent. Excieple: poorly developed. Epithecium: orange-brown to brown, K-, pigment soluble in K. Hymenium: 35 - 50 µm tall, colourless. Hypothecium: about 50 µm tall, colourless. Paraphyses: simple, 2.5 - 3.5 µm wide, not capitate, upper part sometimes slightly moniliform and with distinct septa, coherent. Asc: Lecanora type. Ascospores: colourless, simple, ellipsoid, fairly small (typically about 10-11 x 5-6 µm), with Lecanora type wall, 8 per ascus. Pycnidia: common in some species, laminal, appearing externally as black dots about 0.05 mm diameter; in section: 100% immersed, globose, 120 - 150 µm diameter, mostly colourless, brown near ostiole. Conidia: colourless, straight, usually bifusiform, 5 x 0.5 - 1 µm. Chemistry: medulla with a complex and varied chemistry; thallus always UV-. Photobiont: green, cells globose, 8 - 12 µm diameter. Forming a continuous but sometimes slightly irregular layer.

Differs from other parmelioid genera with brown cortical pigmentation by the N+ blue-green, C+ blue-green reaction of the upper cortex.

**Neofuscelia** is close to *Xanthoparmelia*. Blanco et al. (2004) synonymised them, but *Xanthoparmelia* s. lat. is then an inconveniently large genus of 725 species, and for practical reasons is desirable to subdivide it. One of the subdivisions could be the group of species around *Parmelia pulla*, which clearly forms a monophyletic group in the results presented by Blanco et al. (2004). That group, if treated at generic rank, must be called *Neofuscelia*. *Neofuscelia* in that sense may eventually prove not to include all the species treated below, but none of them has yet been shown, by molecular evidence, not to belong to *Neofuscelia*. 
Over 130 species that some authors have placed in *Xanthoparmelia* s. lat. are brown, though it is not clear how many are congeneric with *N. pulla* and could be placed in *Neofuscelia*. They are widely distributed in temperate regions, though the centre of diversity is in the Southern Hemisphere, especially South Africa. They are normally saxicolous on siliceous rock.

*Neofuscelia* has a complex chemistry, and many species have been described on the basis of minor differences in medullary chemistry. Suffciently sophisticated investigations can uncover many minor chemical differences between collections in almost any group of lichens (and, indeed, of other organisms), but the biological basis of these differences in lichens is not understood and is never investigated. Using them uncritically to define species seems to me as unwise as the old practice of giving formal recognition to every trivial variation in morphology. In my opinion, many of these "species" should be synonymised. The key shows the narrow species concepts for those who wish to apply them, but in my own work I place in *N. pulla* any collection that matches it in morphology, spot tests and UV reaction.

When carrying out spot tests on the medulla, do not allow the reagents to come into contact with the cortex. If they do, they may mobilise some cortical pigment, giving confusing results.

1 Isidia present.

22 Medulla KC+ permanent orange, red-orange or brown-orange, often after a fleeting +purple-pink reaction (Note 1). Isidia usually in pustulate, cauliflower-like clusters; sometimes isolated and then ±globose (Note 2). Thallus pale brown to brown (not dark brown). **N. loxodes**

2 Medulla KC- or KC+ pink or red, the red colouration slowly fading (Note 1).

333 Isidia pustular, 65 - 170 µm diameter, sometimes slightly clustered. Medulla KC+ pink-red. (N. halei)

33 Isidia not pustular, usually somewhat elongate or even coralloid, sometimes clustered, 100 - 300 µm diameter (Note 2). Medulla KC- or KC+ pink or red. Thallus brown to dark brown (not pale brown). **N. verruculifera**

3 Isidia not pustular, very narrow (50 - 80 µm diameter). Medulla KC+ red. See *Melanelixia*

1 Isidia absent.

22 Medulla P+ yellow, K+ red, orange-red or red-orange (norstictic acid). **N. attica**

2 Medulla P-, K- or K+ dirty brown.

33 Thallus not strongly adpressed. Lobes narrow. Lower surface usually mostly pale. Usually on soil.

44 Thallus not or slightly dorsiventral. Upper and lower surface N+ blue. (N. ryssolea)

4 Thallus distinctly dorsiventral. Upper surface N+ blue, lower surface N-.

3 Thallus ±adpressed. Lobes not narrow. Lower surface dark or pale. On rock.

44 Medulla UV+ strongly blue-white (Note 3). Alectoronic and ±alpha-collatolic acids present. **N. glabrans**

4 Medulla UV- or UV+ weakly white or weakly pale green-white (Note 4).

55 Centre of upper surface very rough and wrinkled because of densely aggregated warts or papillae, each with a depression at apex, rather resembling premature apothecia. A pycnidium is often present within a wart. Divaricatic acid present as major compound. **N. perrugata**

5 Centre of upper surface smooth or irregular, but without such warts.

66 Lower surface largely or entirely pale brown.

77 Divaricatic or stenosporic acids present (TLC required). (N. luteonotata)

7 Divaricatic and stenosporic acids absent (TLC required). **N. pyrenaica**

6 Lower surface dark brown to black, sometimes paler at margin.

77 Upper surface strongly maculate. Glomelliferic, glomelic and perlatolic acids as major compounds. **N. delisei**

7 Upper surface usually not maculate (lobe tips sometimes weakly maculate). **N. pulla** by my species concept. If employing narrower species concepts (TLC required):

88 Stenosporic acid present as major compound. **N. pulla**

8 Divaricatic and stenosporic acids absent.

99 Phenolic substances (unidentified) present. **N. pyrenaica**

9 Fatty acids (unidentified) present. (N. pulloides)

(1) The KC reactions may be faint, and can then be misleading. If the +orange reaction of *N. loxodes* is faint, the preceding fleeting +purple-pink reaction can be confused with the fleeting +pink or +red reaction of *N. verruculifera*. If a specimen reacts KC- or only faintly KC+, test other parts of the same thallus. See also Note 2.

(2) Isidia in *N. verruculifera* are often darker than the thallus and rarely exceed 0.2 mm diameter. Isidia in *N. loxodes* are approximately the same colour as the thallus, and not uncommonly exceed 0.2 mm diameter.

(3) The blue tinge occurs in long-wave UV light but is more prominent in short-wave UV.

(4) According to published keys species in this branch have a UV- medulla. I have often seen a faint +white or +pale green-white fluorescence, but without any blue tinge. It is a true fluorescence, not a reflection of visible
wavelengths from the UV lamp, and it occurs even with a short-wave UV source.

**Neofuscelia attica** (Leuckert, Poelt & B. Schwarz) Essl. (1978)


Thallus: foliose, 6 - 10 cm diameter, 150 µm thick. Lobes: 0.5 - 3 mm wide, usually flat, adpress ed, wrinkled and contorted (and sometimes cracked) in older parts, at margins usually smooth or occasionally with faint network of ridges. Upper surface: dark brown, occasionally green-brown at margin, usually matt, sometimes shiny at extreme tips of lobes, rarely slightly white pruinose at lobe tips (last 0.5 mm). Lower surface: black, sometimes brown at extreme margin (last 0.5 mm), smooth, attached by rhizines. Isidia: absent. Rhizines: simple, white when very young, soon black, 0.3 x 0.05 mm. Upper cortex: 10 - 15 (35) µm thick, orange-brown to brown; cellular at least in upper part, cells rounded to subangular, 3 - 4 µm diameter; K- (pigment soluble), C+ blue-green, N+ fleeting blue-green > permanent dull mauve or dull brown-mauve, P-, UV+. Lower cortex: brown, dark brown, cellular; cells subrounded, 4 µm diameter. Apothecia: sometimes present, sessile to slightly stalked, slightly concave to flat, 1.1 - 3 mm diameter, not pruinose. Disc: dark brown, sometimes shiny when young. Thalline margin: present, thin but persistent, smooth, 0.1 mm wide; in section: 60 - 100 µm wide. Exciple: poorly developed, not visible externally; in section 25 µm wide, continuous with hypothecium. Epithecium: orange-brown, K-, pigment soluble in K. Hymenium: 45 µm tall, mostly colourless, sometimes orange-brown in upper part. Hypothecium: 50 µm tall, colourless. Paraphyses: 2.5 µm wide at base, 3 - 3.5 µm at apex, not capitate, sometimes slightly moniliform, septa visible in upper part. Asci: mature ones not seen. Ascospores: not seen. Pycnidia: usually present, laminal, black, 0.05 mm diameter; in section: 100% immersed, globose, 140 - 150 µm tall, 120 - 130 µm wide, mostly colourless, brown or blue-green near ostiole. Conidia: colourless, 5 - 10 x 0.5 - 1.5 µm, straight, usually bifusiform, occasionally fusiform. Chemistry: medulla K+ red-orange, orange or orange-brown (norstictic acid), C-, mostly colourless, brown or blue-green near ostiole. Conidiophores: colourless, 5 - 10 µm tall, mostly colourless, sometimes orange-brown in upper part of medulla, KC+ fleeting +red, P+ yellow > pale yellow-orange, UV+ shades of white; thallus UV-. Photobiont: green, cells 8 - 12 (17) µm diameter, forming a continuous layer 20 - 75 µm thick that is often irregular at upper boundary.

The distinctive spot test reactions with K and P clearly separate this taxon from the others in the genus. Widespread and fairly common in and around the Aegean; occasionally elsewhere. On siliceous, or at most weakly calcareous, rock at altitudes 0 - 1100 m.

Known only from Greece, Cyprus and Asia (Turkey).

**Neofuscelia delisei** (Duby) Essl. (1978)

*Mycotaxon* 7(1): 50; *Parmelia olivacea* β (= var.) *delisei* Duby (1830), Bot. Gall. 2: 602; *Parmelia delisei* (Duby) Nyl.; *Parmelia pulla* var. *delisei* (Duby) H. Magn.; *Xanthoparmelia delisei* (Duby) O. Blanco et al.

Descriptions: Clauzade & Roux (1985) as *Parmelia pulla* var. *delisei*; Esslinger (1977b) as *Parmelia delisei*; Smith et al. (2009) as *Xanthoparmelia delisei*; Thell & Moberg (2011) as *Xanthoparmelia delisei*.

Scattered, in and around the Aegean, with no clear pattern, on rock at altitudes 25 - 1400 m. Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), southern S. America (Argentina, Chile), Australasia (widespread in eastern half of Australia).

**Neofuscelia glabrans** (Nyl.) Essl. (1978)

*Mycotaxon* 7(1): 50; *Parmelia glabrans* Nyl. (1875), *Flora* 58: 15; *Xanthoparmelia glabrans* (Nyl.) O. Blanco et al.

Thallus: foliose, 3.5 cm diameter. Lobes: adpressed, ± wrinkled in centre of thallus. Upper surface brown, without any green tinge. Lower surface: brown at margins, attached by rhizines. Isidia: absent. Rhizines: simple, brown, 0.15 x 0.05 mm. Medulla: white. Apothecia: sessile to slightly stalked, concave, 0.7-1.6 mm diam. Pycnidia: laminal, black. Chemistry: medulla K-, C-, KC- or C+ faint but persistent dull orange in upper part of medulla, KC+ fleeting +red, P+ yellow > pale yellow-orange, UV+ shades of white; thallus UV-. Easily separated from the other non-isidiate Greek species of the genus by the UV+ blue-white reaction of the medulla. Clauzade & Roux (1985) suggest that it can be separated from *N. delisei* and *N. pulla* by having a green-brown tinge on at least part of the upper surface, but in my experience that is not a reliable character, perhaps because colour of the thallus in *Neofuscelia* can be influenced by the intensity of insolation.

Peloponnese and Crete, on siliceous rock at altitudes 0 - 450 m. Southern Europe, from Spain to Greece, plus a doubtful report for Austria. Also Macaronesia, Asia (Turkey, Syria, Mongolia), Africa (Morocco, Algeria, S. Africa), southern S. America (Argentina, Chile), Australasia (widespread), Antarctica (Macquarie Is).
Neofuscelia loxodes (Nyl.) Essl. (1978)

Mycotaxon 7(1): 51; Parmelia loxodes Nyl. (1872), Flora 55: 426; Parmelia isidiotyla Nyl.; Xanthoparmelia loxodes (Nyl.) O. Blanco et al.

Thallus: foliose, to 7 cm diameter. Lobes: 1.2 - 4 mm wide, about 0.3 mm thick, adpressed, not convex, sometimes wrinkled in central parts; younger parts often with distinct network of ridges, ridges often developing into cracks in cortex later. Upper surface: brown, sometimes pale brown or green-brown in places, often shiny at lobe margins, matt elsewhere, sometimes slightly white pruinose at tips (last 1 mm) of lobes. Lower surface: black in central parts, often pale brown to brown at margin, smooth, attacked by rhizines. Rhizines: black, sometimes white to pale brown when young, simple, 0.4 - 0.7 x 0.05 mm. Isidia: present, mainly in central part of thallus; sometimes isolated, globose to subglobose, 0.15 - 0.25 mm diameter; usually forming clusters 1 - 1.5 mm diameter, clusters sometimes agrading and leaving a white patch. Pseudocyphellae: absent. Soralia: absent. Upper cortex: 15 - 20 µm thick, upper part pale orange-brown to pale green-brown, lower part often colourless, ±cellular; cells ±rounded, 2 - 4 µm diameter.; K-, C+ blue-green, N+ blue-green (reaction sometimes patchy, often strongest in upper half of cortex). Medulla: white, 80 - 100 µm thick, of loosely interwoven hyphae about 3 µm wide; hyphae covered in small, colourless crystals about 0.5 - 1 µm diameter. Lower cortex: 12 µm thick, dark brown; cellular in outer part; K-, N-. Apothecia: sometimes present but not abundant, sessile, concave, 0.35 - 1.5 mm diam, not pruinose. Disc: olive-brown, smooth, slightly shiny. Exciple: not visible externally; in section: 15 - 20 µm wide, pale orange-brown near surface, colourless elsewhere, outer part ±cellular; cells rounded, 2 - 3 µm diameter. Thalline margin: present, often isidiate, thin but persistent, 0.05 mm wide, same colour as disc; in section: 25 - 50 µm wide on sides of apothecia, thicker on lower surface. Epithecium: brown, K-, N-, some pigment soluble in K. Hymenium: 45 - 50 µm tall, colourless. Hypothecium: 30 - 40 µm tall, colourless, of two distinct layers; upper layer 8 - 10 µm thick, of anastomosized hyphae on an overall horizontal trend; lower layer obscures cellular with no preferred orientation. Paraphyses: simple, rather broad, 3 µm wide, not capitate, septa clearly visible. Asci: 33 - 35 x 14 - 15 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8.5 - 10 x 5 - 6 µm, 8 per ascus. Pycnidia: often present, laminal, black, t 0.05 mm diameter; in section: 100% immersed, globose, 125 x 125 µm, colourless except for a brown patch near ostiole. Conidia: colourless, 5 x 0.5 µm, bifusiform. Chemistry: medulla K-, C-, KC+ fleeting pink-purple or dull purple > permanent orange, P-, I- (or almost), UV+ white; thallus UV-. Photobiont: green; cells globose, 10 - 12 µm diameter, forming a continuous layer 25 µm thick.

The ridges on the upper surface can briefly resemble a network of white pseudocyphellae before they develop into cracks. However, the medullary hyphae do not grow up into the crack, and true pseudocyphellae are not present.

For separation from N. verruculifera see under that species.

Scattered throughout Greece, but not common. On siliceous rock, or occasionally overgrowing bryophytes thereon, at altitudes 0 - 1450 m. Most reports are from close to the sea, but it can occur well inland.

Widespread in Europe to as far north as mid-Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Ethiopia), N. America (widespread in western half), perhaps S. America (Argentina).

Neofuscelia perrugata (Nyl.) Elix (2002)

Australasian Lichenology 51: 8; Parmelia perrugata Nyl. (1885), Flora 68: 295-296; (?) Parmelia perrugata subsp. petitmeningii Harm.; Parmelia prolisae var. perrugata (Nyl.) Harm.; Xanthoparmelia perrugata (Nyl.) O. Blanco et al.

Thallus: foliose, to 8 cm diameter, about 350 mm thick. Main lobes: 15 - 20 x 2 - 3 mm, repeatedly branched towards tips, flat to slightly convex, not adpressed. Upper surface: brown to dark brown, sometimes with slight white maculation near lobe tips, strongly warted & wrinkled in older parts; warts 0.15-0.35 mm diam, with distinct depression towards tips, flat to slightly convex, not adpressed. Lower surface: very dark brown to black, attached by rhizines. Isidia: absent. Rhizines: simple, black, 0.5 x 0.05 mm. Upper cortex: 12 - 30 µm thick, pale orange-brown to brown in outer part, usually colourless in inner part, distinctly cellular; cells subrounded, 4 - 5 µm diameter; K-, C+ blue-green, N+ blue-green (N reaction patchy). Medulla: white, of loosely interwoven hyphae 3 - 4.5 µm wide, hyphae sometimes with a few, small external crystals. Lower cortex: 18 - 25 µm thick, dark brown, distinctly cellular; cells 6 - 9 x 5 - 6 µm, long axis (when there is one) predominantly vertical; K- Pycnidia: black, 0.05 mm diameter; in section: globose, 100% immersed, 150 tall, 170 µm wide. Conidia: colourless, straight, bacilliform (not bifusiform), 5 x 1 µm. Chemistry: medulla K-, C-, KC- or KC+ fleeting pink, P-, I-, UV+ faintly white by reflection (no blue tinge); thallus UV-. Photobiont green, cells globose to subglobose, 9 - 13 µm diameter. Photobiont layer: 25 - 75 µm thick, ±continuous, often irregular especially on upper surface.

Many authors regard N. perrugata as a synonym of N. pulla. If Greek material that I have seen is representative, that view is difficult to accept.

Easily recognised by the warts on the upper surface, which are very distinctive and unlike anything I have seen in any other lichen. They are well described in Galun (1970: 64). Specimens referred by me to N. pulla have an upper surface which varies from smooth to slightly or moderately wrinkled, but never have anything resembling these warts.

Widely distributed in the south and east of Greece (though not yet reported for Crete); almost absent from the north and west. On siliceous rock at altitudes 10 - 1750 m.
Distribution difficult to assess, owing to confusion with other species. It seems to be predominantly southern in Europe, but may also be present in British Is. Also Asia (widespread as far east as Iran), N. Africa (Morocco, Tunisia, S. Africa), Australasia (NSW).

Neofuscelia pokornyi (Körb.) Esssl. (1978)


Description: Esslinger (1977b) as Parmelia pokornyi.

Crete and Macedonia. On rock and soil at altitudes 1100 - 1300 m.

An infrequently recorded species of southern and central Europe. Also Asia (Turkey, Kazakhstan, southern Siberia).

Neofuscelia pulla (Ach.) Esssl. (1978)


Thallus: foliose, to 8 cm diameter, 400 - 500 µm thick (140 - 240 mm in young lobes). Lobes: 0.5 - 1 (2.5) mm wide, flat to slightly concave, without well-defined ridges but sometimes wrinkled or convoluted, occasionally cracked in older parts, sometimes overlapping, adpressed. Upper surface: usually brown or dark brown, sometimes green-brown at margins, occasionally green-brown over most of upper surface, mostly matt, sometimes shi by margin, rarely slightly white pruinose at extreme tips (last 0.2 - 0.5 mm) of young lobes, smooth to wrinkled, occasionally strongly wrinkled but never with distinct warts. Lower surface: dark brown to black, sometimes pale brown to brown at margin, smooth, attached by rhizines. Isidia: absent. Rhizines: simple, black, sometimes white near margins of lobes, 0.2 - 0.5 (1.0) x 0.05 (0.1) mm; when mature with a core, forming about one-third of their total diameter, of colourless hyphea with a structure resembling that of the medulla, and contiguous with the medulla, surrounded by a sheath of dark brown hyphea structured like and contiguous with the lower cortex. Upper cortex: 10 - 25 µm thick, pale orange-brown, sometimes colourless in lower part, weakly cellular, cells subrounded, 2 - 4 µm diameter; sometimes with numerous remnants of algal cells in lower part; C+ blue-green, N+ blue-green, both reactions sometimes faint and/or patchy. Medulla: white, 75 - 200 µm thick, of loosely interwoven hyphea 2.5 - 4 µm wide, usually without visible septa, with many small crystals about 0.5 mm diameter. Lower cortex: 12 - 25 µm thick, usually dark brown, occasionally orange-brown; outer part distinctly cellular; cells about 3 mm diameter; C-, K-.

Apothecia: sessile to slightly stalked, rounded, concave, 0.8 - 5.5 mm diameter, not pruinose. Disc: brown to dark brown, rarely green-brown sometimes shiny when young. Thalline margin: present, smooth, thin (0.1 mm) but persistent; in section: 100 - 180 µm wide, of which cortex 12 - 15 µm; cortex K+ blue. Exciple: poorly developed, even in section. Epithecium: pale orange-brown to brown, K-.

Pigment soluble in K. Hymenium: 35 - 50 µm tall, colourless. Hypothecium: 50 - 55 µm tall, colourless to very pale brown. Paraphyses: simple, 3.5 µm wide, not capitate, upper part sometimes slightly moniliform and with distinct septa, coherent. Asc: subcylindrical to clavate, 30 x 13 µm, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 11 x 5 - 6 µm, with Lecanora type wall, 8 per ascus. Pycnidia: often present, laminal, black, 0.05 - 0.07 mm diameter; in section: 100% immersed, globose, 150 x 150 µm, wall pale brown. Chemistry: medulla K-, usually C- or patchily C+ faint to very faint but permanent dull brown), KC- or KC+ faint to very faint but permanent dull brown, P-, UV usually + faint white or faint pale green-white (fluorescence never blue-white and never strong); thallus UV-. Photobiont: green; cells globose, 10 - 12 µm diameter, forming a continuous, rather irregular layer layer 35 - 100 µm thick.

In a few specimens (and sometimes in specimens of other closely related species) there are very small spots, localised of intense UV+ blue (not blue-white) fluorescence, in both long-wave and short-wave UV. This fluorescence appears to come from the lichen itself, not from a contaminant. Its source is unclear.

N. pulla does not have really distinctive characters of its own. It is determined by excluding other possibilities.

Common throughout Greece, at altitudes 0 to about 1500 m. Almost always on siliceous rock. However, some reports, especially older ones, might refer to other species.

Throughout Europe, except for arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), perhaps S. America (Argentina, Chile), Australasia (widespread). Reports for N. America may be incorrect. However, some reports may be using the name N. pulla in a very broad sense.

Neofuscelia pyrenaica (Essl.) Esssl. (1978)


Description: Esslinger (1977b) as Parmelia pyrenaica.

Rhodes. No altitude or substrate information was published.

Spain, France, Greece and Cyprus. Also Africa (Morocco, S. Africa).
N. verruculifera (Nyl.) Essl. (1978)
Mycotaxon 7(1): 53; Parmelia verruculifera Nyl. (1878), Flora 61: 247; Parmelia glomellifera (Nyl.) Nyl.; Parmelia prolixa var. glomellifera Nyl.; Xanthoparmelia verruculifera (Nyl.) O. Blanco et al.

Thallus: foliose, 3 cm diameter. Lobes: to 1 mm long, 0.1 - 1 mm wide, usually ± elongate, 160 - 190 mm thick when young. Flat to slightly convex, not or only weakly ridged, sometimes slightly overlapping, often adpressed, often branched or at least with tips incised. Upper surface: brown, mostly matt, sometimes shiny at lobe tips, sometimes slightly white pruinose at tips of lobes (final 0.2 - 0.5 mm), smooth. Lower surface: brown at margin, black in centre, smooth, attached by rhizines. Isidia: usually laminal, globose to cylindrical, 0.1 - 0.2 mm diameter, isolated or aggregated into clusters to 0.7 mm diameter. Pseudocyphellae: absent. Rhizines: dark brown to black when mature, sometimes with white tip when young, simple, 0.5 x 0.05 mm. Soralia: absent. Upper cortex: 13 - 18 mm thick, orange-brown, cellular; cells subrounded, 5 mm diameter; K+ intensifying orange-brown, C+ blue-green (upper part only), N+ fleeting blue-green > permanent dull mauve. Medulla: white, 60-100 mm thick, of loosely interwoven hyphae 2.5 mm wide and covered in colourless crystals 0.5 - 1 mm wide. Lower cortex: 15 - 25 mm thick, brown to dark brown, cellular at least in outer part; cells square, about 6 x 6 mm; N-, K-. Apothecia: uncommon, 0.85 mm diameter, concave, not pruinose. Disc: brown. Thalline margin: brown. Exciple: not visible externally. Pycnidia: fairly common, laminal, black, 0.02 mm diameter; in section: 100% immersed, globose, 150 x 150 µm, wall colourless or almost. Conidia: colourless, bacilliform to bifusiform, 5 - 7 x ¾ µm. Chemistry: medulla K-, C+ faintly fleeting red, KC+ fleeting purple-pink > red (which fades slowly but does not entirely disappear), P-, I-, UV+ white; thallus UV-. Photobiont: green; cells globose to subglobose, 9 - 13 x 7 - 11 mm, long axis (if present) usually vertical. Photobiont layer: 25 - 50 mm thick, continuous, layer slightly irregular, upper and lower boundaries distinctly undulating.

Well-developed isidia are more elongate than those of N. loxodes and have less tendency to form clusters. Collections with younger isidia are best separated from N. loxodes by the chemistry of the medulla. Scattered, with no clear pattern. On siliceous rock at altitudes 0 - 600 m. Widespread in Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread, mainly in western half), C. America (Mexico)

Nephroma Ach. (1809)


Literature: James & White (1987) is a monograph of the European species. Ahti et al. (2007), Burgaz & Martínez (2003), and Smith et al. (2009) are also useful.

Differs from other genera in Peltigerales in having apothecia on the lower surface of the lobes. About 39 species, 11 of which occur in Europe.

111 Lower surface distinctly tomentose, with pale raised papillae. N. resupinatum
11 Lower surface not tomentose but distinctly pubescent, without papillae. N. helveticum
1 Lower surface not tomentose or pubescent, ±smooth or with small ridges or folds.
22 Medulla yellowish, K+ purplish.
   33 Marginal folioles absent (laminal ones may be present) (Note 1). Apothecia usually present. N. laevigatum
   3 Marginal folioles present and sometimes abundant. Apothecia usually absent. N. tangeriense
2 Medulla white, K- or K+ yellow.
   33 Soredia present. N. parile
   3 Soredia absent. N. bellum

(1) Damaged lobes of Nephroma laevigatum may produce a few marginal folioles when regenerating, but undamaged lobes do not have them.

Nephroma bellum (Spreng.) Tuck. (1840)

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985, 1989); Nash et al. (2002). Kefallonia only. (The doubtful report for Peloponnese in Abbott (2009) was the result of a data entry error.) On bark of Abies cephalonica at about 1500 m. This report is in need of confirmation; it may refer to N. laevigatum.

Throughout much of northern Europe, but in central Europe confined to the mountains. Rare in southern Europe, and confined to northern parts or the highest mountains. Also Asia (widespread), N. America (widespread).
**Nephroma helveticum Ach. (1810)**

Lichenogr. Universalis 523 as helvetica.

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Mt. Olympus, on bark at an altitude of 1250 m. This is a rather low altitude for this northern species, and the report is in need of confirmation.

Mainly northern and oceanic parts of Europe. Global distribution depends on whether or not the mainly tropical *N. tropicum* is regarded as synonymous.

**Nephroma laevigatum Ach. (1814)**

Syn. Meth. Lich. 242 as laevigata; *Nephroma lusitanicum* Schaer.; (?) *Nephroma lusitanicum* var. *sublusitanicum* (Gyeln.) Szatala; *Nephromium resupinatum* B (= var.) laevigatum (Ach.) Schaer.; (?) *Nephroma sublusitanicum* Gyeln.; *Nephromium laevigatum* (Ach.) Nyl.; *Nephroium lusitanicum* (Schaer.) Nyl.; (?) *Nephromium neolusitanicum* Gyeln. ex Räsanen.

Thallus: foliose, to 10 cm diameter but usually about 6 cm. Lobes: rounded, 6 - 8 mm wide, sometimes wrinkled or with fine folds, adressed or ascending, 360 µm thick at centre line in transverse section, diminishing to about 100 µm at margins; margins ± smooth, slightly crenulate or slightly wavy. Upper surface: brown, sometimes pale brown or dark brown, rarely ± grey in shade, matt; not tomentose. Lower surface: pale brown, usually ± smooth, sometimes with fine folds or striations, not tomentose, without veins or rhizines. Cephalodia: absent. Isidia: absent, but laminal folioles sometimes present, marginal folioles only present in lobes regenerating after damage. Pseudocyphellae: absent. Soralia: absent. Upper cortex: 40 - 50 µm thick, colourless, of closely packed, ± vertical hyphae with distinct elongated to rounded lumina 3 - 8 x 2.5 - 5 µm, usually giving a cellular texture, K-; sometimes overlain by thin, colourless, structureless epicotyl. Medulla: pale yellow, yellow or orange, appearing pale brown in section. 70 - 100 µm thick, of loosely interwoven hyphae (2) 3 - 4 (5) µm wide, septa occasionally visible in K. Lower cortex: 25 - 65 µm thick, colourless to pale brown, zcellular, K-. Apothecia: usually present, marginal on lower surface of lobes (which are often recurved so that apothecia face sidewards or even upwards), rounded but sometimes missing a small crescent where attached to lobe, 1.5 - 2.5 mm diameter, usually slightly concave, not pruinose. Disc: brown, matt. Thalline margin: present, very thin, persistent; in section: about 70 µm wide. Exciple: not visible externally; in section: poorly developed, 10 - 20 µm wide, of ± vertical hyphae with small visible lumina, giving a weak cellular texture. Epithecium: pale brown, often not clearly differentiated from hyyenium, K-. Hypothesium: 50 µm tall, colourless in lower part, pale brown in upper part. Hypothecium: 90 µm tall, colourless in upper half, dark brown in lower part, without distinct structure. Paraphyses: simple, 1 - 1.5 µm wide, not capitate or moniliform, without visible septa. Ascii: clavate, 45 - 50 x 10 - 12 µm, wall K+ blue, apex K- or with a small indistinct region staining K+ faintly blue. Ascospores: colourless, 3-septate, narrowly ellipsoid to broadly fusiform, 15 - 17 (20) x 5 - 6 µm, 8 per ascus. Chemistry: medulla K+ mauve (occasionally after a strong K+ dark red reaction), in section diffusing a soluble pigment, C-, P-; thallus K-, C-, KC-, P-, UV- or almost. Photobiont: blue-green; cells subglobose, 6 x 4 µm, not in chains, forming a continuous, regular layer 40 - 75 µm thick.

Ascospores in Greek collections were 15 - 17 (20) µm long, shorter then the 17 - 20 µm that is consistently quoted in the literature.

The yellow medulla, reacting K+ purple, easily separates this species from all other foliose species with brown lobes except for *Nephroma tangeriense*. A few species of *Physconia* have a coloured medulla, but their lobes are not brown and their medulla reacts K+ yellow or orange.

Throughout Greece. Usually on bark, and recorded from a wide range of species, but with a preference (one third of records) for *Abies*. Occasionally on other substrates, including bryophytes, siliceous rock, siliceous soil, and wood. At altitudes 0 - 1800 m, but in the southern part of the country rare below 500 m.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread). Reports for Australasia are incorrect.

**Nephroma parile (Ach.) Ach. (1810)**

Lichenogr. Universalis 522 as parilis; *Lichen parilis* Ach. (1799), Lichenogr. Svec. Prodr. 164; (?) *Nephroma parile* var. *subparile* (Gyeln.) Szatala; (?) *Nephroma subparile* Gyeln.

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Scattered, with no clear pattern. Usually overgrowing bryophytes, sometimes directly on bark, at altitudes 200 - 1700 m.

Widspread in temperate and cool parts of Europe; rare in arctic and warm oceanic regions. Also Macaronesia, Asia (widespread), N. America (widespread), C. America (Mexico), southern S. America (Argentina, Chile).
Nephroma resupinatum (L.) Ach. (1810)

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Fairly widely distributed in northern half of Greece. (Old reports for southern Greece probably refer to N. laevigatum.) Usually on bark, though there is a single report from siliceous rock. At altitudes 700 to about 1800 m.

Widespread in boreal and arctic Europe; further south confined to the mountains, but it reaches Portugal, Spain, Italy and Greece. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), perhaps Pacific.

Nephroma tangeriense (Maheu & A. Gillet) Gattefossé & Werner (1931)

Descriptions: Burgaz & Martinez (2003); Clauzade & Roux (1989); Smith et al. (2009).

Epìros, on bark of Pinus nigra at an altitude of 900 m.

Circum-Mediterranean/Macaronesian. Southern Europe, and Atlantic margin to as far north as Scotland and Norway. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia).

Nesolechia A. Massal. (1855)
Symm. Lich. Nov. 75. Often said to have been published first in Misc. Lich. 43. 1856, but I accept the view of Doré et al. (2006). Type: N. oxyspora (Tul.) A. Massal., designated by Clements & Shear, Gen. Fung. 315. 1931. Family: The type species belongs in Parmeliaceae, but the correct placement of the others is unclear.

Literature: There is no good monograph. The best starting point is still probably Clauzade, Diederich & Roux (1989).

Many names have been referred to this genus in the past, but at present 6 remain, 5 of which occur in Europe; most will have to be placed elsewhere.

11 Epitheciun brown.
  22 Ascospores at first globose, later ellipsoid, 10 - 15 x 7 - 10 µm. (N. diversispora)
  2 Ascospores ellipsoid, 14 - 22 x 5 - 7 µm. N. oxyspora

1 Epitheciun dark green-blue. N. oxysporiza

Nesolechia oxyspora (Tul.) A. Massal. (1856)

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004) as Phacopsis oxyspora. Recently placed in Punctelia, but so different from other species of that genus that I hesitate to follow that view.

Scattered, with no clear pattern, on Parmelia sulcata, Parmelia tiliacea and Xanthoparmelia tinctina at altitudes 500 - 750 m.

Widespread and fairly common in Europe. Also Macaronesia, Asia (Turkey, Russia, Nepal, China), Malesia (PNG), Africa (Morocco, Tunisia, Kenya, S. Africa), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (widespread).

Nesolechia oxysporiza J. Steiner (1898)
Description: Clauzade, Diederich & Roux (1989), or see the protologue.

Thessaly, on Lecanora polytropa at an altitude of about 1400 m. A poorly known species reported only for Greece and the French Alps.

Nevesia P. M. Jørg., et al. (2014)

Literature: The only species is discussed in Ahti et al. (2007), Burgaz et al. (2010), and Smith et al. (2009). Nevesia has just one species.

Nevesia sampaiana (Tav.) P. M. Jørg. et al. (2014)
**Fuscopannaria sampaiana** (Tav.) P. M. Jørg.

Descriptions: Ahti et al. (2007); Burgaz et al. (2010), both as *Fuscopannaria sampaiana*; Jørgensen (1978) as *Pannaria ignobilis*, Smith et al. (2009), as *Fuscopannaria sampaiana*.

The only well-localised report is for Evia, where it occurred on *Castanea sativa*, but that report may not be reliable. Spribille (2009) reliably reports this species for northern Greece, on bark of *Abies*, but does not cite a precise locality. There is also a poorly localised report for the Peloponnese, also on *Abies*.

Atlantic and Mediterranean Europe. It reaches Scandinavia but is absent from arctic regions and from continental eastern Europe. Also N. Africa (Tunisia).

**Normandina Nyl. (1855)**


Literature: Aptroot (1991a) purports to be a monograph, but is unsatisfactory. Smith et al. (2009) is better for the two European species.

*Normandina* contains five species. Two occur in Europe but only one is likely to occur in Greece.

**Normandina pulchella** (Borrer) Nyl. (1861)


Thallus: squamulose, blue-grey, not pruinose. Squamules: 0.25 - 0.5 mm diameter, rounded, concave, with distinctive raised margin, often resembling an ear in overall appearance. Soralia: pale green, developing on margins of squamules but later spreading, not delimited, with granular soredia 0.025 mm diameter.

The squamules are very distinctive, and this species can not be confused with any other present in Greece. It can be recognised from even a single squamule.

Scattered on the islands and in NW Epiros, never very far from the sea. On bark at altitudes 0 - 1600 m. Recorded from *Abies cephalonica, Olea europaea, Platanus orientalis* and *Quercus ilex*. Most reports probably refer to bryophytes overgrowing the bark, its preferred substrate, though it can occur directly on bark.

Subcosmopolitan in regions that are not too dry or too cold.

**Obryzum Wallr. (1825)**

According to Nash et al (2007) *Obryzum corniculatum* Wallr. has been reported for Greece. Until I have more information on the source of this claim, I prefer not to include it in this Flora.

**Ocellomma Ertz & Tehler (2014)**


*Ocellomma* contains a single species, formerly placed in *Schismatomma*.

**Ocellomma piccionianum** (Bagl.) Ertz & Tehler (2014)


Thallus: crustose, to a few cm diameter, white to pale grey, thin (20 - 90 µm), without vegetative propagules. Cortex: ±absent; layer above photobiont cells colourless, 10 - 30 µm thick, loose and unstructured. Medulla: poorly developed; photobiont cells often directly overlying bark. Apothecia: abundant, 0.3 - 0.5 mm diameter, subimmersed to sessile, ±flat, sometimes white pruinose. Disc: black (or almost). Thalline margin: present but sometimes pseudo-thalline (algal cells then scarce or absent in section), ±persistent. Exciple: present, sometimes visible externally, dark brown to black; in section: 20 - 40 µm wide, pale brown to dark brown, structure obscured by crystals, I+ red-brown, K-, brown pigment mostly insoluble in K; crystals: abundant, angular, colourless, 2 - 14 x 2 - 6 µm, not soluble in K. Epithecium: brown to dark brown, K-, N-, pigment mostly insoluble in K, partly soluble in N; crystals absent. Hymenium: 60 - 100 µm tall, usually colourless, upper part sometimes with brown pigment, I+ red-brown, KI+ weakly blue. Hypothecium: 20 - 60 µm tall, colourless to very pale brown, I+ blue > red-brown in upper part (reaction paler than hymenium). Paraphyses: often simple, sometimes sparingly branched or anastomosed, 1 µm wide at base, 1 - 1.5 (2.5) µm at apex, not capitulate. Asci: 45 - 50 x 15 - 20 µm, clavate, Opegrapha type. Ascospores: colourless, 3-septate, 20 - 25 (30) x 3 - 5 µm, straight or slightly curved, ends rounded, 8 per ascus. Pycnidia: sometimes present, 0.05 mm diameter, forming slight warts with black centre; in section: 100% immersed, subglobose, 80 - 110 µm tall, 60 - 100 µm
wide, brown at least near ostiole, sometimes in entire upper half, colourless elsewhere. Conidia: colourless, 2.5 - 5 (7) x 1 - 1.5 μm, straight or curved. Chemistry: thallus K-, C-, KC-, UV+ faintly green-white. Photobiont: Trentepohlia, forming a regular but sometimes discontinuous layer 20 - 40 μm thick.

Scattered, with no clear pattern, but always within a few km of the sea. Usually on bark, less commonly on wood, at altitudes 0 - 700 m.

Southern Europe, from Portugal to Greece. Also Macaronesia, N. Africa (Morocco, Algeria, Tunisia). Some reports may refer to Diromma dirinellum, with which it has often been confused.

Ochrolechia A. Massal. (1852)


Literature: Kukwa (2011b) monographed the European species, and greatly clarified the nature of some species. Use of earlier publications to determine Greek collections will lead to confusion.

Thallus: crustose, usually well-developed. Isidia or soralia: present in some species. Apothecia: sessile, medium to large, with prominent, often robust thalline exciple and brown, widely exposed disc. Epithecium: brown or grey-brown, K-, N-.

Hypothecium: colourless (or almost). Paraphyses: much branched and anastomosed, very narrow, not capitate or moniliform. Ascii: with KI+ blue wall, but apex KI- (or almost). Ascospores: colourless, simple, ellipsoid, medium sized to large, 8 per ascus in most species. Chemistry: many species with gyrophoric acid and/or other substances. Photobiont: green.

Species of Ochrolechia are easily recognised when fertile by their fairly large, sessile, lecanorine apothecia with a brown (though sometimes pruinose) disc, and with simple ascospores that in most species are fairly large. Megaspora has immersed apothecia with a black disc. In Pertusaria the disc is usually punctiform, or at least not very widely exposed. Lecanora has generally smaller apothecia, small to medium-sized ascospores, a KI+ blue ascus apex, and paraphyses that are generally simple or only sparingly branched and anastomosed.

About 76 species, of which about 25 are European. Although many species have been reported for Greece, only a few are common; they generally occur on bark or non-calcareous rock.

1 Thallus, medulla or soralia (if present), C+ pink or red, at least in places (Note 1).
222 Thallus ±isidiate. True soredia not present, though some isidia may be soft and some may resemble soredia.

Disc pruinose. On bark. O. subviridis

2 Isidia absent. True soredia present. Soralia C+ red, medulla C-.
33 Soralia not clearly delimited. On non-calcareous rock. (O. crozalsiana)
3 Soralia clearly delimited, at least at first. On various substrates.

44 Soralia UV+ orange, less than 0.5 mm diameter, concave. Thallus thin, not warted, K- or almost. O. arborea

4 Soralia UV+ white, often more than 0.5 mm diameter, concave or convex. Thallus well developed, fairly thick, warted or not.
55 Soralia often convex. Cortex C+ red (but sometimes overlain by a necrotic layer that is C-). O. androgyna

5 Soralia concave to flat, usually surrounded by a distinct upturned thalline rim. Cortex C+ yellow. See Pertusaria dalmatica

2 Isidia and soredia absent.
33 On bark. O. balcanica
3 On non-calcareous rock.

44 Internal part of cortex C+ red (gyrophoric acid) but external part C+ yellow (variolaric acid). O. aegaea

4 Variolaric acid absent. O. tartarea

1 Thallus, medulla and soralia (if present) C-, or C+ faintly yellow (variolaric acid). (Disc may be C+ pink or red.)
22 Soredia present. Variolaric acid (C+ faintly yellow) present in soralia and cortex. Usually on bark or wood. Note 2.

33 Thallus thin. Soralia delimited or confluent. Apothecia rare.

44 Soralia delimited. Not restricted to acidic bark. O. turneri.

4 Soralia at first delimited, soon becoming confluent. Apothecia usually absent. Similar in appearance to Phlyctis argena. Usually on acidic bark. O. microstictoides

3 Thallus fairly thick. Soralia delimited.

44 Variolaric acid present. Margin of thallus not zoned. Soralia rounded or elongate. Soredia to 150 μm diameter. Apothecia sometimes present. Ascospores 20 - 50 μm long, 4 - 8 per ascus. Usually on bark of
conifers. Usually in the uplands. **O. alboflavescens**

4 Variolaric acid absent. Margin of thallus often distinctly zoned. Soralia usually rounded. Soredia to 200 μm diameter. Apothecia very rare. Ascospores 170 - 300 μm long, usually 1 per ascus. Not restricted to bark of conifers or to the uplands. See **Lepra albescens**

2 Soredia absent. Variolaric acid present or absent. On various substrates.

33 Gyrophoric acid present in epithecium. Disc usually C+ or at least KC+ red as a result, though reaction may be faint or obscured by a C+ yellow reaction of pruina (Note 3). Thallus well developed, moderately to very thick.

44 On bark or wood. **O. pallescens**. Note 4.

44 On non-calcareous rock. **O. parella**

3 Gyrophoric acid not present in epithecium. Disc C- or C+ yellow, KC- or KC+ yellow. Thallus thin or thick.

44 On bryophytes or decaying vegetation. Thallus well developed. Cortex of thalline margin not or scarcely broadened at base, white, not glassy in section. (O. upsaliensis) Greek report doubtful.

4 On bark or wood. Thallus usually thin, but may be thick and well developed on rough or strongly nutrient-rich bark. Cortex of thalline margin distinctly broadened at base, glassy but opaque in section. **O. szatalaensis**

1) Caution: in pruinose species the pruina may obscure the thallus reaction in spot tests.

2) This section of the key is written for typical material. Atypical collections do occur, but chromatography is then needed to separate species reliably. See Kukwa (2011b) for a key employing chemical characters.

3) In case of doubt, test a thin section of an apothecium under the compound microscope.

4) O. alboflavescens is said sometimes to occur without soredia, and would then key out here. In that state it can only be reliably separated from O. pallescens by chromatography.

**Ochrolechia aegaea** Kukwa (2009)

*Graphis Scripta* 21(2): 43-44.

Description: See the protologue.

Islands of the Aegean, on siliceous rock at altitudes 20 - 800 m.

Known only from Greece and Turkey.

**Ochrolechia alboflavescens** (Wulf.) Zahlbr. (1927)

Cat. Lich. Univ. 4: 676; *Lichen alboflavescens* Wulf. (1791), *Plantae rariores carinthiacae* 111.

Description: Kukwa (2011b).

Scattered, with no clear pattern. On bark and wood, usually of conifers, at altitudes 300 to about 2000 m, but most records are from above 1000 m. Recorded from bark of *Abies cephalonica*, *Olea europaea* and *Pinus heldreichii*, and wood of *Cupressus sempervirens* and *Juniperus oxycedrus*.

Basically a species of central Europe, just reaching as far north as southern Scandinavia; south of the Alps probably restricted to upland areas. Also Macaronesia, Asia (widespread), N. Africa (Algeria). Reports for N. America are incorrect.

**Ochrolechia androgyna** (Hoffm.) Arnold (1885)


Thallus: crustose, to 6 cm diameter, white, not pruinose, continuous or with some cracks, often warted, very variable in thickness (40 - 450 μm). Isidia: absent. Soralia: pale green when fresh, colour fading in herbarium, mostly delimited, convex, 1 - 3.5 mm diameter, sometimes coalescing later, a few small soralia not well-delimited; soredia coarse, 0.1 mm diameter. Cortex: absent or poorly developed; pseudocortex: 25 - 35 μm thick, colourless, with abundant crystals, K-. Medulla: white. Chemistry: medulla and soralia K-, C+ strongly red (colour fading, but only very slowly), P-, I-; thallus UV+ white. Photobiont: green, cells globose, 9 - 13 μm diameter. Photobiont layer: 30 μm thick, continuous, ±regular but slightly wavy.

The large robust thallus, greenish convex soralia reacting strongly C+ red, and absence of apothecia are fairly distinctive. **Pertusaria dalmatica** has soralia that are excavate, at least when young.

Scattered, rather thinly, throughout Greece. On bark or overgrowing bryophytes or decaying vegetation at altitudes 0 - 1200 m. Recorded from bark of: *Castanea sativa*, *Olea europaea*, *Pinus nigra* and *Quercus pubescens*.

Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), perhaps S. America (Argentina, Peru), Australasia (Tasmania), Pacific (Hawaii).

**Ochrolechia arborea** (Kreyer) Almb. (1952)

Ochrolechia parella

Scattered, with no clear pattern, on bark at altitudes 300 - 1300 m. Reported from Castanea sativa, Olea europaea, Pinus halepensis and Quercus pubescens.

Southern and central Europe, just reaching southern Scandinavia and British Is. Also Macaronesia, Asia (Turkey, Russia, Mongolia, China), N. America (widespread), C. America (Mexico).

Ochrolechia balcanica Verseghy (1962)

The absence of vegetative propagules, C- thallus, C+ red apothecial pruina and the corticolous habit make this name probably belongs elsewhere, and is tentatively placed here.

Ochrolechia pallescens (L.) A. Massal. (1853)

Also western Asia (Turkey, Ural Mts).

Very scattered, with no clear pattern though the few records to date are from the western half of Greece. On bark or wood of conifers at altitudes 900 - 1600 m. Reported from a wide range of species, but avoiding strongly acidic bark.

Circum-Mediterranean. Southern Europe, from Iberian Peninsula to Cyprus and Crimea. Also Asia (Mediterranean Turkey), N. Africa (Algeria, Tunisia).

Ochrolechia microstictoides Rässänen (1936)


Very scattered, with no clear pattern though the few records to date are from the western half of Greece. On bark or wood of conifers at altitudes 900 - 1600 m.

Widespread in Europe, but precise distribution uncertain as the name has often been synonymised with O. turneri. Also western Asia (Turkey, Ural Mts).

Ochrolechia pallescens (L.) A. Massal. (1853)


O. parella f. arborea (DC.) Boistel is probably a synonym of O. tartarea, but the single Greek report under that name probably belongs elsewhere, and is tentatively placed here.

Thallus: crustose, to 5.5 cm diameter, usually smooth at margins, often coarsely warted in central parts, marginal parts 80 - 200 µm thick, much thicker at warts, without vegetative propagules. Cortex: 35 - 60 µm thick, pale brown in upper part, colourless in lower part; when viewed in K of predominantly vertical, narrow, much branched hyphae intermixed with crystals and granules; K-, pigment soluble in K. Apothecia: always present. Disc: strongly white pruinose, usually C+ red but reaction sometimes faint, always strongly KC+ red. Chemistry: medulla C-; thalline margin K-, C- or C+ faintly yellowish, KC- or KC+ faintly yellowish; thallus K-, C-, KC-, P-, UV+ pale green (long wave) or pale orange (short wave). Photobiont: green, cells globose, 9 - 15 µm diameter. Photobiont layer: 35 - 75 µm thick, with slightly irregular, wavy margins, sometimes discontinuous.

The absence of vegetative propagules, C- thallus, C+ red apothecial pruina and the corticolous habit make this species easy to recognise. Lecanora carpinea and related species have much smaller, less robust apothecia. Ochrolechia parella is saxicolous, while O. szatalaensis has a C- or C+ yellowish apothecial disc and a generally less
robust thallus.

Throughout Greece, but not especially common. Usually on bark, occasionally on wood. Reported from all altitudes, though some upland reports may refer to *O. szatalaensis*. On a very wide range of phorophytes with no clear preference, but avoiding strongly nutrient-enriched bark.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Ethiopia, S. Africa), perhaps Caribbean (Bahamas), C. America (CR, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Marquesas, New Caledonia). Reports for N. America are incorrect.

**Ochrolechia parella** (L.) A. Massal. (1852)


Thallus: crustose, pale grey, to 4 cm diameter, continuous to cracked, smooth to slightly warted, 150 - 300 µm thick. Prothallus: sometimes present, white, 0.2 - 1.5 mm wide, sometimes weakly zoned. Isidia and soralia: absent. Cortex: 40 - 70 µm thick, mostly colourless, sometimes pale brown or pale grey in upper part, without distinct structure even in K, K-, pigment partly soluble in K, with abundant crystals. Medulla: white. Apothecia: sub sessile to sessile, concave, 0.8 - 1.6 mm diameter. Disc: heavily white pruinose, pruina C- or faintly C+ red, distinctly KC+ red. Thalline margin: prominent, persistent, 0.2 - 0.4 mm wide. Exciple: not visible externally; in section: 50 - 100 µm wide, colourless, resembling hymenium. Epithecium: brown to grey (grey appearance caused by crystals), K-, N-, brown pigment soluble in K but not N. Hymenium: 200 - 250 µm tall, mostly colourless, sometimes pale brown in upper part. KI+ blue. Hypothecium: 125 µm tall, colourless to very pale brown. Paraphyses: much branched and anastomosed, very thin (less than 1 µm wide in lower part). Asci: 160 - 220 x 50 - 65 µm, clavate, wall thick (5 µm) and prominent in developing ascus, wall KI+ blue but no apical apparatus apparent in KI. Ascospores: colourless, simple, ellipsoid, 50 - 65 x 25 - 33 µm, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C+ red, P-. UV+ white with faint green tinge in long wave, UV+ orange in short wave. Photobiont: green, present below apothecia in small clumps, cells globose, 10 - 15 µm diameter. Photobiont layer: 40 - 80 µm thick, slightly irregular, sometimes discontinuous, cells tendency to form large clumps.

The absence of vegetative propagules, the C- thallus, C+ red apothecial pruina and the saxicolous habit make this species easy to recognise.

Throughout most of Greece, though at present there are no records from the westernmost parts of the mainland. At altitudes 0 - 1100 m, but scarce above 800 m. Nearly always on siliceous rock. The few reports from bark may refer to *O. pallescens*, which has sometimes been regarded as a synonym of *O. parella*.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, S. Africa), perhaps C. America (Mexico), S. America (at least Argentina, Chile, Falkland Is, Australasia (widespread), Antarctica (widespread in subantarctic islands and Antarctic Peninsula) Reports for N. America are incorrect.

**Ochrolechia subviridis** (Hoeg) Erichsen (1930)


Thallus: crustose, to several cm diameter, white, slightly warted, 180 - 250 µm thick. Isidia: abundant, globose, 0.1 - 0.2 mm diameter, white (same colour as thallus), very soft, easily abraded. Soralia: absent. Cortex: poorly developed, colourless, 15 µm. Medulla: white. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C+ red, P-, UV+ white. Photobiont: green; cells globose, 10 µm diameter. Photobiont layer: 50 - 80 µm thick, irregular, sometimes discontinuous, cells tendency to form clumps.

The soft, globose isidia are distinctive. According to Kukwa (2011b), true isidia, with a firm corticate surface, may also occur in this species, but I have not seen them. *Pertusaria coccodes* also has globose isidia, but they are not soft and they react C-, K+ yellow > red.

Throughout Greece, but never very far from the sea. On bark at altitudes 0 - 1100 m. Reported from a wide range of phorophytes, with no clear preference.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Syria, India, Nepal), North Africa (Tunisia). Reports for N. America are incorrect.

**Ochrolechia szatalaensis** Verseghy (1958)


Thallus: crustose, to 5.5 cm diameter, grey, not pruinose, rather thin, 150 - 200 µm, sometimes to 250 µm in central parts, smooth, continuous, sometimes slightly warted, sometimes cracked or almost areolate, without vegetative propagules. Cortex: 25 - 50 µm thick, colourless, poorly structured, not very compact, almost a pseudocortex, K-,
A further concern is that the large genus have come to an end. Also, some of the less well-known species have not been incorporated into the new scheme at all. Opegrapha phylogenetic hypotheses have placed the species in the key below in at least 7 genera: the geographical range of genus, and information in old publications may be unreliable; this must be borne in mind especially when considering western Mediterranean and it is not always entirely satisfactory for regions further east. It is also now a little dated. (1803), listed in Appendix of the ICN. Family: Opegraphaceae.

Opegrapha tartarea (L.) A. Massall. (1852)

Descriptions: Kukwa (2011b); Clauzade & Roux (1985); Smith et al. (2009).

Widespread in Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), N. America (widespread, mainly in western half), S. America (Argentina, Chile).

Ochrolechia turneri (Sm.) Zopf (1896)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Widespread in Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Ascension Is, St Helena), N. America (widespread), Australasia (Queensland, NZN), Antarctica (Signy Is). Reports for S. America are incorrect.

Ochrolechia upsaliensis (L.) A. Massall. (1852)
Probably not correctly reported for Greece. Abbott accepted the record of Hayek (1928), which was from bark of Pinus heldreichii at high altitude, but it seems more likely to refer to O. szatalaensis, which had not been described in 1928.

Opegrapha Ach. (1809)

Literature: Mediterranean species were monographed by Torrente & Egea (1989c), but the emphasis is on the western Mediterranean and it is not always entirely satisfactory for regions further east. It is also now a little dated. There is also much useful information in Smith et al. (2009). There has been much taxonomic confusion in this difficult genus, and information in old publications may be unreliable; this must be borne in mind especially when considering the geographical range of Opegrapha species.

In the sense used here, Opegrapha is an artificial assemblage. It is in the process of being subdivided, and recent phylogenetic hypotheses have placed the species in the key below in at least 7 genera: Alyxoria, Arthonia, Gyrographa, Opegrapha, Phacographa, Pseudochiasmatoma, and Zwackhia. There is no reason to suppose that these redistributions have come to an end. Also, some of the less well-known species have not been incorporated into the new scheme at all. A further concern is that the large genus Arthonia is itself being subdivided, and I am reluctant to transfer any species to
it while it is disintegrating. A practical solution is to indicate the names of the new genera in parentheses, but not to arrange the Flora according to them. For example, *Opegrapha (Alyxoria) varia* means the species treated here as *Opegrapha varia*, which some recent authors would treat as *Alyxoria varia*. When the taxonomy of a new genus appears to have stabilised, information for it will be extracted from this section and placed under the new generic name.


*Opegrapha* in the sense used in this Flora can usually be recognised by the lirellate apothecia, the absence of a thalline exciple, and the carbonaceous exciple. In corticolous collections it is advisable to confirm also that the ascospores react I- and/or that the paraphyses are anastomosed.

A large, and not particularly well-understood, group of over 300 species, of which about 70 have been reported for Europe. They occur on most substrates; some are parasitic. In Greece *Opegrapha* is not rare, but nor is it especially common.

*O. gyrocarpoides* is not included in the key, as I have insufficient information.

11 Apothecia present.
22 Ascospores 3-septate.
  33 Exciple open below (not present below all the hymenium).
    44 On bark. Apothecia distinctly elongated, 0.5 - 2.5 x 0.3 - 0.4 mm. Disc often pruinose. *O. celtidica*
    4 On rock, or parasitic on lichens on rock.
      55 Apothecia 0.5 - 1.0 x 0.3 - 0.5 mm. Disc often pruinose. Not parasitic. Ascospores 13 - 16 x 5 - 6.5 µm. *O. endoleuca*
    5 Apothecia smaller. Disc not pruinose. Usually parasitic. Ascospores often larger.
      6666 On Circiaria on calcareous rock. Ascospores 16 - 22 x 6 - 8 µm, becoming brown when mature. *O. parasitica*
      66 On Verrucaria on calcareous rock, or directly on calcareous rock (Note 1). Ascospores 14 - 22 x 5 - 8 µm, remaining colourless (in material seen to date). *O. rupestris*
      66 On Caloplaca aurantia. Ascospores 14 - 19 x 5 - 7.5 µm. (O. hellespontica)
      6 On Caloplaca erodens or C. albopruinosa. Ascospores 11.5 - 18 x 5 - 8 µm. (O. vulpina)
  3 Exciple closed below (present below all the hymenium).
444 Parasitic on other lichens.
  5555 On Dermatocarpon. Ascospores 20 - 24 x 6 - 7 µm. (O. pulvinata)
  5555 On Xanthoria. Ascospores 12 - 17 x 4 - 6 µm. *O. physciaria*
  555 On Ochrolechia or Pertusaria. Ascospores 17 - 26 x 6.5 - 9 µm. (O. anomea)
  55 On Phlyctis argena. *O. (Phacographa) zwackhii*
  5 Usually on Lecanora rupicola; perhaps also on Protoparmelia. Ascospores 21 - 29 x 7 - 9 µm. (O. (Phacographa) glaucomaria)
44 On bark
  55 Ascospore wall moderately broad, thickening at septum.
    66 Thallus white. Apothecia sessile. Ascospores 16 - 21 x (4) 5 - 6 µm. Conidia 3 - 4 x 1 µm, straight. (O. confertoides)
    6 Thallus grey to brown, with whitish patches. Apothecia immersed to semi-immersed. Ascospores 15 - 23 x 3 - 4 (5) µm. Conidia 4 - 7 x 1 - 2.2 µm, straight to curved. *O. (Pseudoschismatomma) rufescens*
    5 Ascospore wall narrow, not or only slightly thickening at septum.
      66 Ascospores 18 - 24 x 5 - 7 µm. *O. (Alyxoria) culmigena*
      6 Nearly all ascospores less than 20 µm long.
        77 Ascus subglobose to broadly clavate. Ascospores 13 - 18 x 2.5 - 4 µm. Disc remaining slit-like. *O. (Arthonia) atra*
        7 Ascus clavate; length/width exceeding 3.
          88 Lirellae usually unbranched (only occasionally branched or stellate), 0.5 - 1.2 mm long, pruinose or
not. Conidia 4 - 7 µm long.
9 Ascospores 3 - 5 -septate, 14 - 20 x 4 - 5.5 µm. Disc initially slit-like, opening later. Apothecia white pruinose. **O. (Gyrographa) gyrocarpa**
8 Lirellae generally branched, 0.4 - 2.2 mm long, usually pruinose. Conidia 11 - 19 µm long. Pruina of exciple red-orange, K+ red-purple. Ascospores 14 - 16 x 3 - 4.5 µm. **O. (Alyxoria) ochrocheila** Note 2.

4 On rock
55 Ascospore wall moderately broad, thickening at septum. On non calcarceous rock in shaded places. Ascospores 15 - 19 x 4 - 5 µm. **O. (Gyrographa) saxigena**
5 Ascospores wall narrow, uniform or only slightly thickening at septum.
66 Ascospores nearly all less than 20 µm long.
77 Apothecia white pruinose. Ascospores 14 - 18 x 3 - 5 µm. On siliceous rock. **O. demutata**
6 At least some ascospores more than 20 µm long.
777 Disc at first covered by thallus. Ascospores 19 - 25 x 5 - 7 µm. **O. durieui**
77 Disc not covered by thallus, but narrow.
88 Thallus with abundant soralia, reacting C+ red. Ascospores 17 - 25 x 4 - 6 µm. Hymenium 80 - 120 µm tall, I-. **O. (Gyrographa) gyrocarpa**
8 Soralia absent.
99 Apothecia often arranged in small groups. Ascospores 17 - 22 x 5 - 7 µm. Hymenium 85 - 110 µm tall, I+ blue. **O. lutulenta**
9 Apothecia randomly arranged. Ascospores 20 - 26 x 5 - 6 µm. Hymenium 50 - 70 µm tall, I+ reddish. **O. dolomitica**
7 Disc not covered by thallus, open. Ascospores 20 - 23 x 6 - 7 µm. **O. (Alyxoria) subelevata**
2 Ascospores more than 3-septate.
33 Ascospores with 4 - 7 (8) septa, broadly fusiform, usually more than 4 µm wide; perispore thin to thick. 4444 On other lichens. **O. (Phaephyrsia) saxigena**
444 On consolidated soil or sand. **O. areniseda**
44 On bark. **O. (Alyxoria) varia**
4 On rock.
55 Ascospores 4 - 7 -septate, to 25 µm long.
66 Ascospores 17 - 25 x 5 - 7 µm. **O. variaeformis**
6 Ascospores 15 - 20 x 4 - 5 µm. **O. lusitanica**
5 Ascospores 5 - 7 (11) -septate, 23 - 33 µm long.
33 Ascospores 3.5 - 6 µm wide. See (Enterographa zonata)
6 Ascospores 5 - 8 µm wide, usually with enlarged middle cell. **O. (Alyxoria) mougeotii**
6 Curved conidia more than 10 µm long.
7 Disc at first covered by thallus. Ascospores mostly 4 - 6 -septate. Exciple below hymenium strongly carbonised. **O. vulgata**
77 Ascospores mostly 7 - 9 -septate. Exciple below hymenium weakly carbonised. **O. pauciexcipulata**
4 On non-calcarceous rock. **O. cesareensis**, **O. (Zwackhia) circumducta**, **O. lithyrga**
1 Apothecia absent. Note 3.
22 Soralia present and usually abundant.
33 Soralia C+ red. **O. (Gyrographa) gyrocarpa**
3 Soralia C-. **O. (Corticium) cortex**
2 Soralia absent. Pycnidia abundant, black, about 60% immersed, 0.15 mm diameter. Thallus pale grey, sometimes tinged brown, K+, C-, KC-, UV-. Conidia colourless, curved, 5 - 7 x 1 µm. On neutral to basic bark in ±humid sites. (Not strictly coastal, but not found far inland.) **O. niveoatra**

(1) The host might be endolithic and not apparent. **O. rupestris** may also be capable of independent existence.
(2) **O. ochrocincta** and **O. ochrocheila** can be confused, especially when the former has a few branched or stellate
lirellae. They are best separated by their conidia, but pycnidia are often absent. The next best character is the width of the ascospores: 3 - 4 µm in O. ochrocincta, 4 - 5 µm in O. ochrocheila. Apothecia in O. ochrocheila are usually (but not always) orange-pruinose, those in O. ochrocincta are usually not pruinose but a pinkish pruina has been reported. Both have an open disc, unlike the common O. atra.

(3) This branch of the key includes only those species that can be determined fairly easily when sterile.

**Opegrapha** (Arthonia) atra Pers. (1794)

_Ann. Bot. (Usteri) 7: 30; Arthonia atra_ (Pers.) A. Schneid.; (?)_Opegrapha atra f. cerasi_ (Pers.) Arnold; (?)_Opegrapha atra var. opunticulic J. Steiner._

Thallus: crustose, grey, very thin, 10 x 4 mm (in the only specimen seen). Apothecia: sessile, 0.6 - 1 x 0.2 - 0.25 mm, not branched, not pruinose. Disc: black, slit-like. Thalline exciple: absent. Exciple: black, shiny, ±carbonaceous; in section: closed below. Ascospores: pale brown in material seen but probably over-mature, 3-septate, 15 - 17 x 4 - 5 µm, I-.

Photobiont: Trentepohlia.

The closed exciple, fairly short ascospores and slightly shiny apothecia with a slit-like disc separate this species from other corticolous members of the genus.

Scattered rather thinly throughout Greece, at altitudes 0 - 900 m. On bark of a wide range of species, with no strong preference, but not recorded from conifers: also once on wood.

Throughout Europe, except for arctic regions. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda), C. America (Mexico), S. America (Argentina, Chile, Brazil, Colombia), Australasia (Victoria, NZN, NZS), Pacific (Hawaii). Some older reports may be unreliable.

**Opegrapha** (Arthonia) calcarea Turner ex Sm. (1807)

_in Smith & Sowerby, Engl. Bot. 25, tab. 1790; Arthonia calcarea_ (Turner ex Sm.) Ertz & Diederich; _Opegrapha atra var. calcarea_ (Turner ex Sm.) Stiznb.; _Opegrapha chevalieri_ Leight.; _Opegrapha decandollei_ (Stiznb.) H. Olivier; _Opegrapha saxicola var. decandollii_ Stiznb.; _Opegrapha trifurcata_ Hepp ex Müll. Arg.

Thallus: usually completely immersed, sometimes thinly superficial and white grey, usually in small patches less than 1 cm diameter, less commonly forming large thalli more than 10 cm diameter. Apothecia: subsessile to sessile, 0.2 - 0.75 x 0.1 - 0.15 (0.25) mm, unbranched, straight or curved, not pruinose. Disc: black, slit-like. Thalline margin: absent. Exciple: black, carbonaceous; in section: black, opaque, closed below, K-.

Hymenium: 45 - 50 µm tall, colourless, KI+ blue. Hypothecium: 60 - 80 µm tall, black, opaque, K-.

Paraphyses: much branched, 1 µm wide, not capitate. Asci: 30 - 50 x 15 - 21 µm, broadly clavate, sometimes subglobose, KI- or almost. Ascospores: colourless, 3 - septate, 15 - 20 x 6 - 7 µm, ends rounded, I- 8 per ascus.

Photobiont: Trentepohlia.

The 3-septate ascospores, subglobose asci and calcareous substrate are distinctive.

Throughout Greece but not especially common. On calcareous, or at least fairly base-rich, rock at all altitudes, but commonest below 500 m.

Widespread in Europe, to as far north southern Scandinavia. Also Macaronesia, Asia (Turkey, Armenia, perhaps Taiwan), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America and Caribbean may be unreliable.

**Opegrapha** celtidicola (Jatta) Jatta (1880)


Descriptions: Clauzade & Roux (1985); Torrente & Egea (1989c).

Very scattered on the smaller islands, at altitudes 0 - 680 m. It appears to be strongly maritime. On bark of _Juniperus oxycedrus_ subsp. _macrocarpa_, _Olea europaea_ and _Quercus macrolepis_, and on wood of _Olea europaea_.

Southern Europe from Portugal to Greece and Russian Caucasus. Also N. Africa (Morocco, Algeria, Tunisia, Egypt).

**Opegrapha** (Alyxoria) culmigena Lib. (1830)

_Pl. crypt. Arduenna, fasc. 1 no. 15; Alyxoria culmigena_ (Lib.) Ertz; _Opegrapha herbarum_ Mont. nom. superfl.; _Opegrapha turneri_ Leight.

Descriptions: Nash et al. (2007); Smith et al. (2009); Torrente & Egea (1989c), all as _O. herbarum_.

Rare and scattered, in localities close to the sea, at altitudes 0 - 680 m. Usually on bark, occasionally on wood, of numerous phorophytes, with no clear preference.

Widespread in warm to temperate parts of Europe with a mild climate. Also Macaronesia, Asia (widespread), Africa (Morocco; St Helena), N. America (widespread in western half), C. America (Mexico, Guatemala), S. America (Chile), Australasia (warm temperate Australia).

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Torrente & Egea (1989c).

Mt. Olympus and the island of Ikaria, on calcareous rock at altitudes 50 - 1000 m.

Most reports are from central Europe, but its range extends as far north as Scotland and southern Scandinavia, and as far south as Sicily. Also N. America (eastern Canada).

Opegrapha durieui Mont. (1847)
in *Durieu, Expl. Sci. Algérie* 279-280; *Enterographa durieui* (Mont.) Redinger.

Descriptions: Clauzade & Roux (1985); Torrente & Egea (1989c).

Islands of the southern Aegean, including Crete. On calcareous rock at altitudes 0 - 200 m.

Circum-Mediterranean. Portugal to Cyprus. Also western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia).

Opegrapha (Gyrographa) gyrocarpa Flot. (1825)
*Flora* 8: 345.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Island of Kos, on siliceous rock at altitudes 200 - 300 m.

Widespread in Europe as far north as mid Scandinavia. Also Macaronesia, Asia (Russia, Japan, Thailand), N. America (widespread).

Opegrapha gyrocarpoides Müll. Arg. (1884)

Description: See the protologue. The only other mention of this species in the literature is Szatala's report for Greece, which was not accompanied by any description. Müller's description suggests a lichen close to *O. mougeotii*, but the type needs to be studied before a firm conclusion can be reached.

Island of Karpathos, on calcareous rock at an altitude of 200 m.

Known only from the Egyptian type collection, and from Greece.

Opegrapha (Alyxoria) lutulenta Nyl. (1855)

Descriptions: Clauzade & Roux (1985); Torrente & Egea (1989c).

Islands of the southern Aegean, on siliceous rock at altitudes 5 - 300 m.

A maritime-Mediterranean/Macaronesian species. Spain, France, Italy, and Greece. Also Macaronesia, N. Africa (Morocco, Algeria, perhaps S. Africa).

Opegrapha (Alyxoria) mougeotii A. Massal. (1853)
Mem. Lich. 103.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Torrente & Egea (1989c).

Corfu, on limestone. Recorded from an unspecified locality on Mt. Pantokrator.

Widespread in temperate parts of Europe with a mild climate, to as far north as southern Sweden. Present south of the Alps, but uncommon, though its precise range is uncertain owing to confusion with other species. Also Macaronesia, N. Africa (Morocco, Algeria, Tunisia), N. America (widespread).

Opegrapha niveoatra (Borrer) J. R. Laundon (1963)

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009); Torrente & Egea (1989c).

Scattered and uncommon, never very far from the sea. At altitudes 20 - 700 m, usually on bark and recorded from a wide range of phorophytes, sometimes on wood.

Widespread in western half of Europe, to as far north as southern Scandinavia, but avoiding the continental climate of the east. Also Macaronesia, Asia (Turkey, Israel, Russia, perhaps China), N. Africa (Morocco, Algeria), N. America (California, Michigan), C. America (Mexico).

Opegrapha (Alyxoria) ochrocheila Nyl. (1865)
*Flora* 48: 212; *Opegrapha rubescens* Sandst.
Opegrapha ochrocincta Werner (1939)


Thallus: crustose, usually thinly superficial but in places ±immersed, pale grey to very pale brown, smooth, continuous, forming small patches to 1 cm diameter; in section: 350 - 400 µm thick when well developed. Cortex: 150 - 200 µm tall, colourless, with distinct hyphae usually oriented ±horizontally, but sometimes rather randomly oriented, K-.

Medulla: ±absent; photobiont layer directly overlies substrate. Apothecia: sessile, not pruinose, 0.45 - 1 x 0.3 - 0.4 mm, usually unbranched; a few branched and stellate apothecia seen in one collection, straight or curved. Disc: black, widely exposed. Thalline margin: absent. Exciple: black, carbonaceous; persistent; in section: very dark brown to black, opaque, 30 - 70 µm wide, closed below. Epithecium: dark brown, K- or developing a slight greenish tinge along lower margin (where pigment least concentrated). Hymenium: 50 - 80 µm tall, colourless to very pale brown, KI+ blue. Hypothecium: very variable in thickness as it occasionally develops a 'stipe', 30 - 130 µm tall, mostly very dark brown and opaque, paler brown along upper edge. Ascii: cylindrical to clavate, 42 - 45 x 10 - 13 µm, KI- (or almost). Ascospores: colourless, 3-septate, 13 - 18 x 3 - 4 (5) µm, ends rounded, I-, 8 per ascus. Conidia: 5 x 1 µm. Photobiont: Trentepohlia, forming (when thallus well-developed) a continuous, regular layer 200 µm thick.

Usually fairly easily separable from other corticolous members of the genus by the combination of persistently 3-septate ascospores, the closed exciple, open disc, and absence of pruina.

Scattered in the southern half of Greece, very never far from the sea. At altitudes 0 - 640 m, on a wide range of trees and shrubs (but avoiding conifers except for *Juniperus oxycedrus subsp. macrocarpa*) with no clear preference.

Basically circum-Mediterranean/Macaronesian. Spain to Greece (but with a disjunct report for western France). Also Macaronesia (Canary Is), N. Africa (Morocco, Algeria, Tunisia).

Opegrapha parasitica (A. Massal.) H. Olivier (1906)


Thallus: absent. Apothecia: 0.3 - 0.35 x 0.25 mm, slightly immersed in thallus of host at first, often sessile later, not pruinose. Disc: black, slit-like. Thalline margin: absent. Exciple: black, carbonaceous; in section: 30 - 70 µm wide, black, opaque, not closed below, K-.

Epithecium: not well developed, not distinct from upper part of hymenium. Hymenium: 100 µm tall, colourless to very pale brown in lower part, pale brown to brown in upper part, KI+ blue (not strongly), brown pigment K-. Hypothecium: 20 µm, very pale brown, K-. Paraphyses: simple, 1.5 µm wide at base, expanding gradually to 2.5 µm at apex, not capitate, apical cell sometimes with very small amount of brown pigment. Ascii: mature asc 50 - 67 x 16 - 20 µm, clavate (immature ones smaller and often globose), Opegrapha type. Ascospores: brown when mature (colourless at first), 3-septate, 16 - 20 x 6 - 7 microns, I-, 8 per ascus. Photobiont: absent.

The paraphyses appear to be simple, which is not characteristic of *Opegrapha*. Observations on additional material are needed to confirm this. However, the ascii are typical *Opegrapha* type.

The rather short lirellae, parasitic on *Circinaria* on calcareous rock are distinctive.

Only definitely reported for Peloponnese, but some reports of *O. rupestris* may belong here. At altitudes 20 - 800m, on species of *Circinaria* on calcareous rock.

Distribution uncertain, owing to confusion with *O. rupestris*, but apparently a species of southern and central Europe. Probably also western Asia (Turkey, Syria).

Opegrapha physciaria (Nyl.) D. Hawksw. & Coppins (1992)


Descriptions: Atienza (1992); Nash et al. (2007); Smith et al. (2009).

Corfu, close to sea level, on *Xanthoria parietina*.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (Israel, perhaps China), Malesia (PNG), N. Africa (Morocco), N. America (California), C. America (Mexico), perhaps S. America (Brazil).

Opegrapha (Pseudoschismatomma) rufescens Pers. (1794)

*Annln Bot. (Usteri)* 7: 29.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Torrente & Egea (1989c).

Rare in northern Greece. On bark of Platanus at altitudes 0 - 350 m.
Opegrapha rupestris Pers. (1794)

*Annln Bot. (Usteri)* 11: 20; *Opegrapha centrifuga* A. Massal.: *Opegrapha saxatilis* DC.: *Opegrapha saxicola* Ach.

Thallus: poorly developed; a very thin, brown thallus is patchily present; in section it exhibits little structure. Apothecia: 0.25 - 0.5 x 0.25 mm, not pruinose. Disc: black, usually slime-like, becoming exposed (but not widely exposed) in some older apothecia. Thalline margin: absent. Exciple: black, carbonaceous; in section: 25 µm wide, very dark brown to black, opaque, not closed below, K-.

Epithectum: poorly developed, not well delimited from upper part of hymenium. Hymenium: 70 - 80 µm tall, mostly colourless, upper part pale brown to brown, KI+ blue, brown pigment K-.

Hypothecium: 20 - 25 µm tall, colourless to pale brown, K-.

Asci: 40 - 45 x 13 - 14 µm, clavate, Opegrapha type. Ascospores: colourless, 3-septate, 15 - 18 x 4 - 6 µm (excluding perispore), often with prominent perispore to 1.5 µm wide, 8 per ascus. Photobiont: Trentepohlia cells are present near apothecia and within the "thallus", though other kinds of algae may be present too.

3-septate ascospores, an open exciple and a saxicolous substrate are characteristic of only a few species of *Opegrapha*. The only other one that has been reported for Greece is *O. parasitica*, which is always clearly associated with the well-developed white thalli of calcareous species of *Circinaria*. In *O. rupestris* a thallus is absent, or perhaps endolithic, or a very thin brown thallus may be present in a few places. *O. rupestris* is said to be parasitic on species of *Verrucaria*, but Greek material referred here is not obviously parasitic.

Widely distributed in Greece, but never far from the sea. On calcareous rock at altitudes 0 - 1500 m, though more than half of all records are from below 200 m. None of the published reports mentions a parasitic habit.

Distribution uncertain, owing to confusion with *O. parasitica*. There are reports for Europe to as far north as southern Scandinavia. Also Macaronesia, western Asia (Turkey, Syria, Israel, Russia), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America (widespread), perhaps Caribbean (Bahamas), Australasia (NZS). Some reports may refer to *O. parasitica*.

Opegrapha (Alyxoria) subelevata Nyl. (1888)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Torrente & Egea (1989c).

Islands of the southern Aegean, on soil and calcareous rock at altitudes 80 - 175 m.

Commonest south of the Alps, but reported to as far north as SW England. Also Macaronesia, Asia (Israel, Syria, perhaps Thailand), Africa (widespread). Reports for Australasia (NZ) are incorrect.

Opegrapha (Alyxoria) varia Pers. (1794)


Thallus: crustose, white, thin (85 - 200 µm), ±continuous, smooth or slightly scabrid, sometimes extending over several cm. Cortex: 45 - 75 µm thick, colourless, of thick-walled, horizontal hyphae, K-.

Medulla: absent or poorly developed, photobiont cells usually directly overlying bark. Apothecia: sessile, 0.7 - 2 x 0.25 - 0.4 mm, sometimes branched, not pruinose. Disc: black, usually widely exposed. Thalline margin: absent. Exciple: black, carbonaceous; in section: 20 - 70 µm wide, very dark brown to black, opaque, closed below. Epithectum: not well delimited from hymenium, pale brown to brown, K-.

Hymenium: 80 - 160 µm tall, colourless to pale brown, sometimes more distinctly brown in upper part. Paraphyses: branched and sometimes anastomosed, 1.5 µm wide. Asci: 65 x 20 µm, clavate, KI- (or almost). Ascospores: colourless at first, brown when mature, 4 - 7 -septate, 25 - 35 (42) x 7 - 8 µm, I-, sometimes with prominent perispore, 8 per ascus. Chemistry: thallus K-,-, KC-.

Photobiont: Trentepohlia, forming a continuous, ±regular layer 35 - 80 µm thick.

Fairly common throughout lowland Greece. Usually on bark, occasionally on wood, at altitudes 0 - 900 m. Reported from a wide range of phorophytes.

Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (Morocco, Algeria, Tunisia, Namibia), N. America (widespread), perhaps Caribbean (Bahamas), S. America (widespread), Australasia (eastern Australia), Pacific (Fiji).

Opegrapha variaeformis Anzi (1862)


Descriptions: Clauzade & Roux (1985); Torrente & Egea (1989c).

Islands of the southern Aegean, including Crete, on rock at altitudes 50 - 700 m.

Throughout Europe. Also Macaronesia, Asia (Turkey, Israel, Russia, Mongolia, perhaps elsewhere), N. Africa (Morocco), N. America (widespread), Australasia (eastern Australia).
Only central and southern Europe, and N. Africa (Morocco).

**Opegrapha vulgata** (Ach.) Ach. (1803)
Methodus 20-21; *Lichen vulgatus* Ach. (1799), Lichenogr. Svec. Prodr. 21 (The name has a conserved type); *Opegrapha confluens* (Ach.) Nyl.

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009); Torrente & Egea (1989c).

Islands of Amorgos and Corfu, on bark or schist at altitudes 10 - 250 m. This species is usually corticolous, so the report from schist may be incorrect.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Malesia (PNG), N. Africa (Morocco, Algeria), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda), perhaps C. America (Mexico), Australasia (S. Australia, Victoria), perhaps Pacific (New Caledonia).

**Opegrapha (Phacographa) zwackhii** (A. Massal. ex Zwackh) Källsten (1994)

Descriptions: Czyzewska & Kukwa (2009: 67); Smith et al. (2009).

Epiros, on *Phlyctis argena*, at altitudes 630 - 820 m.

Only Europe. Most reports are from temperate latitudes, from Wales to Poland, but it has been reported as far south as Basilicata in Italy.

**Pachyphiale Lönnr.** (1858)

*Flora* 41: 611-612. Type: *P. corticola* Lönnr., the only species originally included. Family: *Gyalectaceae*.

Literature: Egea, Burgaz et al. (2004) is best for the two southern species. Clauzade & Roux (1985) and Smith et al. (2009) are also useful.

Three species, all corticolous, all of which occur in Europe. There are very few Greek records.

The genus is close to *Gyalecta*, and could be merged with it.

11 Ascospores more than 35 µm long, with 7 or more septa.

22 Ascospores straight or slightly curved, 9 - 15 -septate. Apothecia 0.4 - 0.6 mm diameter. **P. carneola**

2 Ascospores curved or helical, sometimes strongly so, usually 7-septate. Apothecia 0.2 - 0.4 mm diameter. **P. ophiospora**

1 Ascospores 15 - 35 µm long, 3 - 7 -septate. (P. fagicola)

**Pachyphiale carneola** (Ach.) Arnold (1871)


Descriptions: Clauzade & Roux (1985) as *Pachyphiale cornea*; Egea, Burgaz et al. (2004); Smith et al. (2009).

Rare and scattered, but always close to the sea. On bark at altitudes 300 - 600 m. A suboceanic species that is not rare in parts of western Europe, but uncommon in Mediterranean regions. Also Asia (Syria, Russia, Japan), Africa (S. Africa), perhaps N. America, S. America (JF), Australasia (NZS).

**Pachyphiale ophiospora** Lettau ex Vězda (1958)


Description: Clauzade & Roux (1985).

Known from a single site in Macedonia, at an altitude of 800 m. The substrate was not reported.

Very scattered, from southern Sweden to former Yugoslavia, and now Greece. Also Asia (south Siberia). Although poorly known, it does appear to be a good taxon.

**Pannaria Delise ex Bory** (1828)


Literature: Jørgensen (1978) is the standard monograph. Ahti et al. (2007), Burgaz et al. (2010), and Smith et al. (2009) are also helpful.

After recent splits about 75 species remain here, but only 4 occur in Europe. Species of *Pannaria* require a humid microclimate, and so are rare in Greece.
111 Isidia present. (P. tavaresii)
11 Isidia absent but soralia present. **P. conoplea**
1 Isidia and soralia absent. **P. rubiginosa**

**Pannaria conoplea (Ach.) Bory (1828)**
Descriptions: Ahti et al. (2007); Burgaz et al. (2010); Smith et al. (2009).
Distribution and ecology in Greece uncertain, because old reports may refer to other species of Pannariaceae, but certainly present in Epiros.
Most of Europe, except arctic regions. Also Macaronesia, Asia (widespread outside tropics), Africa (widespread outside tropics and deserts), N. America (widespread), C. America (Mexico, perhaps elsewhere). S. America (Chile, Colombia, Ecuador, Venezuela), Australasia (Victoria). A report for Pacific (Hawaii) may be unreliable.

**Pannaria rubiginosa (Ach.) Bory (1828)**
Descriptions: Ahti et al. (2007); Burgaz et al. (2010); Clauzade & Roux (1985); Jørgensen (1978); Nash et al. (2004); Smith et al. (2009).
Rare and scattered, with no clear pattern. On bark, especially of Abies, at altitudes 500 - 1500 m.
Commonest in oceanic and suboceanic parts of Europe. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), Africa (widespread), N. America (widespread), Caribbean (Cuba, Guadeloupe, PR; perhaps elsewhere), C. America (Mexico, Panama), S. America (widespread). The status of reports for Pacific is unclear.

**Parabagliettoa Gueidan & Cl. Roux (2009)**
Literature: Krzewicka (2012) is best. Gueidan, Savic et al. (2009), and Smith et al. (2009) (under Verrucaria) are also helpful.
This recent segregate from Verrucaria comprises a group of endolithic calcareous taxa. It does seem to represent a natural group within Verrucariaceae, but is not easily delimited on morphological grounds from other endolithic calcareous taxa in the family. At present, three species have been placed here. All are present in Greece, but are rarely recorded.

11 Ascospores 8 - 10 x 6 - 7 µm. **P. disjuncta**
1 Ascospores 12 - 17 x 6 - 8 µm.
22 Perithecia 0.2 - 0.3 mm diameter. Pycnidia usually absent. Thallus white, often forming a mosaic with neighbouring thalli, borders then delimited by single or double brown line. **P. cyanea**
2 Perithecia 0.3 - 0.45 mm diameter. Pycnidia often present. Thallus pale grey to brown-grey, not mosaic-forming; if delimited then by a whitish line or a row of pycnidia. **P. dufourii**

**Parabagliettoa cyanea (A. Massal.) Gueidan & Cl. Roux (2009)**
in Gueidan et al., Taxon 58(1): 195; Verrucaria cyanea A. Massal. (1853), Mem. Lich. 144; Thelidium limitatum (Nyl.) Servit; Verrucaria decussata Garov.; Verrucaria limitata Kremp. ex A. Massal., nom. illeg.
Descriptions: Krzewicka (2012); Smith et al. (2009) as Verrucaria cyanea.
Very scattered, on calcareous rock at altitudes 0 to about 2000 m.
Widespread in temperate and warm parts of Europe. Also N. Africa (Morocco, Algeria). Some reports may be unreliable owing to confusion with other species.

**Parabagliettoa disjuncta (Arnold) Krzew. (2012)**
Mt. Olympus, on calcareous rock at altitudes 1700 - 2650 m.
Scattered, from Germany and Switzerland, south and east to Greece. Not reported for other continents.

**Parabagliettoa dufourii (DC.) Gueidan & Cl. Roux (2009)**
in Gueidan et al., Taxon 58(1): 195; Verrucaria dufourii DC. (1805) in Lamarck & De Candolle, Fl. Franç. Ed. 3, 2: 318;
**Thelidium dufourii** (DC.) Servit (Greek reports as dufourei).

Descriptions: Krzewicka (2012); Smith et al. (2009) as Verrucaria dufourii.

Very scattered in the northern half of Greece, on calcareous rock at altitudes 100 - 1700 m.

Widespread in temperate and warm parts of Europe. Also Asia (Turkey, Ural Mts), Australasia (Tasmania, NZS). Some reports may be unreliable owing to confusion with other species.

**Paracollema Otálora & Wedin (2013)**


Literature: The only European species is discussed by Carvalho (2012), under *Collema*. Paracollema is a recent segregate from *Collema* s. lat. for two species that have unusually small ascospores for *Collemataceae*. Only one species occurs in Europe.

**Paracollema italicum** (de Lesd.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Carvalho (2012); Clauzade & Roux (1985); Swinscow & Krog (1988), all as *Collema italicum*. Mt. Olympus, according to Nimis (1993). I have not been able to trace the source of Nimis’s information.

Southern Europe; not present north of the Alps. Also Africa (Kenya).

**Parmelia Ach. (1803)**

Methodus 153. The name is conserved against *Lichen* L. (1753). Type: *P. saxatilis* (L.) Ach., listed in Appendix of the ICN Family: Parmeliaceae.

Literature: The genus was monographed by Hale (1987b), but several new species have been recognised in Europe since that date. The widespread European species are treated in all the standard floras.

Thallus: foliose, heteromorous, to several cm. diameter. Upper surface: blue-grey in most species, occasionally brown near lobe tips; with white pseudocyphellae forming a reticuloc network when mature. Soralia or isidia present in some species. Lower surface: black or brown, attached by rhizines. Apothecia, with brown disc and thalline margin. Chemistry: upper cortex K+ yellow. Photobiont: green.

Formerly a very large genus of about 1000 species, it has been much subdivided and as understood today it has fewer than 100 species, distributed mainly in temperate to cold regions. The genus is best developed in eastern Asia and Australasia. Europe has 14 species. They usually occur on ±acidic bark and rock, occasionally on other substrates.

111 Isidia present.

22 Isidia small, soft, ±verrucose, derived from soralia. Thallus often forming tufts that are markedly elongate down trunks of trees. Main lobes often distinctly elongate, easily separable from substrate over much of their length. Pseudocyphellae sometimes indistinct. On bark or wood, especially in montane forests. **P. submontana**

2 Isidia ±cylindrical, simple to coralloid, not derived from soralia. Thallus ±round. Main lobes rounded to ±elongate, ±attached to substrate. Pseudocyphellae usually distinct. On bark, wood or rock.

33 At least some rhizines, especially those in centre of lobes, squarrose when mature. Apothecia common. (P. squarrosa)

3 Rhizines simple or dichotomously forked, never squarrose. Apothecia rare.

44 Upper surface and isidia pruinose. Isidia sometimes developing into lobules. **P. ernstiae**

4 Upper surface and isidia not, or scarcely pruinose. Isidia not developing into lobules.

55 Main lobes 1 - 2 mm wide, not overlapping, with ±square ends. Usually on rock in regions with moist climate, sometimes on other substrates. **P. saxatilis**

5 Main lobes 2.5 - 11 mm wide, often overlapping, with ±rounded ends. Usually on bark in montane forests, said to be saxicolous occasionally. **P. serrana**

11 Isidia absent. Soralia present.

22 Soralia ±punctiform. Mature lobes often long, narrow, and strongly revolute. Rhizines simple or rarely forked. **P. submontana**

2 Soralia arising from pseudocyphellae and soon becoming elongate. Lobes never very long, revolute or not. Rhizines simple, forked or squarrose.

33 At least some rhizines squarrose, sometimes densely so near tips. Soralia abundant, laminal and marginal.

Older lobes not revolute. **P. sulcata**

3 All rhizines simple or forked. Soralia sparse, laminal. Older lobes revolute. (P. barrenoeae)
1 Isidia and soralia absent.
   22 Pseudocyphellae marginal and laminal. Lobes usually 2 - 4 mm wide. **P. omphalodes**
   2 Pseudocyphellae mostly laminal. Lobes usually less than 1 mm wide. (P. pinnatifida)

**Parmelia ernstiae** Feuerer & A. Thell (2002)
Description: Thell & Moberg (2011).
Scattered in the northern half of Greece, at altitudes 500 - 2100 m. On siliceous rock, or on bark, or (on one occasion) overgrowing *Parmelia omphalodes*.
Scattered through much of Europe to as far north as southern Sweden. Also Macaronesia, N. Africa (Algeria).
Perhaps more common than records suggest, as it may have been overlooked as *P. saxatilis*.

**Parmelia omphalodes** (L.) Ach. (1803)
Methodus 204; *Lichen omphalodes* L. (1753), Sp. Pl. 1143.
Known from a single site in northern Macedonia, on granite at an altitude of 1600 m.
Throughout northern and central Europe; rare in the south and confined to the uplands. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), perhaps S. America.

**Parmelia saxatilis** (L.) Ach. (1803)
Methodus 204-205; *Lichen saxatilis* L. (1753), Sp. Pl. 1142-1143; *Imbricaria saxatilis* (L.) Flot.; *Parmelia saxatilis* f. aizonianii (Delise ex Duby) Dalla Torre & Santh.; *Parmelia saxatilis* var. aizonianii Delise ex Duby; *Parmelia saxatilis* b. (= f.) *furfuracea* Schaer.; *Parmelia saxatilis* var. *furfuracea* (Schaer.) Arnold; *Parmelia saxatilis* f. isidioides Hillmann; *Parmelia saxatilis* a. (= f.) *manda* Schaer.; *Parmelia saxatilis* f. *rubricosa* J. Steiner.

Thallus: foliose, to 9 cm diameter, blue-grey, occasionally brown near tips of lobes, smooth, not pruinose. Lower surface: black, sometimes brown at margin. Lobes 8 x 2 - 3 mm, 0.1 mm thick, broadening towards tips and there indented into 3-8 small rounded lobules; lobules sometimes slightly ascending, tips of lobules often distinctly blunt or squareish. Isidia: laminal and marginal, blue-grey in lower part, brown to black in upper part, usually simple, occasionally branched, cylindrical, 0.1 - 0.2 x 0.05 - 0.1 mm, not strongly associated with pseudocyphellae. Pseudocyphellae: present on upper surface, white, initially punctiform, later elongating and starting to develop a reticulate network, about 0.1 mm wide. Rhizines: abundant, usually simple, occasionally branched, 0.3 - 1.0 x 0.05 mm. Soralia: absent. Upper cortex: 10 -15 µm thick, colourless, structure indistinct. Medulla: white, of loosely woven, randomly oriented hyphae that are rather broad. Chemistry: medulla C-, K+ red, P+ yellow; thallus K+ yellow. Photobiont: green.

Two of the Peloponnesian collections that Abbott (2009) cited under this name belong to *P. serrana*, but the third collection, from Methana, does belong here. Some upland reports of *P. saxatilis* from other parts of Greece may also refer to *P. serrana* or to *P. ernstiae*.
Throughout Greece at all altitudes, though much less common than in northern Europe. Usually on siliceous rock, occasionally on bark, wood or overgrowing bryophytes. Some reports from bark may refer to *P. serrana*.
Cosmopolitan outside subtropical and tropical regions.

Thallus: foliose, 5 - 10 cm diameter, blue-grey, not pruinose. Lobes: 4 - 11 mm wide, 350 µm thick in central part, 70 µm near tips, ±smooth, sometimes overlapping, not adpressed, margins wavy. Lower surface: dark brown to black. Rhizines: abundant on entire lower surface, mostly black, tip sometimes pale, 250 - 500 x 25 - 40 µm, usually simple, occasionally forked, formed of parallel agglutinated hyphae. Pseudocyphellae: present, elongate, isolated, not forming a network, often associated with cracks in thallus. Isidia: abundant, mostly laminal, some marginal, globose when young, cylindrical when mature, 0.1 - 0.2 x 0.1 mm, same colour as thallus except for black dot at tip when mature. Soralia: absent. Cortex: 20 µm thick, colourless to very pale yellow-brown, obscurely cellular. Lower cortex: 10 - 20 µm thick, pale brown to brown, structure indistinct or obscurely cellular. Medulla: white, of loosely interwoven hyphae, hyphae in lower part mostly horizontal. Chemistry: medulla K+yellow > red, forming red crystals 0.5 - 2 µm diameter, C-, P+ yellow, I-; thallus UV-. Photobiont: green, cells globose, 10 - 12 µm diameter, forming a continuous, regular layer 25 - 30 µm thick.
Most likely to be confused with *Platismatia glauca*, but that has few rhizines and usually much more irregular and ragged lobes. Isidia in *Platismatia glauca* are mostly marginal, unless riders are present on the surface of the lobes. *Parmelia serrana* does not have riders, and the isidia are predominantly laminal. *P. submontana* also present in the same habitat, has soft, less well developed isidia that arise from soralia, and often has very elongate lobes. Easily
separated from *P. saxatilis* when lobes are large and well developed, but a few collections are difficult to place. Species of *Parmotrema* also have large lobes, but their upper surface lacks pseudocyphellae, their lower surface has a rhizine-free marginal zone, and in Greece they seem to be restricted to the lowlands (below 1000 m).

Uplands of the Peloponnese and of northern Macedonia, at altitudes 1200 - 1500 m. The Peloponnesian collections that can be referred here with certainty were from bark of *Pinus nigra* at an altitude of 1500 m in the Taigetos Mountains. (Collections from the northern Peloponnese tentatively referred here have characters that overlap with *P. saxatilis*.) Collections from Macedonia were on siliceous rock.

Probably scattered thinly through much of Europe, though there are few records. Also Macaronesia.

**Parmelia submontana** Hale (1987)


Thallus: foliose, not usually rosette forming, sometimes forming loose, subpendent tufts, blue-grey, not pruinose. Mature lobes to 6 cm long, 2 - 3 mm wide over much of their length, broadening to 6 mm wide near tips, 200 - 250 µm thick, dichotomously branched. Lateral margins of mature lobes often strongly revolute. Pseudocyphellae: frequent on upper surface, forming a conspicuous, white network; eroding to form soralia. Soralia: punctiform, white to blue-grey, mainly laminal, some marginal, to 0.3 mm diameter, soon turning into clusters of isidia. Isidia: blue-grey, subglobose, 0.2 mm diameter, densely clustered, mainly laminal, some marginal. Lower surface: black, brown at extreme margin. Rhizines: abundant, black, simple, rarely forked, 0.3 - 0.5 x 0.05 mm, rather uniform in size, of ±parallel, conglutinated hyphae. Upper cortex: 10 µm thick, obscurely cellular; cells 2 - 3 µm wide, subrounded to slightly elongate; K-, pigment soluble in K. Medulla: white, 100 - 150 µm thick, of loosely woven, randomly oriented hyphae; hyphae rather brown (2.5 - 3 µm wide), sometimes tinged brown in lowest part of medulla. Lower cortex: 15 - 25 µm thick, brown, cellular; cells subrounded, 5 - 7 µm diameter; K-, pigment mostly not soluble in K. Chemistry: medulla K+ red, C-, P+ orange; thallus K+ yellow, C-, P-, UV+ faintly orange. Photobiont: green; cells globose, 10 - 14 µm diameter; forming a continuous layer 20 - 100 µm thick.

This species is usually easily recognised by its very elongate lobes, which can be so well developed as to make the thallus appear pendent or subfruticose. Forms in which the lobes are not so elongated can be recognised by the isidia, which are unlike those of other species of the genus.

Throughout upland Greece. Commonest in the Peloponnese, from where it was first described. Usually on bark, and recorded from a wide range of phorophytes, but half of all reports are from *Abies cephalonica*. Occasionally on wood or siliceous rock. Recorded from 300 - 1800 m altitude, but commonest between 1000 and 1500 m. This is a very characteristic species of montane forests in the Peloponnese.

In Europe commonest in the south. North of the Alps, where its range appears to be extending, it is widely distributed but probably not common. Also Macaronesia, western Asia (Turkey, Syria, southern Ural Mts), N. Africa (Morocco, Tunisia).

**Parmelia sulcata** Taylor (1836)


Thallus: foliose, to several cm diameter, grey to blue-grey, sometimes brown at tips of lobes, not pruinose. Lobes to 2 x 0.6 cm, 200 - 250 µm thick, margins ±flat (not distinctly downturned or upturned). Pseudocyphellae: abundant, white, long and narrow (0.05 - 0.1 mm wide), often merging and forming a conspicuous reticulate network that is often raised. Soralia abundant, laminal and marginal, initially punctiform and about 0.4 mm diameter, later becoming elongate and extending along the pseudocyphellae. Soredia white to pale grey. Isidia: absent. Lower surface: black. Rhizines abundant, black, rarely brown to white at tips, simple or forked, older rhizines sometimes with strong squarrose branching especially near tips, 0.6 - 1.3 x 0.05 mm. Upper cortex: 50 µm thick, pale brown in upper 12 µm, colourless below, cellular, K-, pigment soluble in K. Medulla: white, of loosely woven hyphae; hyphae broad, 3 µm wide, predominantly horizontal. Lower cortex: 20 µm thick, dark brown, weakly cellular, lumina rounded or horizontally elongate, K-, pigment not soluble in K. Chemistry: medulla K+ red, C-, P+ yellow-orange, I-; soralia K+ red-orange; thallus K+ yellow, UV+ faintly orange. Photobiont: green, trebouxioid; cells globose to subglobose, 8 - 14 µm diameter, forming a continuous layer about 35 µm thick.

The thallus in this species is said, e.g. by Smith et al. (2009) to react UV-, but all the collections I have tested have a faint but distinct dull orange colour in both long wave and short wave UV light.

Usually easily separated from *P. submontana* by its ±rounded, never strongly elongate, lobes, its squarrose rhizines, and the absence of isidia. The lichenicolous fungi *Abrothallus parmelia*um,* Arthrophacopsis parmelia*um, and *Nesolechia oxyssora* have each been reported once from this host.

Almost throughout Greece. Usually on bark, and recorded from a wide range of species. There are also a few records from wood, siliceous rock and calcareous rock (the latter probably leached of bases). At altitudes 0 - 1800 m.
Cosmopolitan outside the tropics.

**Parmeliella Müll. Arg. (1862)**


Literature: Jørgensen (1978) monographed the European species. The widespread European species are treated by Jørgensen in Ahti et al. (2007), Burgaz et al. (2010), and Smith et al. (2009).

Differs from *Pannaria* in the squamulose, rather than foliose, growth form, and in the absence of pannarin.

About 50 species, of which 3 occur in Europe. They usually occur on bark, or overgrow bryophytes on bark, in ±humid places.

| 11 Thallus with enlarged, radiating marginal lobes. (P. testacea) |
| 1 Thallus without enlarged, radiating marginal lobes. |
| 22 Isidia present. | **P. triptophylla** |
| 2 Soralia present. | (P. parvula) |

**Parmeliella triptophylla** (Ach.) Müll. Arg. (1862)


Descriptions: Ahti et al. (2007); Burgaz et al. (2010); Clauzade & Roux (1985); Jørgensen (1978); Nash et al. (2002); Smith et al. (2009); all as triptophylla.

Rare and scattered on the mainland, on bark at altitudes 300 - 1400 m. Some older reports may refer to *Fuscopannaria mediterranea*, which is common in Greece but was only described in 1965.

Widespread in Europe. Also Macaronesia, Asia (widespread), N. America (widespread), C. America (Mexico), perhaps Australasia (Australia; reports for NZ are incorrect). Reports for S. Africa are incorrect.

**Parmelina Hale (1974)**


Literature: Monographed by Hale (1976a), though about half of the taxa treated there have since been placed in other genera. The common European species are treated in all the standard floras.


Chemistry: K-, medulla C+ red, P-. Photobiont: green, trebouxioid.

Differs from *Parmelia* most obviously in the absence of pseudocyphellae.

About 17 species. Six species occur in Europe, though one is cryptic. They *Parmelina* usually occur on bark, sometimes on wood, rock or soil.

| 11 Isidia present. |
| 122 Mature isidia distinctly longer than broad, ±cylindrical (if slightly clavate then apex not markedly wider than stem); simple or sometimes branched when mature; often densely covering upper surface of thallus; to 0.15 mm tall, 0.02 (immature) - 0.08 mm diameter (Note 1). |
| 33 Apothecia absent. | **P. tiliacea** s. lat. Note 2 |
| 3 Apothecia present. |
| 44 Ascospores 3 - 5 µm wide. | (P. cryptotiliacea) |
| 4 Ascospores 5 - 7 µm wide. | **P. tiliacea** s. str. |
| 2 Mature isidia distinctly broader than long, like squashed spheres, or sometimes with an obvious stalk and like small mushrooms; simple; ±separated and not forming a dense cover; 0.03 (immature) - 0.15 (0.25) mm diameter (Note 1). | **P. pastillifera** |

1 Isidia absent.

22 Apothecia with many rhizines developing from thalline margin. Lobes with distinct white maculae. On bark. If present in Greece, probably restricted to sites with an oceanic microclimate. **P. carporrhizans**
2 Apothecia with, or more commonly without rhizines developing from thalline margin. Maculae, if present, indistinct. On bark or rock. Not restricted to oceanic sites.
33 Central parts of thallus with lobules. Rhizines, shiny, thin, 0.8 - 2 mm long. On rock. (P. atricha)
3 Lobules absent. Rhizines matt, ±thick, 0.3 - 1 mm long. On bark. P. quercina

(1) Examine mature specimens with well-developed isidia. Immature specimens may have only scattered, subglobose isidia.
(2) P. cryptotiliacea and P. tiliacea can not be separated when sterile.

Parmelia carporrhizans (Taylor) Hale (1974)
Phytologia 28(5): 482; Parmelia carporrhizans Taylor (1847), London J. Bot. 6: 163; (?) Parmelia carporrhizans var. endocarporrhizans Harm.

The circumscription of this species and its separation from P. quercina have caused much confusion, probably because Taylor's original description is not very helpful. Hale (1976a) regarded P. carporrhizans as a synonym of P. quercina, but European authors often distinguished them. The application of both names was fixed by the lectotypifications in Arguello et al. (2007). According to those authors, P. carporrhizans is a species of oceanic Europe and Macaronesia. Many Greek reports are probably based on collections of P. quercina with rhizinate apothecia.

Descriptions: Poelt & Vězda (1977); Smith et al. (2009).

Reports are very scattered, with no clear pattern. On bark at altitudes 300 - 1200 m. However, many of these reports are probably unreliable.

Southern and central Europe, reaching British Is. Also Macaronesia, western Asia (Turkey), N. Africa (Algeria, Tunisia). Reports of P. quercina for N. America, C. America, and Australasia may belong here.

Parmelia pastillifera (Harm.) Hale (1976)

Thallus: foliose, to 11 cm diameter, pale blue-grey, usually not pruinose, rarely with obscure white pruina near lobe tips . Lobes: 1 - 3 mm wide, 170 - 220 µm thick near margin, to 500 µm in centre of thallus, margins wavy to incised; upper surface smooth or (when pruinose) slightly rough with clusters of colourless crystals, without pseudocyphellae; lower surface black. Pruina: in section of very small colourless crystals, from 2 µm diameter down to the limit of resolution at x400, not soluble in K. Rhizines: black, simple, 0.4 - 0.6 (2.0) x 0.05 - 0.075 mm, broadening to 0.08 to 0.09 mm wide at base; in section: very dark brown, formed of parallel agglutinated hyphae (best seen in young rhizines, before they darken). Cilia: present but not abundant, marginal, usually in axils of lobes, resembling short rhizines 0.2 - 0.5 mm long. Isidia: present in central parts of lobes, absent from marginal parts, black, sparse to fairly abundant, broader than tall, usually resembling squashed spheres, sometimes with distinct stalk and resembling mushrooms, 0.05 - 0.12 mm diameter; in section: first appearing as hemispherical buds on surface of thallus, later becoming globose and attachment point narrowing, containing photobiont cells within a brown corticate surface. Soralia: absent. Cortex: 25 - 40 µm thick, colourless to pale brown, generally darker in outer part, pigment soluble in K, sometimes obscurely cellular. Medulla: white, of loosely interwoven hyphae 2 - 2.5 µm wide, without external crystals, often more loosely packed in lower half of medulla. Lower cortex: 15 - 20 µm thick. Pale brown to dark brown, obscurely cellular; cells (when visible) rounded, small, 2 - 3 µm diameter. Chemistry: medulla K-, C+ red, KC+ red, P-, I-; thallus K+ yellow, UV-. Photobiont: green, cells globose, 7 - 10 µm diameter, forming a continuous, regular layer 60 - 80 µm thick.

When mature isidia are present this species can not be confused with any other, but immature specimens may be difficult to separate from P. tiliacea. For a detailed comparison see Dobson & Hawksworth (1976).

Widely distributed, but not particularly common. Usually on bark, less commonly on rock (calcareous or siliceous) or wood, at altitudes 250 - 1750 m.

Throughout Europe except for the far north, but more oceanic than P. tiliacea. Also Macaronesia, Asia (Turkey, Syria, Ural Mts, northern India), N. Africa (Morocco).

Parmelia quercina (Willd.) Hale (1974)

Thallus: foliose, 5 - 6 cm diameter. Upper surface: grey, smooth when young, becoming wrinkled in older parts of thallus, not pruinose. Lower surface: black, attached by rhizines. Lobes: 20 x 4 - 8 mm, 150 - 300 µm thick, adpressed; margins slightly incised. Isidia: absent. Pseudocyphellae: absent. Rhizines: black, matt, 0.3 - 0.5 x 0.1 mm, simple, of parallel agglutinated hyphae (best seen in C). Upper cortex: 25 - 50 µm thick, mostly colourless, sometimes pale brown near surface, obscurely cellular or with some predominantly vertical hyphal lumina; sometimes covered by thin epicortex with many crystals (best seen in K). Medulla white; 65 - 85 µm thick; of very broad hyphae,
3-5 µm wide, forming loose prosoplectenchyma with hyphae oriented parallel to lobe axis. Lower cortex: 15-25 µm thick, dark brown, brown pigment sometimes extending a little way into medulla, opaque. Apothecia: usually present, 0.5-5 mm diameter, sessile to shortly stalked, concave, not pruinose, usually without rhizines, sometimes with a few, less commonly many rhizines developing from thalline margin. Apothecial rhizines, if present, usually on lower surface of thalline margin, sometimes on inner surface and extending over disc. Disc: brown, shiny. Thalline margin: present, smooth, persistent; in section 80-110 µm wide. Exicle: not apparent externally; in section: colourless to orange-brown, 50 µm wide. Epithecium: orange-brown, K-. Hymenium: 45-60 µm tall, colourless. Hypothecium: 70-75 µm tall, colourless; of two distinct layers. Paraphyses: simple, 1.5 µm wide in lower part, to 2.5 µm at apex, not or scarcely capitate or moniliform, generally without visible septa though apical cell sometimes distinct. Ascii 45-60 x 9-12 µm, narrowly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 7.5-9 x 5-5.5 µm, with Lecanora type wall, 8 per ascus. Pycnidia: sometimes abundant in surface of lobes, black, 0.03-0.08 mm diameter; in section: 100% immersed, globose, 140 µm tall, 120 µm wide, colourless except around ostiole. Conidia: 4-6 x 1 µm, bacilliform. Chemistry: medulla K-, C+ red, KC+ red, P-, I-; thallus K+ yellow, UV-. Photobiont: green, forming a continuous layer 65-85 µm thick; also present below apothecia as a continuous layer 20-35 µm thick.

Apothecia with rhizines may occur on the same thallus as erhizinate apothecia.

The absence of isidia and the usually abundant apothecia easily separate this species from P. pastillifera and the very common P. tiliae. Separation from P. carporrhizans on morphological grounds alone is more problematic, mainly because at an early stage of development, before they become black, pycnidia may produce small white patches that seem different from macules. However, P. carporrhizans, if present in Greece, can only have a restricted range on climatic grounds, and I have referred all my collections to the more continental P. quercina.

Throughout Greece, but absent from many of the smaller islands. On bark of a wide range of species, but not common on conifers. At altitudes 0-1400 m.

Reported for much of Europe except the far north. Also Asia (widespread), Africa (widespread outside tropics), N. America (widespread), C. America (Mexico), Australasia (widespread). Reports for Macaronesia are incorrect.

**Parmelina tiliae** (Hoffm.) Hale (1974)


Thallus: 6-10 cm diameter. Lobes: 10-15 x 5 mm, adpressed to slightly ascending at margins, with incised ends, 200-500 µm thick, tips sometimes obscurely pruinose and appearing roughened. Upper surface: grey to blue-grey, matt, smooth, not pruinose. Lower surface: black, occasionally brown at extreme margin, attached by rhizines. Isidia: abundant in older parts of thallus, forming a dense, often almost continuous cover on most of upper surface of lobes, except near lobe margins, globose when young, cylindrical or slightly clavate when mature, simple or occasionally branched, 0.1-0.15 x 0.05 mm, blue-grey in lower part, blue-grey or brown to black in upper part. Pseudocyphellae: absent. Rhizines: abundant on entire lower surface, even at margin, black, simple, 0.35-1.0 x 0.05-0.07 mm. Upper cortex: 30-50 µm thick; outer part (?epicortex) 2-5 µm thick, colourless, without distinct structure, with many small, rectangular polarising crystals about 3 x 1 µm not soluble in K; inner part colourless, cellular, cells subrounded to slightly elongated, 2.5-5 µm diameter. Medulla: white, about 90 µm thick; of very broad hyphae, 2.5-5 µm wide, that form a loose prosoplectenchyma with hyphae oriented parallel to lobe axis. Lower cortex: 15-40 µm thick, dark brown, cellular, cells subrounded, 2-3 µm diameter. Apothecia: uncommon, laminal, sessile, concave, 0.4-1.5 mm diameter, not pruinose. Disc brown. Thalline margin: 0.1-0.2 mm wide, smooth, persistent; in section 20-150 µm wide, thinnest on lower surface of apothecia; with abundant small crystals, mainly in cortex, soluble in K. Excie: not visible externally; in section 30-80 µm wide, mostly colourless, orange-brown at surface, K-, pigment not soluble in K. Epithecium: very pale yellow-brown to pale brown, without crystals, K-, pigment partly to entirely soluble in K. Hymenium: 45-65 µm tall, colourless. Hypothecium: 60-100 µm tall, colourless, obscurely divided into an upper subhymenium and hypothecium proper. Paraphyses: usually simple, sometimes branched, slightly clavate, about 1.5 µm wide at base, to 3 µm at apex. Ascii: 35 x 14 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 7.5-11 x 5 µm, with Lecanora type wall, 8 per ascus. Chemistry: medulla K-, C+ persistent red, P-, I-; thallus K+ yellow, UV-. Photobiont: green, cells globose, 7-11 µm diameter, forming a dense continuous layer, about 100 µm thick; also present below apothecia in a continuous layer about 25 µm thick.

For separation from *P. pastillifera*, see under that species. *P. cryptotiaria* is said to have narrower ascospores than *P. tiliae*, but in fertile material that I have studied, ascospore widths fall in the zone of overlap between these two species. All Peloponnesian collections in the tiliaeace complex, fertile or otherwise, are reported here as *P. tiliae*.

Very common throughout Greece. Usually on bark (about three-quarters of records) or siliceous rock (most of the remainder), but it has been reported from wood, bryophytes and soil. From sea level to at least 1700 m. The lichenicolous taxa *Abrothallus acetabuli*, *Abrothallus buelianus*, *Catillaria mediterranea*, *Nesolechia oxyospora*, *Sclerococcum serusiauxii* have been reported from this host.
Throughout Europe, except for far north. Also Macaronesia, Asia (widespread), perhaps Malesia (Java), Africa (widespread outside tropics). Reports for other regions may be unreliable.

**Parmelinopsis** Elix & Hale (1987)


Literature: Smith et al. (2009) discuss two of the three species included in the key below. For *P. afrorevoluta*, see Thell & Moberg (2011).

A genus of about 21 species, best developed in warm, humid regions. The three European species are distinctly oceanic, and there is only a single Greek report.

11 Soralia present. Isidia absent. *(P. afrorevoluta)*
1 Soralia absent. Isidia present.
22 Isidia with apical cilia. *(P. horrescens)*
2 Isidia without apical cilia. **P. minarum**

**Parmelinopsis minarum** (Vain.) Elix & Hale (1987)


Descriptions: Nash et al. (2002); Smith et al. (2009).

Zakynthos, on bark of *Cupressus sempervirens* at an altitude of 30 m. The report is a modern one by an experienced lichenologist, and can probably be accepted. However, confirmation is desirable, owing to the possibility of confusion with the very common *Parmelina tiliacea*.

Mainly Atlantic margin of Europe; rare in the Mediterranean. Also Macaronesia, Asia (widespread), Malesia (Philippines, PNG), Africa (widespread south of Sahara), N. America (widespread), Caribbean (widespread), C. America (widespread), S. America (widespread), Australasia (eastern Australia, NZN, NZS), Pacific (Hawaii, Henderson Is).

**Parmeliopsis** (Nyl.) Nyl. (1863)


Literature: The best starting point is Nash et al. (2002) or Thell & Moberg (2011), but Clauzade & Roux (1985) and Smith et al. (2009) are also helpful.

Nine species, of which 3 occur in Europe. One is poorly known but the other two are widely distributed.

11 Thallus yellow or green-yellow (usnic acid). **P. ambigua**
1 Thallus pale grey (without usnic acid). **P. hyperopta**

**Parmeliopsis ambigua** (Hoffm.) Nyl. (1866)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Rare and scattered on the mainland. On bark of conifers, less commonly on wood, at altitudes 700 - 1800 m. Most of Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico), Australasia (SE Australia).

**Parmeliopsis hyperopta** (Ach.) Arnold (1881)


Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Rare and scattered in northern Greece. On bark of *Fagus*, *Picea* and *Pinus* at altitudes 700 - 1800 m.

Much of Europe, but more photophobic than *P. ambigua* and so rare south of the Alps. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), C. America (Mexico), southern S. America (Argentina, Chile). Reports for Australasia are incorrect.
Parmotrema A. Massal. (1860)


Literature: There is no good unified treatment of the European species. Clauzade & Roux (1985) (under Parmelia) and Smith et al. (2009) are good starting points.

Species with a maculate upper surface have been segregated as Rimelia. According to Divakar, Blanco et al. (2005) this is not supported by molecular evidence, and these species are included in the key here.

At least 300 species, best developed in warm, moist regions. Only 17 species occur in Europe, where they have a generally oceanic distribution. Because several species are rather poorly known in Europe, the key is quite extensive even though at present there are few Greek reports.

111 Isidia present. Soredia present or absent.
   22 Upper surface with reticulate pattern of maculae and cracks. Rhizines simple or squarrose. (P. subsidiosum), (P. saccatilobum)
   2 Upper surface without reticulate pattern of maculae and cracks. Rhizines simple. (P. crinitum)

11 Isidia absent. Soredia present.
   222 Medulla P+ orange or red, K+ yellow, orange or red.
   33 Medulla K+ yellow or yellow-orange.
   44 Lower surface mottled white and brown at margin. (P. hypoleucinum)
   4 Lower surface uniformly brown or black at margin.
   55 Lobes 1 - 2.5 mm wide. (P. carneoportunatum)
   5 Lobes 3 - 8 mm wide.
   66 Upper surface strongly reticulately ridged. (P. croazlsianum)
   6 Upper surface wrinkled, but not reticulately ridged. **P. perlatum**

3 Medulla K+ yellow > deep red.
   44 Upper surface reticulately maculate and cracked.
   55 Cilia absent. Rhizines present right up to margins of lobes. **P. reticulatum**
   5 Sparse marginal cilia present. Rhizines absent in a broad marginal zone. (P. pseudoreticulatum)
   4 Upper surface smooth, without maculae or cracks. (P. stuppeum)

22 Medulla P+ red, K- or K+ dull yellow or brown. (P. dilatatum)
2 Medulla P-, K-. (P. arnoldii), (P. austrosinense)

1 Isidia and soredia absent. (P. perforatum) Greek report doubtful.

**Parmotrema perlatum** (Huds.) M. Choisy (1952)


Thallus: foliose, to several cm. diameter, blue-grey, not pruinose. Lobes: 10 - 20 x 5 - 9 mm, smooth, 125 - 175 µm thick; margins ascending, ± rounded. Isidia: absent. Soralia: pale green, marginal, at first delimited on small extensions of the lobes, later coalescing. Cilia: abundant on lobe margins, black, simple, 0.3 - 0.5 x 0.05 mm. Lower surface: pale brown near lobe margins, black elsewhere. Rhizines: abundant but not present near lobe margins, black, simple, 0.5 - 1.8 x 0.05 mm. Cortex: 5 - 25 µm thick, colourless. Medulla: white, of loosely interwoven hyphae 2.5 - 4 µm wide. Lower cortex: dark brown. Chemistry: medulla K+ yellow, C-, P+ orange, I-; soralia K-, C-, KC-, P+ faintly orange; thallus K+ yellow, C-, UV-. Photobiont: green; cells globose, 8 - 13 µm diameter, forming a continuous, regular layer 45 - 75 µm thick.

The soralia may contain the same lichen substances as the medulla, but presumably at lower concentration, judging from spot test reactions.

Scattered throughout Greece, though usually fairly close to the coast, at altitudes 0 - 1000 m. Usually on bark, rarely on rock. Not very common.

Cosmopolitan wherever the climate is ± oceanic or suboceanic and the temperature is not too cold.

**Parmotrema reticulatum** (Taylor) M. Choisy (1952)


Corfu and a few islands of the Cyclades. On bark or siliceous rock at altitudes 0 - 700 m. Cosmopolitan wherever the climate is ± oceanic and the temperature is not too cold.
Peccania A. Massal. ex Arnold (1858)

*Flora* 41: 93. Arnold introduced the name as "Peccania Mass. in lit. 4. Decbr. 1856", without a description, but he cited "Corinophorus Mass. ... 1856" (as 'Corynophorus') in synonymy. Massalongo's description of *Corinophorus* provides the "previously and effectively published description" needed for valid publication of Arnold's *Peccania*. *Peccania* would be a superfluous name, except that it is conserved against *Corinophoros* A. Massal. Type: *P. coralloides* (A. Massal.) A. Massal., listed in Appendix of the ICN. Family: *Lichinaceae*.

**Literature:** There is no monograph, and information is scarce and scattered. Moreno & Egea (1992b) is a good starting point. Nash et al. (2007) is a good introduction to the genus as a whole, but does not treat many of the European species.

About 14 species, though some are poorly known and may eventually be reduced into synonymy. At least 6 species have been reported from Europe. There are few Greek reports.

The poorly known *P. coralloides* var. *arenicola* and *P. teretiuscula* are not included in the key.

11 Thallus appearing fruticose. Lobes cylindrical and branched. (Note 1)

22 Thallus much more than 3 mm diameter, much more than 2 mm tall. Ascospores globose to ellipsoid, 8 - 15 x 6 - 10 µm. Usually on rock, occasionally on soil in rock fissures. **P. coralloides**

2 Thallus to 3 mm diameter, 1 - 2 mm tall. Ascospores ellipsoid, 10 - 16 x 4 - 9 µm. On soil. (P. fontqueriana)

1 Thallus not appearing fruticose.

22 Lobes irregularly folded, giving thallus a brain-like appearance. Thallus often more than 3 mm diameter and more than 1.5 mm in height. **P. cerebriformis**

2 Lobes not folded. Thallus not exceeding 3 mm diameter and 1.5 mm in height. (P. tiruncula)

(1) P. teretiuscula belongs in this branch.

**Peccania cerebriformis** Henssen & Büdel (1984)


Description: Moreno & Egea (1992b).

Crete, on limestone at an altitude of 700 m.

Southern Spain and Crete. Also Macaronesia, SW Asia (Kuwait, Oman), northern Africa (Morocco, Socotra).

**Peccania coralloides** (A. Massal.) Arnold (1858) var. *coralloides*


Description: Clauzade & Roux (1985); Moreno & Egea (1992b).

Scattered in the southern Aegean and adjacent coasts of Crete. On calcareous rock and soil at altitudes 100 - 300 m.

Mainly southern and central Europe (but, surprisingly, recently reported for Greenland). Also Macaronesia, Asia (widespread as far east as Mongolia), northern Africa (Morocco, Algeria, Tunisia, Socotra), N. America (Arizona).

**Peccania coralloides** var. *arenicola* Hue (1897)

in Patouillard, Cat. Raisonné 136-137.

Description: See the protologue. Perhaps just a trivial morph of *P. coralloides*.

SE Peloponnese on soil at close to sea level.

The only other reports of this taxon that I have found are for North Africa (Morocco, Tunisia).

**Peccania teretiuscula** (Flagey) Henssen (1990)


Description: See the protologue. Unfortunately, it is not adequate for modern needs.

Crete, on calcareous rock at altitudes 0 - 900 m.

Known only from Crete, Canary Is and the Algerian type collection.

**Pectenia** P. M. Jørg. et al. (2014)


**Literature:** The two commonly recognised European species are treated in Burgaz et al. (2010), and Smith et al (2009), under *Degelia*. For the recently described *P. cyanoloma*, see below.
Thallus: foliose, to 5 cm diameter, plate like and ±monophyllous in central part, becoming divided into ±distinct lobes in outer part, adpressed, often with isidia or similar structures. Lower surface attached by dense mat of rhizines that become blue-black and eventually extend beyond the thallus in the manner of a hypothallus. Upper cortex: cellular. Lower cortex: often not sharply delimited from medulla, of longitudinal hyphae. Apothecia: laminal with red-brown disc and without a thalline exciple. Ascospores: colourless, simple, ellipsoid, 8 per ascus. Chemistry: all reactions negative. Photobiont: blue-green.

Differs from *Parmelia* in the overall growth form, which is flattened and plate-like rather than typically foliose, and in the absence of lichen substances.

*Pectenia* has 4 species, all of which occur in Europe. One of those, *P. ligulata*, is hyper-oceanic, but the other three occur in Greece. All species require ±humid conditions, and in Greece *Pectenia* is most commonly found in montane forests, usually on bark.

11 With many wart-like, often ±coralloid isidia, not resembling lobules, sometime obscuring thallus and forming a ±areolate crust. Apothecia usually absent. *P. atlantica*

1 Isidia absent, or if present then rounded and resembling small lobules, not wart-like and coralloid. Apothecia usually abundant. *P. plumbea s.lat.* Sometimes subdivided as follows.

22 Disc dark red to black. Central part of thallus without small lobules. Lobes (1 mm from tip) 2.5 - 3.5 mm wide. Thallus pale grey to blue-grey, thick, loosely attached. *P. cyanoloma*

2 Disc light red to red-brown. Central part of thallus sometimes with small lobules. Lobes (1 mm from tip) 1 - 2.5 mm wide. Thallus blue or, sometimes with yellow-brown tinge, thin, adpressed. *P. plumbea s.str.*

### Pectenia atlantica (Degel.) P. M. Jørg. et al. (2014)


Thallus: foliose, to 3 cm diameter, olive-brown, matt, plate-like and firmly adpressed to substrate. Isidia: present over most of upper surface, wart-like, irregularly globose, cylindrical or subcoralloid, 0.2 mm diameter. Rhizines: forming a very dense mat that resembles a hypothallus, blue-black, extending about 0.5 mm beyond margin of thallus. Cortex: 100 - 150 µm thick, not sharply delimited from photobiont layer, colourless to pale brown, distinctly cellular; cells usually square or rectangular, occasionally irregularly angular, 8 - 15 x 8 µm, long axis, if present, vertical. Medulla: white to pale brown, of two distinct layers; upper layer 30 µm thick, of densely compacted hyphae with no air spaces; lower layer of loose hyphae with many air spaces; hyphae oriented ±randomly in both layers. Lower cortex: of hyphae oriented predominantly horizontally. Medullary hyphae 5 µm wide, often with distinct septa when. Chemistry: medulla K-, C-, KC-, P-; thallus K-, C-, KC-, P-, UV-. Photobiont: blue-green, cells not in obvious chains. Photobiont layer 50 - 100 µm thick, with very irregular upper margin.

Easily distinguished from *P. plumbea* by its isidia.

Scattered thinly throughout Greece, at altitudes 200 - 1400 m, on bark that is not strongly acidic. The lichenicolous fungus *Toninia plumibia* has been reported twice from this host.


### Pectenia cyanoloma (Schaer.) P. M. Jørg. et al. (2014)


Description: Blom & Lindblom (2009), as *Degelia cyanoloma*.

Recently resurrected from the synonymy of *P. plumbea*, not well known, and perhaps not distinct from *P. plumbea* (see remarks below under that species).

The only Greek report is from the island of Kefallonia, where it occurred on *Abies cephalonica* at an altitude of around 1400 m.

Western Europe from Spain to Norway, Corsica and Greece.

### Pectenia plumbea (Lightf.) P. M. Jørg. et al. (2014)

in Ekman et al., *Lichenologist* 46(5): 652; *Lichen plumbeus* Lightf. (1777), Fl. Scot. 2: 826-827; *Amphiloma plumbeam* var. myriocarpa (Delise) Hepp; *Coccocarpia plumbea* var. myriocarpa (Delise) Nyl.; *Degelia plumbea* (Lightf.) P. M. Jørg. & P. James; *Pannaria delisei* Bory; *Pannaria plumbea* (Lightf.) Bory; *Parmelia plumbea* (Lightf.) Ach.; *Parmeliella plumbea* (Lightf.) Vain.; *Parmeliella plumbea* var. myriocarpa (Delise) Zahlbr.

Thallus: foliose, to 5 cm diameter, grey or yellow-grey, matt, ±monophyllous in central part, becoming divided into discrete but contiguous, lobes in outer part. Lobes: (in outer part of thallus) 1.5 - 2.5 mm wide, sometimes
longitudinally ridged and/or cracked, 230 - 280 µm thick, adpressed. Rhizines: present, forming out of a very loose mat of amorphous, colourless hyphae about 4 µm wide that extend from lower cortex; these hyphae then aggregate into fibres of parallel hyphae about 25 µm diameter; fibres usually soon becoming blue-black in colour, occasionally the colour develops late and rhizines remain white at tips and pale orange-brown towards base for a long time; the mass of rhizines eventually extends out beyond margin of thallus by 0.5 - 2 mm, and then resembles a hypothallus rather than an ordered structure of rhizines. blue-black pigment in rhizines and hypothallus K-. Lobules: often present in central parts of thallus, eglobose, about 0.2 mm diameter. Upper cortex: 35 - 55 µm thick, lower margin not sharply delimited from photobiont layer, pale brown to brown, cellular; cells usually subrounded, 5 - 8 µm wide, occasionally elongated with long axis vertical. Medulla: white to pale orange-brown, hyphae sometimes oriented randomly, sometimes ±longitudinally; structurally not very distinct from lower cortex but slightly darker in colour. Lower cortex: 25 - 50 µm thick, colourless, of longitudinally oriented hyphae. Apothecia: abundant in central part of thallus, often present but less frequent towards margins, laminal, sessile, flat to convex, to 1.5 mm diameter, not pruinose, usually rounded, older ones sometimes becoming irregular. Disc: orange-brown to red-brown. Thalline margin: absent. Excipule: pale orange-brown to brown-orange, paler than disc, thin, persistent or becoming excluded; in section distinctly cellular on an overall radiating trend, cells small in inner part, larger in outer part. Epithecium: colourless. Hymenium: 80 µm tall, very pale yellow, K-, CI+ blue, pigment soluble in K. Hypothecium: pale yellow. Paraphyses: coherent, 1 - 2 µm wide in lower parts, 1.5 - 2.5 µm wide towards apex, sometimes slightly capitate, not moniliform, with visible septa (at least in K). Ascii: 35 x 10 µm, slightly clavate, upper half CI+ blue in two parallel layers with a CI- layer between (as though asci were double-walled). Ascospores: colourless, simple, ellipsoid, one end sometimes slightly pointed, 15 - 18 x 6 - 7 µm, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-, UV-. Photobiont: primary photobiont blue-green, cells not in chains. Photobiont layer: 45 - 80 µm thick, often with globose clumps of cells about 40 µm in diameter descending down into medulla.

This distinctive species is unlikely to be confused with any other.

Characters of all my collections are intermediate between those cited in the key for P. plumbea and P. cyanoloma. I am not convinced that P. cyanoloma is a good species; it may just be an extreme morph of P. plumbea.

Fairly widespread, though there are no records from the NE part of the country, perhaps because of its more continental climate. From altitudes of 50 m to over 1500 m, but commonest in upland and montane forests. Usually on bark, most commonly of Abies or Quercus, but also reported from Pinus and Ulmus. Seen once on wood of Juniperus oxycedrus. The lichenicolous fungus Tonia plumbinichas has been reported once from this host.

Range similar to P. atlantica, but extending further north and east (map in Jorgensen & James 1990: 260). Widespread in southern and western Europe. Also Macaronesia, Asia (Turkey, Syria, Russia), Africa (Morocco, Algeria, Tunisia, perhaps S. Africa), and a small area of N. America (SE Canada, NE USA.

Peltigera Willd. (1787)


Literature: Several monographs are relevant to Europe, but they often contradict each other on points of detail, and determination of Peltigera species can still be difficult. Vitikainen (1994) treats all the European species, but his key to species is unsatisfactory. Martinez (1999) treats the species of the Iberian Peninsula and covers all the species included in the key below. Much of her information reappears, in condensed form, in Burgaz & Martinez (2003). Holtan-Hartwig (1993), Nimis & Martellos (2004) and Smith et al. (2009) are also helpful. For the anatomical differences between P. canina, P. membranacea and P. praetextata, see Martinez & Burgaz (1996).

Until the mid 1980s species in branch 1:2:33 of the key below, those around P. canina, were not well understood. Earlier publications are best ignored and earlier published records may be unreliable.

Thallus: foliose, usually at least several cm diameter. Upper surface: usually some shade of grey or brown, matt or shiny, tomentose or not. Lower surface: usually white, at least at margins, attached by rhizines; veins present in most species. Cephalodia: present in those species with a green primary photobiont, otherwise absent. Isidia or similar: present in a few species. Rhizines: always present; size, colour and morphology variable. Soralia: present in a few species. Veins: present on lower surface in most species. Lower cortex: absent. Apothecia: common in some species, on upper surface of lobes, often on distinct extensions of the lobes. Ascospores: colourless, usually 3-septate. Chemistry: all spot test reactions negative. Photobiont: primary photobiont blue-green in most species, green in a few; the latter have cephalodia with a blue-green photobiont.

About 93 species, of which 32 occur in Europe; 15 are reliably reported for Greece. Species of Peltigera are normally terricolous or overgrow terricolous or corticolous bryophytes, but sometimes grow directly on bark or wood.

When determining collections of Peltigera it is often necessary to examine rhizines and veins on the lower surface. These are often obscured by debris from the substrate. It is always advisable to clean carefully a representative portion of the lower surface, under a binocular microscope, to remove adhering soil, bryophytes and decaying vegetation, before
attempting a determination.

11 Photobiont in lobes green. Blue-green photobiont in wart-like or button-like cephalodia on upper or lower surface of lobes.

22 Cephalodia on lower surface of lobes. Thallus small, to a few cm diameter, attached to substrate at a single central point; rhizines absent. **P. venosa**

2 Cephalodia on upper surface of lobes. Thallus large, to 20 cm diameter, attached by rhizines.

33 Cephalodia warded everywhere. Rhizines usually separate. Veins on lower surface forming distinct network. Lower surface of apothecia with discontinuous cortex. **P. leucoplebia**

3 Cephalodia smooth, at least in central part. Rhizines often confluent. Veins usually absent; if present then diffuse and not forming distinct network. Lower surface of apothecia with continuous cortex. **P. aphthosa**

1 Photobiont in lobes blue-green. Cephalodia absent.

22 Soralia present.

33 Soralia marginal. **P. collina**

3 Soralia laminal. (P. didactyla var. didactyla), (P. didactyla var. extenuata)

2 Soralia absent.

33 Upper surface tomentose, at least at lobe margins, matt. Notes 1, 2.

44 Isidia or isidia-like structures (phyllidia, schizidia) present.

55 Isidia laminal, button-like, resembling cephalodia. Lobes less than 1 cm wide. Thallus small, to 5 cm diameter. (P. lepidophora)

5 Isidia laminal and marginal, squamulose. Lobes usually more than 1 cm wide. Thallus large, to 25 cm diameter. **P. praetextata**

4 Isidia absent.

55 Lower surface without veins. (P. malacea)

5 Lower surface with distinct veins. Notes 3, 4.

66 Rhizines separate, basal part of each rhizine forming a single, ±well-defined cylinder; branching absent or infrequent, or consisting only of very fine squarrose extensions from main cylinder (Note 5).

77 Rhizines with very fine, squarrose branches. Lobe margins downturned (Note 6). Note 7. **P. membranacea**

7 Rhizines unbranched, or with few branches, or rhizines unraveling slightly towards tip; squarrose branches absent (or, rarely, present on a few rhizines). Lobe margins flat to upturned (Note 6).

88 Thallus to 25 cm diameter. Lobes more than 1 cm wide, margins flat or slightly upturned. Veins pale at lobe margins (more than just extreme margin), dark brown in central part of thallus (Note 8). Rhizines dark in central parts of thallus. Probably confined to shady habitats in forests. **P. praetextata** Note 7.

8 Thallus to 10 (15) cm diameter. Lobes less than 1 cm wide, margins upturned. Veins and rhizines various (Note 8). Not confined to forests.

99 Veins pale, not darkening much towards centre of thallus. Rhizines remaining pale and simple in centre of thallus. Thallus sometimes exceeding 10 cm diameter. **P. ponojensis**

9 Veins brownish except at extreme margins of lobes. Rhizines becoming darkened and tufted towards centre of thallus. Thallus not exceeding 10 cm diameter (probably not exceeding 7 cm, but published information contradictory). **P. monticola**

6 Rhizines fasciculate, basal parts ±merging together and so not forming a single cylinder, or strongly branched (Note 5).

77 Lobes 1 - 3 cm wide, margins often downturned (Note 6). Veins and rhizines near margins whitish. Apothecia often present. **P. canina**

7 Lobes to 1.5 cm wide, margins often upturned (Note 6). Veins and rhizines darkening not far from lobe margins. Apothecia present or absent.

88 Central part of lobes not tomentose, appearing brown. Veins in the centre tomentose, with rounded interstices. Apothecia often present. **P. kristinssonii**

8 Lobes tomentose and grey everywhere. Veins smooth, with angular interstices. Apothecia uncommon. **P. rufescens**

3 Upper surface not tomentose, usually at least slightly shiny in most species.

444 Lower surface without veins. (P. elisabethae) See Note 9. Greek reports need confirmation.

44 Lower surface with pale veins.

55 Veins narrow and prominent, well delimited, remaining white to margin of lobes. Lobes shiny. **P. degenii**

5 Veins broad and flattened, sometimes diffuse, brown-yellow or yellow-brown at margin of lobes. Lobes matt
to slightly shiny. (P. hymenina) Greek report doubtful.

4 Lower surface with dark veins, at least in centre of thallus.

55 Veins broad (typically 2 mm wide or more).

56 Veins dark only in central half of thallus, diffuse. Rhizines simple to fasciculate, usually very narrow, usually separated. (P. hymenina) Greek report doubtful.

6 Veins dark in at least two-thirds of thallus, diffuse or well delimited. Rhizines fasciculate, not very narrow, separate or confluent.

77 Rhizines separate, more than 5 mm long. Interstices between veins rounded. Apothecia red-brown.

Lobes 2 - 4 cm wide. Lobes not pruinose. (P. neopolydactyla)

7 Rhizines confluent, less than 5 mm long. Interstices between veins elongate. Apothecia dark brown to black. Lobes 0.7 - 2.5 cm wide. Lobes sometimes with a little white pruina near tips. **P. neckeri**

5 Veins narrow (typically 1.5 mm wide or less), well delimited.

66 Veins confluent in central part of thallus. Rhizines resembling an artist's paintbrush. **P. polydactylon**

6 Veins not confluent in central part of thallus. Rhizines bushy. **P. horizontalis**

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(1) These species are difficult to separate. The key uses only characters that I have found to work fairly well. Use published monographs with caution, as they contain much contradictory information.

(2) Isidia (or similar) must be distinguished from small regenerating lobes that occur in many species following injury.

(3) The following short-cuts may be helpful for this group:

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**Large thalli and broad lobes**: occur in *P. canina*, *P. membranacea* and *P. praetextata*; sometimes also in *P. rufescens*.

**Upturned (involute) lobe margins**: occur in *P. monticola*, *P. ponojensis* and *P. rufescens*, even when sterile. They only occur in other species near apothecia.

**Downturned (revolute) lobe margins**: occur in *P. canina* and *P. membranacea*.

**Dark veins or rhizines**: extending very close to lobe margins occur in *P. kristinssonii*, *P. monticola*, and *P. rufescens*.

**Habitat.** *P. praetextata* is probably restricted to shaded habitats in montane forests. *P. ponojensis* is probably restricted to fissures in strongly calcareous rocks in upland or montane regions. *P. ponojensis* is probably restricted to soil or rock fissures. The others may occur on many substrates.

(4) In this part of the key, when referring to rhizines or veins, "pale" means white, pale brown or (less commonly) pale grey; "dark" means distinctly brown, or dark brown. Rhizines and veins on lower surface of lobes help separate these species, but they can be variable. Examine several lobes, so as not to be misled by an atypical one. Rhizines in this group are pale at lobe margins, but sometimes only very close to the margin. Any change in their colour towards the centre of the thallus is an important character. Morphology of rhizines refers to rhizines that are mature but situated fairly close to lobe margins. Rhizines in the central part of the thallus may appear different, as contact with the substrate can cause their tips to branch or unravel extensively.

(5) Occasionally two or more separate rhizines may happen to grow close together, and may then appear almost fasciculate. Rhizines may sometimes unravel towards the tips; in *P. praetextata* they commonly do so. This is not branching. Less commonly, they may unravel almost from the base, and can then resemble confluent and/or strongly branched rhizines. The only way to avoid confusion is to examine many rhizines, to determine what is typical for the specimen.

(6) Flat, upturned (involute), or downturned (revolute) lobe margins refers to sterile parts of lobes. Lobes may be very different where they bear apothecia.

(7) Rhizines of *P. praetextata* are very variable. Usually they lack squarrose branches, but some specimens have a few squarrose rhizines. Such specimens lacking phyllidia might be difficult to separate from *P. membranacea*, but that species is rare in Greece and restricted to the north.

(8) Much published information on the width of veins, the extent to which they are raised, and their branching pattern, is unreliable.

(9) Some collections of *P. neckeri* have indistinct veins, and may cause confusion. *P. neckeri* usually has at least a little white pruina on the upper surface near the lobe tips, whereas *P. elisabethae* does not. Fertile collections can be separated by the size of the ascospores: 25 - 45 x 3 - 7 µm in *P. elisabethae*, 50 - 75 x 2.5 - 3 µm in *P. neckeri*.

**Peltigera aphthosa** (L.) Willd. (1787)

Fl. Berol. Prodr. 347, as aphthosa; *Lichen aphthosus* L. (1753), Sp. Pl. 1148, as aphtosus. (The Greek word from which the epithet is derived has the letter θ, not τ, and θ is usually transliterated as ’th’): *Peltidea aphthosa* (L.) Ach.

Descriptions: Ahti et al. (2007); Burgaz & Martinez (2003); Clauzade & Roux (1985); Martinez (1999); Vitikainen (1994).

Scattered, on the northern half of the mainland. On rock at altitudes 20 - 1200 m, but usually above 1000 m. Widespread in northern and central Europe; uncommon in the mountains of the south. Also Asia (widespread), N. America (widespread). Reports for Australasia are incorrect.
Peltigera canina (L.) Willd. (1787)

Thallus: foliose, to 15 cm diameter. Lobes: (6) 10 - 22 mm wide, without vegetative propagules. Lobe margins: flat to involute overall, but extreme margins usually revolute. Upper surface: usually grey at margins, sometimes with brown tinge in central parts, matt, white tomentose at least near lobe tips; tomentum erect, usually not very dense. Lower surface: white, except for veins, attached by rhizines. Rhizines: abundant, variable, most commonly fasciculate and strongly branched, a few unbranched, very rarely squarrose, white to pale brown in marginal 10 mm, dark brown in central parts, 0.7 - 2.5 x 0.2 - 0.3 mm. Veins: present almost to lobe margin, raised (less strongly so in central part of lobes), pale brown, atomentum at least in outer parts, 0.2 - 0.6 mm wide near lobe margins. Photobiont: blue-green.

This species is easily confused with several others. It is essential to examine rhizines carefully.

Throughout Greece. However, early reports may be unreliable as the name has been used in a broad sense including P. membranacea and P. praetextata. Usually terricolous or overgrowing bryophytes, occasionally on bark or rock. At altitudes 20 - 2300 m, but uncommon below 500 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (Morocco, Algeria, Ethiopia, S. Africa), N. America (widespread), S. America (widespread), probably Australasia (NZS; reports for Australia incorrect). Reports for C. America (Mexico), Antarctica are incorrect.

Peltigera collina (Ach.) Schrad. (1803)

Thallus: foliose, to 6 cm diameter. Lobes: 15 - 23 x 5 - 9 mm, about 200 µm thick, usually grey to blue-grey, sometimes brownish, not pruinose, smooth, matt, margins ascending and often rather wavy, attached by rhizines. Lower surface: white in a broad zone at margins, brown towards centre of thallus. Rhizines: white to brown, simple but sometimes unravelling especially towards tips (and may then appear slightly fasciculate), discrete, 0.7 - 1 x 0.05 - 0.1 mm. Veins: sometimes present but not well developed. Soralia: abundant, dark blue-grey, on lobe margins, rarely laminal along cracks in thallus, not delimited; soredia rather coarse, 50 - 70 µm diameter. Cortex: colourless, 25 - 40 µm thick, of subrounded cells 7 - 11 µm diameter. Medulla: white, of loosely interwoven hyphae 5 - 8 µm wide, often with visible septa. Lower cortex: absent. Chemistry: thallus and soralia UV-. Photobiont: blue-green; cells globose, 8 - 12 µm diameter, not in obvious chains, forming a continuous, regular layer 50 µm thick.

Easily distinguished from other species of the genus by the marginal soralia. The common Fuscopannaria mediterranea is a much smaller lichen.

Scattered, mainly in the south west half of Greece. Probably restricted to the most favourable and least disturbed, localities in upland forests, and usually found together with other sensitive species. Usually on bark, but sometimes on wood or overgrowing bryophytes. Usually at altitudes 800 to 1600 m, rarely as low as 600 m.

Throughout Europe, but commonest in cool, suboceanic or oceanic regions; in the south restricted to the uplands. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread), C. America (CR, Mexico), S. America (widespread).

Peltigera degenii Geyln. (1927)

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (195); Martínez (1999); Smith et al. (2009); Vitikainen (1994).

Macedonia and perhaps also Evia, on bark at altitudes 600 - 1200 m.

Mainly central and northern Europe, with a few scattered records from the south. Also Macaronesia, Asia (widespread), Africa (Tanzania), N. America (widespread), perhaps S. America (Uruguay).

Peltigera horizontalis (Huds.) Baumg. (1790)
Fl. Lips. 562; Lichen horizontalis Huds. (1762), Fl. Angl. 453.

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Scattered on the mainland, mainly in the north. Reports for the Peloponnese may be incorrect. On bryophytes (about 50% of records), bark, rock or soil at altitudes 400 to at least 1400 m, and perhaps to alpine levels.

Throughout most of Europe, except the extreme south. Also Macaronesia, Asia (widespread), N. America (widespread). Reports for Malesia, Australasia, Antarctica are incorrect.

Peltigera kristinssoni Vitik. (1985)

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Martínez (1999); Vitikainen (1994).
Reported from a single locality in Macedonia at an altitude of about 1800 m. The substrate was not stated. Most European localities are in the northern part of the Nordic countries and the Alps, but there are a few outliers elsewhere. Also Asia (Turkey, Georgia, Siberia, Mongolia), N. America (widespread).

**Peltigera leucophlebia** (Nyl.) Gyeln. (1926)


Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Macedonia, according to the map in Vitikainen (1994: 55). No substrate or altitude was indicated.

Most of Europe, but in the south restricted to high mountains. Also Asia (widespread), N. America (widespread).

**Peltigera membranacea** (Ach.) Nyl. (1887)


Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Macedonia and perhaps Evia at altitudes 600 - 1200 m, on bark.

Common in northern Europe, fairly common in central Europe, rare in the south. Also Macaronesia, Asia (widespread), perhaps Africa (S. Africa), N. America (widespread), S. America (Colombia, perhaps elsewhere), Australasia (NSW, widespread in NZ), Pacific (W. Samoa).

**Peltigera monticola** Vitik. (1994)


Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Martínez (1999); Nash et al. (2004); Vitikainen (1994).

Scattered on the mainland, mainly in the north but reliably reported for southern Peloponese. (According to Vitikainen, the Peloponnesian specimen was collected by Lindqvist in 1982 at an altitude of 1200 m; this must mean site 1B of Lindqvist, 1983.) Usually at altitudes 600 - 1100 m, but there is a single report, perhaps unreliable, from sea level in Thessaly. Terricolous.

This species has been overlooked in the past. There are scattered records from many parts of Europe, but the pattern is hard to interpret, though in southern Europe *P. monticola* clearly prefers the uplands. Also Asia (widespread), N. America (Arizona, California), C. America (Mexico), probably S. America.

**Peltigera neckeri** Hepp ex Müll. Arg. (1862)


Thallus: foliose, to 12 cm diameter. Lobes: 0.8 - 1.5 mm wide, often divided near tips, involute, without vegetative propagules, 200 - 250 µm thick when dry, swelling slightly when wet. Upper surface: grey to brown-grey, smooth, slightly shiny, not tomentose, sometimes slightly white pruinose at tips of lobes. Lower surface: white, but largely occupied by dark veins, attached by rhizines. Rhizines: fasciculate, branched, to 1.8 mm long, white when very young, soon pale brown; dark brown to black in centre of lobes. Veins: broad and diffuse, to 3 mm wide, occupying much of lower surface, mostly dark brown to black, paler near lobe margins, most interstices distinctly elongate, a few broadly ellipsoid. Cortex: 20 - 25 µm thick, colourless, distinctly cellular; cells thin-walled, subrounded to subangular, 5 - 12 µm diameter, without preferred orientation. Lower cortex: absent. Chemistry: medulla K- or faintly K+ pale brown, C-, KC-, P-, I-.

This species has no really clear-cut characters, and careful attention to detail is the only reliable way to separate it from similar species. The apothecia are generally darker than in other similar species. The white pruina at the lobe tips is helpful, but may be scanty or absent.

Mainland Greece, and the islands of Alonisos and Naxos. Usually overgrowing bryophytes, occasionally directly on soil or bark, at altitudes 200 - 2100 m.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Algeria, Tunisia), N. America (widespread), C. America (Mexico), S. America (Chile), Australasia (widespread in NZ), Antarctica (S. Georgia).

**Peltigera polydactylon** (Neck.) Hoffm. (1789)


Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Scattered on the mainland and Crete at altitudes 100 - 1700 m, but most records are from 400 - 1400 m. Usually
terricolous, sometimes on rock, rarely on bark.

Subcosmopolitan in regions with a temperate or cool climate.

**Peltigera ponojensis** Gyeln. (1931)


At species rank the earliest name is *Peltigera plittii* Gyeln. (1930). Vitikainen (1994) preferred the name *Peltigera ponojensis*, which he described as “nom. cons. prop”. I have not found any conservation proposal and the name is not listed as conserved in the present Code. The correct name for this species is probably *Peltigera plittii*.

Thallus: foliose, to 8 cm diameter. Lobes: 20 x 5 - 13 mm, without vegetative propagules. Lobe margins: involute, sometimes wavy. Upper surface: pale brown to brown, white tomentose at tips of lobes (sometimes only slightly and only at extreme tip). Lower surface: white at margin, except for veins, attached by rhizines. Rhizines: usually abundant, variable but most commonly separate and simple, sometimes unraveling at tip; white to pale brown near lobe margins, brown in central parts, 1 - 5 x 0.1 - 0.2 mm. Veins: present on lower surface, reaching almost to tips of lobes but becoming less prominent at extreme tips; raised near lobe margins, often flatter and less distinct in centre, white to pale brown at lobe margins and for about 1 cm inwards, brown in centre, 0.3 - 0.7 mm wide. Apothecia: sometimes present, 1.5-2.5 x 2-3.5 mm, not pruinose. Disc: red-brown. Ascospores: 35 - 46 x 4 µm. Photobiont: blue-green.

*P. ponojensis* has a smaller thallus and narrower lobes than *P. canina* and *P. praetextata*. It also differs from *P. canina* in its rhizines, which are usually separate, not confluent, and not branched (though they may unravel).

Scattered on the mainland, on soil or overgrowing bryophytes on soil, at altitudes 800 - 2000 m.

Throughout Europe. Also Macaronesia, Asia (widespread), N. America (widespread).

**Peltigera praetextata** (Flörke ex Sommerf.) Zopf (1909)


Thallus: foliose, to 22 cm diameter. Lobes: to 6 cm long, 1.0 - 3.0 (3.2) cm wide, 200 - 400 µm thick. Lobe margins: often ±flat, sometimes slightly involute, rarely slightly revolute; rarely slightly wavy. Upper surface: grey, grey-brown or pale brown, matt, white tomentose (sometimes only slightly) at margins of lobes. Lower surface: white to pale at lobe margins (except for veins), pale brown to dark brown near centre, veined, attached by rhizines. Isidia: true isidia absent, flattened phyllidia often present, sometimes abundant, usually in dense clusters on lobe margins, occasionally laminal in smaller discrete clusters; individual phyllidia 0.4 - 0.7 mm wide, 0.1 mm thick. Rhizines: abundant; white or pale brown near lobe margins, brown to black in central parts, separate (never fasciculate); usually unbranched, though often unraveling near tips, rarely minutely squarrose; 1 - 7 x 0.15 x 0.4 mm (width excludes any unravelled part); in section: with a distinct dense core of parallel anastomosed hyphae, surrounded by a looser outer layer of irregularly oriented anastomosed hyphae. Veins: always present, raised, white to pale brown near lobe margins and for about 1 cm inwards, brown to black in central parts, 0.2 - 0.7 mm wide near lobe tips. Cortex: 25 - 35 µm thick (overlain by a loose layer of projecting hyphae 30 - 100 µm thick), colourless, distinctly cellular; cells 6 - 12 µm wide, often rather squareish, with broad lumina and narrow walls. Medulla: white, formed of an irregular network of hyphae. Lower cortex: absent. Apothecia: often present, arising on erect extensions 4 mm long and 1.5 - 2 mm wide from lobe margins; the apothecia themselves are 2 - 5.5 mm diameter, not pruinose. Disc: brown to red-brown. Thalline margin: present, often confined to lower surface of apothecium; in section: 130 µm wide; cortex 40 - 50 µm, cellular, cells large, 7 - 25 x 7 - 17 µm, subrounded. Exciple: pale, thin, often discontinuous; in section: 200 µm wide, ±colourless, distinctly cellular; cells subrounded, large, 10 - 37 x 8 - 27 µm, long axis usually directed outwards. Epitheicium: brown-orange, K-.

Hymenium: 65 µm tall, colourless to pale brown-orange. Hypothecium: 35 µm tall, ±colourless to pale brown-orange, cellular. Paraphyses: simple, 2.5 µm wide in lower part, to 5 µm at apex, sometimes slightly capitate or moniliform, often with visible septa. Asci: 60 - 75 x 11 - 12.5 µm, broadest in central part, weakly K+ blue in thin arch at apex, strongly KI+ blue in a very small region just above top of spore-containing part (Peltigera type). Ascospores: colourless, fusiform, 3-septate but often appearing sparsely up to 7-septate, 35 - 50 x 3 - 4 µm. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K-, C-, KC-, P-, I-. Photobiont: blue-green; cells globose, 5 - 7 µm diameter, not in chains, forming a continuous, regular layer 30 - 50 µm thick.

Easily recognisable when phyllidia are present. Specimens without phyllidia can sometimes be determined simply by the very large diameter of the thallus. It can usually be separated from *P. canina*, the other common species in this group, by the separate (not fasciculate) and mostly unbranched rhizines, though rhizines can be confusingly variable and some specimens are difficult to place.

What looks from above like a thin, pale, often discontinuous thalline margin is usually seen in section to be the exciple. The thalline margin is usually not visible from above.

Fairly common on the mainland and immediately adjacent islands. Usually overgrowing bryophytes, sometimes terricolous or on bark, generally restricted to ±shaded habitats such as well-developed forests. At altitudes 0 - 1500 m, but rare below 500 m.
Throughout Europe, though in the south mainly in the uplands. Also Macaronesia, Asia (widespread), Africa (Tunisia, widespread in E. Africa), N. America (widespread), C. America (CR, Mexico), S. America (Bolivia, perhaps Venezuela), Australasia (NSW, NZS).

**Peltigera rufescens** (Weiss) Humb. (1793)
Fl. Friberg. 2; *Lichen caninus* var. *rufescens* Weiss (1770), Pl. Crypt. Fl. Gott. 79-80; *Peltigera canina* α (= var.) *ulorrhiza* Schaer., nom. superfl.; *Peltigera rufescens* f. *incusa* (Flot. ex Körb.) Arnold; *Peltigera rufescens* var. *incusa* (Flot. ex Körb.) J. Steiner; *Peltigera rufescens* var. *palmata* (Delise ex Duby) Gyeln.

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Widespread and fairly common, but absent from many of the small islands. On soil (usually calcareous) or rock, only occasionally overgrowing bryophytes. At altitudes 600 - 2500 m. Reports from close to sea level are doubtful.

Subcosmopolitan in regions with a cold to temperate climate. In southern Europe confined to the uplands.

**Peltigera venosa** (L.) Hoffm. (1789)

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Rare and scattered in the northern part of the mainland, on soil at altitudes 600 - 2000 m.

Commonest in northern Europe, but quite widely distributed in central Europe and with a few outlying localities in the mountains of southern Europe. Also Asia (widespread), N. America (widespread).

**Peltula Nyl.** (1853)

Literature: Egea (1989) treats most of the European species. McCarthy (2001a) and Nash et al. (2002) are also helpful.

About 49 species, 12 of which occur in Europe. They usually occur on rock or soil in warm, arid regions. The more arid parts of Greece are under-studied for lichens, and the key includes many species reported for western Asia and North Africa whose range might conceivably include Greece.

11 Soredia present. Thallus areolate, placodioid or squamulose.

22 Thallus areolate with lobed margin. (P. placodizans)

2 Thallus squamulose.

33 Squamules 1 - 2 mm diameter, margins undulate. (P. bolanderi)

3 Squamules 1.5 - 3 (10) mm diameter, margins ± lobed. **P. euploca**

1 Soredia absent. Thallus squamulose to foliose.

22 Thallus foliose to subfoliose. Apothecia laminal, sessile, with dark red open discs. (P. lobata)

2 Thallus squamulose. Apothecia various.

33 Squamules attached by rhizohyphae. (P. patellata), (P. psammophila)

3 Rhizohyphae absent.

44 Squamules K+ purple. (P. radicata)

4 Squamules K-

55 Squamules attached by rhizines. (P. crispatula), (P. obscuratula)

5 Squamules attached by an umbilicus.

66 Apothecia punctiform.

77 Thallus to 2.5 mm wide, black-brown, almost hemispherical. **P. omphaliza**

7 Thallus larger, yellowish or bright olive or olive-brown; upper surface flat. (P. rodriquesii)

6 Apothecia open, at least eventually.

77 Ascospores globose or subglobose (length/width 1.5 or less). (P. obscuratula), (P. zahlbruckneri)

7 Ascospores ellipsoid (length/width 2 or more).

88 Squamules concave, pale green-olive, to 3 mm wide. Apothecia immersed in squamules, without an obvious thalline margin. (P. michoacanensis)

8 Squamules flat or convex, dark brown-olive, to 2 mm wide. Apothecia sessile, with a thalline margin. **P. obscurans** s. lat. Two varieties are sometimes recognised in Europe.

99 Epithecium K+ red. (P. obscurans var. obscurans)

9 Epithecium K-. (P. obscurans var. hassei)
Peltula euploca (Ach.) Poelt (1967)

Peltula obscurans (Nyl.) Gyeln. (1935)
Feddes Rep. 38: 308; Endocarpiscum obscurans Nyl. (1873), Flora 56: 200 and Bull. Soc. Linn. Normandie, Sér. II, 6: 309. It is not known which was published first.Descriptions: Clauzade & Roux (1985); Egea (1989), Nash et al. (2002).Islands of the Aegean, on siliceous rock at altitudes 5 - 350 m. It was not reported whether the collections belonged to var. obscurans or var. hassei.Widespread in arid regions around the world. Southern Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread), Caribbean (PR), C. America (Mexico), S. America (Argentina, Chile, Brazil, Peru), Australasia (widespread in Australia).


Peridiothelia D. Hawksw. (1985)

Literature: The standard monograph is Hawksworth (1985a).

Three species of saprophytic fungi, all of which occur in Europe. They are not lichenised, but are sometimes encountered by lichenologists.

11 Ascospores 25 - 33 µm long. (P. grandiuscula)
1 Most ascospores less than 25 µm long.
22 Ascospores 17 - 21 x 7.5 - 9 µm. On bark of Tilia. (P. fuliguncta)
2 Ascospores 22 - 25 x 8.5 - 11 µm. Usually on bark of Olea. P. oleae

Peridiothelia oleae (Körb.) D. Hawksw. (1985)
Description: Hawksworth (1985a).
Corfu and Evia, on bark of Olea europaea and Quercus ilex at altitudes 0 - 200 m.Known only from Spain, Yugoslavia and Greece.

Pertusaria DC. (1805)
in Lamarck & de Candolle, Fl. Franç. Ed. 3, 2: 319. The name is conserved against several earlier names. Type: P. communis DC., listed in Appendix of the ICN. Family: Pertusariaceae.

Literature: The genus is rich in species and there is no modern monograph of the European taxa. The best starting points are Clauzade & Roux (1985) and Smith et al. (2009). Boqueras & Llimona (2003) is also helpful.

Thallus: crustose, to several cm diameter, well developed, white, white-grey, grey, or green-grey, sometimes with distinct prothallus. Isidia: present in some species. Soralia: present in some species. Cortex: well developed in most species. Medulla: white. Apothecia: common in some species, often in thalline warts. Disc: usually black, punctiform to widely exposed. Thalline margin: present in a few species, but in most not well developed independently from warts. Exciple: not visible externally, sometimes well developed in section, colourless. Epithecium: colourless, brown, grey or dark grey, K- or K+ purple, violet or mauve. Hymenium: 200 - 450 µm tall, colourless. Hypothecium: colourless to very pale brown, sometimes poorly developed. Paraphyses: anastomosed, usually rather narrow, not

The former Pertusaria s. lat. was not monophyletic, and is being subdivided into more natural genera. This Flora recognises the segregates Lepra and Varicellaria, and a more narrowly delimited Pertusaria. Unfortunately, the correct placement of many species is unclear at present. That makes it difficult to provide separate generic keys for Lepra, Pertusaria s. str. and Varicellaria, and the species of all three genera are keyed out here.

Many species of Pertusaria s. lat. have been narrowly delimited, and others are known from very few collections. Published descriptions of the less well-known species are often inadequate, and some parts of the keys below may not work well. There is a need for a modern monograph that includes SE Europe. The number of good species is uncertain: estimates vary from 350 to 650. Most species occur on bark or rock.

In this group is often necessary to note the number of ascospores in an ascus when determining collections. Because ascospores are usually large, a conventional thin section may disrupt individual asci and release the ascospores. Cutting a thick section sometimes makes it easier to count ascospores.

P. graeca Erichsen, reported for Greece, and P. teneriffensis Vain., tentatively reported for Greece, are not included in the keys as I have insufficient information.

Key to Pertusaria main groups

11 Isidia (or papillae resembling isidia) present. Group 1

1 Isidia absent.

22 Soralia present, at least some of which are independent of apothecia. (Species possessing both soralia independent of apothecia and soralia covering apothecia belong here.) Group 2.

2 Soralia absent or forming a covering to each apothecium.

33 Thallus or medulla K+ yellow > very red. Norstictic acid present or absent. Group 3

3 Thallus and medulla K- or K+ yellow. Norstictic acid absent.

44 Thallus or medulla C+ or KC+ orange. Ascospores to 170 µm long (Note 1). Group 4

4 Thallus and medulla C- or C+ yellow or pink, KC- or KC+ yellow or pink. Outscores more than 170 µm long in some species. Group 5.

(1) P. caesioalba has ascospores more than 170 µm long and a C- thallus. However, the thallus sometimes reacts faintly and rather obscurely KC+ orange-ish. It is keyed in Group 5, not Group 4.

Key to Pertusaria group 1: Isidia present

11 Norstictic acid present in cortex or medulla. Spot tests K+ yellow > red; needle-like crystals in section.

22 On bark.

33 Thallus yellow-green, C+ orange. (P. praelutescens)

3 Thallus white, grey or green-grey, C-. P. coccodes

2 On siliceous rock.

33 Isidia globose, rounded, 0.5 - 1 mm diameter, brown at apex, not easily eroding. Soredia absent. (P. pseudocorallina)

3 Isidia merely small papillae, globose, 0.1 mm diameter, not brown at apex, easily eroding and leaving granular-sorediate patches. P. lactescens

1 Norstictic acid absent. Spot tests K- or K+ yellow; no needle-like crystals.

222 Cortex and medulla C+ or KC+ orange.

33 On bark. P. flavida

3 On siliceous rock. (P. rupicola v. coralloidea)

22 Cortex and medulla C+ or KC+ carmine red or pink.

33 Medulla P+ orange or red.

44 On bark. (Lepra slesvicensis)

4 On siliceous rock. (Lepra melanochlora) Greek reports doubtful.

3 Medulla P-. Varicellaria velata

2 Cortex and medulla C-, KC- or C+, KC+ yellow.

33 Thallus and/or medulla P+ orange or red. On bark or siliceous rock.

44 On bark. P. coronata
4 On siliceous rock. **Lepra corallina**

3 Thallus and medulla P-. Usually on bark.

44 Isidia small, granular, to 0.2 mm diameter. **Lepra albescens var. corallina**

4 Isidia at least 0.5 mm in longest dimension.

5 Margin of thallus distinctly zoned. Apothecia very rare. Isidia to 1 mm wide. **P. jurana**

5 Margin not zoned. Apothecia often present. Isidia very broad, tuberculate, to 5 mm wide. (Lepra tuberculata)

**Key to Pertusaria group 2:** Isidia absent; soralia (not associated with apothecia) present.

111 Cortex, medulla or soralia C+ or KC+ orange. On rock.

22 Thallus less than 0.3 mm thick, cracked, grey or with patches of yellow-grey, P+ orange. Soralia white to pale grey. **P. amarescens**

2 Thallus more than 0.3 mm thick, coarsely areolate, yellow or green-grey, P-. Soralia pale yellow-green. **P. flavicans**

11 Cortex, medulla or soralia C+ or KC+ carmine red, pink or purple. On various substrates.

22 Medulla and/or soralia P+ orange or red.

33 Soralia broad, flat or convex, not arising from papillae.

44 Soralia immarginate. **Lepra amara**

4 Soralia with distinct thalline margin. (P. szatalae)

3 Soralia small, arising from small papillae. (Lepra pulvinata)

2 Medulla and soralia P-.

33 Usually on siliceous or slightly calcareous rock. Thallus white or grey-white, without a blue-grey tinge, ±areolate. Soralia 0.5 - 1.5 mm diameter, with narrow base, usually remaining discrete. **Varicellaria lactea**

3 Usually on bark. Thallus and soralia various.

44 Mature soralia large, 1 - 2 mm diameter, white, usually distinctly convex. Thallus white but often with a blue-grey tinge, continuous or slightly cracked. Medulla and soralia both C+ red. **Varicellaria hemisphaerica**

4 Mature soralia usually not exceeding 1 mm diameter (unless coalescing). Medulla C- but soralia C+ red.

55 Soralia 0.5 - 1 mm diameter, flat or slightly excavate, bordered by distinct upturned rim, sometimes coalescing, sometimes becoming irregularly convex later. On ±acidic bark. **P. dalmatica**

5 Soralia punctiform, sometimes coalescing. Consider **Ochrolechia arborea**

1 Cortex, medulla and soralia C- or C+ yellow, KC- or KC+ yellow. On various substrates.

22 Thallus, medulla or soralia K+ yellow > red. Ascospores 100 - 200 x 35 - 55 µm, usually 2 per ascus, sometimes 1. **P. servitiana** Note 1.

2 Thallus, medulla and soralia K+ yellow or K-. Ascospores various.

33 Ascospores 10 - 16 µm long. (P. pupillaris)

3 Ascospores at least 20 µm long, or apothecia absent.

44 On bark or, less commonly, wood.

55 Soralia P+ red, but cortex and medulla P+ yellow. Apothecia usually present. (Lepra multipuncta)

5 Soralia, medulla and cortex P-. Apothecia present or absent.

66 Most soralia associated with apothecia. Ascospores 130 - 150 x 50 - 70 µm, 1 per ascus. **Lepra ophthalmiza**

6 Few or no soralia associated with apothecia.

77 Variolaric acid (C+ faintly yellow in spot tests, if concentration high enough) present in cortex and soralia. Thallus UV+ blue-white. Thallus margin not zoned. Apothecia sometimes present. Ascospores 20 - 50 µm long, 4 - 8 per ascus. On bark or wood of conifers in upland areas. See **Ochrolechia alboflavescens**

7 Variolaric acid absent. Thallus UV- (Note 2). Thallus margin often zoned. Apothecia very rare. Ascospores 170 - 300 µm long, usually 1 per ascus. Not restricted to conifers or to upland areas. **88 Soralia clearly delimited. Lepra albescens v. albescens**

8 Soralia not clearly delimited. **Lepra albescens v. corallina**

4 On siliceous rock.

55 Thallus dark.

66 Thallus dark brown-grey. Soralia P+ red (reaction generally faint). **Lepra mammosa**

6 Thallus dark grey. Soralia P-. (Lepra ocellata) Greek report doubtful.

5 Thallus pale grey.

66 Thallus less than 1 mm thick, P+ distinctly red. **Lepra aspergilla**
6 Thallus more than 1 mm thick, P- or P+ slightly reddish (thallus, not medulla).
7 Medulla and soralia P+ red, KC-.
Lepra leucosora
7 Medulla and soralia P+ orange, faintly KC+ pink (P. digrediens) Greek report tentative.

(1) The poorly known (P. multipuncta var. leptosporoides), not reported for Greece, would probably also key out here.
(2) The white thallus reflects any visible wavelengths in the incoming spectrum, and this is easily misinterpreted as a UV+ white fluorescence. This is a common problem with Lepra albescens when using a long-wavelength UV source. It is advisable to investigate further any apparent fluorescence using a short wavelength UV source (which is less likely to contain visible wavelengths).

**Key to Pertusaria group 3**: Isidia and (independent) soralia absent; medulla K+ red.

1 Ascospores 8 per ascus, 80 x 25 µm. On siliceous rock. Thallus coarsely warted, with a green tinge. P. huneckiana
1 Ascospores 1 or 2 per ascus.
22 Disc punctiform. Ascospores 1 or 2 per ascus.
33 Ascospores 1 or 2 per ascus, 150 - 250 x 55 - 85 µm. (P. apennina)
3 Ascospores 2 per ascus. 70 - 95 x 25 - 35 µm. (P. luteola)
2 Disc ±open, at least eventually. Ascospores various.
33 Norstictic acid present in medulla (red, needle-like crystals in K in section). Ascospores 1 or 2 per ascus.
44 Ascospores 1 per ascus, 100 - 300 x 50 - 100 µm. Thallus white or grey. Usually on non-calcareous rock, occasionally on bark. Lepra monogona
4 Ascospores usually 2 per ascus, rarely 1.
55 Ascospores 110 - 135 x 65 - 75 µm. On rock. P. pentelici
5 Ascospores 290 - 315 x 85 - 100 µm. On bark. P. rhodiensis
3 Norstictic acid absent (red, flat, ±polygonal crystals in K in section). Ascospores 2 per ascus. P. parotica

**Key to Pertusaria group 4**: Isidia and (independent) soralia absent; medulla K- or K+ yellow; thallus or medulla C- or KC+ orange.

111 Asci 1-spored. On non-calcareous rock. Ascospores 75 - 110 x 35 - 60 µm. P. pluripuncta
11 Ascii 2-spored. On bark or wood. Ascospores 60 - 170 x 25 - 65 µm.
22 Ascospore wall with distinct radial striations in mature ascospores (young ones may have a smooth wall); usually at least 10 µm wide (Note 1). Ascospores 70 - 170 x 25 - 65 µm. Fertile warts 1 - 2 mm diameter.
33 Fertile warts with broad base. Ascospore wall 10 - 15 µm thick. P. heterochroa
3 Fertile warts with narrow base. Ascospore wall 15 - 20 µm thick. (P. ficorum)
2 Ascospores without radial striations; boundary between inner and outer wall rather irregular; wall 2 - 5 µm wide (Note 1). Ascospores 60 - 140 x 20 - 45 µm. Fertile warts 0.4 - 1 mm diameter. P. pustulata
1 Ascii 4 - 8 -spored.
22 Ascospores 30 - 60 x 20 - 32 µm. On bark. (P. plombii)
2 Ascospores 60 - 110 x 30 - 50 µm. On bark, wood or non-calcareous rock.
33 Ascospores wall 6 - 10 µm thick, distinctly zoned. On bark or wood. P. hymenea
3 Ascospore wall 10 - 15 µm thick, not zoned. On non-calcareous rock. P. rupicola subsp. rupicola


**Key to Pertusaria group 5**: Isidia and (independent soralia) absent; medulla K- or K+ yellow; thallus or medulla C- or C+ yellow or pink; KC- or KC+ yellow or pink

11 On bark or wood.
22 Disc eventually broadening when mature, not remaining punctiform. Ascospores 1, 2 or 8 per ascus.
333 Ascospores usually 1 per ascus, more than 100 µm long and more than 60 µm wide. P. caesioalba Note 1.
33 Ascospores 2 per ascus, 65 - 95 x 25 - 27 µm. Disc eventually flat, covered with thick whitish pruina.
Ascospore wall 3 - 4.5 µm wide. P. carmeli
3 Ascospores 8 per ascus, 16 - 42 µm long. (P. carneopallida)
2 Disc remaining ±punctiform. Ascospores 2, 4 or 8 per ascus.
33 Ascospores more than 120 µm long, 2 per ascus. Fertile warts with several apothecia. P. pertusa
3 Ascospores less than 120 µm long, (2) 4 - 8 per ascus. Number of apothecia per wart various.
44 Fertile warts with broad base. Ascospores 8 per ascus; ±uniseriate in ascus.
55 Thallus P+ orange (stictic acid). Ascospores 34 - 75 x 20 - 35 μm. (P. alpina) Greek report doubtful.
5 Thallus P-. Ascospores 45 - 60 x 25 - 30 μm. P. werneriana
4 Fertile warts spheroid, with narrow base. Ascospores (2) 4 - 8 per ascus; uniseriate or not.
55 Ascospores (4) 8 per ascus, 34 - 74 x 20 - 32 μm; wall 2 - 3 μm thick. Probably restricted to upland or montane forests. P. constricta
5 Ascospores (2) 4 (8) per ascus, 45 - 95 x 25 - 50 μm; wall 2 - 6 μm thick in most places, but 10 - 20 μm thick at ends of ascospores. Ascospores ±biseriate in ascus. Fertile warts usually with a single apothecium. Not restricted to montane forests. P. leioplaca

1 On rock.
222 Asci with 8 ascospores. Ascospores less than 50 μm long. P. chiodectonoides
22 Ascii with 2 (4) ascospores.
33 Ascospores 100 - 125 x 50 μm. Lepra pseudoparotica
3 Ascospores more than 140 μm long.
44 Thallus pale yellow. P. pallidoflava
4 Thallus grey or green-grey. P. pertusa
2 Asci with 1 ascospore. Ascospores 180 - 200 x 60 - 70 μm. Lepra mammosa

(1) P. paramerae, widely distributed around the Mediterranean but not reported for Greece, would also key out here. It can only be separated reliably from P. caesioalba by chromatography. Both species have thiophaninic acid. P. paramerae also has planaric acid whereas P. caesioalba has 2′-O-methylperlatolic acid. I am not persuaded that these minor differences in chemistry warrant its recognition as a distinct species.

**Pertusaria amaurescens** Nyl. (1874)

*Flora* 57: 311.


Very rare in northern Greece, on siliceous rock close to sea level.

Southern and south central Europe, with scattered reports to as far north as Scotland. Also Macaronesia, Asia (Turkey, Sikkim, perhaps HK).

**Pertusaria caesioalba** auct., non (Le Prév. ex Duby) Nyl. (1855)

(?) *Pertusaria corinthiaca* Erichsen.

The nomenclature is confused. The name is usually cited with authorship (Flot.) Nyl. Nylander made the combination in *Mém. Soc. Imp. Sci. Nat. Cherbourg* 3: 180-181. 1855, and also in *Ann. Sci. Nat. Bot. Sér. IV, 3 :160. 1855*. In the former he introduced the name as "P. caesioalba (Fw. s. Phlyct.)", in the latter as "P. caesioalba (Fw. in Bot. Zeit. 1850, p371, sub Phlytide)". Flotow's name *Phlyctis caesioalba*, in *Botanische Zeitung* 8: 572. 1850, is unambiguously a combination from *Urceolaria caesioalba* Le Prév. ex Duby (1830) in Bot. Gall. 2: 671. 1830, a name that is validly published and legitimate. The basionym of Nylander's name is thus *Urceolaria caesioalba* Le Prév. ex Duby. Unfortunately, Duby described a lichen that was saxicolous, whereas the name *Pertusaria caesioalba* has been applied to a corticolous lichen. Duby's name may be a synonym of *Circinaria contorta*.

(Note that the name published, rather unclearly, by Flörke in *Mag. Ges. naturf. Freunde Berlin* 4(2): 115-116. 1810 is *Urceolaria ocellata* var. *caesioalba*, not *U caesioalba*, so Duby's name is legitimate. If Flörke were regarded as having published the name *U. caesioalba*, then Duby's name would be an illegitimate later homonym, but the epithet was legitimated by Fries, as *Parmelia caesioalba* Fr. in *Lichenogr. Eur. Reform.* 185. 1831, leading to *Pertusaria caesioalba* (Fr.) Nyl. Fries also described the lichen as saxicolous.)

The correct name for the corticolous species may be *Pertusaria pruinosa* Kremp. (1868) in *Verhandl. k. k. zool.-bot. Ges. Wien* 18: 326, but I prefer not to take up that name until the matter has been studied by a specialist in this genus.

Thallus: crustose, to several cm diameter, white-grey to green-grey, occasionally slightly white pruinose, 280 - 460 μm thick, margin not zoned, without vegetative propagules. Cortex: 40 - 50 μm thick, colourless to very pale brown, upper half of hyphae parallel or oblique to surface; orientation of hyphae in lower half variable but often perpendicular to surface. Medulla: white. Apothecia: immersed to sessile in fertile warts, usually 1 per wart, flat, rather aspicilioid in appearance; warts 0.5 - 1.5 mm diameter. Disc: black, wide exposed, slightly to moderately white pruinose. Thalline margin: basically absent; disc surrounded by remnants of thallus but there is no well-structured thalline margin. Exciple: not visible externally; in section: 50 - 60 μm wide, colourless to greyish, rather opaque. Hypothecium: grey to dark grey, K+ violet. Hymenium: 200 - 300 μm tall, colourless, upper part sometimes with some epithecial pigment. Cortex: not visible externally; in section: 50 - 60 μm wide, colourless to very pale brown. Paraphyses: anastomosed, 1 - 1.5 μm wide, not capitate or moniliform. Asci: 175 x 65 μm, clavate, wall uniformly KI+ blue.
Ascospores: colourless, simple, ellipsoid, 150 - 190 x 50 - 80 µm; wall 10 - 15 µm thick, 2 layered, inner layer often with many fine concentric lines; 1 per ascus. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, KC- (or sometimes very faintly and obscurely + orange), P-, UV+ orange. Photobiont: green, cells globose, 9 - 14 µm diameter. Photobiont layer: 50 - 80 µm thick, regular, continuous.

Asci were 1-spored in all material seen. According to some published descriptions they are sometimes 2-spored. Well characterised among corticolous species by the negative spot test reactions, the widely exposed disc and the very large ascospores, 1 per ascus. *P. pertusa* has a punctiform disc and 2-spored asci. According to some published descriptions they are sometimes 2-spored.

Well characterised among corticolous species by the negative spot test reactions, the widely exposed disc and the very large ascospores, 1 per ascus. According to some published descriptions they are sometimes 2-spored. Well characterised among corticolous species by the negative spot test reactions, the widely exposed disc and the very large ascospores, 1 per ascus. According to some published descriptions they are sometimes 2-spored. Well characterised among corticolous species by the negative spot test reactions, the widely exposed disc and the very large ascospores, 1 per ascus. According to some published descriptions they are sometimes 2-spored. Well characterised among corticolous species by the negative spot test reactions, the widely exposed disc and the very large ascospores, 1 per ascus. According to some published descriptions they are sometimes 2-spored. Well characterised among corticolous species by the negative spot test reactions, the widely exposed disc and the very large ascospores, 1 per ascus. According to some published descriptions they are sometimes 2-spored.

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**Pertusaria carmeli Reichert & Galun (1965)**

in Galun & Reichert, Israel J. Bot. 14: 11.

Western Greece, not far from the sea, at altitudes 20 - 150 m. No substrate was reported.

Only Croatia, Greece and western Asia (Israel).

**Pertusaria chiodectonoides Bagl. ex A. Massal. (1856)**

Misc. Lichenol. 26; Pertusaria inquinata (Ach.) Th. Fr.; Pertusaria inquinata var. personata (Th. Fr.) J. Steiner; Pertusaria inquinata f. subinquinata (J. Steiner) Erichsen; Pertusaria personata (Th. Fr.) J. Steiner; Pertusaria subinquinata J. Steiner.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Throughout Greece, but never very far from the sea. On siliceous rock at altitudes 200 - 1900 m, though two-thirds of reports are from above 1000 m.

Throughout Europe, though in the south almost restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan), Africa (Morocco, S. Africa), N. America (California).

**Pertusaria coccodes (Ach.) Nyl. (1858)**


Pertusaria coccodes var. farinosa Erichsen.

Thallus: crustose, to several cm diameter, well delimited, white, pale grey or green grey, often slightly warted, 50 - 400 µm thick. Prothallus: sometimes present, 0.3 - 1 mm wide, usually ±concolourous with thallus (and so not very apparent), sometimes blue-grey in outer part, rarely zoned. Isidia: always present, soft and easily abraded, usually globose, 0.1 - 0.15 mm diameter, sometimes becoming elongate to 0.5 x 0.1 mm. Soralia: absent. Cortex: true cortex absent or poorly developed; pseudocortex: 30 - 50 µm thick, colourless, without distinct structure. Medulla: white: mostly of broad, loosely interwoven hypha. Chemistry: thallus K+ yellow > red (norstictic acid), C-, P+ yellow or yellow-orange, UV-. Photobiont: green, cells globose, 8 - 15 µm diameter. Photobiont layer: irregular, discontinuous.

The abundance of isidia and their tendency to become cylindrical vary greatly.

The soft, usually globose isidia, and the corticolous habit are diagnostic. Abraded isidia may resemble soralia, and could cause confusion with *Phylctis argena*, but some unabraded ones are usually present. Also, *Phylctis argena* has a smoother thallus.

Fairly common throughout Greece. On bark, rarely wood, at altitudes 100 - 1300 m, but commonest above 600 m. Recorded from a wide range of phorophytes, avoiding only strongly acidic bark. The lichenicolous fungus *Cyphelium sessile* has been reported once from this host.

Throughout Europe to as far north as mid-Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Namibia, S. Africa), N. America (Maine, Washington), perhaps C. America, perhaps S. America, Antarctica (S. Shetland Is).

**Pertusaria constricta Erichsen (1935)**


Description: Clauzade & Roux (1989).

Evia, on bark of *Abies cephalonica* at an altitude of 700 m. Confirmation of the Greek report is desirable.

Mostly central Europe; present but rare in the south. Also Asia (Turkey, Russia, Armenia).
Pertusaria coronata (Ach.) Th. Fr. (1871)
Lichenogr. Scand. 321; Porina coronata Ach. (1810), Lichenogr. Universalis 310; (?) Pertusaria coronata f. detonsa Harm.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Mt. Olympus, on bark of Fagus at altitudes 1250 m and above.
Throughout Europe to as far north as southern Scandinavia, but south of the Alps probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia, India).

Pertusaria dalmatica Erichsen (1936)
Rabenhorsts Kryptogamen Flora, Ed. 2, 9(5.1): 540; Ochrolechia dalmatica (Erichsen) Boqueras.
Thallus: crustose, to 5 cm diameter, fairly thick, white-grey, sometimes with a yellow tinge, margin sometimes zoned. Soralia: rounded, usually delimited but sometimes coalescing eventually, 0.4 - 1.1 mm diameter, usually flat or slightly excavate, surrounded by a distinct upturned thalline rim. Medulla: white. Chemistry: medulla C-; soralia K-, C+ persistent red, P-; thallus K-, C-, P-, UV+ slightly whiteish. Photobiont: green.
The small, delimited, C+ red soralia surrounded by a distinct, upturned thalline rim are characteristic. Juvenile material of P. hemisphaerica, in which the soralia are not yet large and convex, can cause confusion, but young soralia of that species are less regular and do not have such a well-defined, upturned thalline rim.
Throughout Greece, but commoner in the southern half. Usually on bark, sometimes on wood, at altitudes 20 - 1400 m.
Basically a species of southern Europe, from Iberian Peninsula to European Turkey, though there are a very few reports from north of the Alps (France, Germany). Also Macaronesia, Asia (widespread), Africa (Ascension Is).

Pertusaria flavicans Lamy (1880)
Islands of the Aegean. On siliceous rock at altitudes 0 - 450 m. The lichenicolous fungus Sphinctrina leucopoda has been reported once from this lichen.
Widespread in Europe to as far north as southern Scandinavia, but uncommon south of the Alps. Also Macaronesia, Asia (widespread), Africa (Ascension Is).

Pertusaria flavida (DC.) J. R. Laundon (1963)
Lichenologist 2(2): 144; Variolaria flavida DC. (1815), Fl. Franç. Ed. 3, 5: 177; Pertusaria lutescens (Hoffm.) Lamy; Pertusaria lutescens f. phragmaea (Ach.) Erichsen.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered in the northern half of Greece. Incorrectly reported for Peloponnese in Abbott (2009). On bark, less commonly wood, usually at altitudes 0 to 1000 m, though there is an old report from high on Mt. Olympus.
Throughout Europe to as far north as southern Scandinavia. South of the Alps it is probably commonest in, but not restricted to, upland deciduous forests. Also Macaronesia, Asia (Turkey, Syria, Russia; a report for Goa seems doubtful to me), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America are incorrect.

Pertusaria graeca Erichsen (1936)
Description: See the protologue.
Scattered, with no clear pattern. On bark of Abies and Acer at altitudes of 500 m and above.
Known only from Corsica, Sardinia and Greece.

Pertusaria heterochroa (Müll. Arg.) Erichsen (1936)
Thallus: crustose, to many cm diameter, white to pale green-grey, not pruinose, slightly warted, sometimes cracked, 150 - 400 µm thick, without vegetative propagules. Cortex: 50 - 60 µm thick, colourless, of predominantly vertical hyphae; filled with very small crystals (less than 1 µm diameter) soluble in K. Medulla: white, filled with very small crystals (less than 1 µm diameter) soluble in K. Apothecia: frequent, 1 per wart in fertile warts 0.8 - 1.5 mm diameter; warts opening by an elongated tear. Disc: at first entirely covered by thallus, never widely exposed (in material seen). Thalline margin: not developed; exciple adjoins unmodified thallus. Exciple: in section: 20 µm wide, colourless, formed of narrow parallel hyphae. Epitheicum: colourless to very pale brown; brown pigment K+ faintly violet, then mostly dissolving in K. Hymenium: 350 - 450 µm tall, colourless, with abundant crystals in lower 25 - 50%.
Hypothecium: not well developed, colourless. Paraphyses: anastomosed, 1 µm wide, not capitulate or moniliform. Ascii: opening by a slit (no apical apparatus). Ascospores: colourless, simple, ellipsoid, 70 - 97 x 37 - 50 µm; wall broad, 8 - 11 µm wide, distinctly 2 layered, with radial striations when mature; 2 per ascus. Chemistry: medulla K-, C+ orange, P-, I-; thallus K-, C-, KC+ orange, P+ dull brown-pink in places (elsewhere P-), UV+ orange. Photobiont: green, cells globose, 8 - 10 microns diameter. Photobiont layer: 20 - 250 µm thick (strongly influenced by thickness of thallus), ±regular but sometimes discontinuous, with large crystals, to 60 µm diameter, soluble in K.

The anatomy of the cortex is not apparent in water mounts, but becomes visible when the crystals have been removed by K.

The 2-spored ascii with large ascospores with a thick, 2-layered wall with radial striations are fairly distinctive. Scattered, with no clear pattern, but never far from the sea, at altitudes 0 - 650 m. Usually on bark, rarely on wood. Recorded from a wide range of phorophytes, but never conifers.

Basically circum-Mediterranean/Macaronesian. In Europe almost restricted to the south of the continent, though there are a few reports for north of the Alps (France, southern Germany). Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia).

**Pertusaria huneckiana** Feige & Lumbsch (1993)


Thallus: crustose, pale green, not pruinose, coarsely warted, without vegetative propagules. Medulla: white. Apothecia: 0.4 mm diameter, not pruinose. Disc: usually ±punctiform (in material seen; said to become open in mature apothecia). Epithecium: brown-grey to grey, K+ dull mauve in places. Ascospores: colourless, simple, ellipsoid, 80 x 35 µm, 8 per ascus. Chemistry: medulla K+ yellow > orange (norstictic acid), C-, P+ faintly orange; thallus K-, C+ faintly orange, KC+ orange, P-, UV+ strongly orange.

This distinctive species is unlikely to be confused with any other.

Methana, on fresh lava near the summit of the volcano at 430 m altitude.

Otherwise known only from Minorca, from where it was described.

**Pertusaria hymenea** (Ach.) Schaer. (1836)


Thallus: crustose, white-grey to pale green-grey, not pruinose, continuous, warted, to several cm diameter, without vegetative propagules; to 700 µm thick. Cortex: 20 - 40 µm thick, mostly colourless, upper half sometimes with a slight green-brown tinge, formed of hyphae with long, narrow lumina, orientated horizontally or (?) at incipient warts) vertically. Medulla: white. Apothecia: in fertile warts 0.7 - 2 mm diameter, 1 per wart. Disc: initially punctiform, later widely exposed, black, sometimes slightly white pruinose when young. Thalline margin: thick, 0.3 - 0.5 mm wide, persistent; in section: 200 - 350 µm wide of which cortex 20 - 30 µm, large crystals present in medulla. Exciple: not visible externally; in section: 35 - 50 µm wide, colourless, of hyphae parallel to paraphyses. Epitheicum: brown to grey-brown, K+ purple (reaction sometimes patchy). Hymenium: 400 - 500 µm tall, colourless, K+ blue. Hypothecium: 40 - 100 µm tall, colourless to very pale brown, sometimes with oil droplets. Paraphyses: anastomosed, 1 - 1.5 (2) µm wide, occasionally slightly capitulate (apex to 3 µm), not moniliform. Ascii: 190 x 60 µm, ±elavate, a very narrow ocellar chamber sometimes visible in water mounts (perhaps an incipient tear), wall K+ blue. Ascospores: colourless, simple, ellipsoid, 67 - 90 (130) x 28 - 40 (45) µm; wall prominent, 4 - 7 µm wide at sides, usually not thickening much at tips but occasionally to 12 µm, formed of more than one layer (not apparent in all ascospores); 8 per ascus. Pyenidia: 100% immersed in a thalline wart with a pale brown dot, 0.05 mm diameter, near apex; in section: 450 µm tall, 350 µm wide, mult-chambered, colourless. Conidia: colourless, 10 - 16 x 0.5 µm, usually straight. Chemistry: medulla K-, C-, KC-, P+, I-; thallus K- (or almost), C+ orange (reaction sometimes faint), KC+ distinctly orange, K-, P-, UV+ orange. Photobiont: green, cells globose, 10 - 14 µm diameter. Photobiont layer: 40 - 60 µm thick, ±regular but sometimes discontinuous.

Easily recognised by the combination of a C+ (or at least KC+) orange thallus, the 8-spored asci, and the substrate.

Throughout Greece, though scarce in the more continental parts of northern Greece. At altitudes 0 - 1200 m, but rare above 1000 m. Usually on bark, occasionally on wood, and there is a single record, perhaps erroneous, from serpentine rock. Reported from a wide range of phorophytes, but never from conifers. The lichenicolous fungi *Sclerococcum parasiticum*, *Sclerococcum parellarium*, and *Sphinctrina turbinata* have been reported from this host, the first and last three times.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Syria, Russia, perhaps elsewhere), Africa (Algeria, Tunisia, St Helena, perhaps elsewhere), N. America (Arizona, California), C. America (Mexico), S. America (Argentina, Brazil, French Guiana), Pacific (Hawaii). Reports for Australasia are incorrect.
Pertusaria jurana Erichsen (1936)
*Feddes Rep.* 41: 100.
Description: Clauzade & Roux (1985).
Western Crete, on bark at altitudes 900 - 1340 m.
Scattered mainly in south-central Europe: rare south of the Alps. Not reported for other continents.

Pertusaria lactescens Mudd (1861)
Description: Smith et al. (2009).
Iraklia, on schist at an altitude of 125 m.
The reported distribution of this species is hard to understand, and more than one taxon may be involved. Mudd's species was described from upland areas of northern England and from Northern Ireland, and its presence in the distinctly Mediterranean climate of Iraklia is hard to understand.

Mostly mid latitudes of Europe, from England to Germany. Further south, reported for Spain, Greece and European Turkey, but absent from Italy. Also Asia (Turkey).

Pertusaria leioplaca (Ach.) DC. (1815)
The nomenclatural situation is confused, mainly because a passage in Massalongo's Ric. Auton. Lich. Crost. is hard to interpret. The earliest name may be *Sphaeria leucostoma* Bernh. (1800), but it is a later homonym and not legitimate. The name was legitimated as *Thelotrema leucostoma* Ach. (1803) (as leucostomum, but the epithet is a noun). However, the epithet *leucostoma* is not available in *Pertusaria*, owing to *P. leucostoma* Massal. (1852), which is, in my opinion, a superfluous name for *Lichen pertusus* L.

The status of Massalongo's name is unclear, but my interpretation is as follows. Massalongo's name is not a combination, as the only previous *leucostoma* name he mentioned was *Pertusaria communis* (rank undefined) *leucostoma* in Schaeer (1850: 229), a nomen nudum which is not associated with any references to any previous literature or any previous names. Massalongo did not refer, directly or indirectly, to Acharius's name or Bernhardt's name. The names *Pertusaria communis* f. *leucostoma* (Ach.) Fr. (1831) and *Pertusaria communis* var. *leucostoma* (Ach.) Link (1833), both based on *Thelotrema leucostoma* Ach., had been published previously, and Massalongo did not cite any of them or give any clear reference to any of them. However, Massalongo did include *Lichen pertusus* L. within the scope of his name, first by citing *P. communis var pertusa* in synonymy (even though that combination had not been validly published at the time, nor was it validly published by Massalongo), and also via his reference to *Pertusaria communis* (indefinite rank) *segregata* in Schaeer, *Enum. Crit. Lich. Eur.* 229. 1850, where *Lichen pertusus* L. is mentioned directly..<br>
Thallus: crustose, to several cm diameter, white to pale grey, not pruinose, developing warts that usually bear apothecia, rather thin (75 - 125 µm) except at fertile warts (to 800 µm), sometimes with weakly zoned margin or poorly developed prothallus, without vegetative propagules. Cortex: colourless; structure not well developed and rather variable, usually with distinct hyphae of varying orientation, occasionally developing a weak cellular texture. Medulla: white, poorly developed except at warts. Fertile warts: 0.5 - 2 mm diameter, ±hemispherical (i.e. with narrow base), usually with a single apothecium (but contiguous warts may give the impression of several apothecia per wart). Disc: punctiform, black. Thalline margin: apothecia surrounded by thalline tissue, but no well-structured thalline exciple develops. Exciple: not visible externally, poorly developed in section: if discernible at all then to about 20 µm wide and differing from hymenium only in that hyphae are more regularly parallel. Epithecium: colourless to brown, K-, pigment not soluble in K. Hymenium: 450 µm tall, colourless. Hypothecium: poorly developed, colourless to very pale brown. Paraphyses: anastomosed, 1 µm wide, apex 1 - 2 µm, usually not capitulate, not moniliform. Asci: 220 - 400 x 40 - 45 µm, ±cylindrical, wall Ki+ blue, a broad apical region staining more intensely +blue. Ascospores: colourless, simple, ellipsoid, 57 - 100 (110) x 33 - 45 µm; wall prominent, 2 - 4 µm wide at sides of ascospores, 6 - 12 µm at ends; 4 - 8 per ascus, uniseriate. Chemistry: medulla K- or faintly +brown-yellow or orange-yellow, C-, KC-, P-, I-; thallus K- or faintly +brown or yellow, C-, KC-, P+, UV+ orange. Photobiont: green, cells globose, 8 - 14 µm diameter. Photobiont layer: 50 - 100 µm thick, continuous, ±regular.

Could be confused with *P. pertusa*, but that species has larger ascospores and several apothecia per wart.
Throughout Greece, though usually not very far from the sea. At altitudes 0 - 1400 m, but uncommon above 1000 m. Nearly always on bark, but reported once from wood. The lichen *Catillaria nigroclavata* was reported once from this lichen, as was *Sphinctrina turbinata*. Subcosmopolitan.
Pertusaria pallidoflava Erichsen (1938)  
Description: See the protologue.  
Island of Lesvos, on siliceous rock.  
Known only from Lesvos. It is not clear whether the two reports in the literature refer to the same collection.

Pertusaria parotica Sipman (1999)  

Thallus: crustose, to several cm diameter, white to grey-white, not pruinose, 300 - 800 µm thick, of convex warts, without vegetative propagules. Cortex: 50 - 90 µm thick, colourless, mostly of hyphae with long narrow lumina, occasionally developing a weak cellular texture; hyphal orientation various with no clear pattern. Medulla: white. Apothecia: frequent, in warts, 1 per wart, at first covered by thalline tissue, 0.5 - 1 mm diameter. Disc: black, sometimes white pruinose, fairly widely exposed eventually, pruina C-. Thalline margin: absent (in material seen). Exciple: present, over-arching the disc; in section: 50 - 80 µm wide, pale brown to pale green-brown. Epithecium: dark grey. Hymenium: 250 µm tall, colourless, Ki- or very weakly Ki+ blue. Hypothecium: 40 µm tall, colourless. Paraphyses: often anastomosed, 1 - 1.5 µm wide, not capitate or moniliform. Asci: 200 x 60 microns, ecylindrical in upper part, wall uniformly Ki+ blue. Ascospores: colourless, simple, ellipsoid, 75 - 160 x 40 - 70 µm, 2 per ascus. Pycnidia: externally resembling apothecia; in section: 100% immersed, U-shaped, 80 - 150 x 50 - 90 µm, mostly colourless, brown in outermost part, ostiole broad. Conidia: colourless, bacilliform, straight, 5 - 6 x 1 µm. Chemistry: medulla K+ red, in section diffusing a yellow to red pigment into solution which forms flat, red, plate-like crystals 2 - 6 µm wide at sides, 10 - 12 µm at tips; 2 per ascus. Chemistry: medulla K+ yellow > pale orange or brown-orange (no crystals), C-, P+ faintly orange, I-; thallus K-, C-, KC-, P-, UV+ orange. Photobiont: green, cells globose, 8 - 12 µm thick, often anastomosed, 1 - 1.5 µm wide, not capitate or moniliform. Asci: 200 x 60 microns, ecylindrical in upper part, wall uniformly Ki+ blue. Ascospores: colourless, simple, ellipsoid, 75 - 160 x 40 - 70 µm, 2 per ascus. Pycnidia: externally resembling apothecia; in section: 100% immersed, U-shaped, 80 - 150 x 50 - 90 µm, mostly colourless, brown in outermost part, ostiole broad. Conidia: colourless, bacilliform, straight, 5 - 6 x 1 µm. Chemistry: medulla K+ red, in section diffusing a yellow to red pigment into solution which forms flat, red, plate-like crystals 2 - 6 µm wide at sides, 10 - 12 µm at tips; 2 per ascus. Chemistry: medulla K+ yellow > pale orange or brown-orange (no crystals), C-, P+ faintly orange, I-; thallus K-, C-, KC-, P-, UV+ orange. Photobiont: green, cells globose, 8 - 12 µm thick, ± regular but sometimes discontinuous.

Provided that the K reaction of the medulla is examined in thin section, this species can not be confused with any other.  
Islands of the southern Aegean and adjacent parts of the mainland, on siliceous rock at altitudes 5 - 800 m.  
Known only from Greece.

Pertusaria pentelici J. Steiner (1893)  
Description: See the protologue.  
Islands of the Aegean including Crete, and adjacent coasts of the mainland. On siliceous rock at altitudes 0 - 1100 m.  
Known only from Greece and Bulgaria.

Pertusaria pertusa (L.) Tuck. (1845)  
*Enum. N. Amer. Lich.* 56; *Lichen pertusus* L. (1767), *Mant. Pl.* 131; *Endocarpon pertusum* (L.) Wahlenb.; *Pertusaria chionea* (Ach.) DC.; *Pertusaria communis* DC.; *Pertusaria communis f. meridionalis* Zahlbr.; (?) *Pertusaria laevigata f. meridionalis* (Arnold) Arnold; (?) *Pertusaria laevigata var. meridionalis* Arnold; (?) *Pertusaria leucostoma var. areoascens* Erichsen; *Pertusaria pertusa var. meridionalis* (Zahlbr.) Szatala; (?) *Pertusaria pertusa f. pisiformis* Servit; *Pertusaria pertusa var. polycarpa* (Clemente) Zahlbr.; *Pertusaria pertusa var. rupestris* (DC.) Nimis; *Pertusaria rupestris* (DC.) Schauer; (?) *Pertusaria rupestris var. deplanata* Erichsen; (?) *Pertusaria rupestris var. polystigma* Erichsen; *Porina pertusa* (L.) Ach.

Under the Vienna Code, the name *Lichen pertusus* L., was superfluous, and the correct authorship was (Weigel) Tuck., basionym *Sphaeria pertusa* Weigel. Under the wording of the Melbourne Code, Linnaeus's name is legitimate and authorship is as cited here. Under the wording of the Shenzhen code, Linnaeus's name is again superfluous, but so is *Sphaeria pertusa*. The best solution is probably to conserve the name *Lichen pertusus* L. with a conserved type, and here I treat is as though so conserved.

Thallus: crustose, to several cm diameter, pale grey to grey or green-grey, not pruinose, rather thin (200 µm) except at the abundant fertile warts (to 1 mm wide), without vegetative propagules. Cortex: 20 - 30 µm thick, colourless in upper half, pale brown in lower half, structure usually rather indistinct but lower half sometimes with weak cellular texture. Medulla: white. Fertile warts: ± hemispherical (i.e. with narrow base), 0.8 - 2.5 mm diameter, each with (1) 4 - 6 (15) apothecia. Disc: black, punctiform, not pruinose. Thalline margin: apothecia surrounded by thalline tissue but no well-structured thalline exciple develops. Exciple: not visible externally; in section: poorly developed, to 20 µm wide, scarcely distinguishable from hymenium. Epithecium: colourless to brown, K-. Hymenium: 450 - 500 µm tall, colourless. Hypothecium: poorly developed, to 25 µm tall, very pale brown. Paraphyses: anastomosed, 1 - 1.5 µm wide, not capitate or moniliform. Ascospores: colourless, simple, ± ellipsoid, 170 - 225 x 42 - 60 µm; wall thick, 5 - 8 µm wide at sides, 10 - 12 µm at tips; 2 per ascus. Chemistry: medulla K+ yellow > pale orange or brown-orange (no crystals), C-, P+ faintly orange, I-; thallus K-, C-, KC-, P-, UV+ orange. Photobiont: green, cells globose, 8 - 12 µm
Pertusaria pluripuncta Nyl. (1883)

Flora 66: 532.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Crete. (Precise location uncertain, as the place name cited is ambiguous). Altitude and substrate were not reported.

Warm Atlantic margin of Europe to as far north as southern England, extending also into the Mediterranean (Provence, Italy, Greece). Also Macaronesia, N. Africa (Morocco, Algeria, Tunisia).

Pertusaria pustulata (Ach.) Duby (1830)

Bot. Gall. 2: 673; Porina pustulata Ach. (1810), Lichenogr. Universalis 309; Pertusaria melaleuca (Turner & Borrer) Duby.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Corfù, on bark of Olea europaea close to sea level, and perhaps western Peloponnese (determination tentative)

Southern and central Europe, to as far north as England. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa, perhaps elsewhere), N. America (widespread), perhaps Caribbean (Bermuda), perhaps C. America (CR), S. America (Argentina, Bolivia, Colombia, Paraguay), Australia (NSW, Queensland). Many reports are old and may be unreliable

Pertusaria rhodiensis Erichsen (1938)


Description: See the protologue.

Islands of the southern Aegean, plus a disjunct report for northern Greece. Usually on bark, occasionally on wood, at altitudes 0 - 1300 m.

Known only from southern Italy (Basilicata) and Greece.

Pertusaria rupicola (Sommerf.) Harm. (1898)

Bull. Soc. Sci. Nancy, Sér. II, 15: 246; Endocarpon fallax β (= var.) rupicola Sommerf. (1826), Suppl. Fl. lapp. 135-136; (?) Pertusaria rupicola f. fallax (Schaer.) Erichsen; Pertusaria wulfenii var. rupicola (Sommerf.) Fr.

Thallus: crustose, to a few cm diameter, grey-green, not pruinose, thick (to 1 mm), warted, without vegetative propagules. Cortex: 25 - 30 µm thick, mostly colourless, sometimes pale brown in outermost 5 - 10 µm, of hypheae with elongated, rather narrow lumina; orientation of hypheae variable. Medulla: white. Apothecia: 1 - 3 mm diameter, very contorted. Disc: widely exposed, black, not pruinose, central parts sometimes with remnants of the original thalline covering of the apothecia. Thalline margin: prominent, thick, persistent; in section: 300 - 420 µm wide of which cortex 30 - 60 microns, structure of cortex as for thallus. Exciple: not visible externally; in section: 25 - 30 µm wide, colourless, of hypheae ±parallel to paraphyses. Epithecium: colourless to pale brown, K+ violet. Hymenium: 380 - 420 µm tall, colourless. Hypothecium: 60 µm tall, colourless, basically a continuation of the exciple but hypheal orientation less regular. Paraphyses: anastomosed, 1 µm wide, not capitate or moniliform. Ascospores: colourless, simple, ellipsoid, 62 - 90 x 26 - 46 µm; wall 10 µm thick in mature ascospores, without distinct structure or ornamentation; several per ascus. Pycnidia: visible externally as concave depressions, often at apex of a wart, 0.05 - 0.1 mm diameter, at first concolourous with thallus, later black; in section: 100% immersed, multi-chambered, the whole complex 200 x 200 µm, individual chambers about 80 µm diameter, mostly colourless, wall in upper part sometimes very pale brown. Conidia: colourless, usually straight, occasionally curved, 14 - 17 x 0.75 µm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K+ orange-yellow, C+ orange, P-. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: regular, continuous, 50 - 70 µm thick.

Well characterised by the C+ orange thallus, the 8-spored asci and the substrate.

Islands of the Aegean and adjacent coasts of the mainland. Quite common within this region, but apparently absent from other parts of Greece. On siliceous rock at altitudes 5 - 1100 m. The lichenicolous lichen Rhizocarpon episipilum has been reported several times from this host.

Basically circum-Mediterranean/Macaronesian. Mostly southern Europe, though present around or just north of the Alps (Germany, Switzerland, Bulgaria). Also Macaronesia, Asia (Turkey), N. Africa (Morocco). I am sceptical of a report for S. America (Chile).
Pertusaria servitiana Erichsen (1934)
Feddes Rep. 35: 389.
Thallus: crustose, to several cm diameter, white, not pruinose, continuous, usually strongly warted or folded, sometimes smooth in younger parts, 100 - 500 µm thick. Isidia: absent. Soralia: present, independent of apothecia (though thalline covering of apothecium may resemble a sorailum as it starts to fragment), white to very pale green, at first delimited, flat, 0.5 - 1.5 mm diameter, soon becoming confluent. Cortex: 10 - 60 µm thick, colourless to pale grey, without distinct structure. Medulla: white, of loosely interwoven hyphae, sometimes with numerous voids 20 - 60 µm diameter (especially at warts); hyphae 1 - 2.5 µm wide, forming a loose network, often with small crystals to 1 µm diameter. Apothecia: in subhemispherical warts 0.7 - 1.2 mm diameter, at first entirely covered by a thalline layer. Disc: open when mature, black, moderately white pruinose. Thalline exciple: present; in section: 50 - 100 µm wide. Exciple: not visible externally; in section: colourless, 10 - 30 µm wide, of anastomosed hyphae, usually more reticulate than paraphyses. Epithecium: brown, K-, pigment slightly soluble. Hymenium: 250 µm tall, ±colourless. Hypothecium: 25 µm tall, colourless of ±horizontal hyphae. Paraphyses: anastomosed, narrow, 0.75 - 1.5 µm at apex, not capitate or moniliform, usually parallel and vertical, with some horizontal anastomoses, not usually forming an irregular net. Ascii: 190 - 240 x 45 - 65 µm, ±clavate, wall uniformly KI+ blue. Ascospores: colourless, simple, ellipsoid, (80) 120 - 170 x (40) 47 - 55 µm, with a distinctive cellular wall, 1 per ascus (in material seen; said to be more commonly 2). Chemistry: medulla K+ orange (reaction much weaker than cortex), C-, P+ pale yellow, I-; soralia K+ red, C-, P+ orange-yellow; thallus K+ red (norstictic acid), C-, P+ orange-yellow, UV- or almost (faint green tinge in long wave and faint orange tinge in short wave). Photobiont: green; cells globose, 9 - 13 µm diameter. Photobiont layer: 30 - 120 µm thick, irregular, often discontinuous, cells often forming large clumps 50 - 60 µm diameter.

The combination of C- and K+ red (norstictic acid) thallus spot tests is distinctive among species with independent soralia.

Rhodes, Peloponnese and Evia. On bark of Juniperus drupacea, Phillyrea and Pinus halepensis at altitudes 50 - 1000 m.

A rather poorly known species, reported from only a few countries in central Europe, plus Montenegro and Greece. Also Asia (Russia).

Pertusaria werneriana Boqueras (2003)
in Boqueras & Llimona, Mycotaxon 88: 489-490.
Description: See the protologue.
Islands of the Aegean. On bark at altitudes 160 - 400 m.
Only Iberian Peninsula, Corsica and Greece.

Petractis Fr. (1845)

Summa Veg. Scand. 1: 120. Type: P. exanthematica (Sm.) Fr., the only species originally included. Family: Gyalectaceae.

Literature: Most of the European species are treated in Clauzade & Roux (1985). Seven species, 6 of which occur in Europe. They occur on calcareous rock. The genus is uncommon in Greece.

11 Apothecia, even when mature, mostly covered by thick thalline margin with prominent radial cracks. Ascospores with perispore, at least in K.
22 Ascospores mostly 3-septate, rarely also with a few longitudinal septa. P clausa
2 Ascospores mostly with 3 - 5 transverse septa, quite often also with some longitudinal septa. P. leutkemuelleri
1 Mature apothecia less completely covered by thalline margin; exciple not, or only weakly, radically cracked.
Ascospores with or without perispore.
22 Ascospores distinctly muriform. (P. thelotremella)
2 Ascospores basically septate; longitudinal septa rare.
33 Ascospores 3-septate, 15 - 25 µm long. (P. crozalsii), (P. nodispora)
3 Ascospores 5 - 9 -septate, 20 - 38 µm long. (P. hypoleuca)

Petractis clausa (Hoffm.) Kremp. (1861)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Very scattered in the southern half of Greece. On limestone at altitudes 5 to about 2000 m.
Widespread in Europe, except for the far north. Also Asia (Turkey, Russia, Japan), N. Africa (Algeria), N. America
Petractis luetkemuelleri (Zahlbr.) Vězda (1965)


Thallus: crustose, thin, very pale brown. Apothecia: urceolate, 0.25 - 0.35 mm diam, remaining ±covered by thalline margin. Thalline margin: present, with several prominent radial cracks. Ascospores: colourless, (3) 4 - 5 (6) -septate, or submuriform, 27 x 8 µm, ends ±pointed, perispore sometimes visible. Photobiont: Trentepohlia.

Similar to P. clausa, and some reports of that species may belong here, but distinguished microscopically by the different ascospore septation.

Very scattered, but always close to the sea. On limestone at altitudes 0 - 900 m.
Southern Europe, from Portugal to Greece. Also N. Africa (Morocco).

Phaeophyscia Moberg (1977)


Literature: The best starting point for southern Europe is still Clauzade & Roux (1985). Ahti et al. (2002), Moberg (1977), Nash et al. (2004), Smith et al. (2009), and Swinscow & Krog (1988) are also helpful.

Thallus small foliose, to 2 cm diameter. Surface: usually some shade of grey, not pruinose. Lobes ±adpressed.

Differs from Physcia in lacking atranorin, and in having a thallus which is generally smaller.

About 41 species, of which 20 occur in Europe. They occur on a wide range of substrates, but most require some nutrient-enrichment. Except for the common P. orbicularis the genus is not often encountered in Greece, although many species are reliably reported.

Species of Phaeophyscia may grow in close proximity, and mixed gatherings can be a source of confusion.

111 Soralia present.

22 Upper surface with fine hairs (x10), typically about 0.15 - 0.25 x 0.03 mm (Note 1).

33 Soralia mostly apical and ±lip-shaped. See Physciella chloantha

4 Soralia not apical and lip shaped.

55 Thallus large, 4 - 10 cm, with lobes 2 - 3 mm wide. (P. hispidula) Greek report tentative.

5 Thallus smaller, 1 - 4 cm, with lobes 0.2 - 1 mm wide.

66 Soralia arising from marginal isidia. Usually on calcareous rock, rarely on bark or wood. P. nigricans

6 Soralia not arising from isidia. Not commonly on rock.

77 Soralia on upturned lobe tips. Apothecia rare. Usually on mosses. P. pusilloides

7 Soralia laminal and/or marginal, not on lobe tips. Apothecia often present. Usually on bark or wood.

88 Thallus usually less than 1 cm diameter, very adpressed. Lower surface and rhizines brown. Lobes 0.2 - 0.6 mm wide. Soralia round, clearly delimited. On bark or rock. P. insignis

8 Thallus to 3 cm diameter, less closely adpressed. Lower surface and rhizines black. Lobes 0.5 - 1 mm wide. Soralia often becoming confluent. Usually on nutrient rich bark. P. orbicularis

11 Soralia absent. Isidia present.

22 Thallus to 1 cm diameter. Lobes to 1 mm wide, ascending. Lower side pale. P. nigricans

2 Thallus larger. Lobes sometimes more than 1 mm wide, not ascending. Lower side black.

33 Isidia usually developing into ciliate lobules. Abundant rhizines projecting beyond lobe margins. (P. kairamoi)

3 Isidia not developing into ciliate lobules. Rhizines rarely projecting beyond lobe margins. P. sciastra

1 Soralia and isidia absent.

22 Medulla white, K-. Margin of apothecia often with cilia.

33 Thallus grey or brown-grey, without hairs. Lower surface black. Apothecia nearly always present. P. ciliata

3 Thallus green-grey, covered with fine hairs (x20). Lower surface dark brown to black only at centre, much paler at margin. Apothecia often absent. P. poeltii
2 Medulla with orange-red pigment, K+ purple. Apothecia without cilia. (P. endococcina)

(1) Hairs are white or colourless, never black. Some species have white rhizines that project beyond the lobe margins, and these can be confused with hairs. Rhizines arise from lower surface or extreme margin of lobes, and most project downwards or outwards, few or none point upwards. Hairs arise from extreme margin and upper surface of lobes, and often point upwards.

**Phaeophyscia cernohorskyi** (Nádv.) Essl. (1978)


Some authors regard *P. cernohorskyi* as a synonym of *P. hirsuta*.


Thessaly and Crete, on conglomerate rock and bark of *Platanus* at altitudes around 500 m.

Widespread in southern and central Europe to as far north as Belgium. Also Macaronesia, Asia (Turkey, Mongolia), N. America (widespread).

**Phaeophyscia ciliata** (Hoffm.) Moberg (1977)


Thallus: foliose. Lobes: 120 µm thick, without hairs or vegetative propagules. Upper surface: grey, not pruinose. Lower surface: black, attached by rhizines. Rhizines: always abundant, simple, black, sometimes white at tips, 0.2 x 0.03 mm, sometimes projecting beyond margin of lobe. Upper cortex: 20 - 25 µm thick, very pale brown in top 10 µm, colourless in lower part; cellular, cells subglobulous or slightly elongated in vertical direction, 6 - 8 µm diameter; brown pigment K-, not or only slightly soluble in K. Medulla: white; in section: 35 - 40 µm thick, colourless, of loosely interwoven hyphae oriented ±parallel to long axis of lobe. Lower cortex: 20 µm thick, dark brown, almost opaque, brown pigment K-, not soluble in K; cellular. Apothecia: sessile, flat, 0.7 - 1.2 mm diameter. Disc: very dark brown, not pruinose. Thalline margin: present, persistent, lower surface often with corona of few to many white hairs; in section: 100 µm wide, of which cortex 30 µm. Exciple: not visible externally; in section: 15 µm wide, of hyphae ±parallel to paraphyses. Epithecium: orange-brown, K+, pigment not soluble in K. Hymenium: 90 µm thick, colourless. Hypothecium: 70 µm tall, colourless. Paraphyses: 1.5 µm wide at base, 3 µm at apex, not or only slightly capitulate, sometimes with visible septa especially in upper part. Ascii: 65 - 70 x 15 - 25 µm, narrowly clavate to ±cylindrical, Lecanora type. Ascospores: brown, 1-septate, ±ellipsoid but sometimes slightly curved, 20 - 24 x 8 - 10 µm, Dirinaria type (like Physcia type but septum inserted late), 8 per ascus. Chemistry: thallus and medulla K-. Photobiont: green; cells ±globose, 8 - 13 µm diameter; in a ±continuous and ±regular layer 35 - 40 µm thick.

The white medulla and absence of isidia and soralia separate this species fairly easily from others in the genus.

*P. ciliata* is closely related to *P. orbicularis*, from which it differs only in lacking soralia and in being more frequently fertile. The two names might be better treated as synonyms, but I refrain from doing so pending molecular investigations. At many Greek sites where I have seen *P. ciliata*, *P. orbicularis* was also present on the same substrate.

Fairly common on the mainland and immediately adjacent islands, but absent from Crete and the islands of the Aegean. On bark that is not strongly acidic at altitudes 100 - 1280 m. Recorded from *Abies, Olea, Platanus and Quercus* spp. The lichenicolous fungi *Arthonia phaeophysciae* and *Lichenochora obscuroides* have been reported once from this host.

Throughout much of Europe, except for the far north. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (widespread), C. America (Mexico), Australasia (SE Australia).

**Phaeophyscia hirsuta** (Mereshk.) Essl. (1978)


Thallus: foliose, 2 cm diameter. Lobes: rounded, ±adpressed, 0.5 - 0.8 mm wide. Upper surface: blue-grey, not pruinose, not maculate. Lower surface: black. Hairs: present on upper surface, white or colourless, usually close to margin, sometimes distinctly laminal, ±erect, 0.15 - 0.25 x 0.03 mm. Isidia: absent. Rhizines: black, simple. Soralia: present but few, blue-grey, marginal, circular to labriform, not well delimited. Medulla: white. Chemistry: thallus K-.

Easily distinguished from most other species by the presence of numerous hairs. When well developed, these give the lobes a rather spiky appearance.

Very scattered, with no clear pattern. On bark at altitudes 0 - 450 m. Reported from *Platanus orientalis*, *Populus* sp., *Prunus spinosa*, *Quercus pubescens* and *Robinia pseudacacia*.

Throughout southern and central Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside deserts and humid tropics), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Peru).
Phaeophyscia insignis (Mereschk.) Moberg (1978)


Chios, on bark of *Pistacia lentiscus* at an altitude of 40 m.

Temperate Europe, with a few reports from the south. Absent from the British Isles and Nordic Countries. Also N. America (widespread), C. America (Mexico).

Phaeophyscia nigricans (Flörke) Moberg (1977)


Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Cret, on bark of *Quercus macrolepis* at an altitude of 370 m.

Widespread in northern and central Europe, rare south of the Alps. The Cretan report is surprising. Also Asia (widespread), N. America (widespread), C. America (Mexico).

Phaeophyscia orbicularis (Neck.) Moberg (1977)


Thallus: foliose, to 2 cm diameter. Lobes: to 5 mm long, 0.3 - 1.0 mm wide, 90 - 150 µm thick, flat, ±adpressed, sometimes branched, sometimes slightly overlapping, without hairs. Upper surface: grey, sometimes blue-grey in shade, occasionally with green tinge, paler specimens sometimes becoming brown in herbarium, not pruinose, not maculate. Lower surface: black, rarely white at extreme margin, attached by rhizines. Rhizines: abundant, simple, black, sometimes white at tips, sometimes extending out beyond margin of lobe, 0.15 - 0.5 x 0.03 - 0.05 mm. Soralia: always present, usually abundant, usually dark grey, sometimes greenish (in shade?), usually concave to flat, sometimes globose, usually marginal, occasionally laminal; at first delimited and ±circular or slightly elongated, 0.3 - 0.6 mm diameter, later often spreading along lobe margins and becoming confluent. Upper cortex: 20 - 25 µm thick, not sharply delimited from photobiont layer, pale brown in outer 5 - 10 µm, colourless in lower part, cellular; cells surrounded or slightly elongated in direction perpendicular to surface of lobe, 6 - 12 x 6 - 10 µm; brown pigment K-, partly soluble in K. Medulla: white; in section: 15 - 30 µm thick, colourless, of rather broad hyphae, 2.5 µm wide, oriented ±parallel to long axis of lobe. Lower cortex: 12 - 20 µm thick, brown, cellular; cells around 10 x 8 µm, with long axis vertical; brown pigment K-, not soluble in K. Apothecia: often absent or few or immature; when present: sessile, concave to flat, 0.4 - 0.7 mm diameter. Disc: dark brown to black, not pruinose. Thalline margin: present, smooth, persistent, without hairs, 0.1 mm wide; in section: 100 µm wide. Exciple: not visible externally; in section: 15 µm wide, lower part of hyphae ±parallel to paraphyses, hyphae broadening in upper part and producing a weakly cellular appearance. Epithecium: orange-brown, K-pigment fading to pale brown in K. Hymenium: 75 µm tall, colourless. Hypothecium: 50 µm tall, colourless. Paraphyses: 1 - 1.5 µm wide at base, 2 - 2.5 µm at apex, not or only slightly capitate, sometimes with visible septa. Asci: 60 x 17 - 23 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 20 x 10 - 12 µm, Physcia type when mature, 8 per ascus. Pycnidia: uncommon (or perhaps just inconspicuous), appearing externally as brown dots; in section: pyriform, 160 µm tall, 110 µm wide, mostly colourless, pale orange-brown near ostiole. Conidia: ellipsoid, 3 x 1.5 µm. Chemistry: medulla K-, C-, KC-, P-; soralia K-, C-, KC-, P-, UV-; thallus K-, C-, KC-, P-, UV-. Photobiont: green; cells globose or slightly ellipsoid, 12 x 9 - 12 µm; in a regular but sometimes slightly discontinuous layer (0.30 - 80 µm thick.

Rather variable and could be confused with several other species in the genus if keyed out with insufficient care. *Hyperphyscia adglutinata* is much more strongly adpressed, has narrower lobes, and has a hyphal, not cellular, lower cortex.

Throughout Greece, on bark that is not strongly acidic. At altitudes 0 - 1740 m. Recorded from a wide range of phorophytes. The lichenicolous fungi *Arthonia phaeophysciae* and *Lichenochora obscuroides* have been reported from this species.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), perhaps Caribbean (Bahamas), perhaps C. America (Mexico), S. America (Brazil, perhaps Paraguay and Peru), Australasia (widespread), Pacific (Hawaii, New Caledonia).

Phaeophyscia poeltii (Frey) Nimis (1993)


Widespread but not common in southern and south central Europe. Also Asia (Turkey, Iran, Syria, Tajikistan).
Phaeophyscia pusilloides (Zahlbr.) Essl. (1978)

Mycotaxon 7(2): 313; Physcia pusilloides Zahlbr. (1931), Cat. Lich. Univ. 7: 678.
Descriptions: Clauzade & Roux (1985); Esslinger (1978b); Nash et al. (2004).

Peloponnese, on bark of Quercus at an altitude of 400 m.
Mostly central Europe; rare south of the Alps. Also Macaronesia, Asia (Turkey, Russia), N. America (widespread), C. America (Mexico).

Phaeophyscia sciastra (Ach.) Moberg (1977)


Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Sterea Ellada, on limestone at an altitude of about 1400 m. Not recorded since the 19th century.
Present in much of Europe. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread), C. America (Mexico), S. America (Chile, perhaps elsewhere), Australasia (NZS).

Phaeospora Hepp ex Stein (1879)


Literature: Information is very scattered. Etayo & Sancho (2008) is good, but only discusses two species. The species included in the key are treated in Clauzade, Diederich & Roux (1989).

About 15 species are presently placed in Phaeospora, though some probably belong elsewhere and some names may be synonyms. They are lichenicolous. There are about 10 species in Europe. The genus is not very well known.

11 Ascospores 11 - 16 µm long. (Homostegia piggotii), (P. everniae), (P. parasitica), (P. peltigericola)
1 Ascospores more than 16 µm long.
22 Perithecia almost entirely immersed in thallus of host. Ascospores 17 - 22 µm long. P. rimosicola
2 Perithecia at least half emergent. Ascospores smaller or larger than above. (Homostegia piggotii)

(1) There are contradictory statements in the literature concerning the length of the ascospores in P. parasitica. Most sources claim that they do not exceed 16 µm, but Khodosovtsev et al. (2007) claim that they are 18 - 23 µm long.

Phaeospora rimosicola (Mudd) Hepp ex Stein (1879)


Description: Clauzade, Diederich & Roux (1989).
Peloponnese, on Rhizocarpon obscuratum at an altitude of about 2200 m. Not recorded since the 19th century.
Probably the commonest species of the genus and reported for many parts of Europe. Also Macaronesia, Asia (Turkey, Russia), N. America (BC, perhaps elsewhere).

Phlyctis (Wallr.) Flot. (1850)


Literature: The two European species are discussed in all the standard Floras.
Thallus: crustose, white to grey, superficial but fairly thin. Photobiont: chlorococcoid. Usually on bark.
About 29 species, most of them in the Southern Hemisphere. Only two occur in Europe. Both are corticolous.

11 Apothecia always present, in powdery warts; true soralia absent. P. agelaea s. lat.
22 Isidia absent. P. agelaea subsp. agelaea
2 Many small, ± globose isidia present. (P. agelaea subsp. pseudococcodes)
1 Apothecia rare, soralia present. P. argena

Phlyctis agelaea (Ach.) Flot. (1850)


Thallus: crustose, areolate, grey-white, to several cm diameter, 100 - 170 µm thick. Prothallus: said to be often present. Soralia: absent. Cortex: true cortex absent; pseudocortex: 20 - 50 µm thick, mostly colourless, sometimes brown-grey in outermost 10 µm, without distinct structure, K-. Medulla: poorly developed. Apothecia: when immature
totally immersed and globose, without any opening to the surface; mature apothecia 0.4 - 0.6 mm diameter, immersed, flat, around, covered by dense white pruina that makes them rather inconspicuous, pruina not soluble in K. Disc: black but generally obscured by pruina. Thalline margin: absent in mature apothecia; photobiont layer runs uniformly up to the immersed apothecia, but there is little or no development of a distinct margin. Exciple: not visible externally; in section: poorly developed, to 15 µm wide, colourless, distinguished from the hymenium mainly by the less regular arrangement of the hyphae. Epithecium: grey, surface sometimes irregular, K-, pigment not soluble in K, N-. Hymenium: 160 µm tall, colourless, K+ blue. Hypothecium: 15 - 20 µm tall, colourless. Paraphyses: sometimes branched especially in upper part, 1.5 µm wide at base, 2.5 µm at apex, not capitate or moniliform. Asci: 115 x 30 µm, clavate, wall at apex often very thick, to 18 µm, no ocular chamber visible in water, entire wall uniformly and rather faintly K+ blue. Ascospores: colourless, muriform (of small, almost cubic cells about 3 µm along each side; these cells quite often become detached, and then appear globose), ±ellipsoid but sometimes with distinct protruding point at one end (formed from a single cell), 50 - 72 x 27 - 30 µm, 2 per ascus. Chemistry: K+ brown-orange to brown-red or dark red (sometimes with norstictic acid in section), C-, KC-, UV-. Photobiont: green, cells globose to slightly ellipsoid, 10 - 15 x 10 µm, forming a ±continuous but irregular layer 50 - 150 µm thick.

Some collections appear to lack norstictic acid entirely.

All material seen by me belongs to subsp. agelaea. Reports in the literature do not indicate any subspecies.

Externally, could be confused with some species of Pertusaria, but the muriform ascospores are distinctive.

Scattered throughout Greece, but never very far from the sea. On bark that is not strongly acidic, at altitudes 0 - 1000 m.

Widespread in Europe to as far north as southern Scandinavia, but less common than P. argena. Also Macaronesia, western Asia (Turkey, Jordan, Syria), N. Africa (Morocco, Tunisia), N. America (widespread).

**Physcia argena** (Spreng.) Flot. (1850)


For the complex nomenclatural situation see Laundon (1970).

Thallus: crustose, to 8 cm diameter, white to grey-white, superficial, thin (60 - 110 µm thick), usually not well delimited, sometimes bounded by white prothallus 1 - 1.5 mm wide. Soralia: always abundant, not delimited, white, grey or with slight greenish tinge when fresh, developing a very pale pink-brown tinge in herbarium; individual soredia coarse, 0.05 - 0.1 mm diameter, sometimes spreading over much of thallus surface but generally not coalescing into large aggregates. Cortex: poorly structured, colourless but not transparent (even in K). Medulla: colourless, transparent. Chemistry: thallus and soralia K+ strongly yellow > red (abundant norstictic acid), C-, P+ strongly yellow > orange, UV-.

Photobiont: green, cells globose to slightly ellipsoid, 10 - 15 µm diameter, sometimes forming clusters; photobiont layer discontinuous, about 25 µm thick.

*P. argena* is not always easy to separate from two other normally sterile species with similar reactions. *Bueelia grisoeovirens* has delimited soralia. *Pertusaria coccodes* has globose, soft, easily eroded isidia that may resemble soredia. Individual soredia in *Physcia argena* are 0.05 - 0.1 mm diameter, isidia in *Pertusaria coccodes* may sometimes be as small as this, but are generally larger. In addition, the thallus of *Pertusaria coccodes* is generally much thicker and more robust than that of *Physcia argena*, it is also usually more clearly delimited. *Pertusaria coccodes* is not recorded from conifers, whereas *Physcia argena* often is.

Common throughout Greece at all altitudes where there are trees. On bark of a wide range of phorophytes, including some with acidic bark such as *Pinus*. Rarely on wood, siliceous rock, or overgrowing bryophytes. The lichenicolous fungus *Opegrapha zwackhii* has been reported twice from this host.

Widespread in Europe, to as far as southern Scandinavia. Also Macaronesia, Asia (widespread in temperate to warm regions that are not very dry), Africa (Morocco, S. Africa), N. America (widespread)

**Physcia** (Schreb.) Michx. (1803)


Literature: There is no unified treatment of the European species. Between them Ahti et al. (2002), Clauzade & Roux (1985), and Smith et. al. (2009) cover most of the species in the key below. For *P. astrostria* see Brodo et al. (2001); and for *P. erumpens* see Nash et al. (2002). For some of these species there are fuller descriptions in Moberg (1977, 1997a), or Nash et al. (2002). The very common *P. biziana* is not well described in any of the European literature, and can be a source of confusion; there are good descriptions in Moberg (1997a) and Nash et al. (2002).

Thallus: foliose, to a few cm diameter, formed of narrow lobes (usually less than 3 mm wide), adpressed or not. Upper surface: grey or blue-grey, not pruinose in most species, some species with white maculae. Lower surface: pale in colour, attached by rhizines. Cilia: present in some species. Isidia: absent. Rhizines: always present, simple. Soralia: present in some species. Upper cortex: cellular. Medulla: white; of loosely interwoven hyphae that are often
distinctly broader than those of lower cortex. Lower cortex: of horizontal hyphae in most species, cellular in a few (of which *P. tribacia* occurs in Greece). Apothecia: abundant in some species, usually laminal on the lobes, ± sessile. Disc: dark brown to black, sometimes slightly white pruinose. Thalline margin: present, smooth, persistent. Exciple: not apparent externally; in section usually narrow, poorly developed, formed of hyphae oriented ± parallel to paraphyses. Epithecium: brown or orange-brown, K-, N-, pigment not soluble in K or N. Hypothecium: colourless. Hymenium: colourless. Paraphyses: simple, occasionally sparingly branched in upper part, clavate, typically less than 2 µm wide at base, broadening to 3 or more µm at apex, not capitulate. Ascii: narrowly clavate or almost cylindrical, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, Physcia type, typically between 15 and 25 µm long, 8 per ascus. Pycnidia: laminal, forming black dots about 0.05 mm wide on the lobes; in section: pyriform, 80 - 100% immersed, dark brown around ostiole, colourless to brown elsewhere. Conidia: colourless, simple, bacilliform, typically between 4 and 5 µm long and about 1 m wide. Chemistry: thallus K+ yellow (but reaction sometimes faint, especially in *P. biziana*); medulla K- in most species, less often K+ yellow. Photobiont: green, of globose cells to about 12 µm diameter, usually forming a ± continuous, but sometimes irregular, layer.

About 118 species, of which about 21 occur in Europe. They usually occur on nutrient-enriched substrates, principally base-rich bark and base-rich rock. *Physcia* is well represented in Greece. *P. mediterranea* Nimis is not included in the key, as I have insufficient information.

11 Marginal cilia present, especially near lobe tips, sometimes also along lobe margins, extending far beyond the lobes (Note 1). Thallus loosely adpressed or not adpressed.

22 Soralia absent. Apothecia usually present. *P. leptalea*

2 Soralia present. Apothecia rare.

33 Soralia on inside of convex structures on upper surface of lobes, near lobe tips; upper and lower surface of lobe separating to form these structures. *P. adscendens*

3 Soralia on lower surface of lobes, usually near lobe tips where lobes are often reflexed, less commonly ± marginal; convex structures absent; upper and lower surface of lobe not separating. *P. tenella*

1 Marginal cilia absent (Note 1). Thallus ± adpressed.

22 Soralia or isidia present.

33 Medulla K+ yellow. Thallus rosette-shaped, lobes less than 1 mm wide.

44 Upper surface strongly white maculate, at least in older parts of thallus. *P. caesia*. s. lat.

55 Soralia globose, laminal and sometimes marginal. *P. caesia var. caesiella*

5 Soralia lip-shaped, marginal. *P. caesia var. caesiella*

4 Upper surface not maculate.

55 Lower surface white to pale grey everywhere. (P. tribacioides)

5 Lower surface brown, dark grey or black at least in central parts (may be pale near lobe tips).

66 Thallus with pustules that often break up into coarse, granular soralia. Soralia sometimes covering most of thallus. *P. clementei*

6 Thallus without pustules. Soralia ± delimited, not covering most of thallus. (P. erumpens)

3 Medulla K-. Thallus various.

44 Lower cortex distinctly cellular.

55 Lobe margins not ascending. On siliceous rock. *P. tribacia*

5 Lobe margins distinctly ascending. On bark. (P. vitii)

4 Lower cortex not cellular, distinct hyphae visible.

55 Upper surface usually densely covered with crystals (of calcium oxalate).

66 Thallus with many small lobules. Distinct soralia absent, but margins of some lobules occasionally breaking down and becoming slightly sorediate. *P. biziana v. leptophylla*

6 Lobules few or absent. Soralia distinct, frequent, not developing from lobules; usually on lobe margins, sometimes also laminal. (P. dimidiata) Greek reports need confirmation.

5 Upper surface without crystals (and usually without pruina). *P. dubia*

2 Soralia and isidia absent.

33 Medulla strongly K+ yellow. Upper surface of lobes usually with conspicuous white maculae. On bark.

44 Thallus distinctly pruinose, especially towards margins. Thallus developing yellow tinge in herbarium. (P. aipoliioides)

4 Thallus not, or scarcely, pruinose. Thallus not developing yellow tinge in herbarium. *P. aipolia*

3 Medulla K-. Upper surface with or without maculae. On various substrates.

44 Ascospores with distinct ornamentation. Thallus densely pruinose. On siliceous rock at high altitude. (P. magnussonii)

4 Ascospores without ornamentation. Thallus pruinose or not. On various substrates; not restricted to high
altitud
55 Thallus usually strongly pruinose (pruina crystalline); usually ±strongly adpressed. Apothecia sessile with th\n
narrow hyphae that arise from lower cortex. Soralia: absent. Upper cortex: 50 ± 70 µm thick, of very loosely interwoven hyphae with large air spaces between them; hyphae 3 - 4 µm wide, distinctly broader than hyphae in lower cortex. Lower cortex: 30 - 60 µm thick, colourless to very pale brown, of thin hyphae, 1 µm wide, oriented ±horizontal in longitudinal section of lobe, K-. Chemistry: medulla K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter, forming a continuous but very irregular layer 25 - 100 µm thick.

Gavalas & Sipman (2019) report a morph in which soralia are scattered over the thallus surface and are associated with perforations of the lobes. This morph is said to be common in the Aegean.

Well-developed specimens can not be confused with any other species. However, the convex structures containing the soralia are sometimes grazed, and may then need to be examined carefully to exclude P. tenella.

Common throughout Greece. Usually on bark, sometimes on rock, occasionally on wood or even soil. At altitudes 0 - 1800 m, but with a definite preference for lower altitudes. Recorded from a wide range of phorophytes, even Pinus. Cosmopolitan outside tropical regions.

Physcia aipolia (Ehrh. ex Humb.) Führnr. (1839)

Naturhist. Topogr. Regensburg 2: 249; Lichen aipolius Ehrh. ex Humb. (1793), Fl. Friberg. 19-20; Parmelia aipolia (Ehrh. ex Humb.) Ach.: Physcia aipolia f. angustata (Nyl.) Vain.; Physcia aipolia var. anthelina (Ach.) Cromb.

Thallus: foliose, to about 4 cm diameter. Lobes: 1 - 5 x 0.5 - 0.8 mm, 200 - 390 µm thick, ±flat, adpressed, not ascending at tips, often overlapping slightly. Upper surface: grey, strongly white maculate everywhere, not normally pruinose, rarely slight white pruina present at tips of some lobes, sometimes warted in central part of thallus. Lower surface: white to pale grey, attached by rhizines. Cilia: absent. Rhizines: black, usually simple, occasionally forked, 0.2 - 0.4 x 0.05 mm, often extending beyond margin of lobes; in section formed of ±parallel, occasionally anastomosing, narrow hyphae that arise from lower cortex. Soralia: absent. Upper cortex: 50 - 70 µm thick, pale brown in top part,
colourless in lower part, cellular; cells 5 - 8 x 3 - 5 \( \mu m \), with long axis vertical; K- or almost (atranorin reaction faint), pigment soluble in K. Medulla: white, 80 - 170 \( \mu m \) thick, of loosely interwoven hyphae 4 - 5 \( \mu m \) wide. Lower cortex: 50 - 75 \( \mu m \) thick, usually colourless, occasionally pale brown at extreme surface, formed of narrow hyphae about 1.5 \( \mu m \) wide; K-; Apothecia: usually present, sessile, usually rounded, sometimes distorted by compression, to 2 mm diameter. Disc: black, rarely brown in shade, often slightly to strongly white pruinose. Thalline margin: present, smooth, persistent 0.1 - 0.15 mm wide; in section 120 - 250 \( \mu m \) wide; cortex 40 - 90 m wide, formed of hyphae perpendicular to surface, sometimes weakly cellular. Exciple: not visible externally; in section 15 - 20 \( \mu m \) wide, of hyphae \( \parallel \) to paraphyses, mostly colourless, outermost part orange-brown. Epitheicum: orange-brown, K-, orange pigment soluble in K, brown pigment not soluble, N-. Hymenium: 90 \( \mu m \) tall, colourless. Hypothecium: 75 \( \mu m \) tall, colourless. Paraphyses: simple, clavate, 1 \( \mu m \) wide at base, to 3 \( \mu m \) at apex, not capitulate, septa occasionally visible near apex, apex with very thin layer of orange-brown pigment. Asci: 65 x 18 - 22 \( \mu m \), \( \approx \) cylindrical or narrowly clavate, Lecanora type. Ascospores: brown, ellipsoid, 1-septate, Physcia type, 17 - 22 x 7.5 - 9 \( \mu m \), 8 per ascus. Pycnidia: often present, laminal, black, 0.05 mm diameter; in section: pyriform with a long neck, 300 \( \mu m \) tall (of which neck accounts for about 135 \( \mu m \)), 200 m wide, multi-chambered when mature; wall pale brown in mid part, \( \approx \) colourless at base, dark brown around ostiole; 80% immersed, emerging 60 - 80 \( \mu m \) above thallus surface. Conidia: colourless, bacilliform, 5 x 1 \( \mu m \). Chemistry: medulla K+ yellow, C-, KC-, P-, I-; thallus K+ yellow or orange-yellow, C-, KC-, P-, UV-. Photobiont: green; cells globose, 10 - 12 \( \mu m \) diameter, often in clusters 50 - 70 \( \mu m \) in diameter. Photobiont layer: \( \approx \) continuous but very irregular, 25 - 125 \( \mu m \) thick.

The maculation on the upper surface is caused by clustering of the photobiont cells. The lower cortex comprises two layers. In the inner layer, hyphae are mostly horizontal in longitudinal section and few anastomoses are visible. In the outer layer there are many more hyphae in other orientations, including some vertical, and many anastomoses. The outer layer is especially well developed above rhizines, but is present elsewhere. Usually easily recognised by its strong maculation. In doubtful cases, the K+ medulla provides confirmation. P. stellaris has more elongate lobes and a K- medulla.

Throughout Greece. On bark that is not strongly acidic at altitudes 0 - 1700 m. Recorded from a wide range of phorophytes.

Cosmopolitan in regions with a cool to warm-temperate climate.

**Physcia albinea** (Ach.) Malbr. (1868)


*P. albinea* is separated from *P. stellaris* by slight morphological differences, but mainly by the different substrate. It is possible that the differences in morphology are induced by the substrate, and that *P. albinea* is merely a synonym of *P. stellaris*.

Scattered thinly throughout much of Greece, with no clear pattern. Usually on rock, sometimes over bryophytes on rock. There are scattered reports from sea level to 2600 m; they may not all be reliable.

Southern and south-central Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco) perhaps N. America (scattered in western USA).

**Physcia biziana** (A. Massal.) Zahlbr. (1901) var. biziana

*Öst. Bot. Z.* 51(9): 348; *Squamaria biziana* A. Massal. (1856), Misc. Lichenol. 5-6; (?)*Physcia ragusana* var. *argentata* Zahlbr.

Thallus: foliose, to several cm diameter. Lobes: 0.5 - 1 mm wide, often broadening to 2 mm at tips, usually ±adpressed, usually ±flat; lobules absent or few. Upper surface: grey to blue-grey, usually not maculate, sometimes weakly maculate in centre of thallus, slightly to strongly white pruinose especially at tips of lobes, pruina distinctly crystalline. Lower surface: white at margin, sometimes with a distinct pale pink or pale pink-brown tinge, darkening towards centre of thallus, attached by rhizines. Cilia: absent. Rhizines: simple, white to grey, 0.5 x 0.07 mm. Soralia: absent. Upper cortex: cellular; cells 10 x 5 \( \mu m \), long axis vertical. Medulla: white. Lower cortex: in longitudinal section formed of horizontal hyphae. Apothecia: always present, to 2 mm diameter, sessile, concave. Disc: dark brown to black, often white pruinose. Thalline margin: present, sometimes white pruinose, 0.1 - 0.15 mm wide, persistent; in section, 100 \( \mu m \) wide, of which cortex 12 - 35 \( \mu m \) (cortex becoming thinner towards top of apothecium); cortex cellular, differentiated into colourless outer layer, 10 \( \mu m \) thick, and a very pale brown inner part. Exciple: not visible externally; in section, poorly developed, 15 \( \mu m \) wide, formed of hyphae \( \parallel \) to paraphyses or slightly radiating. Epitheicum: brown, K-, some pigment soluble in K. Hymenium: 60 - 80 \( \mu m \) tall, colourless. Hypothecium: to 80 \( \mu m \) tall at centre of apothecium, thinner elsewhere, colourless to very pale brown. Paraphyses: mostly simple, sometimes sparingly branched in upper part, 2 \( \mu m \) wide at base, 3 - 4 \( \mu m \) wide at apex, not or only slightly capitulate, with hemispherical cap of brown pigment. Asci: 62 - 65 x 15 - 18 \( \mu m \), usually cylindrical or slightly clavate, occasionally bulging in middle.
Physcia biziana var. leptophylla Vězda (1964)


Similar to var. biziana, but rarely fertile and with many lobules, especially around lobe margins. Lobules to 0.5 x 0.3 mm. Occasionally the lobules break down, giving a slightly sorediate appearance, but well-developed soralia are absent. Apothecia absent or very few.

A distinctive taxon which is not likely to be confused with any other except perhaps Physconia grisea subsp. lilacina, which has a thallus reacting K-, simple rhizines, a pruinose upper surface and many lobules. However, in that taxon the upper surface is often brown, at least in places, whereas it is never brown in Physcia biziana. Also Physconia grisea subsp. lilacina usually has much denser pruina than Physcia biziana.

Scattered, usually not very far from the coast. Less common than var. biziana. At altitudes 0 - 1350 m, but commonest at low altitudes. On bark or on rock (calcareous or siliceous rock) that is not too poor in bases.

Southern Europe, form Iberian Peninsula to Greece. Also N. Africa (Tunisia).

Physcia biziana var. phyllidiata Poelt & Vězda (1993)


Similar to var. biziana, but rarely fertile and central part of thallus with numerous lobules.

Northern Peloponnesse, on limestone at an altitude of 1050 m, and island of Alonisos on bark of Cupressus sempervirens and Olea europaea near sea level. Perhaps more common, but may have been overlooked as var. leptophylla.

Elsewhere only reported for Austria, Albania and Sardinia.

Physcia caesia (Hoffm.) Fürnkr. (1839)


Thallus: foliose, forming small circular patches to a few cm diameter. Lobes: 2.5 - 4.5 x 0.8 - 1 mm, often divided especially at apices, adpressed, 200 - 300 μm thick. Upper surface: grey, not pruinose, strongly white maculate at least in older parts of thallus. Lower surface: white at margin, pale brown in central parts, attached by rhizines. Cilia: absent. Isidia: absent. Rhizines: black, usually simple, rarely forked, 0.3 - 0.5 x 0.1 mm, sometimes extending out beyond lobe margins. Soralia: frequent at least in older parts of thallus, marginal, blue-grey, initially small, excavate, and discrete, later becoming larger, 0.3 - 0.5 mm diameter, ±globose, sometimes confluent, sometimes appearing laminal. Upper cortex: 20 - 55 μm thick, cellular; cells 9 - 10 x 6 - 9 μm, the long axis vertical; in K diffusing yellow pigment into solution (atranorin), N-. Medulla: white, 75 - 100 μm thick, of loosely interwoven hyphae about 4 μm wide. Lower cortex: 40 - 50 μm thick, of narrow hyphae, 1.5 μm wide, oriented ±horizontally in longitudinal section; K-, N-, P-, C-, medulla K+ yellow to orange-yellow, ±globose, 0.1 mm diameter; in section: 100% immersed, globose to pyriform, simple or multi-chambered, 120 - 170 μm tall, 80 - 180 μm wide; wall colourless in lower half, colourless to pale brown in upper half. Conidia: colourless, straight bacilliform, 4 - 5 x 3/4 μm. Chemistry: medulla K+ yellow to orange-yellow, C-, P-, I-; thallus K+ yellow to orange-yellow, C-, P-, UV-. Photobiont: green, cells globose, 8 - 11 μm diameter. Photobiont layer: continuous, 30 - 170 μm thick; lower surface ±irregular but upper surface very irregular as clumps of algae rise above general level; gaps between clumps probably correspond to maculae on upper surface.

The combination of small, adpressed, strongly maculate lobe with abundant soralia is distinctive, and this species is unlikely to be confused with any other.

Scattered, with no clear pattern. Not very common. On siliceous rock, rarely directly on soil, at altitudes 100 - 1350 m.
Physcia caesia s. lat. is cosmopolitan outside regions with a hot climate, and is present in much of Europe. The distribution of var. caesia is not clear, as the two varieties are not often distinguished.

Physcia caesia var. caesiella (de Lesd.) Clauzade & Cl. Roux (1985)

Likenoj de Okcidenta Europo 827; Physcia tribacioides var. caesiella de Lesd. (1906), Bull. Soc. Bot. Fr. 53(7): 515;
Physcia caesiella (de Lesd.) Suza; Physcia subalbinea Nyl.; Physcia wainioi Räsiänen.

Description: Clauzade & Roux (1985).

The status of var. caesiella is not clear to me. I have not seen any Greek collection that unambiguously belongs here. Material of var. caesia has globose soralia that are both laminal and marginal, but a few marginal labiform soralia are occasionally also present, suggesting the existence of intermediate morphs. Some authors, including Moberg (1977), treat var. caesiella as a synonym of var. caesia, but he examined mainly Scandinavarian material. Nimis (1993) claims that in Mediterranean regions the two varieties are distinct.

The discaeana, including Crete, at altitudes 250 - 500 m. Usually on siliceous rock, but once on bark of Juniperus phoenicea.

Widely distributed in Europe, though there are far fewer records than for var. caesia. Also Macaronesia, Asia (widespread), N. Africa (Tunisia), N. America (California, Colorado, Michigan, N. Carolina).

Physcia clementei (Sm.) Maas Geest. (1952)

Blumea 7(1): 228 (A 1935 combination by Lyngae was not validly published.); Lichen clementei Sm. (1807) in Smith & Sowerby, Engl. Bot. 25, tab. 1779, as clementi.

The epithet commemorates the Spanish botanist Clemente, and is correctly written clementei.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Corfu, on bark of Olea europaea at an altitude of 20 m.

Southern and central Europe, to as far north as British Is. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, Egypt, S. Africa), N. America (scattered in USA), C. America (Nicaragua), perhaps S. America (Peru), perhaps Australasia (Australia).

Physcia dubia (Hoffm.) Lettau (1912)

Hedwigia 52(3-4): 254; Lobaria dubia Hoffm. (1796), Deutschl. Fl. 2: 156; Physcia dubia var. teretiuscula (Ach.) Clauzade & Cl. Roux.

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Scattered in the northern half of the mainland. On siliceous rock at altitudes 500 - 2200 m.

Widespread in northern and central Europe, much less common in the south. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), C. America (Guatemala, Mexico), southern S. America (Argentina, Chile, Brazil), Australasia (SE Australia, NZS), Antarctic (widespread).

Physcia leptalea (Ach.) DC. (1805)


Thallus: foliose but appearing subfruticose in some specimens, to about 3 cm diameter. Lobes: 1.5 - 6 x 0.4 - 0.6 mm, 150 - 190 µm thick, never strongly adpressed; attached to surface along most of their length, or only in older parts and thallus then appearing almost fruticose. Upper surface: grey, not pruinose, sometimes white maculate, occasionally strongly so. Lower surface: white, attached by rhizines. Cilia: always present, usually abundant, apical or less commonly marginal, brown to black, sometimes white at base, 0.3 - 2.4 x 0.06 mm. Rhizines: white, simple, resembling cilia but not extending beyond lobes; in section formed of parallel, agglutinated hyphae, that originate largely in medulla, not lower cortex. Soralia: absent. Upper cortex: 15 µm thick, very pale brown, of subrounded cells 4 - 7 x 4 - 5 µm; in section usually clearly K+ yellow (alcanorin), yellow pigment diffusing into solution. Medulla: white, 50 µm thick, of loosely interwoven hyphae 3 - 4 µm wide. Lower cortex: ± colourless, of narrow hyphae, about 1 µm wide, arranged horizontally in longitudinal section, K-. Apothecia: always present, laminal, sessile to slightly stalked, 1.1 - 5.3 mm diameter. Disc: dark brown to black, sometimes slightly white pruinose. Thalline margin: present, smooth, persistent, thin (0.05 - 0.1 mm); in section: 80 - 150 µm wide including cortex; cortex 10 - 35 µm thick (thinner where groups of algal cells push towards surface), of radiating hyphae with broad lumina, appearing cellular; cells rounded to slightly elongate, 5 - 10 µm wide in longest dimension. Excipule: poorly developed, not visible externally, in section: about 10 µm wide. Epithecium: orange-brown, K-, but becoming more brown and less orange in K, N-. Hymenium: 80 µm tall, colourless. Hypothecium: 50 µm tall, colourless, formed of a dense mass of tightly interwoven hyphae (individual hyphae not always visible) oriented predominantly horizontally. Paraphyses: simple, 1 - 1.5 µm at

1700 m, though half of records are from below 500 m.
base, 2.5 µm at apex, slightly capitate (best seen in N), with very thin pigment layer on top surface. Ascii: 65 - 70 x 15 - 20 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 15 - 20 x 9 - 11 µm, Physcia type, 8 per ascus. Pycnidia: sometimes common; black, laminal, 0.05 - 0.1 mm diameter; in section: 90 - 100% immersed, globose to subglobose, 90 µm tall x 80 µm wide, wall brown throughout. Conidia: colourless, bacilliform, 3 - 5 x ¾ µm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K+ yellow, C-, usually P-, sometimes very faintly P+ yellow, UV-. Photobiont: green, cells globose, 10 - 20 µm diameter, in a continuous, regular layer, 45 microns thick.

When reasonably well-developed, this species can not be confused with any other. Anaptychia ciliaris, another common foliose species with cilia, is much larger.

Common throughout Greece. Usually on bark (95% of records), occasionally on wood or rock. Recorded from a wide range of phorophytes. At altitudes 0 to about 2000 m, but scarce above 1500 m. The lichenicolous fungi Arthoria epiphytica, Heterocephalacria physiceaeum, Polycoccum pulvinatum and Tremella christiansenii have been reported from this host, the first twice.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread).

Physcia mediterranea Nimis (2016)

Lich. Italy 2: 20; Physcia scopulorum (Lambinon & Vêzda) Poelt & Nimis, nom. illeg.

Description: Described briefly in Paz-Bermúdez et al. (1998). This species is said to be close to P. aipolia, but is restricted to coastal siliceous rock. It is not clear to me whether it merits formal taxonomic recognition.

Chios, Crete and Samothraki, on siliceous rock at altitudes 100 - 480 m.

Southern Europe, from Spain to Cyprus. Also Macaronesia, western Asia (Turkey).

Physcia stellaris (L.) Nyl. (1853)

Bot. Notiser 1853: 155 ; Lichen stellaris L. (1753), Sp. Pl. 1144; Parmelia stellaris (L.) Ach.; (?) Physcia stellaris f. albogranulosa Mérat; Physcia stellaris var. radiata (Ach.) Lyng; Physcia stellaris var. rosulata (Ach.) Kremp.

Thallus: foliose, to 2 cm diameter. Lobes: 10 x 0.7-1.5 mm, 150 - 250 µm thick, not to moderately adpressed, without cilia or soralia. Upper surface: grey to blue-grey, not pruinose, not to distinctly maculate. Lower surface: mostly white. Rhizines: simple, white to black, 0.3 - 0.4 x 0.05 mm; in section, formed of ±parallel, agglutinated hyphae arising from lower cortex. Upper cortex: 25 - 40 µm thick, pale brown in upper part, colourless in lower part, cellular; cells 6 - 11 x 6 - 8 µm, if not isodiametric then with long axis vertical; K- or almost (atranorin reaction indistinct), brown pigment soluble in K. Medulla: white; 50 - 85 µm thick, of loosely interwoven hyphae, 3 - 3.5 µm wide. Lower cortex: 20 - 30 µm thick, usually entirely colourless, rarely pale brown at extreme surface, formed of narrow hyphae, 1.5 µm wide, oriented predominantly horizontally, K-. Apothecia: usually present, to 2 mm diameter, sessile, ±concave. Disc: black, usually not pruinose, rarely with faint white pruina. Thalline margin: present, persistent, usually smooth, sometimes slightly crenulate in older apothecia; in section 100 µm wide, of which cortex 25 - 50 µm. Exciple: not visible externally; in section: poorly developed, about 15 µm wide, formed of hyphae ±parallel to paraphyses. Epithecium: orange-brown to brown, K-, N-, pigment insoluble in K and N. Hymenium: 65 µm tall, colourless, K+ blue. Hypothecium: 75 µm tall, colourless. Paraphyses: simple, 1 - 1.5 µm wide at base, 2.5 µm at apex, not capitate. Asci: 85 x 18 µm, ±cylindrical or narrowly clavate, Lecanora type. Ascospores: brown, ellipsoid, 1-septate, 17 x 8 µm, Physcia type, 8 per ascus. Pycnidia: often present, laminal, black, 0.05 mm diameter; in section: slightly pyriform, 210 µm tall (of which neck about 40 µm), 210 µm wide, 100% immersed; wall brown except around ostiole, where it becomes darker brown, sometimes multi-chambered. Conidia: colourless, simple, bacilliform, 5 x 1 µm. Chemistry: medulla K-, C-, KC-, P-, I-, thallus K+ yellow, C-, KC-, P-, UV-. Photobiont: green; cells globose, 11 - 13 µm diameter, forming a ±continuous but rather irregular layer 40 - 55 µm thick.

Fairly easily recognised when not, or scarcely pruinose, but moderately pruinose morphs can be confuse with P. biziana. In that case it is essential to pay careful attention to all characters in the key. Maculate morphs, which are quite common, resemble P. aipolia, but that has a distinctly K+ yellow medulla and its lobes are never very elongate.

Throughout Greece. On bark at altitudes 0 to at least 1700 m. On bark of a wide range of species, but avoiding strongly acidic bark.

Subcosmopolitan.

Physcia tenella (Scop.) DC. (1805)


Thallus: foliose, forming an irregular patch to about 1 cm diameter, but thalli often contiguous. Lobes: 1 - 2 x 0.3 - 0.8 mm, 160 - 230 µm thick, weakly adpressed in central part of thallus, ascending at tips. Upper surface: grey, sometimes slightly white pruinose. Lower surface: free, attached by rhizines. Cilia: always present, simple, very
rarely forked, marginal, usually at tips of lobes, usually dark brown to black, sometimes white to pale brown at base, 0.3 - 0.5 (1.0) x 0.05 mm. Rhizines: simple, resembling cilia but paler and not extending beyond lobe margins. Soralia: on lower surface of reflexed lobe tips. Upper cortex: 22 - 30 µm thick, pale brown in upper part, colourless below, of rounded cells about 5 µm diameter. Medulla: white, 0 - 75 µm thick, sometimes poorly developed near lobe tips, of loosely interwoven hyphae without preferred orientation; hyphae broad, about 5 µm wide. Lower cortex: about 75 µm thick, often not sharply delimited from medulla but clearly differing from it in width of the hyphae; of loosely interwoven hyphae without preferred orientation; hyphae broad, about 1 µm wide, oriented predominantly but not exclusively parallel to long axis of lobes. Chemistry: medulla K-; thallus K+ yellow (reaction often faint). Photobiont: green. Photobiont layer: 30 - 45 µm thick, ±continuous, but upper and lower surfaces often rather irregular.

This species is usually easily recognised, but poorly developed specimens may be difficult to separate from *P. adscendens*.

Throughout Greece at altitudes 0 - 1500 m, but less common than *P. adscendens*. Usually on bark, rarely on siliceous rock. Recorded from a wide range of phorophytes, avoiding only strongly acidic bark.

Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), perhaps S. America (Argentina), Antarctica.

**Physcia tribacia** (Ach.) Nyl. (1874)


Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Very scattered, with no clear pattern. On siliceous rock or soil at altitudes 10 - 1750 m.

Southern and central Europe, to as far north as Scotland. Also Macaronesia, Asia (widespread), Africa (widespread outside deserts and humid tropics), N. America (widespread), C. America (Mexico, Guatemala), S. America (widespread), Australasia (widespread), Pacific (Henderson Is), perhaps Antarctica.

**Physciella Essl.** (1986)


Literature: Esslinger (1986).

A small genus of 4 species, three of which occur in Europe. It is close to *Phaeophyscia*. The genus is rare in Greece.

11 Soredia present. Apothecia uncommon. *P. chloantha*

1 Soredia absent. Apothecia common. (P. nepalensis)

**Physciella chloantha** (Ach.) Essl. (1986)


Thallus: foliose, grey, brown-grey or green-grey, not pruinose. Lobes: elongate, 1 - 2 x 0.2 - 0.5 mm, not strongly adpressed, often ascending at tips, 90 - 170 µm thick. Cilia: absent. Hairs: absent. Isidia: absent. Soralia: present, mainly on lower surface of reflexed lobe tips, ±lip-shaped, 0.4 - 0.6 x 0.25 - 0.3 mm, green-grey (greener than upper surface). Lower surface: white. Rhizines: simple, white to pale brown, 0.3 - 0.5 x 0.05 - 0.1 mm. Cortex: 20 - 40 µm thick, mostly colourless, sometimes very pale brown in places, cellular, K-. Medulla: white. Lower cortex: not very distinct from medulla, mostly colourless, sometimes brown at surface, of hyphae oriented parallel to long axis of lobes. Chemistry: medulla K-; soralia K-, C-, KC-; thallus K-, C-, KC-, UV-. Photobiont: green; cells globose, 8 - 11 µm diameter, forming a continuous but irregular layer 30 - 50 µm thick.

Could be confused with *Physcia dubia*, but that species is usually saxicolous and its upper cortex reacts K+ yellow (atranorin). *Physcia tenella* also has soralia on the lower surface of reflexed lobe tips, but has abundant cilia.

Scattered in the northern half of Greece, never very far from the sea, on bark at altitudes 20 - 170 m. Reported from *Olea europea*, *Platanus orientalis* and *Quercus pubescens*.

Southern and central Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), C. America (Mexico), S. America (Argentina, perhaps elsewhere).

**Physconia Poelt** (1965)

*Nova Hedwigia* 9: 30. Type: *P. pulverulacea* Moberg. The type is conserved. Family: *Physciaceae*.

Literature: There is no monograph that covers southern Europe, which is unfortunate as the genus is well represented in the region and is a significant component of the lichen biota in some habitats. Atanassova & Mayrhofer (2012) is a good starting point. Clauzade & Roux (1985) cover many of the European species, though not very well.
Moberg (1977) is more thorough but has a northern perspective.


Differs from *Physcia* most obviously in always having at least some pruina on the upper surface, and in the generally browner colour of the upper surface. Other differences are the absence (or very limited development) of apiac wall thickening in the ascospores, and the presence in most species of squarrose rather than simple rhizines.

About 26 species, of which 13 occur in Europe. It is well represented in Greece, and some species are widespread and common. However, *Physconia* can be a difficult genus, as some species are very variable and rather confusing. In response to this variability, numerous infra-specific taxa have been recognised by some authors, but few are accepted here. Most species of *Physconia* occur on substrates that are at least slightly base-rich.

1 Rhizines usually remaining simple or sparingly branched (tips occasionally tufted, especially when in contact with substrate, or slightly squarrose); mostly ±white. Lower surface pale (white to pale brown or pale pink-brown) nearly everywhere. Thalline margin without lobules (though it may occasionally appear isidiate). Upper cortex ±cellular.

2 22 Thallus with isidia or soralia along lobe margins and sometimes on thalline margin. **P. grisea subsp. grisea**

2 Thallus without soralia.

3 33 Central parts of thallus with many lobules. Apothecia usually absent. On various substrates. **P. grisea subsp. lilacina**

3 Thallus without lobules, or with just a few lobules. Apothecia usually present. Usually on bark. Probably restricted to low altitudes. **P. grisea subsp. algeriensis**

1 Mature rhizines squarrose (with many short horizontal branches); white, brown or black. Lower surface black in central parts, often white near margin. Thalline margin with or without lobules. Upper cortex hyphal or cellular.

22 Soralia present (Note 1).

33 Medulla white to yellow, K+ strongly yellow. Soralia K+ yellow. **P. enteroxantha**

3 Medulla white, K-. Soralia K-.

44 Soredia mostly in soralia on tips of short, broad reflexed lobes in older parts of thallus. (Elongate lobes, without soralia, may be present in marginal part of thallus.) Lower cortex absent near lobe ends, gradually forming closer to centre of lobes. Lower surface white at margins of lobes. **P. peristidiosa**

4 Soredia mostly marginal, a few sometimes also laminal, not usually at tips of lobes. Lower cortex present right up to lobe ends. Lower surface black everywhere. **P. deltersa**

2 Soralia absent.

33 Upper surface of lobe tips, and sometimes also thalline margin, with very fine hairs (Note 2). **P. servitii**

3 Hairs absent.

44 Upper cortex ± uniformly cellular in longitudinal section. Medulla usually K- (Note 3). Usually not on bark.

55 Overgrowing bryophytes or decaying vegetation. **P. muscigena**

5 On rock. (P. petrea)

4 Upper cortex hyphal in longitudinal section. Medulla K- or K+ yellow to orange. Usually on bark, but may occur on other substrates.

55 Medulla white or yellowish, K+ yellow or orange. **P. subpulverulenta**

5 Medulla white, K-. The following species are troublesome (Note 4). Care is required as they commonly grow together.

66 Lower surface mostly pale, dark only in central parts. Hyphae in lowermost part of lobes horizontal, but over most of lower surface not forming a well-developed, compact cortex. (A well-defined cortex may be present adjacent to some rhizines.) In transverse section, most hyphae of outermost part of upper cortex oriented horizontally. **P. venusta**

6 Lower surface mostly pale, dark only near lobe margins (Note 5). Lower cortex well developed over most of lower surface, not restricted to vicinity of rhizines, but sometimes absent or poorly developed at extreme margins of lobes. In transverse section, usually most hyphae of outermost part of upper cortex oriented vertically (Note 6).

77 In transverse section, upper cortex with thick-walled hyphae (Note 6). The lumina occupy only a small proportion of the cortex (the rest being occupied by the walls of the hyphae) and are typically several
times longer than wide. Lobes long, narrow (usually distinctly longer than wide), not or only occasionally overlapping (see Note 8). **P. distorta**

7 *In transverse* section, upper cortex with thin-walled cells (Notes 7 and 9). The lumina occupy a significant proportion of the cortex (typically 50% or more) and are subglobose to about twice as long as wide. Those in lower part of cortex are usually more rounded than those in upper part. Lobes short, broad (about as long as wide), often overlapping. **P. thorstenii**

(1) In *P. perisidiosa* soralia may look more like rounded isidia than typical soralia.

(2) Hairs are less than 0.1 mm long, almost colourless, and easily overlooked if few in number, so examine carefully at x15 or better. Some collections have few hairs, and some lobes may lack hairs entirely.

(3) Occasional specimens of *P. muscigena* in which the medulla is pigmented yellow are said to react K+ yellow.

(4) Most published keys include several characters to separate these species in addition to those presented here. Although not entirely without merit, I have found that use of those characters tends to lead to confusion, because of the variability of these species.

(5) The white marginal zone may be quite broad in places, so it is advisable to examine several lobes.

(6) This is a less reliable character than the nature of the lower surface and lower cortex, and collections can be variable.

(7) In longitudinal section both species have a rather similar prosoplectenchymatous cortex.

(8) If the lobes do not seem typical for *P. distorta*, search carefully for small hairs near apices of lobes. Physconia servitii will key out here if its hairs are overlooked, and in some collections they are easily overlooked.

(9) The lower part of the upper cortex in *P. thorstenii* is quite different from that in *P. distorta*, having numerous rounded lumina. The upper part may look rather similar at first glance, but on closer inspection the hyphal walls tend to be thinner. However, some collections are difficult to place.

*Physconia detersa* (Nyl.) Poelt (1965)


Descriptions: Ahti et al. (2002); Clauzed & Roux (1985); Moberg (1977); Nash et al. (2002).

Very scattered, on Crete and the mainland. On bark at altitudes 0 - 1200 m.

Widespread in Europe, but in the south mainly in the uplands and uncommon. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread).

*Physconia distorta* (With.) J. R. Laundon (1984)


Thallus: foliose, to 7 cm diameter, brown, green-brown. grey, blue-grey or green-grey, often much greener when wet, generally browner in more exposed sites, usually with some white pruina at tips of lobes, less commonly elsewhere, sometimes forming distinctly circular patches, without vegetative propagules, hairs or cilia. Lobes: usually much longer than broad, to 12 mm long in entirety, unbranched terminal lobes to 5 mm long but usually less, 0.5 - 1.5 mm wide, often branched, flat or slightly concave, adpressed or not but never ascending, smooth, 170 - 260 (600) µm thick. Lobules: often present in central part of thallus, sometimes on thalline exciple. Lower surface: mostly black, sometimes white in marginal parts, attached by rhizines. Rhizines: black, occasionally white at tips, squarrose (when mature), 0.6 - 1 x 0.05 - 0.15 mm; in section: formed of rather loosely agglutinated, pale brown hyphae; hyphae sometimes separating from main rhizine and growing out ±horizontally (producing the squarrose appearance). Upper cortex: 25 - 50 (90) µm thick, mostly colourless, sometimes pale brown to brown in outermost 10 - 20 µm, hyphal; in longitudinal section of thick walled hyphae, oriented predominantly ±vertically, but sometimes ±horizontally in outermost 10 µm; in transverse section formed of thick walled hyphae with narrow elongated lumina. Medulla: white, of loosely interwoven hyphae. Lower cortex: present almost everywhere on lower surface, only sometimes indistinct near tips of lobes, 35 - 60 µm thick, outer 20 - 40 µm very dark, often opaque, inner part colourless; in longitudinal section formed of ±horizontal hyphae. Apothecia: common, sessile, sometimes shortly stalked, concave, (0.25) 0.5 - 2.8 mm diameter, usually with some white pruina on disc and sometime on thalline margin, sometimes densely pruinoose. Disc: brown to dark brown (below
Physconia enteroxantha (Nyl.) Poelt (1966)

*Nova Hedwigia* 12: 125; *Physcia enteroxantha* Nyl. (1873), *Flora* 56: 196; *Physcia enteroxanthella* (Harm.) H. Olivier; *Physcia grisea* f. *alphiphorm* (Ach.) Lyng.

Descriptions: Ahti et al. (2002); Claúzade & Roux (1985); Möberg (1977); Nash et al. (2002); Smith et al. (2009).

Scattered, mainly in the eastern half of Greece. On bark, bryophytes on bark, or siliceous rock at altitudes 80 - 1200 m.

Throughout much of Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside deserts and the humid tropics), Australasia (widespread in Australia), Pacific (Hawaii, Kermadec Is). Reports for N. America refer to *P. americana*.

Physconia grisea (Lam.) Poelt (1965) subsp. grisea

*Nova Hedwigia* 9: 30; *Lichen griseus* Lam. (1792), Encycl. 3: 480; *Parmelia pulverulenta* var. *farrea* (Turner ex Ach.) ined.; *Physcia grisea* (Lam.) Zahlbr.; *Physcia pityrea* (Durieu & Mont.) C.רמה., nom. superfl.

Thallus: foliose. Lobes: to 1.5 mm wide, slightly adpressed. Upper surface: blue-grey to brown (green when wet), white pruinose. Lower surface: white to pale pink almost everywhere, some darker patches occasionally present. Hairs: absent. Isidia: abundant, blue-grey to brown-grey, arising from lobe margins, eventually becoming coralloid and almost obscuring thallus; often present, and sometimes abundant, also on thalline exciple. Lobules: absent. Rhizines: white, simple, 0.6 - 2 x 0.1 mm. Soralia: said sometimes to develop from isidia. Upper cortex: 37 - 60 µm thick, pale brown in outer 10 µm, colourless elsewhere, ±cellular; cells subangular, 5 - 6 µm wide, isodiametric or slightly elongated vertically. Lower cortex: of thin hyphae oriented parallel to long axis of lobe. Apothecia: 0.7 - 1.5 mm diameter, laminal, sessile, concave, strongly white pruinose. Thalline margin: present, sometimes with many isidia. Exciple: not visible externally; in section: poorly developed, 20 µm wide, of hyphae ±parallel to paraphyses. Epithecium: brown. Hymenium: 135 µm tall, colourless. Hypothecium: 45 µm tall, colourless. Paraphyses: 2 µm wide, not capitante, sometimes with visible septa. Ascospores: brown, 1-septate, ellipsoid, 22.5 - 30 x 14 - 15 µm, ±Physconia type. Chemistry: thallus and medulla K-, P-, ±Physconia type, septum inserted early, 8 per ascus. Ptycquina: fairly common, forming distinct convex bumbs on upper surface of lobes, 0.2 mm diameter; in section: 60% immersed, colourless, 650 µm tall, 320 µm wide. Conidia: colourless, bacilliform, 5 x 1 µm. Chemistry: medulla K-, P-; thallus K-, UV-.

Collections with strongly pruinose lobes, and collections with lobes that are not very elongated, should be checked against *P. thorstenii*. Collections with a dense development of lobules around the apothecium should be checked against *P. venusta*.

Very common throughout Greece. On neutral or basic bark or overgrowing bryophytes thereon (95% of records), occasionally on rock, at altitudes 0 to over 1500 m. Recorded from a wide range of phorophytes. The lichenicolous fungus *Lichenochora weillii* (Flagey) Poelt.

Some of the Peloponnesian reports in Abbott (2009) refer to *P. thorstenii* or *P. venusta*, and some other published reports may also be unreliable.

Most of Europe except for very cold regions. Also Macaronesia, Asia (widespread), Africa (widespread outside deserts and the humid tropics), Australasia (widespread in Australia), Pacific (Hawaii, Kermadec Is). Reports for N. America refer to *P. americana*.

Physconia grisea subsp. algeriensis (Flagey) Poelt (1966)

Physconia grisea subsp. lilacina (Arnold) Poelt (1966)


**Description:** Ahti et al. (2002); Clauzade & Roux (1985); Moberg (1977); Nash et al. (2002); Nimis & Martellos (2004).

Very scattered, mainly on the mainland but also recorded for Amorgos. Usually overgrowing bryophytes, sometimes directly on rock, at altitudes 150 - 1800 m. The reports for low altitudes may be unreliable.

**Subcosmopolitan** in cold or cool regions.

Physconia grisea subsp. grisea (Ach.) Nyl.

*Physcia biziana* var. *leptophylla*, which also has simple rhizines, a pruinose upper surface, many lobules, and in which the thallus can appear to be K-.

**Variation:**

- The soralia on the under surface of reflexed lobe tips make this a fairly distinctive species.
- Differs from subsp. *grisea* in lacking vegetative propagules (other than lGlobules) and in being normally sterile. Could be confused with *Physcia biziana* var. *leptophylla*, which also has simple rhizines, a pruinose upper surface, many lobules, and in which the thallus can appear to be K-.

**Chemistry:** medulla K-; soralia K-, C-, KC-, P-, I-; thallus K-, C-, KC-, P-, UV-.

**Rhizines:** squarrose, black, 1 - 2 mm wide, oriented horizontally only in extreme top part of cortex (top 15 µm, or usually less), elsewhere with almost random orientation; K-.

**Medulla:** white; in section: 70 - 110 µm thick, of rather broad hyphae, about 3 µm wide, of parallel conglutinated hyphae; side branches formed of single brown hyphae, 4 µm wide, with distinct septa. Soralia: mostly in central part of thallus, on tips of short, broad, upturned lobes, delimited when young, sometimes continuous later; soredia coarse, granular, 100 µm diameter, sometimes resembling small isidia. Upper cortex: 15 - 65 µm thick, colourless, hyphal (scleroplectenchyma of Moberg); hyphae rather robust, 2 - 2.5 µm wide, oriented horizontally only in extreme top part of cortex (top 15 µm, or usually less), elsewhere with almost random orientation; K-.

**Medulla:** white; in section: 70 - 110 µm thick, of rather broad hyphae, about 3 µm wide, oriented horizontally in longitudinal section; hyphae more loosely interwoven than lower cortex (when present). Lower cortex: absent near lobe tips, present in central parts of thallus (intermediate parts may have a layer differing slightly from medulla but not a well-developed cortex); when present: about 60 µm thick, usually brown, sometimes colourless, of thin hyphae, about 1 µm wide, oriented horizontally of lobe in longitudinal section (prosoplectenchyma of Moberg); K-.


**Photobiont:** green, cells globose, 11 - 12 µm diameter, forming a continuous, ±regular layer 60 - 110 µm thick.

The soralia on the under surface of reflected lobe tips make this a fairly distinctive species. *P. detersa* is similar, but its soralia are not on the tips of reflexed lobes. *P. grisea* subsp. *grisea*, which has fine isidia and sometimes soralia, is normally fertile, has isidia and/or soredia on the thalline exciple, and a cellular upper cortex.

Throughout Greece. On neutral to slightly basic bark at altitudes 100 - 1400 m. The lichen *Xanthoria aphrodites* has once been recorded parasitic on *P. perisidiosa*.

Throughout most of Europe. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa and E. Africa), N. America (widespread, mainly in western half), perhaps C. America, S. America (Argentina, Chile), perhaps Australasia (Australia).
Physconia servitii (Nádvo.) Poelt (1965)

Thallus: foliose, to 6.5 cm diameter. Lobes: to 10 mm long, (0.2) 0.7 - 1.1 (1.5) mm wide, distinctly long and narrow in many specimens, shorter and more rounded in others, 190 - 210 µm thick, flat to slightly convex, usually ±adpressed except sometimes near tips, often overlapping, often incised at tips, sometimes developing leaf-like or occasionally wart-like secondary lobules in central parts of thallus. Upper surface: grey to brown, white pruinose at tips and occasionally margins of lobes. Lower surface: black, sometimes white to pale brown at marginal 0.2 - 0.3 (0.5) mm. Hairs: abundant to scarce on upper surface and sometimes on margins of most lobes near the tips (though some lobes may lack hairs), absent from older parts of lobes, white or translucent, 0.05 - 0.08 (0.12) x 0.02 mm. Isidia: absent. Rhizines: black, sometimes white at tips when young, squarrose, 0.7 - 2.5 mm long, main stem 0.04 - 0.06 mm wide; in section of dark brown, parallel, conglutinated hyphae. Soralia: absent. Upper cortex: 25 - 50 (85) µm thick, colourless to very pale brown, of rather robust hyphae that are mostly oriented perpendicular or obliquely to surface, but a thin surface layer, 10 - 15 µm thick, sometimes present in which they are oriented mainly parallel to surface (scleroplectenchyma of Moberg). Medulla: white; in section: 50 µm thick, of rather compactly interwoven hyphae, 2.5 µm wide, that oriented roughly horizontally in longitudinal section. Lower cortex: present, 20 - 40 µm thick, very dark brown, of thin hyphae oriented horizontally in longitudinal section (Moberg's prosoplectenchyma) but details hard to observe owing to intense pigmentation (which does not bleach in C). Apothecia: usually present, sessile, concave, 0.6 - 2.0 mm diameter. Disc: brown, but usually obscured by fairly thick white pruina. Thalline margin: present, sometimes white pruinose in young apothecia, persistent, fairly thick, 0.2 - 0.3 mm wide, sometimes with lobules (which occasionally bear hairs); in section: 180 - 250 µm wide. Exciple: not visible externally; in section: not prominent, 50 µm wide, colourless except for a brown surface layer, formed of hyphae parallel to paraphyses. Epithecium: brown, K, pigment not soluble in K. Hymenium: 200 µm tall, usually colourless, sometimes brown in upper part. Hypothecium: 50 - 75 µm tall, colourless. Paraphyses: 2 µm wide at base, 2.5 µm at apex, not capitate. Ascospores: brown, 1- septate, ellipsoid, 25 x 15 µm, ±Physcia type but sometimes with some apical wall thickening at some stages of development, 8 per ascus. Chemistry: thallus and medulla K-. Photobiont: green, of globose cells 8 - 12 µm diameter, forming a continuous layer (35) 70 - 120 µm thick; upper surface often rather irregular where clumps of photobiont cells rise above the general level.

This is a distinctive species, and usually easily recognised. However, in a few specimens many lobes have only a few hairs and some lobes have none at all, so material must be examined carefully. If hairs are overlooked, specimens will key out as *P. distorta* or *P. venusta*, which will lead to confusion as *P. servitii* has some characters that are intermediate between those two.

Fairly common throughout Greece, though perhaps commoner in the south. On neutral or slightly basic bark, rarely on wood. At altitudes 0 - 1900 m, but usually below 1400 m.

South and south-central Europe. Also Macaronesia, Asia (Turkey, Russia, Mongolia), Africa (Morocco, Tunisia, Somalia).

Physconia subpulverulenta (Szatala) Poelt (1966)

Thallus: foliose, to 6 cm diameter. Lobes: to 5 mm long, 0.5 - 1.0 mm wide, 240 - 300 µm thick, ±flat, sometimes slightly overlapping, usually ±adpressed, tip often wavy or indented; sometimes giving rise to secondary lobules in central parts of thallus. Upper surface: grey to brown, white pruinose at least in places, sometimes everywhere. Lower surface: mostly black, sometimes with white or pale brown marginal zone to 0.7 (1.5) mm wide. Hairs: absent. Isidia: absent. Rhizines: squarrose, black, 0.6 - 2 mm long, main stem 0.05 - 0.07 mm diameter (but when side branches are well developed the whole rhizine typically about 0.2 mm diameter); in section: of brown, ±parallel, conglutinated hyphae arising from lower cortex. Soralia: absent. Upper cortex: 55 - 80 µm thick, mostly colourless, pale brown in upper 10 - 15 µm; formed of robust hyphae oriented predominantly oblique or perpendicular to surface of lobe (Moberg's scleroplectenchyma); pigmented layer sometimes overlain by a colourless, structureless layer a5 µm thick; brown pigment K-, N-, not soluble in K or N. Medulla: white to very pale yellow or very pale orange; in section: 75 - 100 µm thick, of rather densely interwoven hyphae oriented predominantly horizontally in longitudinal section; hyphae 3.5 - 4 µm wide, sometimes with visible septa. Lower cortex: 35 - 40 µm thick; in central parts of thallus, where lower surface is black, lower cortex is dark brown and opaque in section; in marginal parts, where lower surface is pale, lower cortex is pale brown in upper half, colourless in inner half, formed of thin hyphae, 1 µm wide, oriented mostly horizontally in longitudinal section (Moberg's prosoplectenchyma); brown pigment K- N-, not soluble in K, N or acetone, not bleached in C. Apothecia: usually present, sessile, slightly concave to flat, 1.2 - 4.2 mm diameter. Disc: dark brown but usually obscured by white pruina. Thalline margin: present, persistent, often white pruinose, sometimes with secondary lobules, 0.15 - 0.2 mm wide. Exciple: not visible externally; in section: poorly developed, 25 µm wide, scarcely distinguishable from hymenium except for absence of asci. Epithecium: brown, K-, N-, pigment not soluble in K or N. Hymenium: 125 µm tall, colourless, K+ blue. Hypothecium: 70 µm tall, colourless. Paraphyses: occasionally
Physconia thorstenii A. Crespo & Divakar (2007)
Thallus: foliose, without vegetative propagules, hairs or cilia. Lobules: common in central parts of thallus and sometimes on thalline exciple. Lower surface: mostly brown to black, sometimes white in marginal parts, attached by rhizines. Rhizines: back and squarrose when mature; immature ones sometimes white, simple. Upper cortex: present; in transverse section intermediate between paraplectenchyma and scleroplectenchyma; lower part with ±rounded lumina, upper part with elongated lumina but hyphal walls thinner than in true scleroplectenchyma Chemistry: medulla K-.
Scattered, but probably much commoner than the few records to date suggest, as it may have been overlooked as *P. distorta* or *P. venusta*. On bark at altitudes 850 - 1300 m
Southern and south-central Europe. Also Macaronesia, Asia (Saudi Arabia, Tajikistan, Afghanistan, Pakistan), N. Africa (Morocco).

Physconia venusta (Ach.) Poelt (1966)
Thallus: foliose, to 9 cm diameter, grey, blue-grey or brown, white pruinose at tips of lobes, without vegetative propagules, hairs or cilia. Lobes: elongate, 3 - 10 x 0.5 - 1.5 mm, often branched, moderately adpressed, usually not overlapping, 200 - 250 µm thick. Lobules: often abundant in central parts of thallus, around apothecia and on thalline margin, sometimes forming a distinctive "ring" around apothecia. Lower surface: mostly white, sometimes black around rhizines. Rhizines: black and squarrose when mature, 0.5 - 2 x 0.1 mm; in section: main axis formed of ±parallel agglutinated hyphae. Upper cortex: 25 - 75 µm thick, mostly colourless, sometimes brown in outermost 10 µm; in longitudinal and transverse section of hyphae with elongated lumina, hyphae with all orientations but in outer part predominantly horizontal. - K-. Medulla: white, of loosely interwoven hyphae 2.5 - 4.5 µm wide. Lower cortex: absent or poorly developed; in longitudinal section there is a broad zone with horizontal hyphae, but no compact cortex is developed. Apothecia: common, sessile, slightly concave, 0.8 mm diameter. Disc: often white pruinose. Thalline margin: present, persistent. Exciple: not visible externally. Chemistry: medulla K-., C-, KC-, P., I-; thallus K-, C-, KC-, P., UV-. Photobiont green, cells globose to subglobose, 200 - 250 µm diameter, forming a continuous, ±regular layer 30 - 70 µm thick.
The absence of a lower cortex is definitive. The dense development of lobules around the apothecia is characteristic of this species, but lobules may occur around apothecia of *P. distorta*, though not so densely, and reliance on this character alone may cause confusion.
Throughout Greece, at altitudes to at least 1500 m. Usually on bark (85% of records), sometimes on wood or overgrowing bryophytes or bark or rock. Reported from a wide range of phorophytes, but avoiding acidic bark. The lichenicolous lichens *Diplotomma pulverulentum* and *Xanthoria aphrodisae* have been recorded from this host.
Southern and south-central Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America are said to be incorrect.

Piccola A. Massal. (1856)
Misc. Lichenol. 41. Type: *P. crocea* (Spreng.) A. Massal., the only species originally included. Family: *Acarosporaceae*. Literature: There is no monograph. For the only European species, see below.
Seven species, all but one of which are tropical.

**Piccola ochrophora** (Nyl.) Hafellner (2004)


Very scattered, with no clear pattern but never very far from the sea. On bark at altitudes 5 - 1200 m. Phorophytes explicitly reported include Abies cephalonica, Olea europaea and Pyrus spinosa.

Fairly widely distributed in ±humid parts of Europe but nowhere common. Also Macaronesia, Asia (Turkey, Iran, southern Siberia, Tajikistan), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile).

**Placidiopsis Beltr.** (1858)


Literature: Breuss (1996b) is a monograph. More convenient starting points for English speakers are Clauzade & Roux (1985), and Nimis & Martellos (2004).

The genus is easily recognised by its distinctly squamulose thallus and perithecia with 1-septate ascospores. About 15 species, most of which are saxicolous or terricolous. Eleven are present in Europe. The genus is poorly represented and uncommon in Greece.

11 On rock. (P. cavicola)
1 On soil, bryophytes or plant remains.
22 Exciple ±brown throughout (in mature perithecia).
33 Rhizoidal hyphae colourless to pale brown. Ascospores 14 - 20 µm long. **P. custnani**
3 Rhizoidal hyphae brown. Ascospores 22 - 28 µm long. (P. cinereoides)
2 Exciple only dark around ostiole, elsewhere ±colourless.
33 Squamules 0.5 - 5 mm diameter, pale grey, pale brown or green-yellow. Perithecia not bulging lower side of squamules. **P. tenella**
3 Squamules 0.15 - 0.35 mm diameter, green-grey to brownish. Perithecia ±bulging lower side of squamules. **P. cinerascens**

**Placidiopsis cinerascens** (Nyl.) Breuss (1985)


Most reports are from the islands of the southern Aegean, including Crete, and the adjacent mainland, but also reported for Corfu. On calcareous soil at altitudes 15 - 1000 m.

Southern and south-central Europe. Also Asia (Syria, Israel, Kirgizstan, Mongolia), N. Africa (Morocco), N. America (DC, California), C. America (Mexico).

**Placidiopsis custnani** (A. Massal.) Körb. (1863)
Parerga Lichenol. 305; Placidium custnani A. Massal. (1856), Lotos 6: 78.

The epithet is derived from the name of a town, Custnano, not a person, so Massalongo's spelling must be retained.

Thallus: squamulose, to 1.5 cm diameter, grey, not pruinose, without vegetative propagules. Squamules: adpressed to ascending, flat when adpressed, sometimes overlapping, 0.3 - 2 mm wide. Lower surface: white to pale brown where visible, with pale brown rhizoidal hyphae. Prothallus: absent. Perithecia: abundant, laminal, black; in section: 100% immersed, 250 µm tall, 210 µm wide, ±globose. Exciple: 30 µm wide, pale brown everywhere, formed of cells elongated parallel to wall of perithecium, cells 7 - 10 x 4 - 5 µm. Involucrellum: absent. Paraphyses: disappearing early. Periphyses: abundant in upper part of perithecia. Ascii: ±cylindrical. Ascospores: colourless, 1-septate when mature), 18 x 5 µm 8 per ascus. Photobiont: green.

Fairly easily recognised by the combination of a brown exciple and rather pale rhizoidal hyphae.

Rare and scattered, in the southern half of Greece. On calcareous soil at altitudes 100 - 900 m.

Scattered from southern Europe to Finland: the pattern is hard to interpret. Also western Asia (Turkey), N. Africa (Morocco).

**Placidiopsis tenella** (Nyl.) Zahlbr. (1921)
Perhaps a synonym of *P. cinerascens*.

Thallus: squamulose, to 2.5 cm diameter, grey to white-brown, usually not pruinose, without vegetative propagules. Squamules: 0.5 - 1.5 mm diameter, usually strongly adpressed, separated to contiguous, not overlapping, 200 - 300 µm thick. Lower surface: usually not visible, brown where visible. Perithecia: 1 - 3 per squamule, 0.1 mm diameter, brown to dark brown; in section: 75 - 100% immersed (when mature), 210 - 270 µm tall, 230 µm wide. Exciple: mostly colourless, brown in uppermost part only, cellular, cells 12 x 6 µm. Lower surface: usually not visible, brown where visible. Perithecia: 1 - 3 per squamule, 0.1 mm diameter, brown to dark brown; in section: 75 - 100% immersed (when mature), 210 - 270 µm tall, 230 µm wide. Exciple: mostly colourless, brown in uppermost part only, cellular, cells 12 x 6 µm. Involucrellum: absent. Paraphyses: disappearing early. Asci: 50 x 13 µm, ±cylindrical. Ascospores: colourless, 1-septate, usually ellipsoid, occasionally pyriform, 17 x 7 - 8 µm, 8 per ascus. Photobiont: green.

Easily recognised by the mostly pale exciple and the fairly large squamules.

Rare and scattered in the southern half of Greece, never far from the sea. On soil at altitudes 0 - 500 m. Circum-Mediterranean. Iberian Peninsula to European Turkey. Also western Asia (Turkey, Syria), N. Africa (Morocco, Algeria).

**Placidium A. Massal. (1855)**


Literature: The best starting point for southern Europe is Prieto et al. (2010). Breuss (1990) treats many species, under *Catapyrenium*.


Generic delimitations in squamulose Verrucariaceae are in a state of flux. As delimited here, *Placidium* is fairly easily recognised by the ±adpressed, fairly large squamules with a very thick upper cortex, conventional perithecia and simple ascospores. *Heteroplacidium* has much smaller squamules. *Catapyrenium* has a thinner cortex. Species with clavate, rather than cylindrical asci are sometimes placed in *Clavascidium*, but that genus is not accepted here.

About 32 species, 17 in Europe, on a wide range of substrates. Many are reliably reported for Greece, but except for *P. squamulosum* they are uncommon.

1 Lower surface of squamules with rhizines.
   22 Pycnidia marginal. Medulla of distinct hyphae. Ascospores 13 - 22 x 7 - 12 µm. **P. semaforonense**
   2 Pycnidia laminal. Medulla of globose cells. Ascospores 12 - 19 x 6 - 9.5 µm. **P. lacinulatum**
1 Lower surface without rhizines.
   22 Margins of (at least young) squamules with fine hairs. **P. pilosellum**
   2 Margins of squamules without hairs.
   33 Pycnidia marginal (only), appearing as ±globular, dark knobs at edge of squamules.
      44 Cells of lower cortex arranged in rows perpendicular to surface. Conidia 5 - 7 µm long. **P. lachneum**
      5 Squamules medium brown to dark brown, 2 - 7 (10) mm wide, usually becoming thicker at margins. **P. adami-borosi**
   4 Cells of lower cortex not arranged in rows perpendicular to surface. Conidia 3 - 5 µm long.
      55 Conidia bacilliform, 1 - 1.5 µm wide. **P. subrufescens**
      5 Conidia oblong or ellipsoid, 1.5 - 2 µm wide. **P. rufescens**
   5 Conidia of distinct hyphae. (P. velebiticum), immersed, mouths showing as dark dots on thallus surface; or pycnidia absent.
      44 Medulla of distinct hyphae. (P. velebiticum)
      4 Medulla mostly of globose cells.
   5 Squamules with black rim. Lower surface black up to margin. On calcareous rock. **P. boccanum**
   5 Squamules without black rim, at least when young. Lower surface pale at margin, brown (not usually black) further in. On soil.
      66 Conidia bacilliform, 4 - 6 x 1 - 1.5 µm. (P. fingens)
      6 Conidia ellipsoid, oblong-ellipsoid, or subcylindrical, 2.5 - 4 x 1.3 - 2 µm. **P. squamulosum**
Placidium adami-borosi Szatala (1956)

Descriptions: Breuss (1990) as *Catapyrenium adami-borosi*; Nimis & Martellos (2004); Prieto et al. (2010).

Southern and south-central Europe. Also central Asia (Tajikistan).

Placidium boccanum (Servit) Breuss (1996)

Thallus: squamulose, without vegetative propagules. Squamules: 2 x 1.5 mm, mostly brown, often black at margins, not pruinose, usually slightly adpressed, sometimes overlapping, slightly concave to flat, 420 - 600 µm thick. Lower surface: black, even at margins. Rhizines: absent. Rhizoidal hyphae: sometimes present, ±colourless, 5 - 7 µm wide. Cortex: 100 µm thick, mostly colourless, sometimes brown in outermost 10 - 15 µm, cellular; cells isodiametric or slightly elongated vertically, 8 - 15 µm wide. Lower cortex: present, not delimited from medulla, brown near surface, colourless in inner part, cellular; cells in medulla. Medulla: white; in section of subrounded cells 8 - 14 µm wide. Perithecia: laminal, black, 0.1 mm diameter; in section: 100% immersed, ±pyriform, 330 µm tall, 230 µm wide. Exciple: brown near ostiole, colourless elsewhere. Involucrellum: absent. Asci: 60 - 80 x 17 - 20 µm, ±cylindrical to narrowly clavate. Ascospores: colourless, simple, ellipsoid, 12 - 15 x 5 - 7 µm, sometimes ±uniseriate. Photobiont: green, cells globose, 10 - 12 µm diameter, forming a continuous, regular layer 100 - 120 µm thick.

Similar to *P. squamulosum*, but saxicolous and with black-margined squamules.

Known from a single site in the Peloponnese, on limestone at an altitude of 1300 m.

Mediterranean Europe and the Atlantic margin to as far north as SW England. Also western Asia (Turkey).

Placidium imbecillum (Breuss) Breuss (1996)

Descriptions: Breuss (1990) as *Catapyrenium imbecillum*; Nimis & Martellos (2004); Prieto et al. (2010).

Chios and Crete, on soil or rock at altitudes 15 - 750 m. Abbott (2009) believed the species to be subalpine, and so did not accept the only Greek report then published. However, Prieto et al. (2010) note that it also occurs in lowland localities in the Mediterranean, e.g. Balearic Is.

Southern Europe, from Portugal to Greece, and the Alps. Also Asia (Turkey), N. Africa (Morocco), perhaps N. America (Oregon).

Placidium lachneum (Ach.) de Lesd. (1932)

Descriptions: Breuss (1990) as *Catapyrenium lachneum*; Nash et al. (2002); Nimis & Martellos (2004); Prieto et al. (2010); Smith et al. (2009).

Scattered, with no clear pattern, at altitudes 0 - 2100 m. Terricolous. Reports from below 1000 m altitude (i.e. most of the reports) are likely to be incorrect, as this species is usually montane. In Spain it occurs above 1200 m according to Prieto et al. (2010).

Throughout central and northern Europe except for truly arctic regions; in the south uncommon and generally montane. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread north of the equator), N. America (widespread), perhaps S. America (Venezuela). Reports for elsewhere are doubtful or definitely incorrect.

Placidium lacinulatum (Ach.) Breuss (1996)

The nomenclature is confused. The name *Placidium rufescens* var. *trapeziforme* A. Massal., *Sched. Crit.* 114, appears, at first sight, to be a superfluous name for *Endocarpon pusillum* var. *hedwigi* Schae., which is itself a superfluous name for *Endocarpon pusillum* Hedw. However, on page 100 Massalongo clearly indicated that he considered Hedwig's name to be a synonym of *Placidium michelii*. (He referred to a Figure in Hedwig's work that Hedwig annotated as *Endocarpon pusillum*, although Massalongo used the name *Lichen pusillus* when referring to it.) Massalongo must therefore be regarded as excluding, by implication, the type of Hedwig's name from *Placidium rufescens* var. *trapeziforme* A. Massal. Massalongo's name is thus the legitimate name of a new taxon. Breuss (1990: 92), who had seen the type, regarded Massalongo's name as a synonym of *Catapyrenium lacinulatum*. 

7 Squamules 0.7 - 2 mm wide. Not common, and restricted to distinctly dry, warm areas. *P. tenellum*
The epithet *lacinulatum* has priority at the rank of species only from 1990. The correct name for the present species is thus *Placidium trapeziforme* (A. Massal.) J. Steiner (1894), *Denkschr. Akad. Wiss., Math.-Nat. Kl.* 61: 320, as *trapeziforme*. Steiner’s combination may have been overlooked, and presumed to be a later homonym of *P. trapeziforme* (J. König) Arnold (1885), *Flora* 68: 64, but Arnold’s name was merely cited in the synonymy of *P. rufescens*, and is not validly published.

The name *Placidium lacinulatum* is not very well established, and it may be better to adopt the correct name, *P. trapeziforme*, than to resort to conservation.

Descriptions: Breuss (1990) as *Catapyrenium lacinulatum*; Nash et al. (2002); Nimis & Martellos (2004); Prieto et al. (2010).

Scattered in the southern half of Greece, with no clear pattern. On rock at altitudes 100 - 700 m.

Scattered rather thinly throughout Europe, from the Mediterranean to Sweden and Greenland. Also Macaronesia, Asia (Turkey, Iran), Africa (Morocco, Egypt, perhaps elsewhere), N. America (widespread), Caribbean (Bahamas, DR, PR), C. America (Mexico), S. America (Brazil), Australasia (scattered in Australia). The pattern is hard to interpret; perhaps many reports are unreliable, or more than one taxon is involved.

**Placidium pilosellum** (Breuss) Breuss (1996)

Descriptions: Breuss (1990) as *Catapyrenium pilosellum*, Nash et al. (2002); Nimis & Martellos (2004); Prieta et al. (2010); Smith et al. (2009).

Scattered, in the Aegean islands, including Crete, and adjacent parts of the mainland. On soil or limestone at altitudes 0 - 1300 m.

Widespread as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Iran, perhaps elsewhere), N. Africa (Morocco, Algeria), N. America (widespread in western half), C. America (Mexico), S. America (Argentina, Bolivia), Australasia (widespread in Australia).

**Placidium rufescens** (Ach.) A. Massal. (1856)

Descriptions: Breuss (1990) as *Catapyrenium rufescens*; Nash et al. (2002); Nimis & Martellos (2004); Prieto et al. (2010); Smith et al. (2009).

Scattered, with no clear pattern. On soil or calcareous rock at altitudes 20 - 1225 m.

Throughout Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread in USA), perhaps C. America.

**Placidium semaforonense** (Breuss) Breuss (1996)

Descriptions: Breuss (1990) as *Catapyrenium semaforonense*; Nimis & Martellos (2004); Prieto et al. (2010).

Islands of the southern Aegean, at altitudes 80 - 350 m. Usually on soil, sometimes on rock.

Southern Europe, from Portugal to Cyprus. Also Macaronesia, Asia (widespread to as far east as Afghanistan), Africa (Morocco, Tunisia, Socotra, S. Africa).

**Placidium squamulosum** (Ach.) Breuss (1996)
*Annln Naturhist. Mus. Wien* 98B (Suppl.): 39; *Endocarpon squamulosum* Ach. (1803), *Methodus* 126; *Catapyrenium squamulosum* (Ach.) Breuss; *Dermatocarpon hepaticum* auct. mult.; (?) *Dermatocarpon trapeziforme* auct. graec.; (?) *Placidium hepaticum* auct. graec.

Thallus: squamulose, usually brown to dark brown, rarely pale brown or pale grey, usually not pruinose, without vegetative propagules. Squamules: 1 - 4 mm diameter, rounded, usually adpressed, discrete to overlapping, slightly concave to slightly convex. Lower surface: pale at margins, brown to black in centre. Prothallus: absent. Rhizines: absent. Rhizoidal hyphae: colourless to pale brown, 30 - 115 x 5 μm. Cortex: 25 - 80 μm thick, colourless in inner part, pale brown to dark brown in outer part, cellular; cells subangular to almost square, 5 - 15 μm wide. Lower cortex: 30 μm thick, dark brown, cellular. Medulla: white, 80 - 150 μm thick. Perithecia: black, laminal, 0.1 - 0.25 mm wide; in section: 75 - 100% immersed, pyriform, (120) 300 - 700 μm tall, (115) 160 - 600 μm wide. Exciple: continuous below, mostly colourless to pale brown, dark brown to black only near ostiole, 25 - 100 μm wide, formed of hymphae or very elongated cells parallel to walls (but in uppermost part extending upwards towards ostiole). Involucrellum: absent. Paraphyses: disappearing early, but hamathecium often with branched or anastomosed pseudoparaphyses. Asci: ± cylindrical. Ascospores: colourless, simple, ellipsoid, 10 - 15 x 4 - 7 (9) μm, 8 per ascus, usually uniseriate. Pycnidia: often present, laminal, black, 0.07 - 0.12 mm diameter. Conidia: colourless, 1-septate, 4 x 3 μm, surface slightly warted (x400). Photobiont: green, cells globose, 4 - 8 μm diameter. Photobiont layer: 80 μm thick, sometimes regular,
sometimes with broad (10 - 30 \( \mu \mathrm{m} \) wide) columns of algal cells.

This is the only common species of the genus in Greece. It can generally be recognised by its erhizinate lower surface, laminal pycnidia and terricolous habit.  \textit{P. boccanum} is similar but occurs on calcarceous rock. \textit{P. tenellum} has much smaller squamules. When pycnidia are absent it can not be separated from \textit{P. fingens} (not reported for Greece), and may be difficult to separate from some other species.

Throughout Greece, but commoner in the southern half. At all altitudes. Usually on soil, especially calcareous soil, occasionally overgrowing bryophytes on soil. Old reports from rock may refer to other species.

Subcosmopolitan outside the humid tropics and truly arctic regions.

**Placodium subrufescens** (Breuss) Breuss (1996)


Scattered, with no pattern. On limestone at altitudes 0 - 700 m.

Described from Tenerife, and otherwise known only from Spain and Greece.

**Placodium tenellum** (Breuss) Breuss (1996)


Islands of the southern Aegean, including Crete, at altitudes 25 - 700 m. Usually on non-calcareous soil, but there is a single report from calcareous rock.

Southern and south-central Europe. Also Macaronesia, Asia (Turkey, Iran, Afghanistan, Mongolia), Africa (Morocco, Tunisia, S. Africa).

**Placocarpus Trevis.** (1860)


Literature: Gueidan et al. (2009) discuss its phylogeny.

Differs from \textit{Verrucaria} in having a much thicker thallus. Differs from the other subsquamulose genera in being initially parasitic on \textit{Protoparmeliopsis muralis}.

Five species, two of which occur in Europe. Only one is likely to occur in Greece.

**Placocarpus schaereri** (Fr.) Breuss (1985)


Thallus: areolate to subsquamulose, to several cm diameter, pale grey, sometimes black at margins of areoles, strongly blue-white pruinose, 500 - 700 \( \mu \mathrm{m} \) thick, without vegetative propagules. Areoles: contiguous but separated by deep cracks, often with internal network of partial cracks, rounded to angular, flat to slightly convex, 0.5 - 4 mm wide. Cortex: 15 - 25 \( \mu \mathrm{m} \) thick, usually brown, without distinct structure or sometimes obscurely cellular, K-, pigment not soluble in K. Medulla: white. Perithecia: black, often white pruinose around ostiole, 0.15 mm diameter; in section: 90 - 100\% immersed, slightly pyriform but with flat top, 500 \( \mu \mathrm{m} \) tall, 430 \( \mu \mathrm{m} \) wide. Exciple: colourless in lower part, dark brown in upper part, 20 - 25 \( \mu \mathrm{m} \) wide in lower part, broadening to 40 \( \mu \mathrm{m} \) in upper part; in section transverse to wall appearing hyphal, hyphae with elongated lumina; when viewed from outside peritheciurn (i.e. normal to wall) often appearing cellular. Involucrellum: absent. Paraphyses: disappearing early. Ascii: 75 x 32 \( \mu \mathrm{m} \), broadly clavate, wall often with two distinct layers; wall KI+ faintly blue, but without apical structures, contents of asci often KI+ orange-brown especially in immature asci. Ascospores: colourless, simple, narrowly ellipsoid, 20 - 27 x 7 - 12 \( \mu \mathrm{m} \), 8 per ascus. Chemistry: medulla K-, C-, KC-, P-, I+ greyish (not blue); thallus K-, C-, KC-, P-, UV-.. Photobiont: green, cells globose, 8 - 12 \( \mu \mathrm{m} \) diameter. Photobiont layer: moderately regular, ±continuous except at perithecia, 70 - 120 \( \mu \mathrm{m} \) thick.

Fairly easily recognised, even when not parasitic, by the combination of thick, pale coloured, strongly pruinose, subsquamulose areoles, and the rather large ascospores. \textit{Placopyrenium canellum} is similar but has smaller areoles, not exceeding 1 (2) \( \mu \mathrm{m} \) diameter, and when young is parasitic on \textit{Circinaria calcarea}.

Scattered, with no clear pattern, at altitudes 0 - 1400 m. On limestone or parasitic on \textit{Protoparmeliopsis muralis} on calcareous rock.

Southern and central Europe, to as far north as Belgium. Also Asia (widespread as far east as Tajikistan), N. Africa.
(Morocco, Algeria, Tunisia). Reports for N. America are incorrect.

**Placolecis Trevis.** (1857)


Literature: The genus is rarely discussed in the literature. For the only species, see Clauzade & Roux (1985), or Wasser & Nevo (2005).

Distinguishes from *Catillaria* in the placodioid growth form and the pigmented medulla.

**Placolecis opaca** (Dufour) Hafellner (1984)


Thallus: placodioid, to 5 cm diameter, central parts sometimes warded, brown, sometimes dark brown at tips of marginal lobes, not pruinose, central parts to 450 µm thick (thicker when warded). Marginal lobes: 0.5 - 1.7 (7.0) x 0.3 - 0.7 mm, adpressed, usually not overlapping, flat to convex, often much branched, branching generally dichotomous, sometimes palmate near tips. Cortex: 20 - 35 µm tall, pale brown to brown in outer 7 - 10 µm, colourless in inner part, distinctly cellular; cells subrounded, 5 - 7 µm wide. Lower cortex: absent, though upper cortex sometimes extends a short way round tips of marginal lobes. Medulla: upper half distinctly orange, lower half generally with much less pigment and appearing white to pale orange. Apothecia: not very common, sessile, flat to slightly convex, 0.25 - 1.2 mm diameter, not pruinose. Disc: black, sometimes slightly shiny. Thalline margin: usually absent. Exciple: black, sometimes slightly shiny when young, persistent; in section: 60 - 80 µm wide, brown to dark brown in outer part, colourless to very pale brown in inner part, formed of radiating hyphae with very broad and robust lumina and appearing cellular; cells 5 - 10 x 5 - 8 µm; pigment mostly K-, sometimes slightly K+ reddish in a few places, N, pigment not soluble in K, pigment between hyphae (but not pigment within apical cell of hyphae) soluble in N. Epithecium: brown to dark brown, K-, N-, pigment between paraphyses dissolving in N but not in K. Hymenium: 40 - 65 µm tall, colourless, KI+ blue. Hypothecium: about 50 µm tall but not clearly delimited from medulla, pale brown to pale orange-brown. Paraphyses: 1.5 µm wide at base, 4 - 5 µm at apex, capitulate, sometimes slightly moniliform, apical cell with internal pigment cap, often with visible septa; pigment K-, N-, not soluble in K or N. Ascii: 40 x 10 - 11 µm, narrowly clavate, *Catillaria* type. Ascospores: colourless, 1-septate, ellipsoid, 10 - 12 x 5 - 7 µm, 8 per ascus. Pyecnidia: often abundant, black, 0.1 - 0.2 mm diameter; in section: 50 - 90% immersed, 160 - 200 µm tall, 125 - 190 µm wide, colourless except for an orange-brown layer which is sometimes present at surface. Conidia: colourless, bacilliform, straight, 3 - 6 x 0.75 µm. Chemistry: medulla C+ red, K+ strongly purple-red, P-, I-; thallus UV-. Photobiont: green, cells globose, 7 - 12 µm diameter, forming a continuous, regular layer 35 - 40 µm thick.

The understated elegance of this distinctive, but rather uncommon species makes it very easy to recognise, even when sterile. Among Mediterranean lichens it is the author's favourite.

Scattered, with no clear pattern. On calcareous rock at altitudes 0 - 1000 m, but usually below 600 m.

Predominantly southern Europe, though it has been recorded as far north as Belgium. Also Macaronesia, Asia (Turkey, Israel, southern Siberia, Rajasthan), Africa (Algeria, Tunisia, Socotra).

**Placopyrenium Breuss** (1987)


Literature: Information is scattered. *Krzewicka* (2012) is probably the best starting point. For phylogeny see Gueidan et al. (2009).

Distinguished from *Verrucaria* by its much better developed thallus, and from other areolate-subsquamulose genera of *Verrucariaceae* by the form of its areoles, which are attached by a central stipe.

Seventeen species, most of which are not very well known. They are saxicolous, but often lichenicolous when young. Nine species occur in Europe. The genus is uncommon in Greece.


22 Mature ascospores mostly 1-septate. *P. bucekii* var. *bucekii*

2 Mature ascospore mostly 3-septate. (P. bucekii var. trisepatum)

1 Marginal lobes not elongate and divided. On various substrates.

222 Thallus squamulose. Squamules 4 - 15 mm wide. On weakly calcareous or non-calcareous substrates. Ascospores 13 - 18 x 5 - 7 µm. *P. trachyticum*
22 Thallus areolate-subsquamulose. Most ascospores more than 20 µm long.
33 Squamules to 1 (2) mm wide. Parasitic on Circinaria calcarea when young. Ascospores 17.5 - 26.5 x 7.5 - 9.5 µm. **P. canellum**
3 Squamules to 4 mm wide. Parasitic on Protoparmeliopsis muralis when young. Ascospores 18 - 25 x 6 - 10 µm. See Placocarpus schareri
2 Thallus areolate. Most ascospores less than 20 µm long.
33 Parasitic on Aspicilia calcitrapa. Ascospores 16.5 - 22 x 7.5 - 10.5 µm. (P. breussii)
3 On calcareous rock; not parasitic on Aspicilia calcitrapa.
44 Areoles with distinct black base, not stipitate. Ascospores 13 - 17 x 5 - 6.5 µm. **P. fuscellum**
4 Areoles without black base, but base with black stripes in places. Thallus of stipitate areoles. Ascospores 15 - 18 x 6.5 - 7.5 µm. (P. bullatum)

**Placopyrenium bucekii** (Nàdv. & Servít) Breuss (1987)
Rare and scattered in the southern half of Greece, on calcareous or siliceous rock at altitudes 250 - 600 m. This is usually a species of siliceous rock, and the single report from calcareous rock may be unreliable.
Southern and south-central Europe. Also Macaronesia, Asia (Turkey, Israel, Iran, Armenia), and, surprisingly, S. America (Argentina).

**Placopyrenium canellum** (Nyl.) Gueidan & Cl. Roux (2007)
Islands of the southern Aegean, including Crete, and adjacent parts of the mainland, at altitudes 0 - 1000 m. Usually parasitic on species of *Aspicilia* s. lat. especially *Circinaria calcarea*, less commonly directly on limestone.
Widespread in Europe to as far north as southern Sweden. Perhaps also N. America.

**Placopyrenium fuscellum** (Turner) Gueidan & Cl. Roux (2007)
Scattered, rather thinly, throughout Greece. On calcareous rock (two thirds of records) or parasitic on lichens on calcareous rock, at altitudes 10 - 1400 m. Reported hosts are: *Caloplaca chalybaea*, *Caloplaca variabilis* and *Circinaria calcarea*.
Widespread in Europe to about the Arctic Circle. Also Macaronesia, Asia (widespread), Malesia (Christmas Is), Africa (Morocco, perhaps St Helena - determination tentative), N. America (widespread), C. America (Mexico), Australasia (Australia). Reports for Pacific (Cook Is) are tentative and may refer to a different taxon.

**Placopyrenium trachyticum** (Hazsl.) Breuss (1987)
Scattered, mainly in the southern half of Greece. Not common. On calcareous or siliceous rock at altitudes 30 - 1000 m.
Southern and central Europe to at least as far north as Belgium. Also Asia (Turkey, southern Siberia, Mongolia, HK), Australasia (NSW).
Placynthiella Elenkin (1909)


Literature: The best starting point for the European species is Smith et al. (2009).
About 6 species, usually on moist, acidic substrates such as rotting bark or wood, or decaying vegetation, and so uncommon in Greece.

11 Thallus minutely granular-isidiate, coralloid or ±subgelatinous. Granules less than 100 µm diameter.
22 Thallus C+ red (Note 1), of isidiate to minutely coralloid-elongate granules, not subgelatinous. Exciple ±persistent. Disc flat or slightly convex. P. icmalea
2 Thallus C-, of rounded, never elongated, granules, ±subgelatinous. Exciple soon excluded. Disc soon convex. P. uliginosa
1 Thallus granular-warted. Granules 100 - 300 µm diameter. (P. oligotropha)

(1) Best tested in a squash preparation.

Lichenologist 16(3): 244; Lecidea icmalea Ach. (1808), K. Vet.. Akad. Nya Handl. 29(4): 267; Lecidea fuliginea Ach., nom. superfl.; Lecidea humosa f. fuliginea (Fr.) Vain.; Lecidea humosa var. fuliginea (Fr.) Szatala, nom. superfl.

Thallus: entirely isidiate, forming small patches to about 1 cm diameter. Isidia: dark brown, cylindrical to coralloid, 0.1 x 0.03 mm. Apothecia: usually absent. Chemistry: thallus C+ red (in squash preparation).
The small, brown isidia reacting C+ red are distinctive.
Scattered throughout Greece, but not common, on bark, rock or wood, at altitudes 500 - 1800 m. This is an inconspicuous species and may be under-reported.
Almost throughout Europe, but uncommon south of the Alps and probably confined to the uplands. Also Macaronesia, Asia (widespread), perhaps Malesia (PNG), N. America (widespread), Caribbeand (DR), C. America (Mexico), S. America (Argentina, Brazil, Bolivia, Colombia), Australasia (eastern Australia), Antarctica (widespread).

Placynthiella uliginosa (Schrad.) Coppins & P. James (1984)

Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).
NW Greece and Ikaria, on bark at altitudes around 800 m.
Widespread from the Alps northwards; rare south of the Alps. Also Macaronesia, Asia (widespread), N. America (widespread), perhaps C. America (CR), S. America (widespread), Australasia (SE Australia, NZN, NZS).

Placynthium (Ach.) Gray (1821)


Literature: Information is rather scattered. Ahti et al. (2007), Burgaz (2011), Clauzade & Roux (1985), and Smith et al. (2009) are all helpful.
Thallus: crustose, dark brown, sometimes with marginal lobes. Hypothallus often present, though sometimes only apparent in section, black. Apothecia: sessile, rather small (0.3 - 0.6 mm diameter). Epithecium, and sometimes also upper part of hymenium, with a distinctive blue pigment. Asci with small KI+ blue central plug (Peltigera type). Ascospores colourless, 1- to multi-septate, small to medium sized. Chemistry: lichen substances said to be absent. Photobiont: blue-green, not Nostoc.
About 21 species, of which 20 occur in Europe; they usually occur on rock. Many of the European species are distinctly northern, only 6 species have been reported for Greece, 4 of them are rare and 3 are confined to Mt. Olympus. The genus has never been properly monographed, and there are unresolved taxonomic problems.
Sterile collections can not be determined with certainty but most will belong to P. nigrum.

11 Cortex without obvious structure. Ascospores 3 - 7-septate, 25 - 35 µm long. Thallus without marginal lobes. P. caesium
1 Cortex distinctly cellular. Ascospores various. Thallus with or without marginal lobes.
22 Ascospores 3 - 7-septate, 23 - 53 µm long. (P. garovaglii)
2 Ascospores 1 - 3-septate, generally less than 30 µm long.
33 Thallus with distinctly elongated marginal lobes.
44 Thallus consisting entirely of branched lobes. Ascospores 1-septate. **P. filiforme**

4 Thallus lobed only at margin, the centre areolate and often decaying. Ascospores 1-3-septate. **P. filiforme**

55 Thallus with squamule-like isidia. Aquatic, or at least in seepage tracks. Ascospores 2-3-septate. (P. flabellosum)

5 Thallus without isidia. Not aquatic. On calcareous rock. Ascospores 1- or 3-septate. **P. subradiatum**

66 Ascospores 1-septate, 11-15 x 5-7 µm. Marginal lobes 0.05-0.2 mm wide. Thallus pruinose or not. **P. baumgartneri**

3 Thallus without marginal lobes, or with marginal lobes that are only weakly elongated.

44 Thallus granular or of flat areoles. Ascospores 0-1-septate, broadly ellipsoid, 10-13 x 6-8 µm. (P. tautenlae)

4 Thallus coralloid. Ascospores 1-3-septate, narrowly ellipsoid, 4-6 µm wide.

55 Mature ascospores 1-3-septate, 8-25 µm long. On calcareous rock. **P. tremniacum**

5 Mature ascospores 1-3-septate, 8-25 µm long. On calcareous or non-calcareous rock. **P. nigrum**

**Placynthium baumgartneri** (Zahlbr. ex Szatala) Gyeln. (1939)

Borbasia 1(3-7): 53; *Pterygium baumgartneri* Zahlbr. ex Szatala (1938) in Degen, Flora Velebitica 3: 317; *Collolechia caesia* var. **baumgartneri** (Zahlbr. ex Szatala) Szatala, nom inval.

Description: Clauzade & Roux (1985).

Mt. Olympus, on calcareous rock at altitudes 1200-1600 m.

Only France, Austria, Slovakia, Croatia and Greece. It is not clear to me whether it is a good taxon or just a morph of **P. garovaglii** (A. Massal.) Malme.

**Placynthium caesium** (Fr.) Jatta (1900)

Syll. Lich. Ital. 38; *Lecidea contigua* var. **caesia** Fr. (1831), Lichenogr. Eur. Reform. 302-303; *Collolechia caesia* (Fr.) A. Massal.

Descriptions: Ahti et al. (2007); Smith et al. (2009), both as *Collolechia caesia*.

Mt. Olympus, on calcareous rock at altitudes 700-2300 m. Although *P. caesium* has often been confused with *P. garovaglii*, these reports seem plausible as *P. caesium* is most commonly found in ±alpine habitats.

Mainly western half of central Europe, but reaching southern Scandinavia and a few mountains of southern Europe. Also western Asia (Turkey), N. Africa (Algeria). Reports for N. America may be incorrect.

**Placynthium filiforme** (Garov. ex Nyl.) M. Choisy (1951)


Mt. Olympus, on calcareous rock at about 1700 m altitude.

Central Europe, and upland areas south of the Alps. Also Asia (Turkey, Tajikistan).

**Placynthium nigrum** (Huds.) Gray (1821)


Thallus: crustose, coralloid, to 4 cm diameter; usually of elongate finger-like lobes (resembling recumbent, randomly oriented isidia), about 0.2 x 0.05 mm, but sometimes of ±rounded, ±flatted squamules to 0.3 mm diameter. "Lobes": brown to dark brown, smooth, not pruinose; in section, consisting of globose to ellipsoid clusters of photobiont cells 80-180 (300) x 75-150 µm, with a surface layer that is initially colourless but later darkens and develops a cellular appearance (presumably formed by the mycobiont, though actual hyphae are not apparent). Hypothallus: black, generally visible in most places below thallus; in section: formed of very broad (8-10 µm wide), colourless or pale blue hyphae with distinct septa; hyphae generally conglutinated and oriented horizontally. Prothallus: conspicuous all around margin of thallus, blue-black to black, 0.5-0.7 mm wide. Apothecia: often present, sessile, flat, not pruinose, (0.25) 0.3-0.55 (0.6) mm diameter. Disc: usually black, sometimes very dark brown. Thalline margin: absent. Exciple: black, smooth, usually persistent; in section: 50-100 µm wide, blue in a very thin layer near surface, elsewhere usually purple-brown to dark purple-brown, occasionally brown (no purple tinge) or colourless, purple tinge intensifying in K; distinctly cellular, cells 5-15 x 5-9 µm, usually elongated in radial direction, those in lowermost part of exciple sometimes larger and more rounded (to 20 x 15 µm); lowermost part of exciple sometimes with projecting hairs formed
from a single, colourless hypha, 15 - 40 x 5 - 7 µm. Epithecium: usually blue, sometimes colourless, pale brown, pale green or green-black; K- blue colour becoming a little fainter and duller in K. Hymenium: 55 - 120 µm tall, usually colourless in lower half, upper half often with epithelial pigment, K+ blue. Subhymenium: 25 - 50 µm tall, sometimes poorly developed, colourless to pale brown, without distinct cellular structure, sometimes with faint, fine cellular stricture on a scale of 2 - 3 µm. Hypothecium: 40 - 80 µm tall, usually purple-brown, sometimes almost black and opaque, sometimes brown or orange-brown (no purple tinge), usually with very distinct cellular structure. Paraphyses: sometimes branched, 1 - 2.5 µm wide at base, 3 - 5 µm at apex, clavate, not capitulate, not or only slightly moniliform, with distinct septa. Ascii: 37 - 50 x 11 - 12 µm, ±cylindrical to narrowly clavate, with K+ strongly blue plug in centre of apical part and K+ faintly blue wall (Peltigera type). Ascospores: colourless, mostly 3-septate when mature, some 1- and 2-septate ascospores usually also present, (10) 14 - 20 x (4) 5 - 6 µm, ends rounded, 8 per ascus. Chemistry: thallus K- in section, C- in section, UV-. Photobiont: blue-green, cells globose or subglobose, to 10 - 11 x 4 - 7 µm, not in chains or sometimes forming very short chains (7Scytonea).

Throughout Greece, but commoner in the southern half of the country. Usually on calcareous rock, rarely on calcareous soil or base-enriched siliceous rock. At altitudes 0 - 1800 m. The lichenicolous lichens Toninia diffusa and Toninia verrucarioides have been recorded from this species.

Subcosmopolitan outside the tropics.

### Placynthium subradiatum (Nyl.) Arnold (1884)


Thallus: ±crustose, dark brown, not pruinose, forming small, circular patches to 1 cm diameter, central parts dying away; margin of elongated, adpressed lobes 0.5 - 0.8 x 0.1 - 0.2 mm; in section: 55 - 75 µm thick, not stratified, but with some orange-brown pigment in top 10 - 15 µm. Hypothallus: in section: 15 - 20 µm thick, dark purple-brown to black, without obvious structure except below apothecia, where uppermost 5 - 8 µm develops a distinct cellular structure. Prothallus: absent. Apothecia: sessile, convex, 0.2 mm diam, not pruinose. Disc: black. Thalline margin: present, 25 - 50 µm wide. Exciple: poorly developed, scarcely distinguishable from hymenium. Epithecium: blue to blue-black. Hymenium: 45 - 85 µm tall, mostly colourless, sometimes with faint traces of purple-brown pigment, upper part sometimes with epithelial pigment. Hypothecium: 25 - 60 µm, colourless to pale brown, with a weak cellular structure on a scale of 2 - 5 µm. Paraphyses: 2 µm wide at base, 3 µm at apex, usually not capitulate or moniliform, with visible septa. Ascii: 35 x 12 µm, clavate. Ascospores: colourless. Photobiont: blue-green.

The small, brown, circular patches, with decaying centre are distinctive, and this lichen is not likely to be confused with any other.

Scattered thinly throughout Greece. On calcareous rock at altitudes 50 - 1400 m.

Most of Europe. Also Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), perhaps Australasia (SE Australia; reports for NZ are incorrect).

### Placynthium tremniacum (A. Massal.) Jatta (1900)


Some authors have regarded *P. tremniacum* as synonymous with *P. nigrum*.

Descriptions: Ahti et al. (2007); Burgaz (2011); Clauzade & Roux (1985); Smith et al. (2009).

Rhodes and Peloponnesse. On calcareous rock at altitudes 700 - 850 m.

Most records are scattered from the Alps to southern Scandinavia, but occasionally encountered south of the Alps. Perhaps often overlooked as *P. nigrum*. Also Macaronesia, Asia (Siberia, Tajikistan), N. Africa (Tunisia).

### Platismatia W. L. Culb. & C. F. Culb. (1868)


Literature: The two widespread European species are treated by Clauzade & Roux (1985), Smith et al. (2009), and Thell & Moberg (2011).

Differs from *Parmelia* in the absence of pseudocyphellae, the scarcity of rhizines, and the often irregular, ragged shape of the lobe margins.

Eleven species, of which four occur in Europe, but only one is likely to occur in Greece. The European species occur on a wide range of acidic substrates.

### Platismatia glauca (L.) W. L. Culb. & C. F. Culb. (1868)

**Plectocarpon Fée (1825)**


Literature: The genus was monographed by Ertz et al. (2005). *Plectocarpon* contains 40 formally described species of lichenicolous fungi. Seven species occur in Europe, but most have a strongly northern distribution and will not occur in Greece.

11 Sterile stromatic tissue not carbonised. Ascomata red-brown. On Lobaria scrobiculata. **P. scrobiculatae**

1 Sterile stromatic tissue at least partly carbonised, black and opaque in all but very thin sections. Ascomata not red-brown. On Lobaria pulverulenta. **P. lichenum**

**Plectocarpon lichenum** (Sommerf.) D. Hawksw. (1894)


Descriptions: Clauzade, Diederich & Roux (1989); Ertz et al. (2005); Nash et al. (2007).

Stereia Ellada, on *Lobaria pulverulenta* at unspecified but fairly high altitude.

Scattered throughout Europe, but in Mediterranean regions restricted by its host to upland regions. Also Macaronesia, Asia (Turkey, Russia, Japan), Africa (widespread), N. America (widespread), southern S. America (Chile). Reports for Australasia are incorrect.

**Plectocarpon scrobiculatae** Diederich & Etayo (1994)


Description: Ertz et al. (2005).

Known from two sites in Epiros, on *Lobaria scrobiculata* at altitudes 570 - 750 m.
Scattered, mainly in the western half of Europe. Also Macaronesia, Asia (Turkey), N. America (Nova Scotia).

**Pleopsidium Körb.** (1855)

Syst. Lich. Germ. 113. Type: *P. flavum* (Bellardi) Körb., the only species originally included Family: *Acarosporaceae.*

Literature: The species are treated in all the standard Floras, though sometimes under *Acarospora.*

The genus has four species, but only two occur in Europe.

11 Disc flat, distinctly darker than thallus. Surface of marginal lobes rough. *P. flavum*

1 Disc convex, concolourous with or only slightly darker than thallus. Surface of marginal lobes smooth. (P. chlorophanum)

**Pleopsidium flavum "(Bellardi) Körb."** (1855)


The correct name is *P. unicolor* (Ach.) ined., but a proposal has been made to conserve current usage.


Scattered, with no clear pattern. On siliceous rock at all altitudes.

Widespread in northern and central Europe, but in the south predominantly upland. Also Macaronesia, Asia (widespread), Malesia (Sabah), N. Africa (Morocco), N. America (widespread in western half), C. America (Mexico), perhaps S. America (Uruguay).

**Pleurosticta Petr.** (1931)


Literature: The only widespread species is treated in all the standard Floras. Differs from *Parmelia* in the upper cortex, which is brown or brown-green in colour and reacts N+ purplish, and in the absence of pseudocyphellae. The strongly crenulate thalline exciple of *Pleurosticta acatabulum* also differs from *Parmelia.*

Two species. Both occur in Europe, but one has a limited range in the Alps, Carpathians and Caucasus.

**Pleurosticta acatabulum** (Neck.) Elix & Lumbsch (1988)


Thallus: foliose, to 6 cm diameter. Lobes: 1.0 - 2.0 x 0.7 - 1.1 cm, without pseudocyphellae or vegetative propagules, 100 - 175 µm thick, ascending at margins, margins wavy. Upper surface: green-brown to brown when dry, dark oily green when wet, sometimes shiny and/or smooth at lobe margins, matt and usually wrinkled in older parts of thallus, rarely slightly white pruinose at tips of lobes. Lower surface: mostly black, often white to pale brown at margin, often with prominent raised veins, attached by rhizines. Rhizines: black, sometimes white at tips, simple, 0.15 - 0.55 x 0.03 - 0.10 mm. Upper cortex: 10 - 20 µm thick, pale brown in outer part, colourless in inner part, formed of hyphae with prominent lumina 3 - 10 x 3 µm and no preferred orientation, sometimes with many small crystals, pigment K-, N+ purplish, pigment soluble in K. Medulla: white, of loosely interwoven hyphae oriented ± parallel to long axis of lobe; hyphae 3 - 5 µm broad. Lower cortex: 10 µm thick, brown, of vertical hyphae, with swollen tips giving a ×cellular structure (best seen in K), K-, some pigment soluble in K. Apothecial exciple: usually present, sessile or shortly stalked on lobes, 1.5 - 6 mm diameter, concave, not pruinose. Disc: pale orange-brown to orange-brown, shiny. Thalline margin: present, persistent but often thin, strongly but irregularly crenulate; in section: 85 - 170 µm wide, often with two algal layers separated by medullary-like tissue; cortex 25 µm, structure as for upper cortex of thallus. Exciple: not visible externally; in section: poorly developed, 20 - 25 µm wide, colourless. Epithecium: usually pale yellow, but varying from colourless to pale orange-brown; K-, N-, pigment soluble in K; sometimes overlain by colourless, structureless layer 5 - 7 µm thick. Hymenium: 50 - 55 µm tall, colourless, sometimes pale yellow in upper part. Subhymenium: 25 µm tall, colourless, of horizontal hyphae. Hypothecium: 40 - 70 µm tall, colourless, of randomly oriented hyphae. Para-hymenium: usually simple, very robust, 3 - 6 µm wide, not (or scarcely) capitate or moniliform, with easily visible septa throughout. Asci: 50 - 55 x 17 - 26 µm, usually cylindrical initially, sometimes clavate or broadly clavate when mature, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 x 15 µm. 8 per ascus. Pycnidia: fairly common, laminal, black, 0.06 - 0.07 mm diameter; in section: 100% immersed, subglobose, 210 µm tall, 200 µm wide, colourless except around ostiole. Conidia: colourless, bacilliform, 5 - 6 x 1 µm. Chemistry: medulla K+ strongly red (norstictic acid usually abundant), C-, P+ orange (reaction sometimes faint), I-; thallus UV-.

Photobiont: green; cells globose, 10 - 15 µm.
diameter, trebouxioid. Photobiont layer: continuous, 50 - 100 µm thick (25 - 35 µm thick below apothecia). This species can not be confused with any other.

Throughout Greece. Usually on bark (95% of records), occasionally on rock, wood, or overgrowing bryophytes. Recorded from a wide range of phorophytes. At altitudes 200 - 2000 m, but commonest between 600 and 1600 m. Throughout much of Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). Reports for S. America are incorrect.

**Polyblastia A. Massal. (1852)**


Literature: There is no monograph. Clauzade & Roux (1985) and Smith et al. (2009) treat many of the European species.

The genus is not well known. On present information, about 70 species occur in Europe, but many names are probably synonyms. Most species are northern or alpine, and there are few reliable Greek records. As presently circumscribed, *Polyblastia* is not a natural group.

*P. foveolata* Arnold is not included in the key, as it is not well characterised by Arnold’s protologue.

11 On soil. Mature ascospores colourless to dark brown. *(P. rouxiana)*
1 On calcareous rock. Mature ascospores colourless.
   222 Ascospores more than 60 µm long, 1 or 2 per ascus. **P. helvetica**
   22 Ascospores 8 - 12 (18) µm long. *(P. plicata)* Greek report doubtful.
   2 Ascospores 20 - 55 µm long.
   33 Involucrellum present.
      44 Ascospores distinctly muriform. Exciple colourless to pale brown in lower part. Perithecia immersed or not, but not in well-developed pits. **P. cupularis**
   3 Involucrellum absent.
   444 Ascospores distinctly muriform, with 10 - 36 cells. **P. albida**
   44 Ascospores submuriform, with 3 - 4 transverse septa, 1 - 2 longitudinal septa, and 6 - 14 cells. **P. dermatodes**
   4 Ascospores usually 3-septate. *(P. sepulta)* Greek reports doubtful.

**Polyblastia albida Arnold (1858)**
*Flora 41: 551 (as '251'); Polyblastia obsoleta Arnold; Thelidium abscenditum f. minusculum Zschacke.*

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Mt. Olympus on calcareous rock at alpine levels. A report for Evia at about 1000 m altitude is doubtful.

Mostly central and northern Europe, very rare south of the Alps. Also Asia (Turkey, Syria, southern Siberia), N. Africa (Morocco, Algeria), N. America (widespread in Canada).

**Polyblastia cupularis A. Massal. (1852)**


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Mt. Olympus, on calcareous rock at an altitude of 2600 m.

Mostly central and northern Europe, very rare south of the Alps. Also Asia (widespread), N. America (widespread), Australasia (Victoria). Reports for hot countries (e.g. Thailand, Brazil) are almost certainly incorrect.

**Polyblastia dermatodes A. Massal. (1855)**

Symm. lich. nov. 101-102

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Skyros, on calcareous rock at an altitude of 225 m. In Europe, this is usually considered to be a rather northern species, and one would expect it to occur in southern Europe only in high mountains. The collection from Skyros may belong to an undescribed species.

Mainly northern and central Europe; rare in the south. Also western Asia (Turkey), N. Africa (Algeria), Australasia (NSW, Tasmania).
Polyblastia foveolata Arnold (1887)

Flora 70: 149.

Description: See the protologue.

Known only from the type collection on Corfu, where it occurred close to sea level on an unspecified substrate. It is unlikely that it belongs in Polyblastia.

Polyblastia helvetica Rostrup (1871)


Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Known from a single site in Epiros, at an altitude of 1100 m. The substrate was not reported.

Widespread in central and northern Europe, but very rare south of the Alps. Also Asia (southern Siberia).

Polychidium (Ach.) Gray (1821)


Literature: Burgaz (2011) and Smith et al. (2009) treat the European species.

Four species, two of which occur in Europe. One of them is strongly oceanic and will not occur in Greece.

Polychidium muscicola (Sw.) Gray (1821)


The small, dark brown, richly-branched, cushion-forming, fruticose thallus is distinctive. Some species of Scytinium may appear small-fruticose, owing to isidia, marginal lacerations, or narrow elongated lobes, but close examination will reveal some distinct lobes.

Scattered on the mainland, usually overgrowing bryophytes on siliceous rock, but reported once from bark. At altitudes 500 - 1450 m. This species is small and inconspicuous, so may be more common than records suggest.

Widespread in the west of Europe, but in Mediterranean regions restricted to the uplands. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, Algeria, Tunisia, Kenya), N. America (widespread), perhaps C. America, Pacific (Hawaii).

Polycoccum Saut. ex Körb. (1865)

Parerga 470. Type: P. sauteri Körb., the only species originally included. Family: Polycoccaceae.

Literature: The genus was monographed by Hawksworth & Diederich (1988), but there have been many changes since then and there is no recent summary. The species of the Iberian Peninsula are monographed in Atienza, Calatayud & Hawksworth (2003). A few other European species are discussed in Calatayud & Rambold (1998), Etayo & Diederich (1998), and Hawksworth (1994).

About 60 species of lichenicolous fungi, of which 34 have been reported for Europe. There are few Greek records.

1 Fungus modifying thallus of host, never present in ascoma of host. Asci usually 8-spored.

22 Mycelium brown, clearly visible on thallus of host (Note 1). Ascospores with a perispore. P. kernerii

2 Without visible mycelium. Ascospores without a perispore.

33 Asci with 4 - 6 ascospores. (P. clauzadei), (P. epizoharyi)

3 Asci usually with 8 ascospores.

44 Most ascospores less than 12 µm long (9.5 - 12.5 x 4 - 5 µm). On Rinodina. (P. ibericum)

4 Most ascospores more than 12 µm long.

55555 On Acarospora cervina. (P. acarosporica)

555 On Aspicilia cinerea. (P. aksoyi)

555 On Cladonia. (P. cladoniae), (P. microcarpum)

55 On Peltigera. (P. peltigerae)

5 On Physcia. P. pulvinatum

1 Fungus not modifying thallus of host, sometimes present in ascoma. Asci 4 or 8 spored.
22 Asci with 4 ascospores. (P. crassum), (P. microsticticum), (P. peltigerae)
2 Asci with (4) 8 ascospores.
33 Ascospores with a perispore. (P. opulentum)
3 Ascospores without a perispore.
444 Many ascospores more than 25 µm long.
55 Perithecia entirely immersed. Hymenium I-.
66 Asci almost cylindrical. On lichens on calcareous rock. (P. cartilaginosum)
6 Asci cylindrical to clavate. On Lepraria incana. (P. anatolicum)
5 Perithecia partly emergent when mature. Hymenium I+ blue. Asci long but clavate. P. marmoratum
44 Ascospores 16 - 26 µm long.
55 Ascomata mostly more than 200 µm diameter. Ascospores constricted at septum. On Caloplaca (Blastenia) ferruginea. (P. tinantii)
5 Ascomata less than 200 µm diameter. Ascospores usually not constricted at septum. On other hosts. (P. decolorans), (P. evae), (P. squamarioides)
4 Ascospores less than 18 µm long. (P. arnoldii), (Didymocyrtis bryonthae), (P. microsticticum), (P. peltigerae), (P. rubellianae)

(1) It is not clear whether superficial brown mycelium is a good character, or whether it was merely a hyphomycete fortuitously present on the type specimen (now lost). Brown mycelium is mentioned in the description of this species in Clauzade, Diederich & Roux (1989), but not in Hawksworth (1994) or Nash et al. (2004).

**Polycoccus kerneri** J. Steiner (1893)
Descriptions: Clauzade, Diederich & Roux (1989); Hawksworth (1994); Nash et al. (2004).
Attica, on _Lecidea fuscoatra_ at an altitude of about 1100 m.
Scattered, mainly in southern and central Europe, but reaching Sweden. Also Macaronesia, N. America (Arizona, California).

**Polycoccus marmoratum** (Kremp.) D. Hawksw. (1980)
Description: Clauzade, Diederich & Roux (1989).
Scattered, on Crete and the mainland, at altitudes 20 - 900 m, on limestone or parasitic on undetermined crustose lichens on limestone. Many Greek records refer to a fungus growing directly on limestone. The description of _Microthelia marmorato_ in Swinscow (1966a) indicates that this organism often grows directly on rock, and can be lichenised with _Trentepohlia_. Hawksworth (1985: 155) remarks that is is primarily lichenicolous, but can take over the photobiont cells of its host and become facultatively lichenised.
Mainly temperate Europe, though also reported for Sweden. Reports for Spain are incorrect, and the only other reports for southern Europe are those for Greece. Also Asia (Turkey, Russia, Tajikistan, Mongolia).

**Polycoccus pulvinatum** (Eitner) R. Sant. (1993)
Known from a single site in Epiros, on _Physcia leptalea_ at an altitude of 900 m.
Probably throughout Europe. Also Macaronesia, Asia (Turkey, Iran, Russia, India), Malesia (Malaysia, Java), N. America (Alaska, Quebec, California), C. America (Mexico), S. America (Chile, Peru), Australasia (widespread in NZ).

**Polysporina Věžda** (1978)

Literature: Kantvilas (1998) is a good introduction to the genus. Clauzade & Roux (1985), and Smith et al. (2009) are also helpful.

Species concepts in this genus are in need of revision, and the key below may not work well.

About 9 species. Five are European, but the genus is distinctly northern and is rare in southern Europe.
Parasitic on crustose lichens. **P. subfuscescens**
Not parasitic.

On calcareous rock.

- **P. subfuscescens**
- **P. cyclocarpa**
- **P. pusilla**
- **P. urceolata**

On non-calcareous rock.

- **P. simplex**
- **P. subfuscescens**

**Polysporina cyclocarpa** (Anzi) Vězda (1978)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Macedonia, on calcareous rock at altitudes 400 - 1800 m. Widespread in central Europe. Uncommon in northern Europe and very rare south of the Alps. Also Asia (widespread), N. Africa (Morocco). Reports for N. America are incorrect; a report for Hong Kong is not credible.

**Polysporina pusilla** (Anzi) Nimis (1993)


Scattered in the northern half of the mainland. On limestone, usually at altitudes above 1600 m. A report for sea level in Thessaly seems very doubtful to me.

Mainly central Europe. Absent from northern Europe, and rare south of the Alps. Also western Asia (Turkey, Iran), N. America (scattered).

**Polysporina simplex** "(Davies)" Vězda (1978)

Unfortunately, *Lichen simplex* Davies is a later homonym of *Lichen simplex* Roth (1788), and is illegitimate. The earliest legitimate name is *Lecidea privigna* Ach. (1803), a nomen novum for *Lichen simplex* Davies. Unfortunately, this makes all later *simplex* names at species rank superfluous and illegitimate. The correct name is *Polysporina privigna* (Ach.) ined. Conservation is required, but first it will be necessary to typify Davies's name.

Abbott (2009) listed separately *Polysporina simplex f. complicata* (Cromb.) N. S. Golubk., for which there is a single Greek report, though he expressed doubt about whether it merited formal taxonomic recognition. In the opinion (pers. comm.) of Mr. K. Knudsen, a specialist in *Acarosporaceae*, it probably does not, though he has not seen type material.

Thallus: crustose, cracked to areolate, brown, not pruinose, without vegetative propagules, 170 - 220 µm thick. Cortex: 20 - 25 µm thick, brown in uppermost 5 - 10 µm, colourless in lower part, of predominantly horizontal hyphae, brown pigment K-, not soluble in K. Medulla: poorly developed, white when visible. Apothecia: 0.5 - 0.8 mm diameter, ±rounded but irregular internally, flat, not pruinose. Disc: black, with central sterile umbo often clearly visible, usually raised above level of fertile part. Thalline margin: absent. Exciple: black, persistent, cracked and discontinuous; in section: 30 - 40 µm wide, black, opaque. Epithecium: orange-brown, K-, orange tinge vanishing in K, brown pigment not soluble in K. Hymenium: 90 - 100 µm tall, colourless. Hypothecium: 20 - 25 µm tall, colourless to pale brown. Paraphyses: anastomosed, 1 µm wide at base, 1 - 2.5 µm at apex, usually broadening gradually, rarely slightly capitate, not moniliform. Ascospores: colourless, simple, narrowly ellipsoid, 4 - 5 x 1.5 µm, many per ascus. Chemistry: medulla K-. Thallus UV-. Photobiont: green; cells globose to broadly ellipsoid, 8 - 13 x 6 - 13 µm. Photobiont layer: 50 - 130 µm thick, continuous, lower margin irregular.

Scattered, mostly around the Aegean. On rock, usually siliceous, at altitudes 10 - 1100 m.

Widespread in northern and central Europe, occasional in the south. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread), S. America (Argentina, Ecuador, Venezuela), Australasia (Western Australia, NZN, NZS).

**Polysporina subfuscescens** (Nyl.) Knudsen & Kocourk. (2008)
Linn. Normandie Sér. II 6: 308. "1872", but that was published in July 1873.
Description: Roux & Navarro-Rosín (2011).
Chios, on siliceous rock at an altitude of 420 m.
Mainly cold and temperate Europe; rare in the south. Also Macaronesia, Asia (widespread), N. America (widespread), C. America (Mexico).

Polysporina urceolata (Anzi) Brodo (1987)
Descriptions: Clauzade & Roux (1985); Kantvilas (1998); Nash et al. (2007).
Reported from two localities on the mainland, but that for the Peloponnese was from an altitude below 800 m and is doubtful. The other, for Sterea Ellada, was from limestone at about 2000 m.
Widespread in northern and central Europe; rare south of the Alps. Also Asia (Iran, Russia, Kazakhstan, Tajikistan), N. Africa (Morocco), N. America (widespread), S. America (Bolivia).

Porina Ach. (1809)


Literature: There is no good summary of the genus in southern Europe. However, only a few species are known for Greece and, between them, Smith et al. (2009) and Clauzade & Roux (1985) cover all but P. rechingeri.
Nearly 400 described species, predominantly in humid tropical and subtropical regions, though a few range as far north as the Arctic Circle. Even in Europe, where 39 species are known, it shows a marked preference for mild, humid climates, and is best developed along the Atlantic margin. The genus is rare in Greece.
The segregates Pseudosagedia and Segestria, recognised by some authors, are not taken up here.

P. rechingeri Szatala is not included in the key, as the available information is insufficient.

111 Ascospores 1-septate. On bark. See Strigula
11 Ascospores 3-septate.
222 On soil or bryophytes. (P. mammillosa)
22 On bark.
33 Perithecia externally orange to red-brown. In section, lower part of exciple colourless. (P. leptalea)
3 Perithecia externally black. Lower part of exciple colourless or not.
44 In section, lower part of exciple usually with at least some pigment (pale brown to dark brown). Perithecia 0.1 - 0.3 mm diameter. Ascospores 3.5 - 5 µm wide. P. aenea
4 In section, lower part of exciple colourless. Perithecia 0.3 - 0.45 mm diameter Ascospores 4.5 - 6 µm wide. See Strigula affinis

2 On rock.
33 Involucrellum with purple pigment that is K+ blue-grey (sometimes mixed with other pigments). On calcareous or non-calcareous rock.
44 Perithecia to 500 µm diameter. Involucrellum with much orange pigment. On damp, non-calcareous rock. (P. lectissima)
4 Perithecia to 300 µm diameter. Orange pigment, if present, confined to area near ostiole. On calcareous rock.
5 Thallus superficial. Perithecia not in pits. Perithecia remaining colourless. Ascospores 5 - 7 µm wide. P. byssophila

3 Involucrellum not K+ blue-grey (may be purple-brown, grey or brown). On non-calcareous rock. P. chlorotica
1 Many ascospores with more than 3 septa.

22 On bark.
33 Isidia present. (P. coralloidea), (P. hibernica)
3 Isidia absent.
44 Base of perithecia colourless. See Strigula
4 Perithecia black everywhere. (P. borreri)

2 On rock.
333 Mature ascospores with 3 - 7 septa. On non-calcareous rock. (P. guentheri)
33 Mature ascospores with 6 - 8 septa. On calcareous rock. P. oleriana
3 Mature ascospores with 7 - 12 septa. On calcareous rock. P. ginzbergeri
Porina aenea (Körb.) Zahlbr. (1922)

The name Verrucaria aenea Wallr. (1831), sometimes cited as basionym, is an illegitimate later homonym of V. aenea Eschw. The earliest name is Verrucaria carpinea Pers. ex Ach. (1803), but it too is illegitimate, being a later homonym of V. carpinea (L.) F. H. Wigg. The first legitimate use of these epithets at species rank was in 1852 for carpinea and 1855 for aenea, and the correct name appears to be P. carpinea (Wallr.) Zahlbr. Conservation is desirable.

Thallus: crustose, brown, forming small patches to 1 cm diameter, very thin (15 - 35 µm, sometimes to 50 µm adjacent to perithecia); in section: zcolourless, with little structure. Perithecium: black, 0.15 - 0.2 mm diameter; in section: 50% immersed, globose to slightly pyriform, 130 - 180 µm tall, 140 - 210 µm wide. Involucrellum: present, dark brown, opaque, covering at least upper 60% of perithecium, sometimes separating from perithecium in lower part. Excipulum: pale brown to brown, paler than involucrellum, of hyphae parallel to wall of perithecium. Paraphyses: persistent, simple, 1.5 µm wide. Copenhagenum: present in upper one third to one half of perithecium, dark brown to black, K-.

Paraphyses: simple, 1 µm wide. Ascii: 65 ± 8 µm. Ascospores: colourless, 3-septate, 14 - 17 x 3 - 3.5 µm, sometimes slightly curved, ends ±rounded, 8 per ascus. Photobiont: Trentepohlia.

Could be confused with Strigula affinis, but that has larger perithecia and is said usually to occur on smooth bark, especially Juglans.

Scattered, rather thinly, throughout Greece, usually fairly close to the sea. On bark of a wide range of phorophytes, at altitudes 0 - 1200 m, but commonest at low altitudes.

Widespread in Europe to as far north as southern Scandinavia, but avoiding areas with distinctly continental climate. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), Australasia (Queensland, Tasmania).

Porina byssophila (Körb. ex Hepp) Zahlbr. (1903)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Corfu, on limestone at an altitude close to sea level.

Western Europe to as far north as Scotland and southern Sweden, and southern Europe. Also western Asia (Israel), Africa (Morocco, Tunisia).

Porina chlorotica (Ach.) Müll. Arg. (1884)
Rev. Mycol. 6: 20; Verrucaria chlorotica Ach. (1810), Lichenogr. Universalis 283; Sagedia chlorotica (Ach.) A. Massal.

Thallus: crustose, superficial but thin, continuous, green-grey, not pruinose. Perithecium: black, 0.15 mm diameter, not immersed; in section 160 µm tall, 175 µm wide. Excipulum: pale brown, thin, K-. Involucrellum: present in upper one third to one half of perithecium, dark brown to black, K-. Paraphyses: persistent, simple, 1.5 µm wide. Ascospores: colourless, 3-septate, 14 - 17 x 3 - 3.5 µm. Chemistry: thallus UV-. Photobiont: green; cells globose, 8 - 11 µm diameter.

Rare and scattered, with no clear pattern, at altitudes from sea level to 1160 m. The Peloponnesian collection was on siliceous rock, the usual substrate. A 19th century report for Corfu, on limestone, may be unreliable. Reports for the northern part of mainland Greece are from bark of Platanus orientalis.

Subcosmopolitan in temperate to warm regions, provided the climate is not too continental or too dry.

Porina ginzbergeri Zahlbr. (1903)
Öst. Bot. Z. 53: 150-151; Porina oleriana var. ginzbergeri (Zahlbr.) Clauzade & Cl. Roux

Descriptions: Clauzade & Roux (1985) as Porina oleriana var. ginzbergeri; Smith et al. (2009).

Corfu, and islands of the southern Aegean. On calcareous rock at altitudes 200 - 300 m.

Southern Europe, and the Atlantic margin to as far north as Scotland. Not reported for other continents.

Porina linearis (Leight.) Zahlbr. (1922)
Cat. Lich. Univ. 1: 391; Verrucaria linearis Leight. (1851), Brit. Angiocarp. Lich. 52; (?) Porina linearis f. geographic Szatala; Porina plumbea (Bagl.) Zahlbr.

Thallus: immersed, to a few cm diameter. Cortex: true cortex absent; pseudocortex: 30 - 40 µm thick, colourless, without distinct structure, K-.. Perithecium: black, 0.15 - 0.2 mm diameter, immersed in pits in substrate; in section: 200 - 450 µm tall, 300 - 500 µm wide (including involucrellum). Excipulum: brown. Involucrellum: present in upper two thirds of perithecium, not separating from excipulum, not distinguishable from excipulum, dark brown, some purple pigment present in and just below it; purple pigment K+ grey-blue. Paraphyses: simple, persistent. Ascii: 110 x 11 µm, narrowly cylindrical, K-. Ascospores: colourless, 3-septate when mature, 16 - 23 x 3.5 - 4 µm, ends slightly pointed. Pycnidia: black, 0.05 - 0.07 mm diameter; in section: 100% immersed, globose to slightly pyriform, 190 µm tall, 170 µm wide, centrum mostly colourless, some purple pigment present in uppermost part, wall brown, purple pigment K+ grey-blue.
Conidia: colourless, bacilliform, 3 - 4 x 0.75 μm. Photobiont Trentepohlia; cells ±globose, 10 - 15 μm diameter. Photobiont layer: 55 μm thick, regular, acontinuous but photobiont cells not densely packed.

Scattered in localities close to the sea, on calcareous rock at altitudes 5 - 1000 m, but usually below 400 m. Widespread in Europe to as far north as southern Scandinavia, but commonest in the south. Also western Asia (Israel), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America.

Porina oleriana (A. Massal.) Lettau (1912)
_Hedwigia_ 52(3-4): 105; _Sagedia oleriana_ A. Massal. (1855), Symm. Lich. Nov. 95.
Description: Clauzade & Roux (1985).
Naxos, on limestone at an unspecified altitude.
Only Iberian Peninsula, France, Italy and Greece.

Porina rechingeri Szatala (1943)
Description: See the protologue. It describes a lichen from calcareous rock, with an endolithic thallus, ascospores 31 - 52 x 3.4 - 4 μm in size with 7 - 11 septa, and Trentepohlia as photobiont. It seems close to _P. ginzbergeri._ Known only from Macedonia and Ikaria, on calcareous rock at altitudes 50 - 400 m.

Porpidia Körb. (1855)
_Syst. Lich. Germ._ 221. Type: _P. trullisata_ (Kremp.) Körb., the only species originally included. Family: _Lecideaceae._

Literature: Many species have been misunderstood, and older publications may be unreliable. The best general introduction to the European species is Smith et al. (2009). Fryday (2005a) is helpful, but emphasises the species of NW Europe, most of which do not occur in Greece.


The genus is easily recognised by the Porpidia type asci (which are fairly easy to observe in this genus), the N+ red epithecium, and the substrate (only siliceous rock).

About 39 species are presently referred to _Porpidia_, 26 of them European, but species concepts are in a state of flux. Most species occur on hard, siliceous rock in temperate or cold regions, so _Porpidia_ is rather poorly represented in southern Europe.

In the group of species around _P. cinereoatra, P. crustulata_ and _P. macrocarpa_, species concepts developed in western Europe are sometimes difficult to apply in Greece. Many collections are hard to place.

11 Soredia present.
22 Medulla I+ blue or violet. Soralia often with bluish tinge. _P. tuberculosa_
2 Medulla I- Soralia white or grey, without blue tinge. (P. rugosa) Greek reports need confirmation.
1 Soredia and isidia absent.
22 Disc heavily grey-pruinose, contrasting with the black, non-pruinose exciple. On shaded, siliceous rocks in ±moist woodlands. Not present in truly Mediterranean vegetation. Thallus grey, superficial, fairly well developed, fairly smooth. Apothecia subimmerged (in material seen to date). _P. albocaerulescens_
2 Disc not, or only slightly, pruinose. On siliceous rock, not restricted to shaded moist woodlands. Thallus well developed or not. Apothecia either definitely immersed, or ±sessile, not usually subimmerged.
33 Exciple and medulla K+ yellow > red (norstictic acid). _P. platycarpoides_
3 Exciple and medulla K- or K+ yellow (stictic acid).
44 Thallus well developed, clearly epilithic, cracked to areolate, white to light grey (never tinged orange or rust red). Exciple uniformly very dark in section. _P. cinereoatra_
3 Thallus usually thin or endolithic, white to grey, sometimes tinged orange or rust red. Exciple not uniformly very dark in section.
55 Thallus rarely tinged orange or rust red. Exciple very thin, to 0.08 mm wide, only slightly raised. Ascospores 12 - 16 μm long. _P. crustulata_
5 Thallus commonly tinged orange or rust red. Exciple broad and massive, 0.15 - 0.2 mm wide (Note 1), distinctly raised. Ascospores 16 - 20 µm long. P. macrocarpa

(1) In younger apothecia the broad exciple is obvious. However, in some older apothecia, especially if convex, it may become thin.

Porphidia albocaerulescens (Wulf.) Hertel & Knoph (1984)
in Hertel, Beih. Nova Hedwigia 79: 433; Lichen albocaerulescens Wulf. (1788), Pl. Rar. Carinth. 4: 184-185; Lecidea albocaerulescens (Wulf.) Ach. (sometimes as albocoerulescens); Lecidea albocaerulescens f. albocarpa auct. graec.
The name has been much misapplied, and descriptions in many publications are unreliable.
Thallus: crustose, white, slightly cracked, 3 cm diameter, 125 - 160 µm thick. Cortex: true cortex probably absent; layer above photobiont 30 - 50 µm thick, ± colourless, without distinct structure, K-.. Apothecia: subimersed, 0.55 - 0.9 mm diameter, slightly concave to flat. Disc: black, white pruinoose. Thalline exciple: absent. Exciple: black, prominent, 0.1 - 0.15 mm diameter, persistent, clearly raised above level of disc; in section: dark purple-brown, almost opaque, K- or K+ purple-brown intensifying. Epithecium: brown to grey-brown, K- some pigment soluble in K. Hymenium: 100 µm tall, colourless. Hypothecium: dark brown, K- or K+ purple-brown intensifying. Paraphyses: almost simple (branching and anastomoses rare), 1 µm wide at base, 2 µm at apex, not capitate or moniliform. Asci: 65 x 15 µm, Porphidia type. Ascospores: colourless, simple, ellipsoid, 15 - 17.5 (20) x 7.5 µm, 8 per ascus. Chemistry: medulla K-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer 30 - 50 µm thick, sometimes discontinuous.
Scattered, with no clear pattern, but always close to the sea. On siliceous rock at altitudes 0 - 470 m. Some reports are probably unreliable. The only recent report is that of the author for the Peloponnese, from sandstone in a shaded woodland at an altitude of 470 m.
European distribution unclear, as the name has often been misapplied. There are reports for many other continents, but they are also difficult to assess. However, it is reliably reported for N. America.

Porphidia cinereoatra (Ach.) Hertel & Knoph (1984)
in Hertel, Beih. Nova Hedwigia 79: 437; Lecidea cinereoatra Ach. (1810), Lichenogr. Universalis 167; Lecidea convexa (Fr.) Flagey; Lecidea meiospora (Nyl.) Nyl.
Thallus: crustose, 1 cm diameter (in only collection seen), white to pale brown, sometimes white pruinoose, areolate, 130 - 210 µm thick. Areoles: 0.5 - 1.3 mm wide. Medulla: white, I-. Apothecia: subimersed, 0.4 - 1 mm diameter, flat, not pruinoose. Disc: black. Thalline margin: absent. Exciple: persistent, thin, 0.03 - 0.05 mm wide, level with disc; in section: dark brown, almost opaque, K-, N- (or almost). Epithecium: olive-grey, N+ red. Hymenium: 75 µm tall, colourless. Hypothecium: 25 µm tall, colourless to very pale brown. Hypothecium: 200 µm tall, dark brown, opaque, N- (or almost). Paraphyses: very sparingly branched and anastomosed, 1 µm wide at base, 2.5 µm at apex, not capitate or moniliform. Asci: 62 - 65 x 14 - 16 µm, clavate. Porphidia type. Ascospores: colourless, simple, ellipsoid, 17 - 18 x 7.5 µm, 8 per ascus. Chemistry: thallus UV-.
Well characterised by the immersed apothecia with a narrow exciple that is ±level with the disc.
Scattered throughout Greece, usually not very far from the sea. On siliceous rock at altitudes 10 - 900 m., rarely higher. A record for Evia, from calcareous rock, may refer to some other species.
Widespread in Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, S. Africa), No. America (widespread, mainly in eastern half), Australasia (widespread in Australia).

Porphidia crustulata (Ach.) Hertel & Knoph (1984)
Descriptions: Clauzade & Roux (1985); Fryday (2005a); Nash et al. (2004); Smith et al. (2009).
Scattered, with no clear pattern. On siliceous rock at altitudes 0 - 1200 m.
Subcosmopolitan outside the tropics.

in Hertel, Beih. Nova Hedwigia 79: 437; Patellaria macrocarpa DC. (1805) in Lamarck & de Candolle, Fl. Franç. Ed. 3, 2: 347; (?) Lecidea contigua auct. graec.; Lecidea macrocarpa (DC.) Steud.; Lecidea macrocarpa f. oxydata (Körb.) Stein; Lecidea macrocarpa var. platycarpa (Ach.) Th. Fr.; Lecidea phaea (Flot. ex Körb.) Nyl.; Lecidea platycarpa Ach.; Lecidea steriza (Ach.) Flot.; Lecidea steriza f. contigua (Vain.) Lyng.; (?) Lecidea steriza f. decussata Szatala; Lecidea steriza f. ferrosa (Vain.) Vain.; Lecidea steriza f. macrocarpa (DC.) Vain.; Lecidea steriza f. phaea (Flot. ex Körb.) Vain.; Lecidea steriza f. praetoria (Th. Fr.) Vain.; (?) Lecidea steriza f. submusiva Vain.
Thallus: crustose, to 8 cm diameter, grey-white, pale grey or pale brown-grey, superficial but thin, rarely exceeding
100 µm thickness, sometimes cracked when well developed. Prothallus: sometimes present, inconspicuous, dark grey, 0.4 - 1.5 mm wide. Cortex: 20 - 25 µm thick, colourless, obscurely cellular or without distinct structure. Medulla: sometimes poorly developed, white when present. Apothecia: subimmersed to sessile, usually flat, sometimes becoming convex when very old, 0.65 - 1.5 mm diameter, sometimes slightly white or grey pruinose. Disc: black. Thalline margin: absent. Exciple: black, persistent, usually very broad (0.1 - 0.2 mm), sometimes thin in old apothecia especially when convex; in section: 75 - 250 µm wide, dark brown in central part, innermost and sometimes outermost parts paler (colourless, pale brown or olive), of rather broad (2 µm wide) radiating hyphae; pigment K-, N+ reddish. Epithecium: brown, olive or grey, K-, N+ reddish (reaction sometimes faint). Hymenium: 100 - 110 µm tall, colourless. Subhymenium: 25 - 40 µm tall, colourless. Hypothecium: 100 - 150 µm tall, dark brown, opaque (even in K).

Paraphyses: sometimes branched and anastomosed, 1 - 1.5 µm wide in lower parts, 2 µm at apex, not capitate or moniliform. Asci: 75 - 80 x 17 - 20 µm, clavate, Porpidia type. Ascospores: colourless, simple, usually ±ellipsoid, 17 - 20 x 6 - 8 (11) µm, 8 per ascus. Chemistry: medulla (when present) K-, C-, KC, I-; thallus K-, C-, KC-, P-, UV- or almost. Stictic acid (K+ yellow, P+ orange) said to be present, and spot tests sometimes give a faint positive reaction, especially with P, but often appear negative. Photobiont: green, cells globose, 7 - 10 µm diameter. Photobiont layer 40 - 80 µm thick, ±regular, sometimes discontinuous.

The thin thallus and massive exciple are fairly distinctive. According to Smith et al. (2009), P. macrocarpa s. str. has an immersed thallus. Greek collections that I have referred here have a thin, but unambiguously superficial thallus.

Scattered throughout Greece. On siliceous rock at altitudes 10 - 2150 m, but usually below 1200 m.

Subcosmopolitan outside the tropics.

Porpidia platycarpoides (Bagl.) Hertel (1987)
Description: Smith et al. (2009).
Chios, on siliceous rock at altitudes 450 - 490 m.
Cold and temperate Europe, but absent from regions with strongly continental climate; rare in the south. Also Macaronesia, Asia (Turkey, HK, Japan, Taiwan), N. America (New York), S. America (Brazil), Australasia (NZS).

Porpidia tuberculosa (Sm.) Hertel & Knoph (1984)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Island of Samothraki, on siliceous rock at an altitude of 775 m.
Throughout northern and central Europe, but rare south of the Alps. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan, Japan), N. America (widespread), S. America (Falkland Is).

Porpidinia Timdal (2010)


Porpidinia has a single species that was formerly treated in Toninia, though it clearly does not belong there.

Porpidinia tumidula (Sm.) Timdal (2010)
Biblioth. Lichenol. 104: 334; Lichen tumidulus Sm. (1791), Trans. Linn. Soc. 1: 82; Thalloidima tumidulum (Sm.) Szatala (as Thalloedema); Toninia tumidula(Sm.) Zahlbr.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as Toninia tumidula.
Islands of the southern Aegean, including Crete, and adjacent coast of the mainland. On calcareous rock at altitudes 20 - 700 m.
Southern and central Europe, just reaching England and southern Sweden. Also Macaronesia (CVI), western Asia (Turkey), N. Africa (Morocco, Algeria), and surprisingly Australasia (NZN, NZS).

Protoblastenia (Zahlbr.) J. Steiner (1911)


Literature: Between them, Smith et al (2009) and Clauzade & Roux (1985) treat all the Greek species. The genus is also discussed at some length in Poelt & Vezda (1977).

Differs from Psora in having a crustose rather than squamulosely thallus, and orange rather than brown to black
apothecia. However, *Protoblastenia macrocarpa* and *Psora testacea* cut across this circumscription of the genera, and the boundaries of the two genera may be in need of revision.

About 20 species worldwide, about 11 in Europe, on calcareous rock and soil in cold to warm-temperate areas. The genus is absent from the tropics. It is not common in Greece.

11 Thallus squamulose. On soil. (P. macrocarpa)
1 Thallus crustose. On calcareous rock.
22 Apothecia K- or K+ weakly reddish in spot tests. *P. lilacina*
2 Apothecia distinctly K+ purple or purple-red in spot tests.
33 Apothecia 0.2 - 0.5 mm diameter, clearly immersed in pits in the rock. Ascospores ellipsoid, 9 - 13 x 4.5 - 7 µm. *P. incrustans* s. lat.
44 Thallus immersed; if thinly superficial then white, grey or slightly yellowish. Not restricted to alpine levels. *P. incrustans var. incrustans*
4 Thallus yellow-brown. Restricted to alpine levels. *P. incrustans var. coniasis*
3 Apothecia sometimes more than 0.5 mm diameter, not immersed (or at most with only lowermost part immersed in shallow pit). Ascospores various.
444 Ascospores globose or subglobose (aspect ratio less than 1.25), 6 - 10 µm diameter. *P. cyclospora*
44 Ascospores ellipsoid (aspect ratio 1.5 or more), 9 - 16 x 6 - 10 µm.
55 Thallus immersed, or very thin and ±white. *P. calva*
5 Thallus distinctly superficial, with brown, grey or green tinge. *P. rupestris*
4 Ascospores narrowly ellipsoid, 6 - 11 x 3 - 6 µm. *P. siebenhaariana* s. lat.
55 Thallus well-developed, superficial. (P. siebenhaariana var. siebenhaariana)
5 Thallus poorly developed, thin or immersed. *P. siebenhaariana var. alpina*

**Protoblastenia calva** (Dicks.) Zahlbr. (1930)
Cat. Lich. Univ. 7: 1; *Lichen calvus* Dicks. (1790), Fasc. Pl. Crypt. Brit. 2: 18; *Biatora rupestris f. calva* (Dicks.) Arnold; *Biatora rupestris var. calva* (Dicks.) Rabenh.; *Lecanora rupestris var. calva* (Dicks.) Vain.; *Protoblastenia rupestris var. calva* (Dicks.) J. Steiner.

Description: Very similar to *P. rupestris* (see description below), but thallus immersed, or very thinly superficial and white. May occur together with *P. incrustans*, but the two species are easily separated.

Widely distributed in sites that are not very far from the sea. On calcareous rock at all altitudes, but usually below 1400 m.

Throughout Europe. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread in Alaska and Canada), Australasia (Tasmania).

**Protoblastenia cyclospora** (Hepp ex Körb.) Poelt (1975)

Thallus: ±immersed, inconspicuous. Apothecia: 0.6 - 0.8 mm diameter, mostly above level of substrate but lowest part sometimes slightly immersed in shallow pits, convex, not pruinose. Disc: brown-orange. Thalline margin: absent. Exciple: soon excluded. Epithecium: orange-brown, K+ strongly red-purple. Hymenium: 55 µm tall, colourless or (especially in upper part) with some orange-brown pigment. Hypothecium: 60 µm, colourless to pale orange-brown. Ascospores: colourless, simple, subglobose, 7 x 6 µm, with distinct Lecanora type wall.

Easily separated from other species of the genus by the subglobose ascospores.

Scattered, with no clear pattern but never far from the sea, on limestone at altitudes 500 -1200 m.

Most European records are from latitudes between the Alps and southern Sweden; rare south of the Alps. Also Asia (Russia), N. America (Alaska).

**Protoblastenia incrustans** (DC.) J. Steiner (1915)


For more extensive descriptions see: Clauzade & Roux (1985) or Smith et al. (2009).

*Clauzadea immersa* is similar, but has larger apothecia that are K- or at most K+ faintly pinkish.

Scattered rather thinly throughout much of Greece. On calcareous rock, rarely calcareous soil, at all altitudes.
Throughout Europe. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), perhaps S. America (Bolivia).

Protoblastenia incrustans var. coniasis (A. Massal.) Nimis (1993)
Lich. Italy, 573. (A 1977 combination by Poelt & Vězda was not validly published.);
Protoblastenia rupestris var. coniasis (A. Massal.) Szatala.

Unfortunately, the epithet ochracea has priority at the rank of variety, if Biatora rupestris var. ochracea Anzi, Cat. Lich. Sondr. 78. 1860, is synonymous, as is generally assumed.

Description: Nimis (1993).

Mt. Olympus, on limestone at altitudes 1800 - 2600 m.

In Europe almost confined to the Alps, though it is reported for Tuscany. The Greek records are disjunct, but plausible. Not reported for other continents.

Protoblastenia lilacina Poelt & Vězda (1970)

Thallus: crustose, inconspicuous, immersed or thinly superficial, cracked, white, sometimes bounded by narrow black prothallus. Apothecia: sessile, convex, 0.4 - 0.8 mm diameter, not pruinose. Disc: orange-brown to brown-orange, sometimes with slight red tinge. Thalline margin: absent. Exciple: excluded early; in section: 50 µm wide, colourless to pale orange-brown in inner part, very dark brown in outermost 10 µm, of distinct hyphae with, in outer part, distinct elongated lumina. Epithecium: orange-brown to dark brown, with orange-brown polarising granules; orange-brown pigment K+, granules K+ purple or red-purple. Hymenium: 70 - 100 µm tall, colourless or with some epithecial pigment in upper part. Hypothecium: 120 µm tall, acolourless to pale orange-brown. Paraphyses: branched, 1 - 1.5 µm wide at apex, 1.5 - 2.5 µm at apex, very coherent, with visible septa. Asci: 45 x 15 µm, ±clavate, apex KI+ blue. Ascospores: colourless, simple, narrowly ellipsoid to almost fusiform, ends subrounded, 11 - 17 x 5 - 10 µm, 8 per ascus. Chemistry: apothecia usually K- in spot tests, sometimes faintly K+ purple; thallus K-, C-, P-, UV-. Photobiont: green; cells globose, 8 - 11 µm diameter, often forming clumps about 50 µm diameter, making photobiont layer irregular and sometimes discontinuous.

Paraphyses are best studied after using C to clear the epithecial pigment.

Scattered, mainly in the southern half of Greece, on limestone at altitudes 60 - 1300 m. Probably much overlooked, owing to confusion with other species.

Easily confused with Clauzadea monticola, and some Peloponnesian reports of that species in Abbott (2009) belong here. Separated from that species by the K+ purple or red-purple reaction of the epithecial granules, but the reaction is often faint and easily overlooked.

Western and Mediterranean Europe. Not reported for other continents.

Protoblastenia rupestris (Scop.) J. Steiner (1911)
Protoblastenia rupestris var. irrubata (Ach.) Lyng; Protoblastenia rupestris var. rufescens (Hoffm.) Zahlbr.; (?) Protoblastenia rupestris var. viridiflavescens (Wulf.) J. Steiner.

Thallus: crustose, superficial, to 1.5 cm diameter, pale brown, without vegetative propagules, continuous in marginal parts, areolate at base, to 300 µm thick but usually less. Areoles: flat to slightly concave, 0.2 - 0.3 mm wide. Cortex: 30 - 50 µm thick, brown, without distinct structure, K-. Medulla: white. Apothecia: 0.3 - 0.55 mm diameter, convex, not pruinose. Disc: orange-brown in young apothecia, brown in older ones. Thalline margin: absent. Exciple: orange-brown, becoming excluded. Epithecium: orange-brown, K+ purple-red. Hymenium: 70 µm tall, colourless in lower part, orange-brown in upper part. Hypothecium: 50 µm tall, ±colourless. Ascospores: colourless, simple, ellipsoid, 10 - 13.5 x 5 - 6.5 µm. Chemistry: apothecia K+ purple; thallus K-. Photobiont: green; cells globose, 7 - 15 µm diameter, forming a rather irregular layer 60 - 100 µm thick.

Scattered and not very common, with no clear pattern but never very far from the sea. On calcareous rock at all altitudes.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Guatemala), Australasia (NSW, Tasmania, NZN, NZS).

Protoblastenia siebenhaariana var. alpina (Arnold) Clauzade & Cl. Roux (1985)
Likenoj de Okcidenta Europo 828; B latora rupestris var. alpina Arnold (1869), Verh. zool.-bot. Ges. Wien 19: 643;
Protoblastenia rupestris var. alpina (Arnold) Szatala.

Description: Clauzade & Roux (1985).

Mt. Olympus, on calcareous rock at an altitude of 2300 m.
Known only from southern Germany, Austria and Greece.


Literature: Jørgensen in Ahti et al. (2007), and Smith et al. (2009) treat the only European species.

The genus has seven species, but six have a very narrow distribution. Only one occurs in Europe.


Descriptions: Ahti et al. (2007); Burgaz et al. (2010); Clauzade & Roux (1985) as *Pannaria pezizoides*; Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Thrace and Mt. Olympus, on soil, saxicolous bryophytes and bark of *Pinus heldreichii* at altitudes 1300 - 1800 m.

Throughout the north and west of Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (widespread), Africa (Algeria, Uganda, St. Helena), N. America (widespread), perhaps S. America.

**Protoparmelia M. Choisy (1929)**

*Bull. Soc. Bot. Fr.* 76: 523. Type: *P. badia* (Hoffm.) Hafellner, the only species originally included (as *Lecanora badia*). Family: *Parmeliaceae*.


*Protoparmelia* contains 26 described species, of which 15 occur in Europe. The common European species are saxicolous, but the genus also contains corticolous, lignicolous and lichenicolous taxa. Species of *Protoparmelia* have been much misunderstood in the past, and care is needed when assessing older records.

*P. psarophana* var. *reagens* (J. Steiner) Sipman. is not included in the key, as I have insufficient information.

11 Parasitic on lichens on siliceous rocks (usually yellow/green Rhizocarpon). Note 1.
22 Thallus with lobed margin, or at least with marginal areoles distinctly more extended than internal ones. (P. cupreobadia), (P. placentiformis)
2 Thallus without lobed margin. **P. atriseda**
1 On siliceous rock; not parasitic.
22 Thallus K+ yellow > red. **P. olivascens**
2 Thallus K-.
33 Ascospores ellipsoid-fusiform with distinctly pointed apices, 3 - 5 µm wide. **P. badia**
3 Ascospores oblong-ellipsoid to oblong, 2 - 3.5 µm wide. Note 2.
44 Thallus not lobed. **P. montagnei**
4 Thallus at least obscurely lobed. (P. nitens)

(1) The distribution of several species in this group is not well known, and my choice of which species are worth including in a key for Greece may be imperfect. For a full key, see Roux (2007).
(2) The next couplet may not work well, as I have not found a good description of the rather poorly known species P. nitens. It may be merely an extreme morph within P. montagnei.

**Protoparmelia atriseda (Fr.) R. Sant. & V. Wirth (1987)**


Descriptions: Nash et al. (2004); Roux (2007); Smith et al. (2009).

Northern Greece, on siliceous rock at altitudes 500 - 1400 m. Not reported since 1941.

Widespread in northern and central Europe; rare in the south. Also Asia (Russia, perhaps Taiwan), N. America (scattered), perhaps C. America.

**Protoparmelia badia (Hoffm.) Hafellner (1984)**

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Scotted, with no clear pattern. On siliceous rock at all altitudes, but usually above 400 m. Some older reports may refer to \( P. \) montagnei.

Almost throughout Europe, but predominantly upland in the south. Also Macaronesia, Asia (widespread), Malesia (PNG), perhaps Africa (S. Africa), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (widespread), Antarctica (S. Orkney Is).

**Protoparmelia montagnei** (Fr.) Poelt & Nimis (1987)

*Studia Geobot.* 7(1): 188; *Parmelia montagnei* Fr. (1831), Lichenogr. Eur. Reform. 107; *Lecanora montagnei* (Fr.) Schae.; *Lecanora psarophana* Nyl.; (?) *Lecanora psarophana* var. *pallida* (Wedd.) Harm.; (?) *Lecanora psarophana* f. *subvirens* J. Steiner; (?) *Protoparmelia picea* aut. graec., non (Dicks.) Hafellner; *Protoparmelia psarophana* (Nyl.) Sancho & A. Crespo.

Thallus: crustose, to 7 cm diameter, to 0.5 mm thick, areolate, pale brown to brown, sometimes white pruinose especially at margins of areoles. Areoles: 0.2 - 0.7 mm wide, usually ±flat, sometimes becoming convex and warty, or even subsquamulose and slightly overlapping. Prothallus: sometimes present, blue-black to black, 0.2 - 0.7 mm wide, sometimes zoned. Vegetative propagules: absent. Cortex: 30 - 70 µm thick, not well delimited from photobiont layer, colourless in lower part, pale orange-brown in upper part, K-; overlay by colourless, structureless layer 5 - 15 µm thick that swells markedly in K to 30 - 70 µm. Medulla: white. Apothecia: always present, subimmersed when young, sessile when mature, 0.4 - 1.5 mm diam, flat, usually not pruinose, sometimes with slight white pruina on exciple. Disc: dark brown, shiny, when over-mature often becoming black and matt. Thalline margin: present, persistent but becoming very thin. Exciple: not visible externally; in section: 40 - 60 µm wide, colourless in inner part, orange-brown in outer part, basically of radiating hyphae sometimes with fairly broad lumina giving a weakly cellular appearance. Epitheicum: brown to orange-brown, K-, pigment partly soluble in K. Hymenium: 55 - 90 µm tall, colourless. Subhymenium: very distinct, 60 µm tall, colourless, of horizontal hyphae. Hypothecium: ±colourless, very variable in thickness. Paraphyses: 1 - 1.5 µm wide at base, 2 - 3 µm at apex, not capitate. Ascii: 52 x 15 µm, narrowly clavate, Lecanoratype. Ascospores: colourless, simple (occasionally appearing sparsely 1-septate), usually oblong with rounded ends, occasionally ellipsoid or dacriform, 7 - 12 x 2.5 - 3.5 µm, with thin but distinct wall, 8 per ascus. Pyenia: often present, black, 0.05 - 0.15 mm diameter; in section: 100% immersed, ±globose, 140 - 200 µm tall, 160 - 210 µm wide, colourless except for a band of orange-brown pigment at the top (like the cortex). Conidia: colourless, straight, 8 - 12 x 0.75 µm. Chemistry: outer part of thallus lacks lichen substances (C-, K-, KC-, P-, UV-); medulla always K- but several chemotypes occur. The following sets of medullary reactions have been recorded: (i) C-, KC+ red, P-; (ii) C+ strongly red (persistent), P-; (iii) C-, KC+ fleeting pink-violet, P+ yellow. Photobiont: green, cells globose, 9 - 12 µm diameter, forming a ±continuous later 30 - 75 µm thick.

Islands of the Aegean, including Crete, and adjacent parts of the Peloponnese. Never very far from the coast. On siliceous rock at altitudes 0 - 800 m.

Basically circum-Mediterranean/Macaronesian. Most European records are from the Alps and Pyrenees southwards, though there are scattered reports for further north. Also Macaronesia, western Asia (Turkey, Syria, Iran), N. Africa (Morocco, Algeria, Tunisia).

**Protoparmelia olivascens** (Nyl.) Llimona (2011)


Descriptions: Clauzade & Roux (1985); Poelt & Vězda (1977), both as *Lecanora olivascens.*

Crete, close to sea level. The substrate was not reported.

Only Iberian Peninsula, France, Bulgaria, Greece, and Macaronesia (Tenerife).

**Protoparmelia psarophana var. reagens** (J. Steiner) Sipman (1999)


*Protoparmelia psarophana* var. *psarophana* is now considered to be a synonym of *Protoparmelia montagnei.* The status of var. *reagens* is not clear to me. Its Greek distribution is similar to that of *P. montagnei,* and it may prove to be a synonym of that species, or an infra-specific taxon within it.

Islands of the Aegean, including Crete. On siliceous rock at altitudes 0 - 700 m. Apparently only known from Greece.
Protoparmeliopsis M. Choisy (1929)

*Bull. Soc. Bot. Fr.* 76: 524. Type: *P. muralis* (Schreb.) M. Choisy, the only species originally included. Family: *Lecanoraceae*.

Literature: There is no monograph. Most of the species are treated in the standard Floras, under *Lecanora*.

Thallus: crustose, to several cm diameter, generally areolate in central part, most species with radiating marginal lobes, usually some shade of green in the common species, grey, brown or white in others, some species with black margin to lobes or areoles, some species slightly white pruinose, without vegetative propagules. Marginal lobes: usually adpressed, otherwise rather variable. Hypothallus: sometimes present, black. Apothecia: usually present in centre of thallus often abundant, 0.3 - 1.8 mm diameter, immersed to sessile, rounded, concave to slightly convex, not pruinose. Disc: brown, pale brown or orange-brown. Thalline margin: present, sometimes excluded in older apothecia. Exciple: usually not visible externally; in section: 15 - 100 µm tall, mostly colourless, upper part sometimes with some epiphytic pigment, KI+ blue. Hypothecium: 50 - 150 µm tall, colourless. Paraphyses: simple to sparingly anastomosed, usually not capitate, not moniliform. Asci: clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 15 x 5 - 7 µm, usually with distinct Lecanora type wall, 8 per ascus. Chemistry: medulla K-, C-, KC-, P- or P+ yellow; thallus K-, C-, KC- or KC+ faintly yellow, P-, UV-. Photobiont: green.

The common species are easily recognised by the green, crustose thallus with marginal lobes occurring on rock. *Squamarina* usually has a more squamulose thallus. However, they are quite variable, and determination to species is sometimes difficult.

About 11 species globally, 10 in Europe, almost always saxicolous. Some are quite common in Greece.

11 Thallus crustose, margin not lobed. **P. laatokkaensis**

1 Thallus subsquamulose or with lobed margin.

22 Thallus chalky, chalk-white to yellow-white, P+ yellow. Apothecia brown to black. On calcareous rock at subalpine to alpine levels *(P. admontensis)*

22 Thallus grey-brown to grey, P-. On siliceous rock. **P. klauskalbii**

2 Thallus green, grey-green, yellow-green or yellow-brown (but white pruina may be present), P+ yellow or P-. On calcareous or siliceous rock.

33 Marginal lobes strongly adpressed. Medulla probably P- in most species (but some groups not well understood).

44 Areoles with prominent black margin. On non-calcareous rock. **P. bolcana**

4 Areoles without prominent black margin (Note 1).

55 Lobes flat to convex. Thallus grey-green. **P. macrocylos**

5 Lobes flat to concave. Thallus yellow-green or white-green. **P. muralis**

3 At least some marginal lobes not strongly adpressed. Medulla P+ yellow or P-.

44 Medulla P+ yellow. Thallus with a brown or yellow tinge. On calcareous or siliceous rock. **P. graeca**

4 Medulla P-. Thallus various. Usually on non-calcareous rock.

55 Thallus of small granules that transform into small, umbilicate squamules. *(P. vaenskaei)*

5 Thallus never granular.

66 Lobes swollen and sinuous. **P. garovaglìi**

6 Lobes not swollen or sinuous. **P. muralis**

(1) A black hypothallus may be present between the areoles. In *P. macrocylos* the lobe tips only may be greisy or even black.

Protoparmeliopsis bolcana (Pollini) Lumbsch (2016)


Thallus: crustose, to 1.5 cm diameter, areolate in centre, with radiating marginal lobes, green, pale green or brown-green, black at margins of areoles and marginal lobes, sometimes white pruinose at tips of marginal lobes or margins of areoles, without vegetative propagules. Areoles: 0.3 - 1.5 mm wide, flat, contiguous, subangular. Marginal lobes: elongate, 0.7 - 6 x 0.25 - 1 mm, slightly concave to slightly convex, adpressed, sometimes overlapping. Hypothallus: black. Medulla: white. Apothecia: present in centre of thallus, often abundant, 0.3 - 0.9 mm diameter, immersed to subsessile, concave to flat, rounded or angular by compression, sometimes white pruinose on thalline margin. Disc: brown, pale brown or orange-brown. Thalline margin: present. Epithecium: brown to pale brown, K-, pigment soluble in K. Hymenium: 55 - 100 µm tall, mostly colourless, upper part sometimes with some epiphytic pigment. Hypothecium: 50 - 125 µm tall, colourless. Paraphyses: not capitate or moniliform. Ascospores: colourless, simple,
ellipsoidal, 10 - 15 x 5 - 7 µm, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-; thallus K-, C-, KC- or almost, P-. Photobiont: green.

*P. bolcana* is close to *P. muralis* but has black margins to the areoles and lobes. However, some collections are difficult to place.

Throughout Greece, on siliceous rock at all altitudes. The lichenicolous lichen *Buellia badia* has been reported once from this host.

Southern Europe, from France to Cyprus, and south-central Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria).

**Protoparmeliopsis garovaglii** (Körb.) Arup, Z. Xin & Lumbsch (2016)

_Fungal Diversity_ 78(1): 301; _Placodium garovaglii_ Körb. (1859), Paraerga Lichenol. 54; _Lecanora garovaglii_ (Körb.) J. Steiner; _Placolecanora garovaglii_ (Körb.) Räsänen.


Scattered, in Crete and northern Greece, with no clear pattern. On calcareous or siliceous rock at altitudes 300 - 1850 m.

Widespread in southern and south-central Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread in western half), C. America (Mexico), S. America (Argentina, Bolivia, Chile, Peru).

**Protoparmeliopsis graeca** (J. Steiner) Sipman & Cl. Roux (2016)


Thallus: placodiod, to 3 cm diameter, central parts areolate to subsquamulose, green-brown to yellow-brown (after 2 years in herbarium; colour not noted when fresh), not pruinose, without vegetative propagules. Marginal lobes: 1.5 - 2 x 0.5 - 1 mm, 450 - 500 µm thick, moderately adpressed, sometimes slightly overlapping, flat to aconvex, usually not strongly radiating; lower surface black, in section with dark brown pigment but lower cortex not developed. Cortex: 45 - 80 µm thick, pale brown in upper part, 0.8 - 1.8 mm diameter, not pruinose. Disc: orange-brown to brown. Thalline margin: present, thin, eventually often restricted to lower part of apothecium; in section: 200 µm wide. Exciple: sometimes visible externally, 0.05 mm wide, same colour as disc; in section: 50 - 80 µm wide, rather poorly developed. Epithecium: brown, K-, pigment soluble in K. Hymenium: 70 µm tall, mostly colourless, upper part with some epithelial pigment, KI+ blue. Hypothecium: 40 µm tall, colourless, not sharply differentiated from underlying medulla. Paraphyses: simple, 1 µm wide at base, 2 µm at apex, not capitate. Ascì: 55 x 11 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 15 x 5.5 - 7 µm, with prominent Lecanora-type wall, 8 per ascus. Chemistry: medulla K-, C-, KC-, P+ yellow, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: 50 - 80 µm thick, continuous, upper surface sometimes irregular.

The thallus is browner than *P. muralis*, and the marginal lobes are more regular and slightly less tightly adpressed; also the medulla in *P. muralis* usually reacts P-.. Could be confused with *Squamarina*, but does not match any species of that genus (see *Squamarina* key).

Scattered in the southern half of Greece, usually not very far from the sea. On calcareous or siliceous rock at altitudes 10 - 1150 m.

Mediterranean Europe, from France to Greece. Also western Asia (Turkey, Iraq, Israel), N. Africa (Algeria, Tunisia).

**Protoparmeliopsis klauskalbii** (Sipman) Senkard. (2011)

_in Sankardesler & Calba, Mycotaxon 115: 266; Lecanora klauskalbii Sipman (2007), Biblioth. Lichenol. 96: 270-273._

Description: See the protologue.

Evia and Samothraki, on siliceous rock at altitudes 20 - 250 m.

Only Greece and Turkey.


Thallus: crustose, 2 - 4 cm diameter, areolate, pale green, not pruinose, without marginal lobes, without vegetative propagules. Areoles: scattered, flat, subrounded, with only slight tendency to become lobulate, to 250 µm thick, 0.25 - 0.5 mm wide before apothecia develop, but soon giving rise to one or more apothecia, sometimes persisting as a ring around apothecium. Hypothallus: present between areoles, black. Cortex: 35 - 45 µm thick, colourless in lower part, brown in upper part, formed of a network of anastomosed hyphae, K-, pigment soluble in K; upper part with abundant crystals 1 - 4 µm wide, not soluble in K. Medulla: white; in section: formed of a rather loose network of interwoven and
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sometimes anastomosed hyphae 1.5 - 2 µm wide. Apothecia: sessile, flat to slightly convex, 0.3 - 0.75 mm diameter, not pruinose. Disc: pale brown to brown. Thalline margin: present, persistent; in section: 40 - 60 µm wide; cortex not very well developed, 10 - 20 µm wide, with abundant small polarising granules not soluble in K. Exciple: not visible externally; in section: 15 µm wide, colourless in inner part, brown at surface, of anastomosed hyphae, outer part sometimes with abundant polarising granules (like epithecium). Epitheicum: brown, K-, pigment soluble in K; with abundant small polarising granules, soluble in K. Hymenium: 80 - 90 µm tall, usually colourless, upper half sometimes with epithelial pigment. Hypothallus: 50 - 150 µm tall, colourless. Paraphyses: usually simple, sometimes sparingly anastomosed, 1 - 1.5 µm wide at base, 1.5 - 3 µm at apex, occasionally capitulate. Chemistry: disc C-, thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 10 - 12 µm diameter. Photobiont layer: 80 - 100 µm thick, regular, continuous at first but soon disrupted by developing apothecia.

This distinctive species is easily recognised by the complete absence of marginal lobes, and by the black hypothallus between the scattered areoles.

Very scattered, with no clear pattern. On siliceous rock at altitudes 130 - 1100 m.

A rarely recorded species that appears to be scattered throughout Europe, from Sicily to Finland. Also Macaronesia, Asia (Turkey, Tajikistan), N. Africa (Morocco), N. America (Arizona).


Known from a single site in Epiros, on serpentinite rock at an altitude of 2100 m.

Mostly northern Europe, with a very few reports from further south. Also Asia (Turkey, western Siberia).

**Protoparmeliopsis muralis** (Schreb.) M. Choisy (1929)

*P. muralis* is very variable, and numerous infra-specific taxa have been described within it. Their taxonomic value is doubtful, but the *muralis* aggregate in SE Europe is in need of a revision and some might eventually be upheld. Published infra-specific concepts have proved difficult to apply to Greek collections, so here I treat *P. muralis* as a single entity. Those who wish to subdivide it could try to apply the following key.

1 At least some marginal lobes not strongly adpressed. 2 Marginal lobes almost as broad as long. Thallus ±shiny, not pruinose. On non-calcareous rock. (P. muralis var. subcartilaginea)

2 Marginal lobes distinctly longer than broad. 3 Thallus white-green, with white, pruinose marginal zone. On calcareous rock. *P. muralis* var. *versicolor*

3 Thallus yellow-green, without white marginal zone, not or only slightly pruinose. Not restricted to strongly calcareous substrates.

4 Areoles with several apothecia. *P. muralis* var. *serpentini* 4 Areoles usually with only one apothecium. *P. muralis* var. *muralis*
In Greece, var. versicolor is the commonest and most clearly defined of these varieties, but it may be just a response of P. muralis to calcareous substrates.

Some of the Peloponnesian collections referred here in Abbott (2009) belong to P. bolcana.

Thallus: crustose, to several cm diameter, with radiating marginal lobes, often areolate in central part, pale green to brown, matt, sometimes white pruinose especially towards tips of lobes, without vegetative propagules. Areoles: 0.2 - 0.5 mm wide, contiguous, subangular, often rather distorted. Marginal lobes: variable in size and shape but usually at least slightly elongate, 1.5 - 8 x 0.3 - 1 mm, usually adpressed, usually ± flat, sometimes slightly concave. Lower surface and hypothallus: black, sometimes visible at margins of areoles but not forming a prominent rim. Cortex: C-. Medulla: white. Apothecia: always present in central part of thallus, often abundant, sometimes crowded, sub sessile to sessile, flat to slightly convex, 0.45 - 1.4 mm diameter, not pruinose. Disc: pale brown to brown. Thalline margin: present, green to brown, occasionally with white rim, sometimes becoming excluded; in section: 125 µm wide, of which cortex 40 - 50 µm; cortex sharply delimited from algal layer. Exciple: not visible externally; in section: 25 µm wide, poorly developed. Epithecium: orange-brown to brown, K-, pigment soluble in K. Hymenium: 65 - 80 µm tall, colourless or with some epithelial pigment in upper part. Hypothecium: 120 - 125 µm tall, colourless. Paraphyses: simple, not capitate. Asci: Lecanora type. Ascospores: colourless, simple, ellipsoid, 11 - 14 x 5 - 7 µm, 8 per ascus. Chemistry: medulla K-, C-, KC-, P- or P+ yellow; thallus K-, C-, KC-, P-. Photobiont: green, present below apothecia.

Throughout Greece, on calcareous or siliceous rock at all altitudes. Reported once on bone. The lichenicolous taxa Diploschistes muscorum, Muellerella erratica, Placocarpus schaereri, Sclerococcus rimulicola and Stigmidium squamariae have each been reported once from this host.

P. muralis as presently delimited is subcosmopolitan outside the tropics. However it may be a complex of closely related species.

**Pseudephebe M. Choisy (1930)**


Literature: Smith et al. (2009) treat both species.

Two species, one of which is strongly northern and unlikely to occur in Greece.

**Pseudephebe pubescens (L.) M. Choisy (1930)**

Icon. Lich. Univ. ser. 2(1): (without page number); *Lichen pubescens* L. (1753), Sp. Pl. 1155.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Known from a single site in northern Macedonia, on granite rock at an altitude of about 1800 m. Throughout northern and central Europe, but in the south confined to high mountains. Also Macaronesia, Asia (widespread), N. America (widespread), C. America (Mexico), S. America (Argentina, Bolivia, Chile, Peru), Australasia (widespread), Antarctica (subantarctic islands, Antarctic Peninsula)

**Pseudevernia Zopf (1903)**


Literature: The only European species is treated in all the standard Floras.

Differs from *Parmelia* in the subfruticos growth form (lobes much longer than broad), in the absence of pseudocyphellae, and in the absence of rhizines on the lower surface.

Four species, but only one occurs in Europe. They are usually corticolous on acidic bark, or lichenicolous, but in favourable conditions may occur on almost any acidic substrate.

11 Medulla C-. *P. furfuracea var. furfuracea*
1 Medulla C+ red. *P. furfuracea var. ceratea*

**Pseudevernia furfuracea (L.) Zopf (1903) var. furfuracea**

Beih. Bot. Zentralbl. 14: 124; *Lichen furfuraceus* L. (1753), Sp. Pl. 1146; Borrera furfuracea (L.) Ach.; *Evernia furfuracea* (L.) W. Mann; Parmelia furfuracea (L.) Ach.; *Parmelia furfuracea var. ericetorum* auct.; (?) *Parmelia furfuracea var. microphylla* Erichsen; *Parmelia furfuracea f. scobisina* (Ach.) Lettau (sometimes as *scobicina*).

Thallus: foliose, but often appearing ± fruticos as lobes are attached to substrate only at one end; forming irregularly circular thalli to about 8 cm diameter, or pendent to 10 cm long. Lobes: elongate, 40 - 50 x 1.5 - 3 (3.5) mm, mature lobes 0.7 - 0.75 mm thick, dichotomously branched (angle between branches up to 90 degrees), usually irregularly overlapping, margins smooth, without cilia or pseudocyphellae. Upper surface: grey, matt, ± smooth before
isidia develop. Lower surface: usually mostly black, often white near tips of lobes, occasionally almost entirely white; strongly channeled; sometimes with small folds or ridges that may occasionally become prominent; without rhizines or veins. Isidia: abundant on older parts of lobes, laminal and marginal on upper surface, occasionally also present on lower surface, initially globose, soon cylindrical, to 0.4 mm long when well developed (`isidia' much longer than this usually transitional to a new lobe), 0.06 - 0.08 mm wide, usually simple, rarely branched, discrete, mostly same colour as upper surface of lobes, sometimes black at extreme tip. Upper cortex: 17 - 30 µm thick, mostly colourless, sometimes brown in outermost 5 - 10 µm, of vertical hyphae but with a weak cellular texture; cells rounded, 3 - 5 µm wide; brown pigment K-, N-, dissolving in K but not in N. Medulla: white, compact to rather loose, of hyphae parallel to lobe axis; hyphae 2.5 - 5 µm wide, without visible septa, encrusted with a few crystals less than 1 µm wide. Lower cortex: 20 - 50 µm thick, red-brown to very dark brown, cellular; cells rounded, 8 - 14 µm wide; pigment K-, N-, not fully soluble in K or N but cortex less opaque in K. Apothecia: rare, shortly stalked, 0.8 - 1.7 mm diameter, concave, not pruinose. Disc: pale green-brown to brown, sometimes shiny. Thalline margin: present, thin, persistent, sometimes slightly crenulate or irregular. Exciple: poorly developed, not visible externally; in section: not well delimited from hymenium or thalline exciple, brown, 25 µm wide. Epictheium: pale orange-brown, K-, swelling markedly in K, pigment not soluble in K. Hymenium: 30 - 50 µm tall, mostly colourless, upper part sometimes with some epiphytic pigment, KI- slightly bluish. Hypothecium: 50 - 55 µm tall, colourless, uppermost 10 - 15 µm sometimes of a different texture, almost forming a subhymenium, but a well-developed, continuous subhymenium absent. Paraphyses: mostly simple, sometimes branched, occasionally anastomosed, 1 µm wide at base, 2.5 µm at apex, moniliform, often with visible septa. Asci: 25 - 30 x 13 µm, broadly clavate, Lecanora type. Ascospores: colourless, simple, globose, 5.5 - 6 x 5 - 6 µm (?immature), 8 per ascus. Pycnidia: often present on upper surface of young lobes, laminal, black, 0.05 - 0.08 mm diameter. Chemistry: medulla K-, C-, KC usually +pink or brown-pink, P-, I-, UV+ faintly blue-white; thallus K+ yellow, C-, KC- (or sometimes intensifying yellow), P-, UV+ faintly orange. Photobiont: green, cells globose, 10 - 14 µm diameter, wall often I+ slightly reddish. Thalline margin: discontinuous and irregular, 20 - 55 µm thick.

Smith et al. (2009) state that the medulla reacts KC-, but in my Greek collections it usually reacts unambiguously, though sometimes faintly, KC+ some shade of pink. The reaction is transient.

A sorediate morph has been reported in the literature, but does not appear to have been seen in Greece. Specimens with a white lower surface could be confused with Evernia prunastri, but that species has a greenish tinge to the upper surface and lacks isidia.

Throughout Greece. (Its apparent absence from a large area of central Greece may be due to under-recording.) Usually on acidic bark (96% of records), sometimes on wood of Juniperus oxycedrus, rarely on rock. Commonest on conifers, but not restricted to them. At altitudes 0 - 2200 m, but commonest in upland forests between 800 and 1600 m. The lichenicolous fungus Lichenostigma maureri has been reported once from this host.

Many authors do not distinguish the two varieties, so the distribution of var. furfuracea is not entirely clear. P. furfuracea s. lat. is widespread in Europe, though in the south confined to upland regions. Also Macaronesia, Asia (widespread), Africa (widespread in northern half). Reports for the Western Hemisphere are incorrect.

Pseudovernia furfuracea var. ceratea (Ach.) D. Hawksw. (1969)

Lichenologist 4(2): 162; Parmelia furfuracea var. ceratea Ach. (1803), Methodus 255; Evernia furfuracea var. olivetorina (Zopf) Elenkin; Parmelia ceratea (Ach.) Sandst.; Parmelia furfuracea f. ceratea (Ach.) Lettau; Parmelia furfuracea var. olivetorina (Zopf) Zahlbr.; Parmelia olivetorina (Zopf) Sandst.; (?) Parmelia olivetorina f. scobinosa (Hillmann) Szatala; Pseudovernia furfuracea var. olivetorina (Zopf) Zopf.

If treated at the rank of an aggregate, which seems a more appropriate rank than variety, the correct name would be P. furfuracea f. candidula (Ach.) ined.

Morphologically the same as var. furfuracea, but medulla C+ red. The two varieties have the same ecology. The C+ reaction of the medulla is always distinct, and var. ceratea can not be confused with var. furfuracea.

Many authors treat var. ceratea as a synonym of var. furfuracea. This view is supported by the fact that they have the same geographical distribution, though the relative frequency of the two chemotypes does vary geographically. Redondo & Reol (1989) discuss the frequency of the two varieties in the Iberian Peninsula; the situation there mirrors, on a smaller scale, that in Europe as a whole, where var. ceratea is the more common variety in the north and the less common in the south. The two chemotypes probably form a single, freely interbreeding population, with the relative frequency of one or a few genes being influenced by environmental factors, in which case var. ceratea would not merit formal recognition. I maintain it here for the practical reason that something with a name will get recorded, thus providing information on the frequency of the two chemotypes, whereas something without a name will not.

Distribution, substrate and altitude range approximately as for var. furfuracea, but in Greece var. ceratea is much less common.

Var. ceratea has the same distribution in Europe as var. furfuracea. Also Macaronesia, western Asia (Turkey) N. Africa (Morocco, Tunisia). Reports for the Western Hemisphere are incorrect.
Pseudoleptogium Müll. Arg. (1885)

*Flora* 68: 516. Type: *P. diffractum* (Kremp. ex Körb.) Müll. Arg., the only species originally included. Family: *Collemataceae*.

Literature: The only species is treated in all the standard Floras, usually as *Leptogium diffractum*.

Pseudoleptogium *diffractum* (Kremp. ex Körb.) Müll. Arg. (1885)


The basionym was published in November 1865. The name *Leptogium placodiellum* Nyl., *Flora* 48: 210, was published on 6 May 1865, may be synonymous, and has priority.

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009); all as *Leptogium diffractum*.

Very scattered, on the eastern side of the mainland. On rock at altitudes 1200 - 1400 m. Southern and central Europe, just reaching Sweden. Also western Asia (Turkey).

Psora Hoffm. (1796)

Deutschl. Fl. 2: 161. The name is conserved against *Psora* Hill (1762) and *Psora* Hoffm. (1789). Type: *P. decipiens* (Hedw.) Hoffm., listed in Appendix of the ICN. Family: *Psoraceae*.

Literature: Monographed by Schneider, in *Biblioth. Lichenol.* 13: 1-291. 1980 (not seen in detail). A basic understanding of the Greek species can be obtained from Clauzade & Roux (1985), Nash et al. (2002), and Nimis & Martellos (2004) taken together. However, published species concepts are proving difficult to apply to Greek collections, and a revision of the genus in southern Europe would be helpful.


The separation from *Protoblastenia* may need further consideration. See the remark under that genus.

Psora has 33 species, on soil and rock especially in dry regions; 10 occur in Europe. Some are common in Greece.

11 Squamules grey. Apothecia red, K+ purple. **P. testacea**
1 Squamules some shade of brown. Apothecia ±black.
22 Squamules pink-brown or red-brown, sometimes with white margin. Medulla K-. **P. decipiens**
2 Squamules brown or green-brown, without a pink tinge (but may have a reddish tinge), margin various. Medulla K+ or K-.
33 Medulla K+ yellow or red, P+ yellow or orange.
44 Squamules to 10 mm wide, usually with a central depression, margin usually down-turned. Upper surface of squamules usually with a reddish tinge. **P. crenata**
4 Squamules 3 - 6 mm wide, concave; margin white, upturned. Upper surface brown or orange-brown, without a red tinge. **P. vallesiaca**
3 Medulla K-, P-.
44 Margin of squamules appearing white, because white lower surface visible. Apothecia ±marginal. **P. pseudorussellii**
4 Margin of squamules not white; lower surface white or dark. Apothecia marginal or laminal.
66 Upper surface brown, sometimes with a red tinge, sometimes paler at margins. Lower surface pale grey. On calcareous rock or soil at high altitudes. **P. globifera**
6 Upper surface green-brown, not paler at margins. Lower surface white. On sandy ground (not strongly calcareous) at Mediterranean altitudes. **P. gresinonis**
5 Epithecium and hypothecium K-. Lower surface of squamules usually brown to dark brown, sometimes white at margins. Thallus round. Apothecia marginal. Hymenium I+ green, orange-brown or blue, KI+ blue. On calcareous rock. See *Romjularia lurida*

Psora *crenata* (Taylor) Reinke (1895)

Descriptions: Clauzade & Roux (1985); Nash et al. (2002).
Crete and Attica at altitudes 0 - 1400 m. None of the published reports cite a substrate.
It is not clear to me whether this species really is present in and around Europe. Nimis (1993) claimed that it is not,
but since then it has been included in published checklists for France, Iberian Peninsula, Russia and Macaronesia. It was reported for Crete by Christensen & Svane (2007). In the careful discussion of the Sonoran species of Psora in Nash et al. (2002), the distribution cited does not include Europe. Greek reports might refer to P. vallesiaca. The matter needs to be clarified.

Elsewhere, reliably reported for Africa (S. Africa), N. America (SW USA), C. America (Mexico), Australasia (widespread). Reports for Asia (Mongolia, China) may be incorrect, as Timdal in Nash et al. (2002) does not mention Asia.

Psora decipiens (Hedw.) Hoffm. (1794)

Descr. Pl. Cl. Crypt. 2(2-4): 63-64; Lichen decipiens Hedw. (1789), Descr. Micr.-Anal. Musc. Frond. 2:7 (and by Ehrhart, Beiträge zur Naturkunde 4: 46; it is not known which was published first); Biatorea decipiens (Hedw.) Fr.; Lecidea decipiens (Hedw.) Ach.; Lecidea decipiens var. alboligandata (Müll. Arg.) Maheu; Lecidea decipiens f. dealbata (A. Massal.) Jatta; (? Lecidea decipiens f. endorubescens Servit; Lecidea decipiens var. galactina Zahlbr.; (?) Lecidea decipiens var. olympica (Gyeln.) Szatala; (?) Lecidea decipiens var. sculpta Zahlbr.; Psora decipiens var. alboligandata Müll. Arg.; Psora decipiens f. dealbata A. Massal.; Psora decipiens var. galactina (Zahlbr.) ined.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

There are published reports of this species from most of Greece and from all altitudes. Most reports are from calcareous soil, a few from calcareous rock. However, some may refer to P. vallesiaca.

Abbott's Peloponnesian collections (Abbott 2009) have been revised and all contain norstictic acid. The thallus colour varies from brown to orange brown (to, in one collection, pink-brown). At present it is not entirely clear to me whether they belong in P. decipiens or P. vallesiaca, but for the present I tentatively refer them to P. vallesiaca. Other authors also appear to have had difficulty with this pair of species; for example, Nimis (1993) states that P. vallesiaca is uncommon in Italy, whereas Nimis & Martellos (2004) state that it is locally common in the south of the country.

At least in the British Is, P. decipiens does not contain lichen products according to Smith et al. (2009). According to Nimis & Martellos (2004) it may rarely contain norstictic acid.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico), S. America (Argentina), Australasia (widespread).

Psora globifera (Ach.) A. Massal. (1852)

Description: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Known from two sites in northern Greece, where it occurred on serpentine at altitudes 1550 - 2070 m.
Throughout northern and central Europe; in the south rare and confined to high mountains. Also Asia (widespread), N. America (widespread), C. America (Mexico), perhaps Australasia.

Psora gresinonis de Lesd. (1930)


Santorini and Crete, on soil at altitudes 0 - 100 m.
Only Mediterranean Europe, from Iberian Peninsula to Greece.

Psora pseudorussellii Timdal (1987)

Bryologist 89(4): 269-271.
Description: Nash et al. (2002).

Crete, overgrowing saxicolous bryophytes at altitudes 700 - 1100 m.
In Europe, apparently only reported for Crete. Also N. America (widespread), C. America (Mexico).

Psora testacea Hoffm. (1790)


Thallus: squamulose, to 2 cm diameter. Squamules: grey to very pale brown, usually heavily white pruinose, 2 - 4 mm diameter, contiguous, sometimes overlapping, 650 µm thick. Lower surface: white to pale brown. Cortex: 70 - 80 µm thick, colourless, diffusing a yellow pigment (probably atranorin) into solution in K. Medulla: white, of fairly densely packed hyphae with no preferred orientation. Lower cortex: absent, but below the medulla is a distinct, pale brown, loosely organised layer 40 - 200 µm thick. Apothecia: 1 - 1.8 mm diameter, strongly convex, often occurring in clusters, not pruinose. Disc: brown-red to dull red, K+ purple. Thalline margin: absent. Exciele: excluded very early, generally not apparent externally, rather poorly developed in section. Epithecium: red-brown, K+ red, diffusing a red pigment into solution where it forms minute dot-like crystals (not norstictic acid). Hymenium: 80 - 100 µm tall, almost

This uncommon but distinctive species can not be confused with any other.

Scattered, mainly in the southern half of the country, at altitudes 20 - 1500 m. Usually on calcareous rock, sometimes on calcareous soil.

Mainly southern and central Europe, but present as far north as southern Sweden. Also Asia (widespread), N. Africa (Morocco, Algeria, Mauretania). Reports for the Western Hemisphere are probably incorrect.

**Psora vallesiaca** (Schaer.) Timdal (1984)


As discussed above under *P. decipiens*, many Greek collections are difficult to place. The description below should therefore be used with caution. For a published description see Nimis & Martellos (2004).

Thallus: squamulose, to 6 cm diameter. Squamules: adpressed, usually ±rounded, 0.5 - 5 mm diameter, 0.25 - 0.5 mm thick, ascending at margins; upper surface brown to orange-brown, often white at margins, not pruinose, sometimes developing a network of cracks in very old squamules. Lower surface white. Vegetative propagules: absent. Cortex: 100 - 220 µm thick, mostly colourless, pale orange-brown in outermost 5 - 10 µm; lowermost 40 - 70 µm of closely packed hyphae with rounded or elongated or lumina and often appearing ±cellular; outer part of widely separated, randomly oriented hyphae. Medulla: white. Lower cortex: absent. Apothecia: often present, usually marginal, convex when mature, 0.5 - 1.5 (1.8) mm diameter, not pruinose. Disc: usually black, occasionally dark red-brown or dark brown. Thalline margin: absent in mature apothecia; sometimes obscurely present on lower surface of young apothecia.

Exciple: excluded early. Epithecium: brown to dark brown, K-, pigment not soluble in K. Hymenium: 70 - 75 µm tall, colourless to pale brown or pale red-brown. Hypothecium: colourless to pale brown. Paraphyses: coherent, ±moniliform. Ascospores: colourless, simple, ellipsoid, 10 - 12 x 5 - 7 µm, 8 per ascus. Chemistry: cortex K-, medulla C-, K+ yellow, orange or red (norstictic acid), P+ yellow or orange, I-; thallus C-, UV-. Photobiont: green; cells globose, 7 - 10 µm diameter, forming a continuous, regular layer 0 - 60 µm thick.

Widely distributed, mainly in the southern half of Greece. On calcareous rock or calcareous soil at altitudes 70 - 1200 m.

Essentially a species of dry, continental habitats. Fairly common in southern Europe, but there are scattered reports to as far north as the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (widespread outside the tropics), N. America (Alaska, arctic Canada).

**Psoroma Ach. ex Michx. (1803)**


Literature: The best treatment of the European species is in Ahti et al. (2007). The widespread *P. hypnorum* is treated in all the standard Floras.

About 30 species, 3 of which occur in Europe. Two are distinctly northern and will not occur in Greece.

**Psoroma hypnorum** (Vahl) Gray (1821)


Descriptions: Ahti et al. (2007); Burgaz et al. (2010); Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

The only Greek report is from an unidentified locality in Thrace. No altitude or substrate was published.

Widespread in northern and central Europe, very rare south of the Alps. Also Macaronesia, Asia (widespread), Malesia (PNG), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (SE Australia, NZN, NZS), Antarctica (widespread).

**Psorotichia A. Massal. (1855)**

Framm. Lichenogr. 15. Type: *P. murorum* A. Massal., the only species originally included. Family: *Lichinaceae*.


About 40 names at species level are presently referred to *Psorotichia*, but the genus is poorly known, many names are probably synonyms, and some species may belong elsewhere. Species of *Psorotichia* occur on calcareous rock.
11 Ascospores 16 - 32 per ascus.  (P. suffugiens), (P. taurica)
1 Ascospores 8 per ascus.
22 Ascospores Æglobose.  (P. frustulosa) Greek report doubtful.
2 Ascospores distinctly ellipsoid.
333 Thallus almost continuous, not pruinose.
44 Ascospores 6 - 7 µm long.  (P. incrustans)
4 Ascospores 8 - 14 µm long.  P. montinii
3 Thallus of Ædispersed granules, not pruinose.  P. numidella s. lat.
44 Epithecidium colourless.  (P. numidella var. numidella)
4 Epithecidium blue-green P. numidella var. flageyana
2 Thallus areolate, squamulose-areolate or squamulose, pruinose or not.
444 Ascospores 9 - 10 x 5 - 6 µm.  Thallus not pruinose.  (P. obtenebrans)
44 Ascospores 10 - 15 µm long.  Thallus pruinose.  (P. diffracta), (P. granulosa)
4 Ascospores 10 - 20 µm long.  Thallus pruinose or not.
55 Thallus pale brown when moist, not distinctly granular, not pruinose.  P. vermiculata
5 Thallus dark brown when moist, distinctly granular, pruinose or not.
66 Areoles finely granular.  Apothecia 0.2 - 0.6 mm diameter.  Disc red-brown.  Thallus sometimes pruinose.  P. schaereri
6 Areoles coarsely granular.  Apothecia 0.1 - 0.2 mm diameter.  Disc black-brown.  Thallus not pruinose.  P. murorum

Psorotichia montinii  (A. Massal.) Forsell  (1885)
Beitr. Gloeolich. 73;  Thelochroa montinii  A. Massal. (1855), Symm. Lich. Nov. 86.
Descriptions:  Clauzade & Roux (1985); Nash et al. (2007).
This species has been treated as Thelochroa montinii in most recent checklists, but it does not belong to that genus.
It may not belong to Psorotichia either, but its correct position is not clear at present.
Very scattered, never far from the sea.  On limestone at altitudes 0 - 50 m.
Scattered in southern and central Europe.  Also Macaronesia, N. Africa (Morocco), N. America (Arizona, California), Caribbean (PR), C. America (Mexico).

Psorotichia murorum  A. Massal.  (1855)
Framm. lichenogr. 15;  Collemopsis murorum (A. Massal.) Stizenb.
Amorgos, on limestone at an altitude of 190 m.
Southern and south-central Europe, but avoiding regions with a strongly continental climate.  Also Asia (Turkey, Taiwan), northern Africa (Morocco, Algeria, Socotra), N. America (Arizona), C. America (Mexico), S. America (Galapagos Is).

Psorotichia numidella var. flageyana  J. Steiner  (1898)
Description:  Nash et al. (2007).
Peloponnese, on limestone at an altitude of 20 m.  Not reported for Greece since 1898.
Only Greece, N. Africa and Mexico.

Psorotichia schaereri  (A. Massal.) Arnold  (1869)
Descriptions:  Ahti et al. (2007); Clauzade & Roux (1985) as Collemopsis schaereri; Nash et al. (2007); Smith et al. (2009).
Very scattered on Crete and the mainland.  On calcareous rock at altitudes 50 - 1700 m.
Reported from most areas of Europe.  Also Asia (widespread), Africa (widespread in N. Africa; also Socotra, St Helena), N. America (widespread), C. America (Mexico), Antarctica (S. Georgia, though that may be a different taxon).

Psorotichia vermiculata  (Nyl.) Forsell  (1885)
Beitr. Gloeolich. 73;  Collemopsis vermiculata Nyl. (1881), Flora 64: 529.
Description:  Clauzade & Roux (1985).
Crete, on limestone close to sea level.
A rarely recorded species of southern and south-central Europe. Also Asia (Syria, Yunnan).

Pterygiopsis Vain. (1890)


Literature: There is no monograph, and information is very scattered. Ahti et al. (2007) and Smith et al. (2009) give brief introductions to the genus, but do not discuss the species of Mediterranean regions.

About 18 species are presently placed here, but the genus is poorly known and some may belong elsewhere. About 4 species occur in Europe, but only one is reported for Greece.

11 Ascospores 8 - 12.5 x 6 - 7 μm, 8 per ascus. (P. atra)
1 Ascospores 4 - 7 x 3 - 4 μm, 12 - 32 per ascus. *P. affinis*

Pterygiopsis affinis (A. Massal.) Henssen (1979)


Description: Clauzade & Roux (1985) as *Forssellia affinis.*

Crete, on limestone close to sea level.

Southern and south-central Europe. Also SW Asia (Yemen), N. Africa (Morocco).

Punctelia Krog (1982)

*Nordic J. Bot.* 2: 290. Type: *P. borreri* (Sm.) Krog. Family: *Parmeliaceae.*

Literature: There is no unified treatment of the European species, but van Herk & Aptroot (2000) monograph the European sorediate species with lecanoric acid; this group includes the only Greek species. Also helpful are Nash et al. (2004), Smith et al. (2009), and van Herk & Aptroot (2004).

About 42 species, of which 8 occur in Europe. Species that are likely to occur in Greece have soredia and lack isidia or corticate isidia-like structures.

The medulla reacts C+ pink-red in all species included in the key.

11 Lower surface black.
22 Upper surface of lobes with a brown tinge, especially towards margins. Pseudocyphellae laminal and marginal. On rock. (P. stictica)
2 Upper surface uniformly grey, without brown tinge (except sometimes for a thin dark margin). Pseudocyphellae laminal. Usually on bark, occasionally on rock. (P. borreri)
1 Lower surface white to pale brown.
22 Upper surface wrinkled or ridged. (P. perreticulata)
2 Upper surface ±smooth.
33 Thallus grey or with a slight green tinge. Soralia predominantly laminal. *P. subrudecta*
3 Thallus with a distinct green tinge. Soralia developing at lobe margins, though they may later spread onto lobe surface. (P. jeckeri)

Punctelia subrudecta (Nyl.) Krog (1982)


The earliest name may be *Lichen dubius* Wulf. (1790), making the correct name *Punctelia dubia* (Wulf.) ined. Wulfen’s name was overlooked because *Parmelia dubia* (Wulf.) Schaer. is illegitimate (later homonym).


Scattered in northern Greece, on bark at altitudes 0 - 160 m.

Widespread in Europe. Also Macaronesia, Asia (widespread), Africa (widespread), Australasia (widespread), Antarctica (St. Paul Island). Probably absent from the Western Hemisphere is unclear.
Pycnora Hafellner (2001)


Literature: There is no monograph.

At present, three species have been referred here. All occur in Europe, but two have a northern distribution and are unlikely to be present in Greece.

Pycnora praestabilis (Nył.) Hafellner (2001)

Description: Nash et al. (2002) as *Hypocenomyce praestabilis*.

Known from two sites in northern Greece, on wood at altitudes 1350 -1800 m. Widespread in central Europe, ranging as far north as southern Norway, but rare south of the Alps. Also Asia (Russia), N. America (widespread in USA), C. America (Mexico).

Pyrenidium Nyl. (1865)

*Flora* 48: 210. Type: *P. actinellum* Nyl., the only species originally included Family: *Dacampiaceae*.

Literature: Information is scattered. Clauzade, Diederich & Roux (1989) treat many of the species, though sometimes under different generic names.

About 11 species of lichenicolous fungi, of which 4 have been reported for Europe. There is only a single Greek report.

11 Ascospores 16 - 24 x 7 - 11 µm, ±ellipsoid, not or scarcely constricted at septa, becoming brown only when mature.
(P. crozalsii)
1 Ascospores 19 - 34 x 7 - 12 µm, central cells distinctly broader than end ones, distinctly constricted at septa, becoming brown when young. *P. actinellum*

Pyrenidium actinellum Nyl. (1865)


Description: Clauzade, Diederich & Roux (1989).

Skyros, on *Diploschistes euganeus* at an altitude of 100 m. Probably throughout Europe. Also Macaronesia, Asia (Turkey, Russia, India, China), southern Africa (Zambia, S. Africa), N. America (Alaska, Arizona, Minnesota, Pennsylvania), Caribbean (Jamaica, Virgin Is), C. America (Mexico), S. America (Chile, Colombia), .Australasia (NSW, NZS).

Pyrenopsis (Nył.) Nyl. (1858)


Literature: Ahti et al. (2007) is a good starting point, but Clauzade & Roux (1985) is sometimes better for southern Europe.

The genus is not well understood. About 39 names at species rank are presently included, 19 of them reported for Europe, but many are poorly known and may be synonymous with other taxa. *Pyrenopsis* is best represented in cold and temperate regions, and only one species has been reported from Greece, where the genus is very rare.

11 Thallus small-fruticose. (P. conferta). This species may belong in *Synalissa*.

1 Thallus crustose.

22 Ascii 16 - 32 -spored. (P. picina)
2 Ascii 8-spored.

33 Thallus granular. (P. micrococca), (P. triptococca)
3 Thallus cracked or areolate. *P. subareolata*

Pyrenopsis subareolata Nyl. ex Cromb. (1894)


Description: Ahti et al. (2007); Smith et al. (2009).
Paros, on siliceous rock (granite) at an altitude of 25 m.
Mainly NW Europe; rare south of the Alps, but present in Corsica, Italy and Greece. Also Macaronesia, Asia (Turkey), I am sceptical of a report for Taiwan.

**Pyrenula Ach. (1814)**


Literature: Smith et al. (2009) treat all the species that are likely to occur in southern Europe.

About 220 species, mostly corticolous, best developed in tropical regions. Fifteen species occur in Europe, but most reports are from humid western regions. The genus is rare and poorly represented in Greece.

All species included in the key have 3-septate ascospores.

11 Involucrellum distinctly extended laterally, separated from exciple. Exciple not continuous below perithecial cavity. Ascospores 10 - 17 x 4 - 6 μm. (*P. coryli*)

1 Involutellum not, or only slightly, extended laterally; not separated from exciple. Exciple continuous below perithecial cavity. Ascospores various.

22 Thallus ± white. Perithecia flattened. (*P. laevigata*)

2 Thallus green, brown or yellowish. Perithecia ± globose.

33 K+ purplish crystals present on perithecial surface or lining perithecial cavity. Most ascospores 19 - 26 μm long.

44 Perithecia 0.6 - 0.8 mm diameter. **P. nitida**

4 Perithecia 0.2 - 0.3 mm diameter. **P. nitidella**

3 Without K+ purplish crystals. Most ascospores 27 - 33 μm long.

44 Perithecia 0.2 - 0.3 mm diameter, forming very low projections in the thallus or not forming projections. **P. chlorospila**

4 Perithecia more than 0.4 mm diameter, distinctly emergent. **P. macrospora**

**Pyrenula chlorospila** Arnold (1887)

*Flora* 70: 155; *Verrucaria chlorospila* Nyl.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, on the islands. On bark at altitudes 0 - 650 m.

Widespread in Mediterranean regions with humid or subhumid climate, and in suboceanic parts of western Europe; rare elsewhere in Europe. Also Asia (widespread), Africa (Morocco, Algeria, Tunisia, perhaps S. Africa). There are reports for N. America, Caribbean, C. America, S. America, Australasia under names that may be synonyms.

**Pyrenula macrospora** (Degel.) Coppins & P. James (1980)


Thallus: crustose, grey-green, smooth, continuous, not pruinose, to a few cm. diameter. Pseudocyphellae: white, mostly punctiform, 0.1 mm diameter. Perithecia: black, distinctly emergent when mature, globose, 0.4 - 0.5 mm diameter. Exciple: 100 μm wide (including involucrellum), black, opaque. Involucrellum: not distinguishable from exciple. Paraphyses: persistent. Ascospores: pale brown to dark brown, darkening as they mature, 3-septate, with angular lumina, 31 x 13 μm. Photobiont: Trentepohlia.

The only Greek report at the time was not accepted by Abbott (2009), who suspected confusion with *P. chlorospila*, but a recent collection from Alonisos fits *P. macrospora* (perithecia distinctly emergent, 0.4 - 0.5 mm diameter). However, *P. macrospora* is close to *P. chlorospila*, apparently differing only in the more emergent and slightly larger perithecia. It could perhaps be subsumed under that species, and was regarded as a variety of *P. chlorospila* by Maas Geesteranus.

Islands of Alonisos and Naxos, on bark at altitudes 280 - 500 m. The only phorophyte explicitly reported is *Quercus ilex*.

Mainly western Europe, but also reported for southern Italy and the Caucasus. Also Macaronesia (widespread), western Asia (Turkey).

**Pyrenula nitida** (Weigel) Ach. (1814)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Rare and scattered in northern Greece. On bark at altitudes up to 1500 m.

Widespread in Europe, but rare south of the Alps. Also Macaronesia, Asia (widespread), perhaps Malesia (old
Pyrenula nitidella (Flörke) Müll. Arg. (1885)

Bot. Jahrb. 6: 414; Verrucaria nitida (= indefinite rank) nitidella Flörke (1815), Deutsche Lichenen no. 10; Pyrenula nitida var. nitidella (Flörke) Schær.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in NW Greece. On bark at altitudes 20 - 400 m.

Widespread in Europe. Also Asia (southern Siberia, perhaps elsewhere), Africa (Morocco, perhaps elsewhere), perhaps Caribbean (Bermuda), Pacific (Hawaii, New Caledonia). Some reports for S. America are definitely incorrect; the status of others is not clear to me.

**Pyrrhospora Körb. (1855)**

Syst. Lich. Germ. 209. Type: *P. querna* (Dicks.) Körb., the only species originally included. Family: *Lecanoraceae*.

Literature: The only Greek species is discussed in all the standard Floras.

As presently delimited *Pyrrhospora* contains 7 species, 2 of which occur in Europe. Only one is likely to occur in Greece.

**Pyrrhospora querna (Dicks.) Körb. (1855)**

Syst. Lich. Germ. 209 + tab 1 + fig 7; Lichen querneus Dicks. (1785), Fasc. Pl. Crypt. Brit. 9; Biatora querna (Dicks.) Fr.

Thallus: crustose, to 5 cm diameter, entirely sorediate, 50 - 80 µm thick. Prothallus: sometimes present at border, black, 0.2 mm wide. Soralia: dull green. Cortex: absent. Medulla: white, 10 - 50 µm thick. Apothecia: sessile, soon becoming convex, 0.35 - 0.6 mm diameter, not pruinose. Disc: brown to black. Thalline margin: absent. Exciple: not visible externally; in section: sometimes poorly developed, when well developed 30 - 35 µm wide, colourless in inner part, brown at surface, of radiating hyphae. Epithecium: orange-brown to brown, K+ diffusing red-purple pigment into solution, brown pigment soluble in K. Hymenium: 50 - 55 µm tall, colourless. Subhymenium: 40 µm tall, colourless to very pale brown. Hypothecium: 40 µm tall, colourless, pale orange-brown or brown, K+ red-purple in places. Paraphyses: simple, 1 µm wide in lower part, 1 - 1.5 µm at apex. Asci: 37 - 50 x 13 - 20 µm, subglobose, broadly clavate or clavate, Lecanora type. Ascospores: colourless, simple but often with 2 distinct locules, ellipsoid, 10 - 12 x 5 - 7 µm, 8 per ascus. Chemistry: soralia K-, C+ orange, KC+ orange, P-, UV+ orange. Photobiont: green.

This distinctive species is unlikely to be confused with any other.

Scattered throughout Greece, usually close to the sea. Usually on bark, occasionally on wood, at altitudes 0 - 1280 m, but commonest below 400 m.

Throughout Europe, to as far north as southern Scandinavia, wherever the climate is not too continental. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico).

**Ramalina Ach. (1809)**


Literature: There is no monograph for Europe. Good starting points are Clauzade & Roux (1985) and Smith et al. (2009). The group of species near *R. panizzei* are discussed by Groner & LaGreca (1997). Stevens (1987) has a good discussion of the anatomy, morphology and chemistry of the genus, though she treats only Australian species.

Thallus: fruticose, grey-green, erect or pendent, a few to many cm long. Branches: flattened in most species, solid or hollow. Soralia: present in some species. Isidia: present in a few species. Apothecia: usually slightly stalked, fairly large (typically 0.5 - 5 mm diameter). Disc: pale green, green-brown or brown, white pruinose in some species. Thalline margin: present, usually fairly thin; in section with prominent cortex formed of anastomosed hyphae. Exciple: not visible externally, usually rather poorly developed in section. Epithecium: colourless, or with brown or grey pigment, often in granules. Hymenium: not very tall (typically about 50 µm), colourless in upper part, often with slight yellow-brown tinge in lower part. Hypothecium: not tall (typically about 25 - 35 µm), pale yellow-brown. Paraphyses: simple, 1 µm wide at base, 2 - 4 µm at apex, sometimes slightly capitate. Asci: rather small (to about 50 x 15 µm), usually clavate, Bacidia type. Ascospores: colourless, 1-septate, ellipsoid, straight or curved, fairly small (to about 20 µm long), 8 per ascus. Chemistry: medulla I-; other reactions various, but many species reacting entirely negatively in spot tests. Photobiont: green, trebouxoid.

Detailed anatomical study of the thallus, and to a lesser degree the apothecia, are handicapped in this genus by the difficulty of cutting good thin sections.
Asci are said to be Bacidia type. In practice, it is usually difficult to distinguish between Biatora and Bacidia type asci, especially when asci are small, as in *Ramalina*. In the descriptions below, when asci are described as Bacidia type it means only that I observed a KI+ blue apical dome with a KI-central region that does not reach the top of that dome; i.e. observations indicate “Biatora or Bacidia” type.

About 270 species, usually on bark (acidic or basic) or siliceous rock. The genus is subcosmopolitan in distribution. About 50 species may be present in Europe, but the precise number is uncertain owing to taxonomic difficulties. In Greece, *Ramalina* often forms a conspicuous element of the epiphytic flora, but this is caused by just a few common species. Many Greek species are known from very few records.

Most species of *Ramalina* are morphologically variable, and some are chemically variable. As a result, some collections are difficult to place. Scanty collections are often indeterminable. Some of the southern European species are not well understood, which adds to the difficulties.

*R. dalmatica* Zahlbr., *R. nuda* J. Steiner and *R. pontica* Vězda, all of which are reported for Greece, are not included in the keys, as I have insufficient information. *R. scoriseda* Zahlbr. is included, but as one of a group of species that needs revision; the group is not keyed out to individual species. The key does not properly include *R. euxini*, not reported for Greece but present in Bulgaria, as the only published description, that in the protologue, is inadequate for this genus, in which many species are very variable.

**Key to Ramalina main groups**

11 Thallus pendent, of many thin branches, like Alectoria.

22 Thallus with a yellowish tinge. Medulla K+ yellow > reddish, P+ orange or red. Soralia absent. Pseudocyphellae common, elongate. *(R. arambii)*

2 Thallus pale green-grey. Medulla K-, P-. Soralia common. Pseudocyphellae rare. *R. thrausta*

1 Thallus erect or pendent, not resembling Alectoria.

22 Soralia and/or isidia present. Group 1.


33 Apothecia only at branch tips. Group 2.

3 Apothecia not restricted to branch tips. Group 3.

(1) If apothecia are absent, and the material is clearly not juvenile, consider *Evernia divaricata*.

**Key to Ramalina group 1**: Branches not very thin; vegetative propagules present.

11 Soralia forming on inside surfaces of lobes. Branches becoming hollow and splitting open.

22 Soralia formed on inside of inflated structure at apex of branches. *R. obtusata*

2 Soralia not confined to apex of branches; apex not inflated. *R. canariensis*

1 Soralia forming on outer surface of lobes. Branches solid or hollow, but not normally splitting open.

22 Main branches perforated with small holes. Main branches to 1 (2) mm wide, dividing into many fine branches and thallus sometimes appearing almost coralloid. Soralia mainly at ends of branches. *R. roesleri*

2 Main branches without (or almost without) holes, more than 1 mm wide in some species, divided or not; thallus not coralloid. Soralia at ends of branches or not.

33 Branches with distinct longitudinal ridges. Thallus erect. On non-calcareous rock.

44 True soralia absent, but corticate granules resembling soralia often present. Granules and apothecia marginal and laminal. Branches to 6 cm long. *R. polymorpha* Note 1.

4 True soralia often present. Soralia and apothecia mostly near the apices. Branches to 2 cm long. *R. capitata* s.lat. The varieties below are not sharply distinct from each other.

55 Soralia ±globose, sometimes capitulate.

66 Main branches finely divided into small branchlets, with very small terminal soralia. *R. capitata* var. *digitellata*

6 Main branches not finely divided into small branchlets. Soralia larger. *R. capitata* var. *capitata*

5 Soralia labriform. *R. capitata* var. *protecta*

3 Branches without longitudinal ridges. Thallus erect or pendent. On bark or rock.

44 Thallus of one, or very few, branches.

55 Thallus rigid. Medulla K+ yellow to red, P+ dark yellow. On rock. *(R. maciformis)*

5 Thallus flexible. Medulla K-, P-. Usually on bark, occasionally on rock. *R. lacerata* Note 2.

4 Thallus of several to many branches.

55 Granular isidia present, not associated with soralia. On non-calcareous rocks, usually near the sea. *R.
requienii

5 Isidia absent, or if present then associated with soralia. On various substrates.
66 Soralia round, clearly delimited, K+ or K-, P+ yellow to orange or P-
77 Holdfast simple. On bark, not forming extensive swards. **R. farinacea**
7 Holdfast spreading. On rock, usually forming extensive swards. **R. subfarinacea**
6 Soralia irregularly round or long, becoming confluent, K-, P-. Often shade-tolerant.
77 Soralia not turned downward. On bark or rock. **R. pollinaria** Note 2.
7 Larger soralia turned downward; soredia then produced mainly on underside of ±horizontal lobes. On bark in coastal regions. (R. hyrcana)

(1) In **R. polymorpha**, medulla and soralia react K-, P-. The poorly known **R. euxini** might also key out here. It is said to be close to **R. polymorpha** but with K-, P+ yellow medulla and soralia and narrower lobes.

(2) **R. lacera** and **R. pollinaria** are variable, and many characters overlap. However branches in **R. lacera** are matt whereas those in **R. pollinaria** are shiny.

**Key to Ramalina group 2:** Branches not very thin; vegetative propagules absent; apothecia only at tips of branches.

11 Branches very hollow and swollen.
22 Pseudocyphellae absent. On bark. **R. pusilla**
2 Pseudocyphellae present, round or elongated. On siliceous rock. **R. clementeana**
1 Branches solid or slightly hollow, if hollow then not swollen. Apothecia all at approximately the same level.
22 On bark. Thallus usually ±erect.
33 Branches distinctly channeled, especially in lower parts. Surface smooth. Lobes often more than 5 cm long.
   Ascospores ellipsoid, not curved. Pseudocyphellae present or absent. **R. calicaris**
3 Branches usually not channeled (occasionally, a few branches may be slightly channeled). Surface ±longitudinally striate. Lobes less than 5 cm long. Many ascospores slightly curved (reniform).
   Pseudocyphellae absent. **R. fastigiata**
2 On non-calcareous rock.
33 Branch tips distinctly blackened. Apothecia partly blackened. **R. carpatica**
3 Branches and apothecia not blackened. **R. breviuscula**

**Key to Ramalina group 3:** Branches not very thin; vegetative propagules absent; apothecia not restricted to tips of branches.

11 On bark.
22 Upper and lower surfaces of branches with elongate pseudocyphellae (size variable, but 0.5 x 0.05 mm is typical)
   (Note 1). Thallus pendent, often very long when mature. Branches solid, flattened, with many ridges or wrinkles. Ascospores distinctly curved. Fairly common throughout Greece. **R. fraxinea** s. lat.
33 Lobes usually robust, broad and flattened. Apothecia marginal and laminal. **R. fraxinea var. fraxinea**
3 Lobes slender, channeled at least in lower half. Apothecia marginal or subterminal. **R. fraxinea var. calicariformis**
2 Pseudocyphellae absent, or present on outer surface only, or if present on both surfaces then often punctiform and indistinct. Thallus pendent or erect, length various. Branches solid or hollow, flattened or rounded, wrinkled or smooth. Ascospores straight or curved. Much less common.
33 Branches channeled, especially at the base.
44 Thallus solid, without perforations or fenestrations. Pseudocyphellae sometimes present. Ascospores straight. **R. calicaris**
4 Thallus hollow, with perforations and/or fenestrations. Pseudocyphellae absent. **R. subgeniculata**
3 Branches not channeled (but surface may be ridged). Note 2.
44 Branches round or only slightly flattened in cross-section.
55 Fenestrations often present. Medulla partly hollow. Cortex often disintegrating or cracked. Thallus K-, P-
   . **R. panizzei**
5 Fenestrations absent. Medulla solid. Cortex not disintegrating. Thallus K+, P+ or K-, P-. **R. implectens**
4 Branches distinctly flattened in cross-section.
55 Thallus rigid. Pseudocyphellae usually absent.
66 Thallus of many long and narrow branches. **R. elegans**
6 Thallus of few ± short and broad branches. **R. lusitanica**

5 Thallus not very rigid. Pseudocyphellae present on outer surface. **R. sinensis**


(1) Pseudocyphellae provide the only characters that do not overlap with the next branch. They are always present, but may be scarce and/or inconspicuous. In case of difficulty, the other characters combined are usually sufficient for a reliable determination, though individually they may be ambiguous.

(2) The part of the key that follows may be unsatisfactory. The relations between some of these species have not been clearly worked out, and I have not found much helpful information in the literature.

(3) This group is in need of revision. It seems unlikely to me that there really are six distinct species. Published information is scanty, and perhaps unreliable, so I am not willing to extend the key.

**Ramalina breviuscula** (Nyl.) Nyl. (1872)


Description: Clauzade & Roux (1985).

Peloponnese and islands of the southern Aegean, including Crete. On siliceous rock at altitudes 25 - 1000 m.

Mainly southern Europe, from Iberian Peninsula to Cyprus, though also present in Bulgaria. Also western Asia (Turkey). A report for N. America (Quebec) seems doubtful to me.

**Ramalina calicaris** (L.) Fr. (1824)

Sched. Crit. (fasc. 1 - 4), page 17; *Lichen calicaris* L. (1753), *Sp. Pl.* 1146. (The name has a conserved type.);

*Ramalina calicaris var. canaliculata* Hornem., nom. superfl.; (?) *Ramalina calicaris var. sorediosa* Sambo; (?) *Ramalina graeca* Mull. Arg.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Throughout Greece. On bark at altitudes 25 to about 1800 m. Most reports are old, and some may refer to *R. fraxinea var. calicariformis*.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread outside tropics), perhaps Pacific (Fiji, Hawaii, New Caledonia, Tahiti). Reports for the Western Hemisphere and for Australasia are said to be incorrect.

**Ramalina canariensis** J. Steiner (1904)


Easily recognised when soralia are well-developed. Often intermixed with immature specimens which lack soralia, and if these were to occur alone they would not be determinable.

Fairly common in sites with a maritime climate, never far from the sea. Usually on bark, occasionally on siliceous rock. At altitudes 0 - 780 m, but half of reports are from below 200 m.

Widespread in those parts of Europe with a mild or warm maritime climate. Also Macaronesia, western Asia (Turkey, Syria, Iran), Africa (Morocco, Tunisia, S. Africa), N. America (California), C. America (Mexico), S. America (Chile), Australasia (widespread).

**Ramalina capitata** (Ach.) Nyl. (1872) **var. capitata**


Descriptions: Clauzade & Roux (1985) as *R. polymorpha* subsp. capitata; Smith et al. (2009).

Morphs with labriform soralia along the lobe margins, in addition to the usual soralia near the lobe ends, are sometimes distinguished as *R. strepsilis*.

Reports without indication of variety are placed here, by default. Northern Greece and Naxos, on granite and serpentine. Reported altitudes are 1250 - 2150 m, but the Naxos report must have been from a lower altitude.

Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco,
perhaps Ethiopia), perhaps N. America (Arkansas).

**Ramalina capitata var. digitellata** (Nyl.) Nimis (1993)
Lich. Italy 597; Ramalina digitellata Nyl. (1880), Flora 63: 10.
*Description:* Nimis (1993) under discussion of *R. polymorpha*.
Rhodes, on bark at an altitude of 50 m. As this taxon is usually saxicolous, the report seems doubtful.
Southern Europe, from Portugal to Cyprus. Also N. Africa (Morocco).

**Ramalina capitata var. protecta** (H. Magn.) Nimis (1993)
*Description:* Clauzade & Roux (1985) as *R. polymorpha* var. *protecta*.
Paros, on gneiss at an altitude of 700 m.
Southern Europe, from Portugal to Greece. Also western Asia (Turkey).

**Ramalina carpatica** Körb. (1870)
*Description:* Şenkardeşler & Calba (2011)
Rare in northern Greece and Thasos, on siliceous rock at altitudes around 1600 m.
Except for the two Greek records, all European reports are from central Europe, from Germany to Ukraine. Also western Asia (Turkey).

**Ramalina clementeana** Llimona & Werner (1975)
Acta Phytotax. Barcinon. 16: 9; Ramalina cribrosa f. fastigiata (De Not.) Szatala.
*Descriptions:* Clauzade & Roux (1985); Nimis & Poelt (1987). This species is close to *R. pusilla*, of which it may just be a saxicolous morph.
Milos, on rock (unspecified) at an altitude of 750 m.
Southern Europe, from Portugal to Greece. Also N. Africa (Morocco).

**Ramalina dalmatica** J. Steiner & Zahlbr. (1903)
*Description:* See the protologue. I have not found any other description in the literature, and the species is poorly known. The protologue describes a sorediate species with a hollow medulla. It does not clearly match any of the species included in the keys. Although the protologue is extensive, I am not willing to include this species in the keys until I have seen a modern description based on authentic material.
Rhodes, on bark of *Cupressus* at an altitude of 700 m.
Only Corsica, Croatia and Greece.

**Ramalina elegans** (Bagl. & Car.) Stizenb. (1891)
*Description:* Clauzade & Roux (1985).
Scattered in northern Greece. (A report for Rhodes is disjunct and may be unreliable.) On bark at altitudes 400 - 1100 m.
A rather uncommon, or perhaps just rarely recognised species with its centre of distribution in central Europe. Its range extends north into southern Scandinavia, and south into the Balkans and northern Greece. Probably absent from regions with true Mediterranean vegetation. I have not seen any reports for other continents.

**Ramalina farinacea** (L.) Ach. (1810)
Lichenogr. Universalis 606; Lichen farinaceus L. (1753), Sp. Pl. 1146; Ramalina farinacea var. flavescens Räsänen; Ramalina farinacea f. gracilenta (Ach.) Nyl.; Ramalina farinacea β R. (= var.) gracilenta Ach.; Ramalina farinacea f. multifida (Ach.) Nyl.; Ramalina farinacea δ R. (= var.) multifida Ach.; Ramalina farinacea var. normalis Räsänen; (?) Ramalina farinacea var. nuda Bory; Ramalina farinacea f. pendulina (Ach.) Nyl.; Ramalina farinacea ε R. (= var.) phalerata (Ach.) Ach.; Ramalina farinacea var. reagens de Lesd.
Thallus: fruticose, grey-green. Branches: erect to slightly pendent, 2 - 7 cm long, 1 - 3 mm wide, 0.2 - 0.5 mm thick, solid or hollow. Isidia: sometimes present on soralia, never independent. Soralia: nearly always present, usually marginal, concave when young, sometimes flat later, delimited, circular or slightly elongated along the branch length,
0.3 - 1 x 0.8 - 1.8 mm, soredia 50 µm diameter. Cortex: 50 - 90 µm thick, colourless to very pale brown, of thin hyphae in two layers; those in inner layer usually vertical, occasionally of no preferred orientation, those in outer layer horizontal, parallel to main axis of branch. Medulla: white; in section: of loosely interwoven, broad hyphae, 2.5 - 4 µm wide, without visible septa, usually smooth but sometimes covered by small, colourless crystals less than 1 µm diameter. Chemistry: medulla K- or K+ red, C-, P+ orange, I-; soralia K- or K+ red, C-, KC-, P+ yellow or orange, UV-; thallus K-, C-, KC-, P-, UV-. Photobiont: green; cells globose, 9 - 13 µm diameter, sometimes forming clusters. Photobiont layer: 125 - 200 µm thick, sometimes slightly irregular, sometimes slightly discontinuous.

I have observed only two chemotypes in Greece, though my observations are biased towards the south of the country. In one the soralia react K-, P+ yellow or orange, in the other K+ red, P+ yellow or orange. The K+ red reaction is accompanied by the formation of small, rounded crystals in section, said to be salazinic acid. I have not observed norstictic acid, though it is said to be sometimes present in small amounts. Other chemotypes are said to exist in this species (see Smith et al. 2009), but they have not been reported for Greece.

A fairly distinctive species, characterised by the numerous rather narrow branches with many delimited, rounded soralia. *R. subfarinacea* is similar but usually saxicolous; for other differences, see the key.

Throughout Europe except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (widespread outside tropics), N. America (widespread), Caribbean (Guadeloupe; perhaps Bahamas and Cuba), C. America (Mexico), perhaps Pacific (Hawaii, Tahiti, W. Samoa). Reports for S. America and Australasia said to be incorrect.

**Ramalina fastigiata (Pers.) Ach. (1810)**

Lichenogr. Universalis 603;  *Lichen fastigiatus* Pers. (1794), Annln Bot. (Usteri) 7: 156;  *Ramalina fastigiata var. multipartita* Erichsen;  *Ramalina fraxinea var. fastigiata* (Pers.) Fr.

Thallus: fruticose, grey-green, usually forming clumps to about 4 cm diameter. Branches: erect, 2 - 3 cm long, 0.5 - 6 mm wide, distinctly flattened, sometimes hollow (especially immediately below apothecia), sometimes with a few holes, not swollen, with many longitudinal wrinkles, folds or low rounded ridges, not or only weakly channelled. Soralia: absent. Cortex: 25 - 80 µm thick, colourless or almost, formed of thin anastomosed hyphae, usually in two layers; lower layer usually well developed, with predominantly vertical hyphae; upper layer commonly thin or poorly developed, with predominantly horizontal hyphae; lower layer may extend down into photobiont layer, especially where that layer is discontinuous. Medulla: white, of loosely interwoven hyphae (very loose in central part of branches). Apothecia: always present, apical, usually concave to flat, less often slightly convex, 0.5 - 4.5 mm diameter. Disc: pale brown but often entirely obscured by white pruina. Thalline margin: thin but persistent; in section: 60 µm wide of which cortex 40 µm; cortex of anastomosed hyphae oriented predominantly perpendicular to surface. Exciple: not visible externally; in section: 25 - 40 µm wide, colourless to pale brown, sometimes only slightly darker than hymenium, of anastomosed hyphae on a basically radiating trend. Epithecium: brown to grey-brown, K- or K+ faintly violet, N-, brown pigment soluble in K leaving a grey residue. Hymenium: 50 - 60 µm tall, colourless in upper part, very pale yellow brown in lower part, pigment K-, not soluble in K. Hypothecium: 25 - 35 µm mostly very pale yellow-brown, pigment K-, not soluble in K. Paraphyses: simple, 1 µm wide at base, 2 - 4 µm at apex, sometimes slightly capitulate, occasionally slightly moniliform. Ascii: 45 - 50 x 12 - 15 µm, clavate to almost cylindrical, Bacidia type. Ascospores: colourless, 1-septate, basically ellipsoid but often curved, 12.5 - 14 x 5 - 8 µm, 8 per ascus. Chemistry: medulla KI-; thallus K-, C-, KC-, P-, UV- (or almost). Photobiont: green, cells globose, 7 - 10 µm diameter. Photobiont layer: 100 - 300 µm thick, ±continuous, but often irregular especially at upper margin.

The upper part of the cortex, where hyphae are predominantly horizontal, may be difficult to recognise in some sections. However, it is distinct in a longitudinal section taken at the extreme margin of a branch, i.e. in a very shallow section. Some authors use the term cortex for the upper layer alone, and call the layer with vertical hyphae a subcortex.

Easily recognised when in its characteristic form of small rounded clumps of ±erect branches, with apothecia on the outer surface of the clump. Otherwise, could be confused with *R. calicaris*, but that species has straight, not curved ascospores. *R. calicaris* can also be separated by its distinctly channelled branches, but that character may be less helpful in doubtful cases as the basal parts of branches in *R. fastigiata* are sometimes slightly channelled.

Common throughout Greece at altitudes 0 - 1650 m. Usually on bark (94% of records), but occasionally on wood or siliceous rock.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Socotra, perhaps S. Africa), S. America (Chile, perhaps Argentina). Reports for N. America and Australasia said to be incorrect.

**Ramalina fraxinea (L.) Ach. (1810) var. fraxinea**

Lichenogr. Universalis 602;  *Lichen fraxineus* L. (1753), Sp. Pl. 1146-1147;  *Ramalina fraxinea f. calycula* (A. Massal.) Zahlbr.;  *Ramalina fraxinea f. luxurians* Delise ex H. Olivier
Thallus: fruticose, grey-green, pendent, sparingly branched. Branches: to 15 cm long, 1.2 - 8 mm wide, flattened, solid, with many longitudinal and sometimes transverse striations, some specimens with rounded warts (?aborted initials of apothecia), usually not channeled. Pseudocyphellae: present on both surface of branches but often inconspicuous, 0.3 - 0.6 x 0.05 - 0.1 (0.2) mm. Soralia: absent. Medulla: white. Apothecia: usually present, shortly stalked, marginal or, less commonly, laminal, flat to convex, 1 - 5 mm diameter, not or scarcely pruinose. Disc: pale green. Thalline margin: present, usually thin, often becoming excluded in convex apothecia; in section: to 200 µm wide, cortex 20 - 40 µm, of anastomosed hyphae. Exciple: not visible externally; in section: poorly developed, to 15 µm wide.

Epithecium: colourless but often with brown or grey granules, K-, granules soluble in K. Hymenium: 50 µm tall, colourless, sometimes very pale yellow-brown in lower part. Hypothecium: 25 µm tall, colourless to very pale yellow-brown. Paraphyses: simple, 1 µm wide at base, 2 µm at apex, not capitate. Asci: 40 - 42 x 11 - 12 µm, clavate, Bacidia type. Ascospores: colourless, 1-septate, basically ellipsoid but slightly to distinctly curved, 12 - 14 x 5 µm, 8 per ascus.


Well developed material of this species can not be confused with any other.

Throughout Greece. On bark at all altitudes. The lichenicolous fungus Tremella ramalinae has been reported once from this host.

R. fraxinea s. lat. is present throughout Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, perhaps S. Africa), N. America (widespread), perhaps C. America (Mexico), perhaps S. America (old reports), perhaps Pacific (Hawaii). Reports for Australasia are incorrect.


Like var. fraxinea, but with narrower branches (0.5 - 1 mm wide in lower parts, to 2 mm in upper parts) that are distinctly channeled, at least in their lower parts.

I have some doubts about the status of this variety, as I have seen material that is intermediate between it and var. fraxinea. (I have referred all such collections to var. fraxinea.)

R. calicaris differs in having straight, not curved, ascospores.

Throughout Greece, but less common than var. fraxinea. On bark at altitudes 400 - 1200 m, and perhaps occasionally higher. The few reports that mention a phorophyte say Quercus: Q. coccifera and Q. pubescens.

Southern and south-central Europe. Also perhaps Macaronesia (old report), Asia (Syria, NW China), perhaps N. America (California - old report).


Description: Clauzade & Roux (1985).

Said to have been reported for Greece in a university thesis, but no further information available.

Circum-Mediterranean/Macaronesian. Southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco).


Thallus: fruticose, grey-green, matt, not pruinose. Branches: erect, rather few, arising from a common holdfast, without holes, 2 cm long, to 4.5 mm wide, but some branches only 0.5 - 1 mm wide in upper parts. Isidia: absent. Soralia: circular and delimited at first, later elongating and become confluent. Chemistry: soralia K-, P-; thallus UV-.

Scattered in sites close to the sea, at altitudes 0 - 250 m. Usually on bark, sometimes on calcareous or siliceous rock.

Widespread in parts of Europe with mild or warm, ±maritime climate; absent from regions with distinctly continental climate. Also Macaronesia, Asia (widespread, but no further east than Oman), Africa (Morocco, Tunisia Egypt, S. Africa; St Helena), N. America (California), C. America (Mexico), S. America (Chile).


Description: Clauzade & Roux (1985).

Apparently reported for Corfu in the same university thesis as R. implectens. No further information available.

Southern Europe, from Portugal to Greece. Also Macaronesia, N. Africa (Morocco).

Description: See the protologue. I have not seen any other description in the literature, and the species is poorly known. According to Steiner it is close to *R. pusilla*. I am unwilling to include it in the key until I have seen a modern description based on authentic material.

*Corfu, on bark of *Olea* at an altitude of 100 m.*

*Only Greece and European Turkey.*

*Ramalina obtusata* (Arnold) Bitter (1901)

*Descriptions: Brodo et al. (2001); Clauzade & Roux (1985).* 

*Macedonia, on bark of *Picea abies* at an altitude of about 1400 m.*

*Mostly northern and central Europe. Present in the south, from Portugal to Cyprus and the Caucasus, but not common. Also Macaronesia, Asia (widespread), N. America (widespread).*

*Ramalina panizzei* De Not. (1846)

*Description: Clauzade & Roux (1985).*

*Crete, on bark of *Quercus ilex* at an altitude of 1000 m. Perhaps also present on Santorini; see Abbott, 2009.*

*Southern and south-central Europe. Also western Asia (Turkey), N. Africa (Algeria).*

*Ramalina pollinaria* (Westr.) Ach. (1810)

*Descriptions: Clauzade & Roux (1985); Smith et al. (2009).* 

*Scattered rather thinly throughout Greece, with no clear pattern. At altitudes 0 - 1800 m. On bark or calcareous or siliceous rock.*

*Throughout Europe except for truly arctic regions. Also Macaronesia (CVI), Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), Caribbean (Trinidad), C. America (Mexico), perhaps Pacific (Hawaii). Reports for S. America and Australasia are incorrect.*

*Ramalina polymorpha* (Lilj.) Ach. (1810)

*Descriptions: Clauzade & Roux (1985); Smith et al. (2009).*

*Islands of the Aegean, including Crete, on siliceous rock at altitudes 10 - 1400 m.*

*Throughout Europe, except for truly arctic regions. Also Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), perhaps S. America (Argentina). Reports for Macaronesia and Australasia are probably incorrect.*

*Ramalina pontica* Vězda (1975)

*Description: See the protologue.*

*Chios, on siliceous rock at altitudes 490 - 670 m.*

*Romania, Ukraine and Greece. Also western Asia (Turkey).*

*Ramalina pusilla* Duby (1830)

*Descriptions: Clauzade & Roux (1985); Groner & La Greca (1997).*

*Corfu, and islands of the southern Aegean, at altitudes 0 - 320 m. Usually on bark, occasionally on wood.*

*Mediterranean Europe, from Portugal to Cyprus, and Macaronesia. Reports for elsewhere are all old, and may be unreliable.*

*Ramalina requienii* (De Not.) Jatta (1900)

*Description: Clauzade & Roux (1985).*

*Islands of the Aegean, including Crete, at altitudes 5 - 800 m. Usually on siliceous rock, sometimes on bark or calcareous rock.*
Southern and south-central Europe. Also Macaronesia, western Asia (Turkey), N. Africa (Tunisia).

**Ramalina roesleri** (Schaer.) Nyl. (1870)

Description: Clauzade & Roux (1985); Brodo et al. (2001).

Amorgos, on bark of *Quercus coccifera* at an altitude of 650 m. Mainly middle latitudes of Europe, but reaching Finland in the north and Sicily in the south. Also Asia (widespread), Africa (Tanzania, Rwanda, S. Africa), N. America (widespread), perhaps S. America (Argentina), perhaps Pacific (Tahiti).

**Ramalina scoriseda** Zahlbr. (1914)
*Annals Mycol. 12(3): 342-343.*

Description: See the protologue.

Samothraki, on rock. No altitude was reported.

Croatia, Ukraine (Crimea) and Greece. Also Asia (Iran).

**Ramalina sinensis** Jatta (1902)
*N. Giorn. Bot. Ital., N. S. 9: 462; Ramalina calicaris var. nervosa Nyl.*


Macedonia, at altitudes 350 - 900 m. No substrate was reported.

Widespread north of the Alps, to as far as southern Scandinavia, rare south of the Alps. Also Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico).

**Ramalina subfarinacea** (Nyl. ex Bromb.) Nyl. (1873)

Thallus: fruticose, erect, grey-green. Branches: 0.5 - 1.2 cm long, 0.2 - 0.5 mm wide, flattened, solid, branching only occasionally. Isidia: sometimes present on margins of soralia. Soralia: frequent, especially on younger parts of branches, formed by a distinct splitting of the cortex to make a ±circular hole, ±flat to slightly convex, 0.5 - 0.6 x 0.3 - 0.4 mm (elongated along branch length), soredia 50 - 75 µm. Chemistry: soralia K+ dark red-orange, P+ yellow or orange-yellow (reaction sometimes faint). Photobiont: green.

Characterised by the numerous rather small branches with many delimited, rounded soralia. *R. farinacea* is similar but usually corticolous; for other differences, see the key.

Widespread, but usually close to the sea. (The single inland report, from the Peloponnese, was corticolous and probably refers to *R. farinacea.*) On siliceous rock at altitudes 20 - 900 m.

Widespread in western Europe, except for truly arctic regions, but absent from large parts of eastern Europe. Also Macaronesia, Asia (scattered but widespread), N. Africa (Morocco, Tunisia). I am sceptical of a report for S. America (Venezuela).

**Ramalina subgeniculata** Nyl. (1870)

Description: Groner & La Greca (1997).

Very scattered in the southern two thirds of Greece, never very far from the sea. On bark at altitudes 0 - 1000 m.

Southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria). Reports for eastern Asia (China, Taiwan, Japan, S. Korea) seem so disjunct that I wonder whether a different species may be involved.

**Ramalina thrausta** (Ach.) Nyl. (1870)

Description: Clauzade & Roux (1985).

Macedonia, on bark of *Picea abies* at an altitude of about 1400 m.

Mostly northern and central Europe; in the south present from Portugal to Greece and the Caucasus, but rare. Also Macaronesia, Asia (Turkey, Iran, Russia, Mongolia), N. America (widespread).
**Ramboldia** Kantvilas & Elix (1994)


**Literature:** Information is very scattered. See the individual species below.

As presently delimited _Ramboldia_ contains 29 species, 7 of which occur in Europe. Many were formerly placed elsewhere.

111 Parasitic on _Lecanora_ varia. (R. insidiosa)
11 on bark or wood.

22 Soredia present. Apothecia bright red. **_R. lusitanica_**
2 Soredia absent. Apothecia various.

333 Apothecia bright red. **_R. cinnabarina_**
33 Apothecia brown-red or black-red. (R. russula) Greek reports doubtful.
3 Apothecia black. (R. elabens)

1 On siliceous rock. ( _R. petraeoides_)

**Ramboldia cinnabarina** (Sommerf.) Kalb, Lumbsch & Elix (2008)


**Descriptions:** Clauzade & Roux (1985), Poelt & Vězda (1977), both as _Protoblastenia cinnabarina_.

_Epiros_, at an altitude of 700 m, on bark.

Widespread in western half of Europe from Alps and Pyrenees to beyond the Arctic Circle, but avoiding those parts of eastern Europe with distinctly continental climate. Very rare in southern Europe. Also Asia (Russia, Mongolia, Yunnan), N. America (widespread), S. America (Venezuela, perhaps Argentina).

**Ramboldia lusitanica** (Rässänen) Kalb, Lumbsch & Elix (2008)


**Description:** Poelt & Vězda (1977) as _Protoblastenia lusitanica_.

_Ikaria_, on bark. No further information was reported.

Mediterranean/Macaronesian. Spain to Greece. Also Macaronesia.

**Rhizocarpon** Ramond ex DC. (1805)


**Literature:** The genus is rich in species and not particularly well understood. The yellow/green species in Europe were monographed by Runemark (1956a, 1956b), but some of his concepts have not been accepted by later workers. Runemark saw rather little material from SE Europe, and his taxonomic conclusions might not work well in Greece. Other parts of the genus have never been monographed on a European scale, and the few regional treatments of particular groups are from NW Europe and could only be used with circumspection in Greece. Smith et al. (2009) discuss species of the British Is, while Timdal & Holtan-Hartwig (1988) provide a key to the species then known from Scandinavia. These can be supplemented by Clauzade & Roux (1985) and Nash et al. (2004).

_Thallus:_ crustose, green, brown or white, often with distinct dark-coloured hypothallus or prothallus. Vegetative propagules: absent in most species. _Apothecia:_ black, without a thalline margin. _Paraphyses:_ much branched, often anastomosed. _Ascospores_ muriform, 3-septate or 1-septate, medium sized to fairly large, pale grey to dark brown when mature, often with visible perispore.

Some 1-septate species could be confused with _Buellia_, but _Buellia_ has simple paraphyses.

As presently circumscribed, the genus is not monophyletic, and its boundaries are likely to change eventually. About 150 species worldwide, about 100 in Europe, all of which are saxicolous or parasitic on saxicolous lichens. Only a few species are associated with calcareous rock.

*R. beckii_, doubtfully reported for Greece, is not included in the keys as I have insufficient information.

**Key to Rhizocarpon main group**

11 Thallus yellow or green. Group 1.
1 Thallus not yellow or green (usually white, grey or brown; or thallus inconspicuous).
22 Mature ascospores 1-septate. Group 2
2 Mature ascospores 3-septate, submuriform or muriform. Group 3.

**Key to Rhizocarpon group 1: Thallus green or yellow.**

11 Mature ascospores 1-septate.

- 22 Ascospores mostly less than 20 µm long.
  - 33 Medulla K+ red (norstictic acid), I-. (R. superficielae)
  
- 2 Ascospores mostly more than 20 µm long. Medulla K+ red (norstictic acid), or K-. *R. eupetraeoides*

1 Mature ascospores 3-septate, submuriform or muriform.


- 2 Medulla distinctly I+ blue or violet. Epithecium without black granules. Ascospores various; more than 32 µm long in some species. Parasitic or not. Note 2.
  
- 33 Ascospores usually 3-septate, rarely with longitudinal septa, 12 - 27 x 6 - 10 µm. Parasitic on crustose lichens (*Lecidea s. lat.*) on non-calcareous rock. *R. furax*

3 Ascospores submuriform to muriform, size various. Parasitic or not.

- 44 Parasitic on Aspicilia. Ascospores 17 - 22 x 11 - 13 µm, submuriform with at most 8 - 10 cells. (R. captans) Note 3.

4 Not as above. Ascospores 20 - 60 µm long.

- 55 Epithecium K- or K+ green (or intensifying green), usually without any +red tinge. Areoles often distinctly crescent shaped (causing some apothecia to appear lecanorine).
  
- 66 Black hypothallus not very apparent. Thallus 0.3 - 1 (3) cm diameter. Ascospores with 12 - 16 cells. *R. ferax*

6 Black hypothallus clearly visible. Thallus 1 - 15 cm diameter. Ascospores usually with more than 16 cells. *R. lecanorinum*

5 Epithecium usually K+ red or purple-red; a K+ green (or green intensifying) pigment may also be present. Areoles sometimes crescent-shaped but usually not. Cells per ascospores various.

- 666 Most ascospores with more than 20 cells.
  
- 77 Areoles mostly 1 - 2 mm wide. *R. sublucidum*

- 7 Areoles mostly less than 1 mm wide. *R. macrosporum*

66 Most ascospores with 12 - 15 (20) cells.

- 77 Hymenium colourless.
  
- 88 Areoles often convex, 0.4 - 0.9 mm thick, 0.3 - 2 mm wide. Probably restricted to high altitude. *R. geographicum subsp. diabasicum*

8 Areoles flat, 0.2 - 0.4 mm thick, 0.2 - 1.3 mm wide. Not restricted to high altitude. *R. geographicum subsp. tinei*

7 Hymenium with a green tinge. (R. tavaresii) Note 4.

6 Most ascospores with 6 - 10 cells. *R. geographicum subsp. geographicum*

(1) Some rather poorly known species that have been reported for southern Europe would key out here. Their reported distribution does not suggest to me that they are likely to occur in Greece, but you could run your specimen through the key in Clauzade & Roux (1985), which includes them.

(2) This group is not well understood. All characters overlap considerably. Taxa can be defined, by emphasising one or a few characters, as in the key, but they are not well delimited. The group might be better treated simply as a broad *R. geographicum* aggregate. Taxa are distinguished here not out of any strong conviction that they are meaningful, but to encourage the acquisition of data that may help in better understanding this group. Abbott (2009) did not separate those taxa treated here as subspecies of *R. geographicum*, but did recognise the others.

(3) Unfortunately the protologue of R. captans did not state the reaction of the epithecium with K, and I have not seen any other published description.

(4) I am sceptical that R. tavaresii is a good species. I have seen collections of *R. geographicum subsp. tinei* in which a few apothecia in a few collections have an epithecium that is tinged distinctly green in places. I have not seen any material in which this green tinge is present uniformly throughout a specimen.
Key to Rhizocarpon group 2: Thallus not green or yellow; ascospores 1-septate

11 Ascospores remaining ±colourless until late; then pale grey, pale brown or pale green. Not parasitic on other lichens.

22 Medulla I+ blue.

33 Epithecium dark brown, K- or K+ red, without crystals. **R. polycarpum**

3 Epithecium olive-green to grey-black, K- or K+ intensely green, with crystals. **R. richardii**

2 Medulla I-. **R. hochstetteri**

1 Ascospores becoming distinctly coloured early. Parasitic or not.

22 Ascospores 10 - 16 µm long. Not parasitic. (**R. simillimum**)

2 Many ascospores more than 16 µm long.

33 Parasitic on other lichens.

44 On Pertusaria.

55 Ascospores 18 - 23 x 11 - 15 µm. (**R. advenulum**) Greek reports doubtful.

5 Ascospores 20 - 28 x 9 - 12 µm. **R. epispilum**

4 On Rhizocarpon geographicum group. (**R. fratricida**)

3 Not parasitic. (**R. badioatrum**) Greek reports need confirmation.

Key to Rhizocarpon group 3: Thallus not green or yellow; ascospores multi-septate to muriform

11 Mature ascospores ±colourless (sometimes becoming pale grey or pale green). Not parasitic.

22 Epithecium with crystals. Exciple sometimes pruinose. Thallus white to medium grey. On ±basic rocks or on siliceous rocks in close proximity to basic rocks.


3 Thallus white, pale grey, grey or brown. Exciple not, or only slightly, pruinose. Ascospores 20 - 50 x 13 - 24 µm. Apothecia sometimes arranged in ±concentric circles. On siliceous rock. **R. petraeum**

2 Epithecium usually without crystals. Exciple not pruinose. Thallus medium grey, pale brown or dark brown. On siliceous rock.

33 Ascospores mainly 3-septate. Thallus orange to red. Medulla I-. On iron-rich siliceous rock. (**R. oederi**). Greek reports very doubtful.

3 Ascospores usually with some longitudinal septa. Thallus not orange to red. Medulla I- or I+ blue. Not restricted to iron-rich siliceous rock.

44 Medulla I+ blue. Exciple and usually also epithecium K+ purple-red. **R. distinctum**

4 Medulla I-. Exciple and epithecium K- or K+ blue. **R. reductum**

1 Mature ascospores distinctly coloured. Parasitic or not.

22 Parasitic on other lichens.

333 Parasitic on Lecanora rupicola group. (**R. inimicum**)

33 Parasitic on terricolous Diploschistes. Asci with 8 ascospores. (**R. malenconianum**)

3 Parasitic on Ochrolechia parea. Asci with 8 or fewer ascospores. (**R. ochrolechiae**)

2 Not parasitic.

33 Asci with 2 ascospores. **R. geminatum**

3 Asci with 1 ascospore. **R. disporum**

**Rhizocarpon disporum** (Nägeli ex Hepp) Müll. Arg. (1879)


There is a single report for Macedonia, at an altitude of 200 m. The substrate was not reported.

Widespread in northern and central Europe, rare south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), C. America (Mexico), S. America (Argentina, Bolivia, Chile), Australasia (SE Australia, NZS), Antarctica (widespread).

**Rhizocarpon distinctum** Th. Fr. (1874)

Lichenogr. Scand. 625-627; Rhizocarpon ambiguus sensu Zahlbr., non (Ach.) Zahlbr.; Rhizocarpon atroalbant sensu Arnold, non (L.) Arnold, nec (Nyl.) Zahlbr.; Rhizocarpon distinctum f. olympicum (J. Steiner) J. Steiner.

Thallus: crustose, areolate, grey to brown-grey, not pruinose, 1 - 2 cm diam (in material seen; said to attain 5 cm), 190 µm thick, without vegetative propagules. Areoles: 0.15 - 0.45 mm wide, subrounded to subangular, ±flat. Prothallus: prominent, black, 0.2 - 1.0 mm wide. Cortex: to 15 µm thick in centre of areoles, decreasing to 0 - 5 µm at
margins, brown, sometimes dark brown in outermost 2 - 6 µm, without distinct structure, without crystals. Medulla: 40 µm thick, white in centre, brown at base. Apothecia: immersed, usually flat, occasionally becoming convex, 0.3 - 0.5 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: present but thin, 0.02 mm wide, black, sometimes becoming excluded; in section: 30 - 40 µm wide, mostly dark brown and opaque, sometimes paler brown adjacent to hymenium. Epitheicum: ±black but with traces of purple pigment, without crystals, K+ purple intensifying. Hymenium: 100 - 125 µm tall, colourless. Hypothecium: 70 - 150 µm tall, brown to dark brown. Paraphyses: anastomosed. Ascospores: colourless, 3-septate to muriform, ellipsoid, 25 - 32 x 14 - 15 µm, 8 per ascus. Chemistry: medulla I+ blue; thallus UV-. Photobiont: green; cells globose to slightly ellipsoid, 10 - 14 µm diameter. Scattered throughout Greece, on siliceous rock at altitudes 0 - 2000 m. The lichenicolous fungus *Muellerella ventosicola* has been reported once from this host.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), southern S. America (Chile, perhaps Argentina), Australasia (Victoria, cooler parts of NZ), Antarctica (Antarctic Peninsula).

**Rhizocarpon epispilum** (Nyl.) Zahlbr. (1926)
Cat. Lich. Univ. 4: 333; *Lecidea epispila* Nyl. (1873), *Flora* 56: 73; *Rhizocarpon superstratum* J. Steiner.
Islands of the Aegean, including Crete, and adjacent parts of the mainland, at altitudes 490 - 1100 m. Usually parasitic on *Pertusaria rupicola*.

Southern and south-central Europe. Also Macaronesia, western Asia (Turkey).

**Rhizocarpon eupetraeoides** (Nyl.) Blomb. & Forssell (1880)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Known from a single site in Macedonia, where it occurred on serpentine at an altitude of 1550 m.
Widespread in northern Europe, very rare further south. Also Asia (Russia, Mongolia, China, Japan), N. America (widespread), Australasia (NSW).

**Rhizocarpon ferax** H. Magn. (1948)
Description: Clauzade & Roux (1985).
Known from a single site in Macedonia, where it occurred on serpentine at an altitude of 2170 m.
Widespread in northern Europe, becoming much rarer southwards. Also Asia (Russia, Tajikistan, northern India), N. America (Nunavut, Quebec, perhaps Yukon).

**Rhizocarpon furax** Poelt & V. Wirth (1970)
Description: Clauzade & Roux (1985).
Known from a single site in Epiros, where it occurred on calcareous rock at an altitude of 2100 m.
Only Spitzbergen, Germany, Austria, Italy and Greece.

**Rhizocarpon geminatum** Körb. (1855)

Thallus: crustose, forming small patches about 1 cm diameter, areolate, pale grey to grey, not obviously pruinose but in fact covered in a layer of fine crystals (polarising light in section). Areoles: rounded to angular, 0.4 - 1 mm wide, 0.4 mm thick, contiguous, flat to convex in surface view, in section sometimes globose with cortex extending round to much of lower surface. Hypothallus and prothallus: ±absent (in material seen). Cortex: 25 µm thick, not sharply delimited from algal layer, colourless to grey or brown, of vertical hyphae that are clearly visible in the uppermost part, as their tips often rise to slightly different heights, but inner part of cortex often appearing cellular, crystals not present within cortex itself; cortex overlain by a colourless, structureless layer 5 - 10 µm thick. Medulla: white, not very well developed in section. Apothecia: subimmersed between areoles, rounded to angular, flat, 0.35 - 0.65 mm diameter, not pruinose. Disc: black, matt. Thalline margin: absent. Exciple: black, thin but persistent; in section: 50 - 100 µm wide, dark brown. Epitheicum: brown to purple-brown, K+ red-purple, N-. Hymenium: 110 - 150 µm tall, colourless. Hypothecium: dark brown, opaque. Paraphyses: anastomosed, 1.5 µm wide, often with visible septa throughout. Ascospores: brown when mature but long remaining colourless or pale grey, muriform, ellipsoid to tadpole shaped, 35 - 55 x 20 - 28 µm, perispore sometimes visible, 1.5 - 2 µm wide, 2 per ascus. Chemistry: medulla K-; P-; thallus UV-; Photobiont: green, cells globose, 10 - 13 µm diameter.
The two-spored asci are distinctive.
Scattered on the mainland, on rock, usually siliceous, at altitudes 650 - 2100 m
Widespread in central and northern Europe, in the south uncommon and restricted to the uplands. Also Macaronesia, Asia (widespread), N. America (widespread), S. America (Falkland Is, Bolivia), Australasia (ACT, NSW, NZS), Antarctica (widespread).

**Rhizocarpon geographicum** (L.) DC. (1805) subsp. geographicum


Thallus: crustose, to 6 cm diameter (in material measured in lab; larger thalli seen in the field), areolate, green, often slightly pruinose, to 0.35 mm thick. Areoles: ±flat, very variable in shape (subrounded, subangular or irregular, less commonly crescent-shaped or even entirely surrounding an apothecium), 0.3 - 1.5 mm wide. Hypothallus: usually present below or between areoles, black; a black, marginal prothallus sometimes also present. Cortex: 25 - 30 ±mm tall, without distinct structure, mostly colourless, sometimes grey in uppermost 5 µm, with abundant small crystals not soluble in K. Medulla: white, of vertical hyphae, I+ blue. Apothecia: usually arising between areoles, surface never rising above level of areoles, usually slightly concave, rounded to slightly irregular, 0.2 - 0.45 (0.8) mm diameter, not pruinose. Disc: black. Thalline margin: absent, but in some collections areoles can almost or entirely surround an apothecium giving the impression of a thalline exciple. Exciple: black, thin but persistent, usually slightly raised above level of disc; in section: 30 - 40 µm wide, pale brown to dark brown. Epithecium: brown, sometimes with faint red or purple tinge in water, K+ faintly but distinctly purplish at least in places; sometimes over lain by colourless, structureless layer 1 - 5 µm thick. Hymenium: 140 - 300 ±mm tall, colourless to brown. Hypothecium: dark brown, opaque. Paraphyses: anastomosed, 1.5 ±µm wide at base, apex 2.5 - 3 µm, with visible septa throughout, sometimes slightly capitate, apical cell often with thin, internal, crescent shaped cap of brown pigment not soluble in K. Ascospores: usually brown to dark brown, occasionally grey, muriform, ±ellipsoid, 35 - 42 x 13 - 20 µm, with 5 - 11 cells; a broad perispore, 5 - 7 ±µm wide, sometimes visible; 8 per ascus. Chemistry: medulla K-, thallus UV+ orange. Photobiont: green, cells globose to slightly ellipsoid, 8 - 18 x 8 - 15 µm, forming a fairly regular layer 100 - 150 µm thick that is almost continuous except where interrupted by narrow bands of vertical hyphae.

Usually fairly easily recognised under the microscope by the weakly muriform ascospores, with fewer than 10 subdivisions.

Probably throughout Greece, though since reports without indication of subspecies are placed here by default it may not be so much more common than subsp. *tinei* as the maps suggest. On siliceous rock at all altitudes. The lichenicolous taxa *Endococcus exerrans*, *Endococcus macrosporus*, *Lambiella furvella*, *Lecidea halacysi*, *Muellerella ventosicola* and *Rhymbocarpus geographici* have been reported from *R. geographicum* s. lat.

*R. geographicum* s. lat. is cosmopolitan outside tropical regions.

**Rhizocarpon geographicum subsp. diabasicum** (Rässänen) Poelt & Vězda (1980)


Thallus: crustose, areolate, bright green, 0.35 - 0.55 mm thick. Areoles: flat to markedly convex, ±rounded to angular, 0.4 - 1.5 mm wide. Hypothallus: generally absent, but black prothallus, 0.1 - 0.5 mm wide, sometimes present. Cortex: 25 ±µm thick, pale brown, without distinct structure, with abundant crystals not soluble in K. Medulla: white, I+ blue or purple, of vertical hyphae. Apothecia: between areoles, surface not rising above level of areoles, slightly concave to flat, not pruinose, rounded to slightly irregular, 0.3 - 1 mm diameter. Disc: black. Thalline margin: absent. Exciple: present but thin and sometimes inconspicuous, black, persistent, usually raised above level of disc; in section: 15 - 50 µm wide, dark brown, opaque, sometimes faintly K+ purplish. Epithecium: brown, generally not well delimited from hymenium, K+ faintly purplish; often overlain by colourless, structureless layer up to 10 ±µm thick. Hymenium: 160 - 210 ±µm tall, colourless, to brown. Hypothecium: dark brown, opaque. Paraphyses: 1.5 - 2 ±µm wide at base, apex to 4 ±µm but usually less, with visible septa throughout, anastomosed, only rarely slightly capitate or moniliform. Ascii: 110 x 32 µm, ±clavate. Ascospores: brown, muriform, ellipsoid, 18 - 38 x 12 - 20 µm, with 8 - 16 cells, perispore is sometimes visible, 8 per ascus. Chemistry: medulla K-. Photobiont: green, cells globose to ellipsoid, 10 - 17 x 10 - 12 µm, forming a layer 200 - 300 µm thick that is almost continuous except where interrupted by groups of vertical hyphae.

The convex areoles are fairly distinctive. This subspecies often has a brighter green colour than the other two.

Peloponness and Sterea Ellada, on siliceous rock at altitudes 1750 - 2400 m. Scattered throughout the cooler parts of Europe, Asia and North America. There is also a report from high altitude in N. Africa (Morroco).
Rhizocarpon geographicum subsp. tinei (Tornab.) Clauzade & Cl. Roux (1982)


This subspecies has no sharp distinguishing characters. In practice, it is recognised by excluding other possibilities.

Scattered throughout Greece, on siliceous rock at altitudes 200 - 1400 m.

Widespread in Europe, but commonest in the south. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria, Tunisia), N. America (Minnesota, New Hampshire, New York), S. America (Argentina, Falkland Is), Australasia (widespread in Australia), Antarctica (Heard Is, Antarctic Peninsula).

Rhizocarpon hochstetteri (Körb.) Vain. (1922)
Acta Soc. Fauna Fl. Fenn. 53(1): 280; Catillaria hochstetteri Körb. (1861), Parerga Lichenol. 195-196; Rhizocarpon applanatum (Fr.) Th. Fr.

Descriptions: Fryday (2002) is best. See also Clauzade & Roux (1985); Smith et al. (2009).

Stereal Ellada, at an altitude of about 2150 m. The substrate was not reported. Not reported for Greece since 1898.

Throughout Europe, though rare south of the Alps and there probably confined to high mountains. Also Macaronesia, Asia (Russia, Mongolia, Japan), N. America (widespread), Australasia (NZN).

Rhizocarpon lecanorinum Anders (1923)
Hedwigia 64(5-6): 261; Rhizocarpon geographicum f. lecanorum (Fröke) Arnold; Rhizocarpon geographicum var. lecanorum (Fröke) A. Massal.

The nomenclature is not straightforward. The earliest name is Lecidea atrovirens var. lecanora Fröke (1819). Rhizocarpon geographicum var. lecanorinum Fröke ex Körb. (1855) is a superfluous name for Lecidea atrovirens var. lecanora, and so is not legitimate at the rank of variety. It was first used at the rank of species by Anders in 1923, and as the epithet lecanora had not then been used at species rank, the name R. lecanorinum Anders is legitimate. Lyne combined Fröke's epithet lecanora into Rhizocarpon at species rank in 1928, but by then the epithet did not have priority at the rank of species and R. lecanora (Fröke) Lyne is a superfluous name and illegitimate.

Descriptions: Clauzade & Roux (1985); Runemark (1956a); Smith et al. (2009).

Rare and scattered, with no clear pattern. On siliceous rock at all altitudes.

Widespread in Europe south of arctic regions. Also Macaronesia, Asia (widespread), Africa (S. Africa), N. America (widespread), S. America (Colombia), Australasia (ACT, Victoria, NZN, NZS).

Rhizocarpon macrosporum Räsänen (1943)
Feddes Rep. 52(2): 139.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Runemark (1956a).

Scattered, mainly in the mountains of mainland Greece, but also reported for Chios. On siliceous rock at altitudes 500 - 2100 m.

Most of Europe (though not British Is). Also Asia (widespread), N. Africa (Morocco), N. America (widespread).

Rhizocarpon petraeum (Wulf.) A. Massal. (1852)

Thallus: crustose, cracked to areolate, pale brown. Prothallus: black, 0.3 - 0.4 mm wide. Apothecia: 0.3 - 0.35 mm diameter, immersed, slightly concave to flat, not or only very slightly pruinose. Disc: black. Thalline margin: absent. Exciple: with crystals. Epithecium: brown, with crystals. Hymenium: 115 µm tall, colourless, sometimes brown in upper part. Hypothecium: dark brown. Ascospores: colourless, muriform, ellipsoid, 32 x 11 - 13 µm. Photobiont: green.

Apothecia in this species are said often to occur in concentric circles, but were not so in my only Greek collection.

Scattered, with no clear pattern. On siliceous rock at altitudes 100 to more than 1500 m.

Throughout Europe. Also Macaronesia, Asia (Turkey, Russia, India), N. Africa (Algeria, Egypt), N. America (widespread), S. America (Colombia), Australasia (Tasmania, widespread in NZ).
Rhizocarpon polycarpum (Hepp) Th. Fr. (1874)
Lichenogr. Scand. 617; Lecidea confervoides var. polycarpa Hepp (1853), Flecht. Eur. no. 35; Lecidea atroalbicans Nyl. ex Leight.

At the rank of species, the epithet polycarpum has priority from 1874. The name Lecidea atrobadia Nyl. (1872) is said to be synonymous, and the correct name appears to be Rhizocarpon atrobadium (Nyl.) ined.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern, on siliceous rock at altitudes 350 - 1100 m. Reports for the northern part of the country are probably reliable; those for the south might not be.

Throughout Europe, though south of the Alps almost restricted to the mountains. Also Macaronesia, Asia (Turkey, Israel, Russia, Japan), N. Africa (Morocco), N. America (widespread), perhaps S. America (Argentina), Australasia (widespread), Antarctica (widespread).

Rhizocarpon reductum Th. Fr. (1874)
Lichenogr. Scand. 633-634; (?) Rhizocarpon obscuratum auct. graec.

Description: Smith et al. (2009).

Scattered, mainly in the islands, on siliceous rock at altitudes 0 - 1200 m, occasionally higher. If most reports of R. obscuratum refer to R. reductum, then present throughout northern and central Europe, but rare south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, S. Africa), N. America (widespread), C. America (Nicaragua, perhaps elsewhere), S. America (Chile, Falkland Is, Bolivia, Venezuela), Australasia (widespread), Antarctica (Macquarie Is, Antarctic Peninsula).

Rhizocarpon richardii (Lamy ex Nyl.) Zahlbr. (1926)
Cat. Lich. Univ. 4: 341; Lecidea richardii Lamy ex Nyl. (1875), Flora 58: 446, as richardi.

Description: Smith et al. (2009).

Chios, on siliceous rock at altitudes 250 - 670 m. Widespread in cold and temperate Europe, rare in the south. Also western Asia (Turkey).

Rhizocarpon sublucidum Rässänen (1944)

Descriptions: Clauzade & Roux (1985); Runemark (1956a).

Peloponnese, at high altitude. No substrate was reported.

Much of Europe, but not common. It may be most common in the Alps. Also Asia (widespread), Africa (Morocco, Ethiopia), N. America (widespread).

Rhizocarpon umbilicatum (Ramond) Flagey (1894)
in: Mém. Soc. émul. Doubs sér. VI, 8: 98; Lecidea umbilicata Ramond (1827), Mém. Acad. Roy. Sci. Inst. Fr. 6: 128; Buellia epipolia var. calcarea (Fr.) Servit; Diplotomma epipolium var. calcarea (Fr.) Flagey; Lecidea calcarea var. weissii Scher., nom. superfl.; Rhizocarpon umbilicatum f. pseudostrifeum (Th. Fr.) Szatala.


Scattered throughout Greece, but not common. On calcareous rock at altitudes 150 - 2600 m. Most records are from above 1000 m.

Throughout Europe. Also Macaronesia, Asia (Turkey, Iran, Russia, Mongolia), N. Africa (Morocco, Algeria, Tunisia), N. America (scattered, in cold regions).

Rhizocarpon viridiatrum (Wulf.) Körb. (1855)

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Runemark (1956a); Smith et al. (2009).

Scattered in the islands of the Aegean, including Crete, on siliceous rock at altitudes 30 - 700 m. Widespread in middle latitudes of Europe, rare north of mid-Scandinavia and south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Natal), N. America (widespread), S. America (Chile, Bolivia, Colombia), Australasia (widespread).
Rhizoplaca Zopf (1905)


Literature: The best introduction to the genus is Nash et al. (2002), but Clauzade & Roux (1985) is also helpful. About 19 species, 6 of which occur in Europe. The five species in the key have recently been dispersed across five different genera, a redispersion which I prefer not to follow for the present.

111 Medulla P+ very red. (R. maheui)
11 Medulla P+ orange. (R. peltata)
1 Medulla P- or P+ yellow.

22 Tips of paraphyses at least partly capitate, green to blue-black, N+ red. Hymenium colourless. \( R. \) melanophthalma

2 Tips of paraphyses clavate, colourless, N-. Hymenium tinged yellow to red in thick section.

33 Thallus squamulose. Lower surface brown to black, never with a green or blue tinge, sometimes with rhizinose strands. (R. subdiscrepans) Greek report doubtful.

3 Thallus usually clearly umbilicate. Lower surface usually at least partly green to blue-black, without rhizinose strands. \( R. \) chrysoleuca

Rhizoplaca chrysoleuca (Sm.) Zopf (1905)


Descriptions: Clauzade & Roux (1985); Nash et al. (2002).

Known from two sites in Epiros, on calcareous and serpentine rock at altitudes 2100 - 2150 m.

Widespread in cooler parts of Europe, very rare south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, perhaps Ethiopia), N. America (widespread), C. America (Mexico), A. America (Chile), Australasia (Queensland).

Rhizoplaca melanophthalma (DC.) Leuckert & Poelt (1977)

in Leuckert et al., Nova Hedwigia 28: 72; \( \text{Squamaria melanophthalma} \) DC. (1805) in Lamarck & de Candolle, Fl. Franç. Ed. 3, 2: 376-377, as \( \text{Squamaria} \).

Descriptions: Clauzade & Roux (1985); Nash et al. (2002).

Known from two sites in Epiros, on calcareous and serpentine rock at altitudes 2100 - 2150 m.

Widespread in cooler parts of Europe, very rare south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Kenya), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Venezuela), Antarctica (widespread).

Rhymbocarpus Zopf (1896)

Hedwigia 35: 357. Type: \( R. \) punctiformis Zopf, the only species originally included. Family: Cordieritidaceae.

Literature: Diederich & Etayo (2000) monograph the genus. There is an updated key to all species in Etayo & Diederich (2011); the key below is a much simplified version of it.

Twelve species of lichenicolous fungi, 10 of which occur in Europe. The genus is rare in Greece.

111 Apothecia immersed and remaining so, to 120 \( \mu \)m diameter, sometimes appearing perithecioid. Margin not or scarcely apparent.

22 Ascospores 11 - 12 x 4 - 5 \( \mu \)m. On Rhizocarpon. \( R. \) geographic\( \text{i} \)

2 Ascospores 8 - 10.5 x 3 - 4 \( \mu \)m.

33 Lower part of exciple brown. On Roccella. (R. roccellae)

3 Lower part of exciple colourless or green. On Dirina ceratoniae, perhaps also on Roccella. \( R. \) boomii

11 Ascomata immersed when young, less so when mature. Margin black, thick, often with deep cracks. On Lecidea fuscoatra. (R. fuscoatrae)

1 Ascomata ±superficial from the beginning; margin distinct, without deep cracks.

222 Exciple with hairs visible in stereo-microscope. On Lepraria. (R. pubescens)

22 Outer margin of exciple with hairs visible only in section (transmission microscope). On Diploicia canescens. (R. cruciatus)

2 Exciple without hairs. On Buellia or Lepraria.

33 Disc pruinose. On Buellia griseovirens. (R. aggregatus)

3 Disc not pruinose. On Lepraria. (R. neglectus)
Rhymbocarpus boomii Etayo & Diederich (2000)
Description: See the protologue.
Amorgos, on Roccella phycopsis at an altitude of 380 m.
In Europe, only Balearic Islands and Greece. Also N. America (California).

Rhymbocarpus geographici (J. Steiner) Vouaux (1913)
Attica and eastern Peloponnese, at altitudes 20 - 1100 m. Always on Rhizocarpon geographicum. Not reported for Greece since 1898.
Sweden, France, Italy and Greece. Also Asia (Turkey, Russia), S. America (Chile).

Rinodina (Ach.) Gray (1821)


Thallus: crustose, immersed or superficial, thin to moderately thick (rarely exceeding 0.5 mm), usually some shade of white, grey or brown. Vegetative propagules: present in a few species. Cortex: usually formed of vertical hyphae, sometimes with a distinct apical cell. Medulla: usually white, always 1-1.5 µm wide at base, with broader apical cell often with internal brown pigment cap. Thalline margin: well developed in most species. Exciple: rather variable: poorly developed and scarcely distinguishable from hymenium in some species, to a well-developed structure of radiating hyphae, often with distinct lumina. Epithecium: brown, K- in most species, K+ violet in a few. Hymenium: colourless. Hypothecium: colourless to brown. Paraphyses: simple, usually 1-1.5 µm wide at base, with broader apical cell often with internal brown pigment cap. Ascii: Lecanora type. Ascospores: brown, usually 1-septate, ±ellipsoid, lumina of various shapes, usually 8 per ascus. Pycnidia: not seen in most species; usually entirely immersed, not visible externally (so encountered only by chance), pyriform. Conidia: colourless, ellipsoid, small. Chemistys: most reactions negative; atranorin and/or pannarin present in some species. Photobiont: green, trebouxioid.

Rinodina is a large genus, with about 330 species worldwide and about 124 in Europe. They occur on all substrates except leaves. It is well represented in Greece. The region of the Aegean Sea and the adjacent coasts of the mainland are by far the richest in numbers of species.

This genus has received much study in recent decades, in many parts of the world, and is now fairly well understood. However, determination of collections is often far from easy. There is not a lot of external morphological variation, and the two most important diagnostic characters, chemistry and ascospore type, are often difficult to determine unambiguously. The most important lichen substances are atranorin and pannarin, but both give rather subtle colour changes in spot tests, and when thalli are dark coloured or thin, as is often the case, determining whether or not those substances are present can be challenging for those without facilities for chromatography. Some ascospore types are not sharply delimited, ascospores in some species are borderline between two types, and ascospores change, sometimes greatly, during development. In determining ascospore types, it is advisable to examine as many ascospores as possible. It is also helpful to study good drawings or photographs of ascospore types, such as those in Giralt (2001) or Sheard (2010). It is also essential to use a good microscope; this is one of the few areas in lichenology where an inexpensive microscope will not suffice even for routine determinations. Even with these precautions, it must be expected that some collections will not be determinable with certainty. Corticolous species tend to be the most difficult.

Ascospore types in Rinodina should be regarded in much the same way as one regards colours in lichenology: useful but imprecise concepts that do not have sharp boundaries and that can merge into each other. The best way to recognise them is with experience, but the key below may be helpful.

A torus is a doughnut-shaped ring around the waist of the ascospores in some species. It lies outside the main ascospore wall.
### Key to Rinodina ascospore types

11 Ascospores with 4 or more lumina. **Conradii** type or submuriform ascospores

1 Ascospores with 2 lumina.

222 Ascospores with 2 brown bands (sometimes faint), one across each lumen. **Bicincta** type

22 Ascospores with 1 brown band (sometimes faint) overlying septum (Note 1). Wall thickened only at septum, never at apices (i.e. lumina like those of Physconia type ascospores). **Bischoffii** type.

2 Ascospores without brown bands.

333 Ascospores without internal wall thickenings.

44 Septum very thin (1 µm). **Rinodinella** type.

4 Septum thicker. **Buellia** type

33 Ascospore wall thickened at septum but not (or scarcely) at apex.

44 Wall thickening extending over a long part of ascospore. **Orcularia** type.

4 Wall thickening extending over a shorter part of ascospore.

55 Lumina at spore ends rounded. Wall never thickened at apex.

66 Ascospores double walled near septum. **Dubyana** type.

6 Ascospores not double walled near septum. **Physconia** type.

5 Lumina at spore ends less rounded. Wall sometimes slightly thickened at apex. **Milvina** type. Note 2.

3 Ascospores wall thickened at septum and at apex.

44 Ascospores with thick outer wall; lumina thus appearing double-walled. **Tunicata** type.

4 Ascospores without thick outer wall, lumina appearing single-walled.

55 Wall uniformly thickened. Lumina rounded, usually throughout entire development of ascospore. (Rarely, young ascospores may show slight apical wall thickening, reminiscent of Physcia type. Young ascospores of R. dalmatica may have unusual, polygonal lumina.) **Pachysporaria** type. Note 2.

5 Wall not uniformly thickened. Lumina not rounded, at least at some stage of development.

666 Lumina extremely angular (but becoming more rounded later). **Mischoblastia** type.

66 Lumina moderately angular.

77 Septum inserted early, before wall thickenings become apparent (type A ontogeny of Giralt). **Physcia** type.

7 Septum inserted late; at least some young ascospores with a single elongated lumen that is not divided by a septum, and walls at ascospore tip distinctly thicker than those at the sides (type B ontogeny of Giralt).

Note 3. **Dirinaria** type.

6 Lumina slightly angular. **Milvina** type. Note 2.

(1) Care is needed. The brown band may be faint, and easily overlooked; also, a broad, pigmented septum can be mistaken for a brown band, especially if using inexpensive optical equipment. The brown band is of ±uniform width across the ascospore, and broader than the narrowest part of the septum. It is usually easiest to observe in ascospores at an intermediate stage of development: it is not present in very young ascospores, and mature ascospore may have a septum that is itself strongly pigmented, making observations harder to interpret. In case of doubt, it is advisable to examine many ascospores.

(2) Typical Pachysporaria type ascospores have a thicker wall than typical Milvina type spores, but the two types overlap.

(3) The distinction between Dirinaria and Physcia type ascospores may disappear while ascospores are still colourless and quite young, so it is advisable to examine many, very young ascospores before excluding Dirinaria type

### Key to Rinodina main groups

1111 Parasitic on other lichens. Group 1.

111 On soil, bryophytes or decaying vegetation on the ground. Subalpine and alpine in Greece. Group 2.

11 On bark or wood. Group 3.

22 Ascospores more than 1-septate or more than 8 per ascus. Group 3A.

2 Ascospores 1-septate, 8 per ascus.

33 Apothecial sections without algal cells. Group 3B.

3 Apothecial sections with algal cells.

44 Epithecium K+ purple or violet. Ascospores Bicincta, Mischoblastia or Tunicata type. Group 3C.

4 Epithecium K-. Ascospores various.

55 Isidia, soralia or blastidia present. Group 3D.
5 Isidia, soralia and blastidia absent.

66 Thallus K+ yellow (atranorin) (Note 1). Ascospores various, but never Physconia or Milvina type. Group 3E.

6 Thallus K-. Ascospores various (including Physconia and Milvina type). Group 3F.


22 Soralia, isidia or blastidia present. On calcareous or siliceous rock. Group 4A.

2 Soralia, isidia and blastidia absent.

33 Thallus or medulla C+ red (reaction may be faint) or KC+ red. On siliceous rock. Group 4B.

3 Thallus and medulla C-, KC-.

44 Thallus K+ yellow (atranorin) (Note 1), P+ orange (pannarin) or P-. On siliceous rock. Group 4C.

4 Thallus K-, P-. On calcareous or siliceous rock. Group 4D.


5 On siliceous rock. Group 4D2.

(1) Atranorin is difficult to demonstrate by spot tests in a dark coloured or thin thallus. Some authors recommend doing a spot test and soaking up the liquid on filter paper to observe any colour, but I have had no success with that method. I apply a little K - as small an amount as possible - to a thin section and observe under the compound microscope. Atranorin, if present, diffuses into solution and the solution goes pale yellow. Using a lot of K dilutes the pigment and may make it unobservable. Make sure that any yellow solution seen comes from the lichen itself. Some kinds of bark and rock can liberate yellow pigments in K. (Note that use of a draughtsman's pen with a nozzle less than 1 mm diameter to hold the K solution makes it possible to add K in very small amounts.)

**Key to Rinodina group 1**: Lichenicolous species.

11 Thallus with blastidia. On Aspicilia. **R. obnascens**

1 Thallus without vegetative propagules. On various hosts.

22 Ascospores to 15 µm long.

33 On Aspicilia intermutans. (Endohyalina brandii)

3 On Lecanora rupicola. **R. insularis**

2 Most ascospores more than 15 µm long.

33 Thallus K+ yellow (atranorin), P+ orange (pannarin). Ascospores Pachysporaria type. **R. santorinensis**

3 Thallus K-, P-. Ascospores Physcia type. (R. parasitica)

**Key to Rinodina group 2**: ± Terricolous species.

111 Ascospores submuriform, with up to 6 lumina. (R. intermedia)

11 Ascospores with 4 lumina (Conradii type). **R. conradii**

1 Ascospores with 2 lumina, Physcia type

22 Apothecia white pruinose. Ascospores 24 - 35 x 8 - 13 µm. Medulla with crystals. **R. roscida**

2 Apothecia not pruinose. Ascospores 16 - 25 x 6 - 10 µm. Medulla without crystals. **R. olivaceobrunnea**

**Key to Rinodina group 3A**: Corticolous; asci with >8 ascospores or ascospores with >1 septum.

11 Asci with 8 ascospores. Ascospores with 4 lumina. **R. conradii**

1 Most asci with 16 ascospores. Ascospores with 2 lumina.

22 Ascospores Milvina type (septum inserted early). A pioneer species commonly occurring on small twigs. (R. crespoae)

2 Ascospores Dirinaria type. Not a distinctly pioneer species. (R. polysporoides)

**Key to Rinodina group 3B**: Corticolous; asci 1 spored; ascospores 1-septate; exciple without algae.


1 Hypothecium brown. Epithecium P-. Apothecia never pruinose. Thallus K-. Ascospores Pachysporaria type when mature. **R. kalbii**
Key to Rinodina group 3C: Corticolous; asci 8 spored; ascospores 1-septate; exciple with algae; epithecium K+ purple.

11 Thallus subsquamulose, sometimes becoming granular. Ascospores Bicincta type. (R. mayrhoferi)
   1 Thallus crustose, thin and smooth. Ascospores not Bicincta type.
      22 Mature ascospores Tunicata type, 14 - 18 (21) x (6.5) 8 - 9 (11) µm, strongly warted. (R. pityrea)
      2 Mature ascospores Mischoblastia type, (16) 18 - 23 x (6) 8 - 12 µm, smooth. **R. colobina**

Key to Rinodina group 3D: Corticolous; asci 8 spored; ascospores 1-septate; exciple with algae; epithecium K-; vegetative propagules present.

11 Thallus and epithecium P+ orange (pannarin)
   22 Soredia present, forming discrete soralia. Blastidia absent. **R. efflorescens**
   2 Soredia absent. Blastidia present.
      33 Blastidia confluent, forming a leprose crust. Ascospores Pachysporaria type, 20 - 34 x 10 - 12 µm. **R. dalmatica**
      3 Blastidia scattered or confluent. Ascospores Physcia type, 17 - 19 x 9 - 10 µm. **R. excrescens**
   1 Thallus and epithecium P-.
      22 Ascospores more than 25 µm long. Apothecia usually with yellow or orange pruina. (R. surfacetoides)
      2 Ascospores less than 20 µm long. Apothecia without pruina.
      33 Blastidia small, 20 - 30 µm diameter. Ascospores Physcia to Physconia type (septum inserted early). **R. furfuracea**
      3 Blastidia large, to 125 µm diameter. Ascospores Dirinaria type. **R. nimisii**

Key to Rinodina group 3E: Corticolous; asci 8 spored; ascospores 1-septate; exciple with algae; epithecium K-; vegetative propagules; absent; thallus with atranorin.

11 Epithecium P+ orange. Apothecia sometimes pruinose, especially when young. Ascospores Dirinaria type (but easily mistaken for Physcia type), 16 - 20 x 8 - 10 µm, swelling around septum in K. Probably restricted to maritime sites at fairly low altitude. **R. pruinella**
   1 Epithecium P-. Apothecia never pruinose. Ascospores not Dirinaria type. Not restricted to maritime sites.
      222 Ascospores Pachysporaria type, 19 - 26 x 10 - 13 µm. (R. euskadiensis)
      2 Ascospores Physcia type.
         33 Apothecial cortex 50 (80) µm thick, I+ blue. Apothecia sessile. Thalline margin usually persistent. Ascospores 18 - 23 (27) x 8 - 12 µm. Not restricted to the uplands. **R. capensis**
         3 Apothecial cortex indistinct, to 10 - 20 µm, I-.. Apothecia immersed. Thalline margin soon excluded.
            Ascospores 13 - 18 x 6.5 - 9 µm. Probably restricted to the uplands. **R. exigua**
      2 Ascospores Physcia type. 18 - 26 x 9 - 11 µm. (R. roboris). Greek report doubtful.

Key to Rinodina group 3F: Corticolous; asci 8 spored; ascospores 1-septate; exciple with algae; epithecium K-; vegetative propagules; absent; thallus without atranorin.

11 Ascospores Pachysporaria type. Probably restricted to Mediterranean or submediterranean vegetation.
   22 Ascospores 25 - 35 x 10 - 18 µm. Thallus subsquamulose, brown to grey-brown. Apothecia 0.6 - 0.9 mm diameter. (R. dolichospora)
   2 Ascospores 13 - 16 x 5 - 8 µm. Thallus thin, not subsquamulose, pale grey to dark grey. Apothecia 0.2 - 0.4 mm diameter, sessile (Note 1). **R. boleana**
11 Ascospores Physcia type.
   22 Thallus dark grey or dark green-brown, forming small patches, often on twigs. Ascospores tending towards Milvina type, 13 - 15 x 7 - 8 µm. Apothecia immersed or subimmersed. Not present in truly Mediterranean vegetation (Note 2). **R. sophodes**
   2 Thallus white, grey or brown, but not dark grey or dark green-brown. Ascospores strictly Physcia type. Apothecia and ecology various.
      33 Most ascospores less than 15 µm long.
         44 Cortex of thalline margin I-.. Ascospores without (or almost without) torus. Thallus white-grey to grey. At all altitudes. **R. pyrina**
         4 Cortex of thalline margin faintly I+ blue. Ascospores with well developed torus. Thallus white, yellow-
brown or red-brown. Restricted to (sub)alpine levels. **R. orculata**

3 Most ascospores more than 16 µm long. Thallus grey to brown. 

44 Apothecia mostly scattered, often becoming convex. Thalline margin often becoming excluded. Probably restricted to alpine levels. (R. trevisanii)

4 Apothecia often contiguous, remaining flat. Thalline margin persistent. Not restricted to alpine levels. **R. archaea**

1 Ascospores Dirinaria, Milvina or Physcia type.

22 Ascospores Dirinaria type (septum inserted late). Thallus never very dark in colour.

33 Ascospores 0.2 - 0.5 mm diameter, flat. Thalline margin usually persistent. Cortex of thalline margin indistinct, 10 - 25 µm thick, I+ faintly blue. Ascospores 13 - 15 x 7 - 8 µm. **R. oleae**

3 Apothecia 0.7 - 1.2 mm diameter, flat to convex. Thalline margin thin, often becoming excluded. Cortex of thalline margin 50 - 70 µm thick, I-. Ascospores 15 - 19 x 7 - 9 µm. (R. limonae) 

4 Ascospores Milvina or Physcia type (septum inserted early). Thallus pale or dark.

33 Ascospores Milvina type (or tending towards Physconia type), 13 - 15 x 7 - 8 µm. Thallus dark grey, forming small patches, often on twigs. Apothecia immersed or subimmerses. Not present in truly Mediterranean vegetation (Note 2). **R. sophodes** (If thallus thin or evanescent, white to pale grey, consider R. pyrina)

3 Ascospores Physcia type (sometimes tending towards Milvina type in R. plana). Other characters various. 

44 Ascospores (16) 18 - 23 (26) x (8.5) 10 - 12 (14) µm, strongly warded even when young, torus not or poorly developed. Apothecial cortex of round, large thin-walled cells, 5 - 8 (10) µm diameter. **R. albana**

2 Ascospores smaller, smooth when young, with a well-developed torus. Apothecial cortex different.

55 Thallus usually delimited by brown or black prothallus. Ascospores (14) 17 - 21 (23) x (7) 8 - 10.5 µm. Thallus grey to grey-brown, without a red tinge. Apothecia subimmerses to adnate, (0.3) 0.5 - 0.8 (1.0) mm diameter. Epithecum yellow-brown. **R. plana**

5 Prothallus absent (except sometimes in R. laevigata when thallus adjoins other species). Ascospores smaller. 

66 Cortex of thalline margin, 50 - 70 µm wide. Ascospores 16 - 20 x 7 - 9 µm. Thallus very thin, mainly of pale brown to brown dispersed areoles. Apothecia sessile to sessile, 0.4 - 0.8 mm diameter. (R. laevigata) Greek report incorrect.

6 Cortex of thalline margin less than 40 µm wide. Ascospores 12 - 19 x 6 - 9 µm.

77 Thallus usually some shade of grey, less commonly with a brown or reddish tinge, forming small patches, ±continuous to areolate. Areoles contiguous, 0.7 mm wide **R. freyi**

7 Thallus often poorly developed, usually reddish-brown, less commonly with a greyish tinge, usually more extensive, distinctly areolate. Areoles discrete, 0.1 - 0.2 mm wide. **R. septentrionalis**

(1) The sessile apothecia clearly separate R. boleana from R. pyrina, some collections of which might key out here.

(2) In the Peloponnese, R. sophodes is uncommon below 700 m altitude but common above that altitude.

**Key to Rinodina group 4A**: Saxicolous; vegetative propagules present.

111 Thallus with isidia, or isidia-like structure.

22 Isidia elongated. Ascospores Dubyana to Dirinaria type, 10 - 16 x 7 - 9 µm. At (sub)alpine levels. (R. furfurea)

2 Isidia ±spherical, very small, very dark in colour. Ascospores Milvina type, 15 - 21 x 8 - 12 µm. Not restricted to high altitude. **R. obnascens**

11 Thallus entirely blastidiate. Usually on nutrient-enriched substrates, including calcareous rock. (R. pityrea)

1 Thallus with soredia

22 Soralia white to pale grey, C+ red. On siliceous rock, usually in coastal sites. **R. aspersa**

2 Soralia white-grey to blue-grey, C-. On siliceous rock; not strictly coastal, but within a few km of the sea. (R. algarvensis)

**Key to Rinodina group 4B**: Saxicolous; vegetative propagules absent; thallus C+ or KC+ red.

11 Thallus K+ yellow (atrarorin)

22 Ascospores Mischoblastia type. **R. trachytica**

2 Ascospores Pachysporaria type.

33 Ascospores 13 - 15 x 8 - 10 µm. Medulla I+ blue. **R. alba**

3 Ascospores 16 - 19 x 9 - 12 µm. Medulla I-. **R. atrocinerea**

1 Thallus K-.

2 Hypothecium colourless. Ascospores Physconia type, 16 - 19 x 8.5 - 10 μm. Not restricted to coastal rock. **R. sicula**

**Key to Rinodina group 4C**: Saxicolous; vegetative propagules absent; thallus C-, K+ yellow

11 Thallus P+ orange (pannarin). Ascospores Pachysporaria type when young, grading into Physcia type later. On coastal rock. **R. santorinensis**

1 Thallus P-. Ascospores various. Not restricted to coastal sites.

222 Ascospores Pachysporaria type (sometimes grading into Physcia type), 15 - 29 x 6 - 15 μm. At low altitude. **R. beccariana** s. lat.

33 Apothecia with thalline margin (algae present in section). **R. beccariana var. beccariana**

3 Apothecia with false thalline margin (algae not present in section). (R. beccariana v. lavicola)

22 Ascospores Physcia type.

33 Ascospores 18 - 23 x 8 - 10 μm. On montane siliceous rock. **R. confragosa**

23 Ascospores 13 - 16 x 6 - 8 μm. On siliceous rock, often shaded; not restricted to the mountains. **R. occulta**

2 Ascospores Mischoblastia type.

333 Ascospores 16 - 19 x 8 - 10 μm. At Mediterranean and submediterranean altitudes. Cortical tissues sometimes with a blue-green pigment reacting N+ red (not seen in my collection). **R. trachytica**

333 Ascospores 19 - 23 x 10 - 12 μm. Probably restricted to the uplands. **R. oxydata**

**Key to Rinodina group 4D1**: On calcareous rock; vegetative propagules absent; thallus C-, K-

1111 Ascospores Tunicata type.

22 Hymenium with oil droplets. **R. tunicata**

2 Hymenium without oil droplets. **R. calcarea**

111 Ascospores Bischoffii type.


2 Apothecia sessile or immersed in thallus, but not in substrate. Thallus usually distinct.

33 Thallus brown, of dispersed to continuous areoles. Strictly alpine. (R. castanomelodes)

3 Thallus usually some shade of grey, with at most a very slight brown tinge. At all altitudes.

44 Oil droplets present, often abundant, in hymenium. Pigmented band well developed and prominent, usually clearly visible across entire width of ascospores. **R. bischoffii**

4 Oil droplets absent. Pigmented band not well developed, often only apparent at edges of ascospores. **R. guzzinii**

11 Ascospores Bicincta type.

22 Thallus thin or immersed.

33 Ascospores 15 - 21 x 11.5 - 14 μm. **R. retica**

3 Ascospores 10 - 16 x 7 - 11 μm. **R. luridata**

2 Thallus superficial, well developed, grey. Ascospores 13 - 20 x 7.5 - 12 μm. **R. lecanorina**

11 Ascospores not as above; without a double wall or brown bands.

222 Ascospores Physconia or Dubyana type.

33 Thallus indistinct. Apothecia immersed in depressions of substrate. Ascospores 14 - 18 x 8 - 10 μm. **R. dubyana** Note 1.

3 Thallus distinct, well developed, pale to dark grey. Apothecia not immersed in depressions of substrate. Ascospores 18 - 21 x 11 - 13 μm. **R. guzzinii**

22 Ascospores Dirinaria type, Ascospores 13 - 15 x 7 - 8.5 μm. Thallus dark grey to black-brown. (R. poeltii)


(1) R. dubyana and R. immersa are easily confused, because both have dark brown septa at some stages of development, and the septum can be misinterpreted as a brown band. R. immersa has ascospores that are larger on average, but there is overlap: collections with ascospores 15 - 18 μm long should be scrutinised carefully. It is advisable to observe *many* ascospores before determining a collection as R. dubyana or R. immersa. Even then, some collections may be difficult to place. In the Peloponnese, R. immersa is much commoner than R. dubyana.
Key to *Rinodina* group 4D2: On siliceous rock; vegetative propagules absent; thallus C-, K-

11 Ascospores *Physconia* type. Gyrophoric acid (C+ red) present in exciple and hypothecium. **R. sicula**

1 Ascospores not *Physconia* type. Apothecia without gyrophoric acid.

2222 Ascospores *Bischoffii* type. On base-rich siliceous rock; never on strongly acidic rock. See Group 4D1 key.

22 Ascospores *Milvina* type, sometimes becoming ±*Pachysporaria* type when mature. Thallus well developed, fairly thick.

33 Apothecial margin with few or no algal cells. (Thalline margin absent or, in immersed apothecia, scarcely distinguishable from thallus.)

44 Areoles usually arising from well developed, black hypothallus. Apothecia 0.5 - 1 mm diameter. **R. milvina**

4 Hypothallus absent. Apothecia 0.2 - 0.5 mm diameter. Non-isidiate morphs of **R. obnascens**

2 Ascospores *Dirinaria* type, 13 - 16 x 7 - 10 µm. Thallus thin, grey. Apothecia sessile. **R. gennarii**

**Rinodina alba** Metzler ex Arnold (1872)

*Flora* 55: 35.

Description: Giralt (2001, 2010).

Islands of the southern Aegean, including Crete. On siliceous rock at altitudes 5 - 600 m. Circum-Mediterranean/Macaronesian. Widespread in southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco).

**Rinodina albana** (A. Massal.) A. Massal. (1852)


Description: Giralt (2001, 2010).

Known from a single site in Macedonia, at an altitude of 200 m. The substrate was not reported.

South and south-central Europe. Also Macaronesia, Asia (Turkey, southern Siberia). Reports for N. America are incorrect.

**Rinodina anomala** (Zahlbr.) H. Mayrhofer & Giralt (1992)


Known from a single site in Macedonia, where it occurred in bark of *Platanus orientalis* at an altitude of 20 m.

A Mediterranean-Macaronesian species. Southern Europe, from Portugal to Greece. Also Macaronesia, N. Africa (Morocco, Tunisia).

**Rinodina archaea** (Ach.) Arnold (1881)


The thin brown thallus (most obviously visible in the colour contrast between the thalline exciple and the black
disc) is fairly distinctive. The large, Physiscon type ascospores and the absence of lichen substances are definitive.

Scattered, with no clear pattern, at altitudes 700 to at least 1600 m. On wood or bark. Reported from wood of Juniperus and Pinus, and bark of Abies and Pauinus.

Widespread in Europe, but rare in the south. Also Macaronesia, Asia (widespread), Africa (Morocco), N. America (widespread in western half), Antarctica (Signy Is, S. Georgia).

**Rinodina aspersa** (Borrer) J. R. Laundon (1986)


Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

NE Peloponnesse, on siliceous rock at an altitude of 600 m. Not reported since the 19th century.

Widespread in western half of Europe, as far north as southern Scandinavia. It Italy it is rare, and confirmation of its presence in Greece is desirable, though as it is a distinctive species the old report seems plausible. Also Asia (Turkey, perhaps Taiwan), N. America (Washington).

**Rinodina atrocinerea** (Hook.) Körb. (1855)


Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

Eastern Crete, at an altitude of 600 m. The substrate was not reported.

Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco). Reports for N. America are incorrect.

**Rinodina beccariana** Bagl. (1871)


Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On siliceous rock at altitudes 0 - 850 m.

Circum-Mediterranean/Atlantic. Fairly common from Portugal to Greece, and are a few reports from the Atlantic margin to as far north as British Is. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco).

**Rinodina bischoffii** (Hepp) A. Massal. (1855)


Thallus: crustose, pale grey when fresh (sometimes developing a pale brown tinge in herbarium), not pruinose, forming small patches to about 2 cm diameter; very smooth: usually crinkled, sometimes continuous, sometimes almost areolate, sometimes very thin, in other cases well-developed and 250 - 350 µm thick. Cortex: present but often poorly developed, almost a pseudocortex, (0) 10 - 25 (40) microns thick, colourless, usually without distinct structure but lower part sometimes obscurely cellular when cortex thick. Medulla: white, thin. Apothecia: immersed in thallus when young, later subsessile, flat, 0.3 - 0.55 mm diameter. Disc: black, not pruinose. Thalline margin: present, persistent, often slightly crenulate, sometimes slightly white pruinose; in section: 60 µm wide. Exciple: almost absent, scarcely distinguishable from hymenium. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 90 - 110 µm tall, colourless, with few to many oil droplets 0.5 - 1 (2) µm diameter, KI+ blue. Hypothecium: 125 - 130 µm tall, colourless, sometimes with oil droplets. Paraphyses: simple, 1.5 µm wide at base, 2.5 - 3.5 µm at apex, without internal pigment. Ascii: 65 - 75 x 19 - 21 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, sometimes slightly swollen at septum in K, 20 - 21 x 10 - 11 µm, Bischoffii type with prominent brown broad and unambiguously Physiscon type lumina, 8 per ascus. Chemistry: hymenium K-, KC-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 7 - 13 µm diameter. Photobiont layer: 70 - 120 µm thick, zcontinuous but rather irregular, as cells tend to form large clumps.

The size and abundance of the hymenial oil droplets vary considerably, but some are always present.

Could only be confused with *R. guazzinii*, but that lacks hymenial oil droplets and has a less distinct brown band across the ascospores.

Widespread and common in the southern half of Greece, scarce in the north. On calcareous rock at all altitudes. The lichenicolous fungus *Muellerella pygmaea* has been reported once from this host.

Throughout Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), perhaps C. America (Mexico), S. America (Argentina), Australasia (widespread).
Rinodina boleana Giralt & H. Mayrhofer (1991)


Description: Giralt (2001, 2010).

Naxos, on bark at an altitude of 5 m.

Southern Europe, from Portugal to Greece. Also southern Africa (Namibia - as *R.* aff. *boleana*, so perhaps different species), N. America (Colorado, Kansas, Nebraska), Australasias (NZN, NZS).

Rinodina calcarea (Arnold) Arnold (1880)


*Rinodina calcarea* var. *graeca* J. Steiner; *Rinodina calcarea* var. *melanocarpa* J. Steiner; (?) *Rinodina calcarea* var. *nummulitica* Flagey.

Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

Scattered in the eastern half of Greece, on calcareous, or at least ±basic rock at altitudes 0 - 1200 m.

Mainly southern and central Europe, with a few records to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Algeria). Reports for N. America are incorrect.

Rinodina capensis Hampe ex A. Massal. (1861)


Description: Giralt (2001, 2010).

Scattered, with no clear pattern. On bark at altitudes 120 - 1200 m, and perhaps occasionally higher. The only phorophytes explicitly reported were *Olea* and *Pinus*.

South and south-central Europe. Also Macaronesia, Asia (Turkey, Georgia, southern Siberia, Taiwan), Africa (Morocco, perhaps S. Africa), N. America (widespread in western half), Australasia (NZS).

Rinodina colobina (Ach.) Th. Fr. (1871)


Hairs on the thalline exciple are not mentioned in any published description that I have seen. Further collections are needed to establish their status.

Characterised by the grey, blastidiate thallus, the K+ violet epithecium and the fairly large Mischoblastia (or Physcia) type ascospores.

Widely distributed in Greece, but scattered and without any clear pattern. Perhaps often overlooked, as it is an inconspicuous species. On bark of deciduous trees at altitudes 100 - 1000 m.

Widespread to as far north as mid Scandinavia, but commonest in the south of Europe. Also Asia (Turkey, Russia, perhaps India, Taiwan), N. Africa (Morocco, Algeria), N. America (widespread in western half).

Rinodina confragosa (Ach.) Körb. (1855)


Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On siliceous rock at altitudes 0 - 1100 m.

Throughout Europe except for truly arctic regions. Also Macaronesia, Asia (Turkey, Armenia, Russia, Mongolia), Africa (Morocco, Algeria, S. Africa), N. America (widespread in western half), C. America (Mexico), perhaps S. America (Argentina, perhaps), Australasia (Victoria).

Rinodina conradii Körb. (1855)


Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Nimis & Martellos (2004); Smith et al. (2009).

Known from a single site in Macedonia, on terricolous bryophytes and decaying vegetation at an altitude of 1300 m.

Throughout Europe, but in the south rare and restricted to the mountains. Also Macaronesia, Asia (widespread), Malesia (PNG), N. America (widespread in western half), S. America (widespread), Australasia (Tasmania, perhaps elsewhere in Australia, NZN, NZS).


Description: See the protologue.

Crete, Lefkada and Corfu, at altitudes 100 - 1000 m. The substrate was not reported.

Sardinia, Croatia, Greece, Ukraine (Crimea). Also Asia (Syria), N. Africa (Tunisia).

**Rinodina dalmatica** Zahlbr. (1901)


Scattered, but never very far from the sea. On bark at altitudes 20 - 350 m. Reported from Juniperus phoenicea, Olea, and Pinus spp.

Southern and south-central Europe. Also western Asia (Turkey).

**Rinodina dubyana** (Hepp) J. Steiner (1919)


Thallus: crustose, forming small patches about 1 cm diameter, immersed or thinly superficial, white (if superficial).

Apothecia: immersed in substrate, flat, sometimes becoming convex, 0.2 - 0.6 mm diameter, sometimes slightly white pruinose. Disc: black. Thalline margin: absent. Exciple: dark brown, becoming almost excluded; in section: 25 - 50 µm wide, colourless in inner part, dark brown in outer part, of ±parallel hyphae sometimes with narrow, elongated lumina. Epithecium: brown, K-. Hymenium: 60 - 100 µm tall, colourless, without oil droplets. Hypothecium: 75 - 100 µm tall, colourless to very pale brown. Paraphyses simple, 1 - 1.5 µm: wide at base, to 5 µm at apex, often capitiate, apical cell with internal brown pigment. Asci: 60 x 17 µm, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, sometimes slightly constricted at septum, 14 - 17.5 x 8 - 10 (11) µm, Physconia type, 8 per ascus. Chemistry: thallus K-, C-. Photobiont: green.

Could only be confused with *R. immensa*, but that has slightly larger, Bischoffii type ascospores.

Thallus: crustose, forming small patches about 1 cm diameter, immersed or thinly superficial, white (if superficial).

Apothecia: immersed in substrate, flat, sometimes becoming convex, 0.2 - 0.6 mm diameter, sometimes slightly white pruinose. Disc: black. Thalline margin: absent. Exciple: dark brown, becoming almost excluded; in section: 25 - 50 µm wide, colourless in inner part, dark brown in outer part, of ±parallel hyphae sometimes with narrow, elongated lumina. Epithecium: brown, K-. Hymenium: 60 - 100 µm tall, colourless, without oil droplets. Hypothecium: 75 - 100 µm tall, colourless to very pale brown. Paraphyses simple, 1 - 1.5 µm: wide at base, to 5 µm at apex, often capititate, apical cell with internal brown pigment. Asci: 60 x 17 µm, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, sometimes slightly constricted at septum, 14 - 17.5 x 8 - 10 (11) µm, Physconia type, 8 per ascus. Chemistry: thallus K-, C-. Photobiont: green.

Throughout Greece. On calcareous rock at all altitudes.

**Rinodina efflorescens** Malme (1927)


Description: Smith et al. (2009).

Skyros, on bark of *Pinus halepensis* at an altitude of 225 m.

Probably throughout Europe, though perhaps less common in the south. Also Asia (Turkey, Russia), N. America (widespread).

**Rinodina excrescens** Vain. (1928)


Western Crete, on wood of *Castanea sativa* at an altitude of 500 m.

Southern and south-central Europe. Also Asia (western Siberia, Japan), N. America (mostly around Great Lakes).

**Rinodina exigua** "(Ach.) Gray (1821)"


Conservation may be required to preserve current usage, since *Lichen exiguus* Ach. (1799) and *Parmelia exigua* Ach. (1803) are illegitimate.

Thallus: crustose, white, very thin, to a maximum of 100 µm thick. Apothecia: subimpressed to subsessile, flat, 0.2 - 0.45 mm diameter, not pruinose. Disc: black. Thalline margin: not usually apparent externally, present in section (though rather weakly); cortex 12 µm thick, I-. Exciple: brown, paler than disc, thin; in section: 25 - 35 µm wide, brown in outer part, colourless to pale brown in inner part, of radiating hyphae. Epithecium: orange-brown to brown, K-, P-, pigment not soluble in K. Hymenium: 80 µm tall, colourless, KI+ blue. Hypothecium: 40 µm tall, colourless to pale brown. Asci: 58 x 17 µm, clavate. Ascospores: brown, 1-septate, ellipsoid, 16 - 18 x 9 - 10 µm, Physcia to Milvina type, 8 per ascus. Chemistry: thallus K+ yellow in section. Photobiont: green.

There are reports from most parts of Greece. However, Giralt (2001) remarks that most of the reports of this species
for the Iberian Peninsula are incorrect, and the same is certainly true for Greece. My only collection was from wood of *Abies cephalonica* at an altitude of 1400 m, which is consistent with the expected ecology of this species.

Widespread in Europe to about the Arctic Circle. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (California; other reports doubtful), perhaps C. America (Mexico), perhaps S. America (Argentina), Australasia (NZN).

**Rinodina freyi** H. Magn. (1947)


Scattered, with no clear patterns, on bark at altitudes 160 - 780 m.

Probably widespread in cool and temperate Europe, though distribution uncertain owing to confusion with other species. May be rarer in the south. Also Asia (Turkey, Russia, Japan), N. America (widespread).

**Rinodina furfuracea** H. Magn. (1947)

*Acta Horti Gothob.* 17: 236.

Description: Giralt (2001, 2010).

Corfu, at an altitude of about 20 m. No substrate was reported.

Southern Europe, from Portugal to Greece, with a disjunct report for England.

**Rinodina gennarii** Bagl. (1861)


The name *Rinodina demissa* (Flörke ex Flot.) Arnold has sometimes been (?mis) applied to this lichen. The basionym, *Zeora metabolica* var. *demissa* Flörke ex Flot., does not appear ever to have been typified, and its application is not clear. If it were synonymous, the epithet *demissa* would have priority.

Thallus: crustose, grey-brown, not pruinose, warted, to a few cm diameter, 180 - 300 µm thick. Cortex: 10 - 15 µm thick, colourless except for thin pale orange-brown surface layer, K-, brown pigment soluble in K. Medulla: ±white. Apothecia: sessile, flat to slightly convex, 0.3 - 0.6 (0.75) mm diameter, not pruinose. Disc: black, matt. Thalline margin: thin, 0.05 mm wide, persistent but sometimes discontinuous in older apothecia; in section: 70 - 80 µm wide. Exciple: sometimes visible externally as a thin brown ring; in section: 15 µm wide, orange-brown at surface, colourless in lower part, similar to hymenium except that some hyphae have small lumina. Epithecium: brown, K-, P-. Hymenium: 80 - 100 µm tall, colourless, KI+ blue. Hypothecium: 60 - 125 µm tall, colourless. Paraphyses: usually simple, occasionally branched close to apex, 1.5 - 2 µm wide in lower part, capitate, apical cell 4 - 5 µm with internal brown pigment cap, sometimes slightly moniliform, sometimes with visible septa. Ascii: 60 x 17 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ±ellipsoid but sometimes constricted at septum in water (swollen at septum in K). 12.5 - 15 x 9 - 10 µm, Dirinaria type, torus absent, 8 per ascus. Pycnidia: entirely immersed, not visible externally, pyriform, 100 µm tall, 75 µm wide. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, P-, UV-. Photobiont: green, cells globose, 7.5 - 13 µm diameter. Photobiont layer: continuous, ±regular, 60 - 75 µm thick.

Unlike to be confused with any other species, if the ascospores are correctly recognised as Dirinaria type.

*R. gennarii* is sometimes considered to be a synonym of *R. oleae*, since the only really clear difference between the two is the substrate. *R. gennarii* is common throughout Europe, but *R. oleae* has been understood here as a southern European species. If the two names are synonymous, it is difficult to understand why the resulting single taxon should be corticolous only rarely in the northern part of its range.

Throughout Greece, usually fairly close to the sea. On siliceous rock at altitudes 0 - 1000 m, but more than half of all reports are from below 200 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (cool to temperate regions of both coasts), C. America (Mexico), S. America (Chile), Australasia (widespread), Antarctica (St Paul Is).

**Rinodina guzzinii** Jatta (1891)


Thallus: crustose, to 2 cm diameter, areolate, grey to dark grey, sometimes slightly white pruinose, thin to moderately thick (150 - 350 µm). Areoles: 0.2 - 0.7 mm wide, ±flat, subrounded to subangular, sometimes with black margin (and then sides brown in thin section). Cortex: 30 - 40 µm thick, colourless, formed of vertical hyphae with ±broad lumina giving a (rather obscure) cellular texture, K-. Medulla: white. Apothecia: submersed in thallus to sub sessile, flat to slightly convex, 0.5 - 0.7 mm diameter, not pruinose. Disc: black. Thalline margin: present, sometimes becoming excluded; in section: 50 - 75 µm wide. Exciple: not visible externally; in section: 10 - 20 µm wide,
brown at surface, colourless elsewhere, formed of hyphae with narrow, elongated lumina. Epithecium: brown to orange-brown, K-, most pigment not soluble in K. Hymenium: 100 - 125 µm tall, colourless, without oil droplets, KI+ blue. Hypothecium: 75 - 125 µm tall, colourless or almost, without oil droplets. Paraphyses: simple, 1.5 µm wide at base, clavate or slightly capitate, apical cell 4 - 5 µm wide, often with some internal brown pigment. Asc: 50 - 55 x 15 - 16 microns, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, usually ellipsoid, occasionally slightly tadpole-shaped, 17 - 20 x 7 - 11 microns, ±Bischoffii type (brown band often faint; lumina as in Physconia or Milvina type), 8 per ascus. Chemistry: medulla K-, C-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose to slightly ellipsoid, 9 - 14 µm diameter. Photobiont layer: 80 - 150 µm thick, ±continuous but irregular as cells tend to form large clumps.

In one of my two collections, ascospores had the Physconia type lumina expected for this species. In the other, lumina were ±Milvina type. More collections are needed to clarify the matter.

Provided the ascospore type is correctly determined, this species could only be confused with R. bischoffii. However, that species has abundant oil droplets in the hymenium and/or hypothecium.

Scattered, with no clear pattern, on calcareous and siliceous rock at all altitudes. The reported distribution and ecology seems rather broad, and perhaps some reports are incorrect.

Southern Europe, from Portugal to Cyprus; also southern Russia. Also Asia (widespread as far east as Tajikistan and Afghanistan), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread in western USA).

**Rinodina immersa** (Körb.) J. Steiner (1893)

Thallus: crustose, usually entirely immersed, to a few cm. diameter. Apothecia: 0.2 - 0.45 mm diameter, usually flat, immersed in pits in substrate, usually not pruinose. Disc: brown to black. Thalline margin: absent. Exciele: dark brown to dark grey-black or black; in section: 30 - 50 µm wide, brown in outer part, usually colourless in inner part, of hyphae that are ±parallel to paraphyses. Epithecium: orange-brown to brown, K-. Hymenium: 70 - 110 microns tall, mostly colourless, upper part sometimes with some epithecial pigment, without oil droplets. Hypothecium: 25 - 100 µm tall, colourless to brown. Paraphyses: simple, 1.5 µm wide at base, often capitate, apical cell 3 - 7 µm wide with internal brown pigment cap. Asc: 70 - 75 x 20 - 22 µm, clavate. Ascospores: brown, 1-septate, ellipsoid, (13) 16 - 22 x 9 - 12 µm, Bischoffii type, 8 per ascus. Pycnidia: rare. Conidia: colourless, bacilliform, 4 x 1 µm. Chemistry: all reactions negative (but this is usually hard to demonstrate because thallus so poorly developed). Photobiont: green; cells globose 10 - 12 µm diameter, in small clumps scattered rather sparsely within the rock.

North American authors have suggested that *R. immersa* may be just a substrate-modified morph of *R. guzzinii*, but I have seen material of the two species growing side by side, and they appeared clearly distinct.

Could only be confused with *R. dubyana*, but that has Physconia type ascospores.

Very common throughout Greece. On calcareous rock at all altitudes.

Throughout Europe to as far north as southern Scandinavia, but commonest in the south. Also Asia (widespread as far east as Tajikistan), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America (where it is usually regarded as a synonym of *R. bischoffii*), Australasia (NSW, NZS).

**Rinodina insularis** (Arnold) Hafellner (1979)

Descriptions: Ahti et al. (2002); Giralt (2001); Nash et al. (2004); Smith et al. (2009). Nadyeina et al. (2010) argue that this species is more closely related to *Buellia* than to *Rinodina*.

Scattered in the southern half of Greece, always close to the sea, at altitudes 110 - 600 m. On *Lecanorarupicola*. Some reports do not mention a host, and it is unclear whether the lichen occurred directly on (siliceous) rock, or whether the host was simply overlooked. According to Giralt (2001) this lichen is always parasitic.

Mainly southern Europe and the Alps, plus scattered reports to as far north as Norway. Also Macaronesia, Asia (Turkey), N. America (Alaska, BC, Arizona), S. America (Chile), Australasia (ACT, NSW, NZS).

**Rinodina kalbii** Giralt & Matzer (1994)

Description: Giralt (2001).

Amorgos and Chios, on bark at altitudes 10 - 690 m.

Southern Europe, from Portugal to Greece. Also Macaronesia.

**Rinodina lecanorina** (A. Massal.) A. Massal. (1854)
Rinodina ocellata (Hoffm.) Arnold (1884) nom. illeg.

The earliest name is Verrucaria ocellata Hoffm. (1790) but the epithet ocellata was not available to Arnold in 1884 because of the earlier Rinodina ocellata (Flot.) Branth & Rostrup (1869). Massalongo's lecanorina is the next available epithet.


Easily recognised by the Bicincta type ascospores and the well developed thallus.

Scattered throughout Greece, but commoner in the southern half. On calcareous rock at all altitudes.

Widespread in southern and central Europe, with a few reports from further north to southern Sweden. Also Asia (widespread as far east as Tajikistan), Africa (Morocco, Algeria, Tunisia, perhaps S. Africa). Reports for N. America, Australasia are incorrect. Those for eastern Asia, Malesia and Caribbean are doubtful.

Rinodina luridata (Körb.) H. Mayrhofer, Scheid. & Sheard (1990)


Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On siliceous rock at altitudes 0 - 700 m.

Widespread along Atlantic margin of Europe, from Portugal to mid Norway, and present throughout much of Mediterranean Europe. Also western Asia (Turkey), N. Africa (Tunisia). I am sceptical of a report for Pacific (Hawaii).

Rinodina luridescens (Anzi) Arnold (1872)


Scattered in the southern half of Greece, at altitudes 800 - 1000 m. None of the reports specify a substrate.

Southern and south-central Europe, with a few reports as far north as mid Scandinavia. Also western Asia (Turkey, Iraq), N. Africa (Morocco), N. America (widespread), Australasia (NSW, Victoria, NZN, NZS).

Rinodina milvina (Wahlenb. ex Ach.) Th. Fr. (1860)

Lich. Arct. 124; Parmelia milvina Wahlenb. ex Ach. (1803), Methodus (Suppl.) 34; Lecanora subconfragosa Nyl.

Thallus: crustose, areolate, brown to dark grey, not pruinose, to a few cm diameter, 180 - 230 µm thick (including hypothallus, which is about half the total thickness). Areoles: contiguous, 0.25 - 0.8 mm wide, angular. Hypothallus: black, not visible externally, well-developed below areoles. Prothallus; sometimes present, usually faint and intermittent, black, 0.2 (0.5) mm wide, radially striate when well developed. Cortex: 20 µm thick, dark brown in upper half, colourless below, of vertical hyphae, tips reaching different levels, apical cell with internal brown pigment cap, pigment K-, not soluble in K. Medulla: often poorly developed, white. Apothecia: submersed to subsessile, flat, 0.45 - 0.65 mm diameter, not pruinose. Disc: black. Thalline margin: fairly thick, persistent; in section: 15 - 100 µm wide, cortex to 20 µm but not very distinct. Exciple: not visible externally; in section: poorly developed, 10 µm wide, scarcely distinguishable from hymenium. Epithecium: brown, K-, P-, pigment not soluble in K. Hymenium: 90 - 100 µm tall, colourless, K+ blue. Hypothecium: 90 - 100 µm tall, colourless. Paraphyses: simple, 1 - 2 µm wide at base, apical cell 2.5 - 4 µm wide with internal brown pigment cap. Asci: 55 - 60 x 17 - 18 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 17.5 - 21 x 10 - 12.5 µm, Milvina type, sometimes tending towards Pachysporaria type when mature, torus present, 8 per ascus. Pycnidia: common, 100% immersed, pyriform, 90 - 150 µm tall, 50 - 100 µm wide, wall brown in upper part, colourless elsewhere. Conidia: ellipsoid, 3 x 1 µm, colourless. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, P-, UV-.. Photobiont: green, cells globose, 8 - 13 µm diameter. Photobiont layer: continuous and regular (within a single areole), 50 - 100 µm thick.

Easily recognised by the combination of Milvina type ascospores and the well developed, black hypothallus.

Scattered rather thinly throughout Greece, with no clear pattern. On rock, usually siliceous. There are reports from altitudes of 200 - 2150 m, but those for low altitude seem rather doubtful to me.

Throughout Europe. Also Asia (widespread), N. Africa (Algeria), N. America (widespread). A 19th century report for Antarctica (St Paul Is) may be incorrect.


Description: Giralt (2001, 2010), or see the protologue.

Islands of the southern Aegean, on bark of Juniperus oxycedrus subsp. macrocarpa at altitudes 0 - 500 m.

Southern Europe, from Portugal to Greece. Also western Asia (Syria).

Rinodina obnascens (Nyl.) H. Olivier (1903)

Rinodina occulta (Körb.) Sheard (1967)

Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

Scattered, with no clear pattern, on siliceous rock at altitudes 1000 - 1200 m. In Greece it appears to be restricted to the uplands, but in Italy it is sometimes coastal according to Nimis (1993).

Widespread in Europe except for truly arctic regions, but uncommon in the south. Also Asia (Turkey, Georgia, southern Siberia), Malesia (PNG), Australasia (SE Australia), Antarctica (S. Shetland Is).

Rinodina olivaceobrunnea C. W. Dodge & G. E. Baker (1938)


Sterea Ellada, at about 1850 m altitude. The substrate was not reported.

Throughout Europe, but in the south rare and restricted to high mountains. Also Asia (Russia, Tajikistan), perhaps Africa, N. America (widespread in western half), S. America (Chile), Australasia (Tasmania, NZS), Antarctica (widespread).

Rinodina orculata Poelt & M. Steiner (1970)


Known from two sites in northern Greece, on bark at altitudes 700 - 1550 m. The only phorophyte explicitly reported was *Pinus sylvestris*.

Mainly central Europe, but reported for Norway, and there are a few reports for the mountains of southern Europe. Also Asia (Turkey, Russia), N. America (widespread).

Rinodina oxydata (A. Massal.) A. Massal. (1854)

Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Sheard (2010); Smith et al. (2009).

Lesvos, on an unspecified substrate at an altitude of 970 m. Abbott (2009) placed reports of *Rinodina discolor* here, on the authority of Sheard (1967), but that name is an obligate synonym of *R. lecanorina*.

Widespread in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Malesia (Java, PNG), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico), S. America (Brazil, perhaps Argentina), Australasia (widespread in Australia).

Rinodina plana H. Magn. (1947)

Thallus: crustose, pale grey or pale green-grey, 50 - 130 thick, cracked (when well developed), forming small patches about 1 cm diameter, sometimes delimited by black prothallus, 0.1 mm wide. Cortex: poorly developed, 0 - 20
μm thick, colourless, without distinct structure. Apothecia: subimmersed at first, later subsessile, 0.3 - 0.65 mm diameter, flat, not pruinose. Disc: dark brown to black. Thalline margin: present, usually persistent; in section: 50 - 70 μm wide. Exciple: not visible externally; in section: 15 - 25 μm wide, colourless except at surface, hyphal. Epithecium: brown to orange-brown, K-, P-, some (not all) pigment soluble in K. Hymenium: 65 - 100 μm tall, colourless, KI+ blue. Hypothecium: (25) 65 - 100 μm tall, colourless to very pale brown. Paraphyses: simple, 1 μm wide at base, 2.5 - 4 μm at apex, slightly capitate, apical cell with internal brown pigment cap. Asci: 55 - 80 x 18 - 28 μm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, (15) 17 - 23 x (6) 7.5 - 10 (12) μm, Physcia type, sometimes tending towards Milvina type, 8 per ascus. Chemistry: thallus K-. Photobiont: green; cells globose, 8 - 12 μm diameter, forming a ±continuous, ±regular later 30 - 50 μm thick.

A rather variable species that is not easily characterised. The black prothallus is helpful, but not always present. Best determined by paying careful attention to details in the keys.

Quite widely distributed in the southern half of Greece, rare in the north. On bark, usually smooth bark, at altitudes 0 - 1100 m.

Southern and south-central Europe. Also Macaronesia, western Asia (Turkey, Syria), N. Africa (Algeria, Tunisia).

**Rinodina pruinella Bagl. (1879)**


Thallus: crustose, pale grey, forming small patches to about 1.5 cm diameter, cracked, sometimes almost areolate, surface slightly warted, thin (90 - 110 μm in section), without vegetative propagules. Prothallus: sometimes present, black, 0.15 - 0.3 mm wide. Cortex: 5 - 50 μm thick, colourless to pale grey. Medulla: white. Apothecia: sessile, flat to slightly convex, 0.35 - 0.7 mm diameter. Disc: black, sometimes slightly white pruinose in young apothecia. Thalline margin: present, ±persistent but sometimes becoming thin or discontinuous; in section: 65 μm wide of which cortex 25 μm. Exciple: sometimes visible externally as a thin ring concolourous with disc but slightly raised; in section: sometimes scarcely apparent, to 25 μm wide when well developed, colourless except at surface, of hyphae parallel to paraphyses. Epithecium: brown to dark brown, K-, P+ orange, pigment not soluble in K. Hymenium: 85 μm tall, colourless, KI+ blue. Hypothecium: 85 μm tall, colourless. Paraphyses: sometimes branched in upper part, 1 μm wide at base, 2.5 - 4 μm at apex, slightly capitate, apical cell with brown pigment. Asci: 55 x 16 - 17 μm, clavate, Lecanora type. Ascospores: brown, 1-septate, usually ellipsoid, sometimes slightly lemon-shaped, 16 - 17 x (6) 9 - 10 μm, Dirinaria type (though this is apparent only in very early stages of development, and not always then), 8 per ascus. Chemistry: medulla C-, KC-, I-; thallus K+ yellow, C-, KC-, P-, UV-. Photobiont: green, cells globose, 8 - 11 μm diameter. Photobiont layer: 20 - 50 μm thick, often discontinuous.

The combination of a K+ yellow thallus and P+ orange epithecium is distinctive.

A rare species of strongly maritime sites in southern Greece. On bark at altitudes 20 - 350 m. Reported from *Quercus coccifera* and *Vitex agnus-castus*.

Southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Israel), N. Africa (Morocco, Algeria, Tunisia).

**Rinodina pyrina (Ach.) Arnold (1881)**

*Flora 64: 196; Lichen pyrinus Ach. (1799), Lichenogr. Svec. Prodr. 52.*

Thallus: crustose, pale grey, forming small patches to 2 cm diameter, thin (30 - 120 μm). Cortex: poorly developed. Apothecia: immersed to subsessile, slightly concave to flat, (0.15) 0.2 - 0.4 (0.5) mm diameter, not pruinose. Disc: brown to black. Thalline margin: present, persistent; in section: 30 - 70 μm wide of which cortex 15 - 30 μm; cortex 1-.

Exciple: visible externally only in a few of the largest apothecia as a thin ring concolourous with disc; in section: 10 - 25 μm wide, colourless except at surface, of hyphae that often develop distinct lumina in their upper parts. Epithecium: brown, K-, pigment (but not within) paraphyses soluble in K. Hymenium: 55 - 70 μm tall, colourless, KI+ blue. Hypothecium: 50 - 70 μm tall, colourless. Paraphyses: simple, 1 - 2 μm wide at base, slightly capitate, to 4 μm at apex, apical cell sometimes with internal brown pigment. Asci: 60 x 14 μm, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 12.5 - 15 x 5 - 8 μm, Physconia type, 8 per ascus. Chemistry: thallus K-, UV-.

Photobiont: green, cells 8 - 15 μm diameter.

According to Giralt (2001), in material from the Iberian Peninsula, the algal cells in the thalline margin are unusually large, but I have not observed that in Greek collections.

The small Physconia type ascospores and the thin, pale grey thallus are fairly distinctive. *R. sophodes* has a much darker thallus and its ascospores usually have at least some apical wall thickening (Milvina type).

Throughout Greece. Usually on bark, rarely on wood, from sea level to about 1400 m. Reported from a wide range of phorophytes, with no clear preferences.

Throughout Europe. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread in western half south of arctic circle), C. America (Mexico), A. America (Chile), Australasia (S and SE Australia, NZS).

Thallus: crustose, areolate, pale grey, not pruinose, to a few cm diameter, to 0.6 mm thick. Areoles: 0.5 - 1.3 mm wide, ±flat, corticate for some way down the sides. Cortex: white in upper part, orange-brown below (? affected by substrate in only collection seen). Medulla: white in upper part, pale orange-brown below, not pruinose, 0.4 - 1.2 mm diameter, to 0.6 mm thick. Thalline margin: weakly developed in some young apothecia, otherwise ± absent both externally and in section. Exciple: thin, black; in section: 25 - 50 µm wide, brown in outer part, colourless within, of radiating hyphae that develop rather obscure lumina in outer part, final cell very distinct (like cortex), with internal brown pigment. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 75 µm tall, colourless, hypothecium: 75 µm tall, pale orange-brown below. Paraphyses: simple, 1 - 1.5 µm wide at base, 3 - 5 µm at apex, septa of last few cells often visible, pigment generally diffused through last few cells, usually no strongly developed pigment cap in terminal cell. Asci: 48 - 50 x 19 - 20 µm, narrowly clavate to almost cylindrical, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, occasionally slightly curved, 14 - 16 x 7.5 - 10 µm, Milvina type, torus absent, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, KC-, P-, UV-. Well characterised by the ecology, and the Milvina type ascospores that lack a torus. R. milvina differs in having ascospores with a torus, a well-developed thalline exciple and a well-developed hypothallus.

Scattered, with no clear pattern. On siliceous rock, usually at altitudes above 1400 m, though there are reports down to 620 m.

Mostly northern and central Europe; in the south uncommon and restricted to the mountains. Also Macaronesia, Asia (Turkey, mountains of northern India), N. America (California).

Rinodina rosicida (Sommerf.) Arnold (1887)

Widespread from Svalbard to the Alps, but very rare further south. The Greek report appears to be the only one from south of the Alps. Also Asia (Turkey, Russia, Tibet, Mongolia), N. America (widespread in western half).

Rinodina sanctorinensis J. Steiner (1919)

Islands of the Aegean, on siliceous rock at altitudes 5 - 750 m.

Southern Europe, from Portugal to Greece. Also Macaronesia, N. Africa (Morocco). The var. olivieri, not reported for Greece, is restricted to the western Mediterranean and Canary Is.

Rinodina septentrionalis Malme (1913)

At least some reports refer to R. freyi. The status of the remainder is unclear, but if correct they indicate a scattered distribution, with no clear pattern, at altitudes 0 - 1300 m, on bark, often of conifers. Low altitude reports may be incorrect, but the report from 1300 m in Macedonia seems plausible.

Widespread in northern and central Europe, rare south of the Alps. Also Asia (widespread), N. America (widespread in western half), Australasia (NZS). Reports for Africa (S. Africa) are incorrect.

Rinodina sicula H. Mayrhofer & Poelt (1979)
Biblioth. Lichenol. 12: 143.

At least some reports refer to R. freyi. The status of the remainder is unclear, but if correct they indicate a scattered distribution, with no clear pattern, at altitudes 0 - 1300 m, on bark, often of conifers. Low altitude reports may be incorrect, but the report from 1300 m in Macedonia seems plausible.

Widespread in northern and central Europe, rare south of the Alps. Also Asia (widespread), N. America (widespread in western half), Australasia (NZS). Reports for Africa (S. Africa) are incorrect.

Rinodina sophodes (Ach.) A. Massal. (1852)

Thallus: crustose, dark grey, dark green-grey or dark brown-grey, forming small patches rarely more than 1 cm diameter, cracked or areolate, very thin, 75 - 110 µm. Prothallus: often present at margin of thallus and between areoles,
black, diffuse. Cortex: 15 - 25 µm thick, colourless to pale brown, without distinct structure or in places obscurely cellular. Medulla: poorly developed. Apothecia: submersed to sessile, flat, 0.25 - 0.45 (0.6) mm diameter, not pruinose. Disc: dark brown to black. Thalline margin: present, persistent; in section: 60 - 100 µm wide, cortex often poorly developed or almost absent, when well developed to 35 µm wide, cellular, 1-2. Exciple: not visible externally; in section: poorly developed, 10 µm wide, colourless except at surface, of hyphae ±parallel to paraphyses. Epithecium: orange-brown to brown, K-, most pigment not soluble in K. Hymenium: 50 - 80 (100) µm tall, colourless, KI+ blue. Hypothecium: 35 - 50 (70) µm tall, colourless. Paraphyses: simple, 1 - 1.5 µm wide at base, 2 - 4 µm at apex, slightly capitate, sometimes slightly moniliform, apical cell with internal brown pigment cap. Asci: 50 x 13 - 14 µm, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, (10) 12 - 16 x 6 - 8.5 (10) µm, Milvina to Physconia type, 8 per ascus. Chemistry: thallus K-, UV-. Photobiont: green, cells globose, 8 - 13 (20) µm diameter. Photobiont layer: 40 - 80 µm thick, continuous except where thallus very thin, rather irregular.

The small patches of dark grey thallus, with immersed apothecia, make this species easy to recognise when it occurs on young twigs. On other substrates, the small, Milvina type ascospores are diagnostic. R. pyrina has a paler coloured thallus and Physconia type ascospores.

Throughout Greece. Usually at altitudes between 600 and 1400 m, but reported as low as 20 m, though at least some low altitude reports may be erroneous. Nearly always on bark, but reported once from wood. On a wide range of phorophytes. A species often occurring on young twigs, especially at internodes.

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria). Reports for N. America are doubtful; those for Australasia (NZ) are incorrect.

Rinodina teichophila (Nyl.) Arnold (1863)


Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).

Very scattered, with no clear pattern. On siliceous rock at altitudes 30 - 550 m. Almost throughout Europe to as far north as southern Scandinavia, but uncommon in the most continental parts of eastern Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria). Reports for N. America are incorrect, and I am sceptical of reports for S. America and Pacific.

Rinodina trachytica (A. Massal.) Arnold (1873)


Thallus: crustose, white to pale grey, areolate, to a few cm diameter, moderately thick (150 - 280 µm). Areoles: 0.3 - 0.7 mm diameter, subrounded to subangular, occasionally slightly white pruinose. Prothallus (and hypothallus): often present, black. Cortex: 30 - 50 µm thick, orange-brown in outermost 5 - 10 µm, colourless below, formed of broad ±vertical hyphae, giving a weak cellular texture (best seen in K), K+ yellow (reaction faint, not always observable), N-.

Medulla: white. Apothecia: immersed when young, later subimmersed to sessile, flat to slightly convex, 0.25 - 0.6 mm diameter, not pruinose. Disc: black. Thalline margin: present, persistent. Exciple: not visible externally, poorly developed in section. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 75 µm tall, usually colourless, upper half sometimes with epithecial pigment, KI+ blue. Hypothecium: 120 µm tall, ±colourless, K+ yellow. Paraphyses: simple, 1 µm wide at base, apical cells 2.5 - 3 µm sometimes with internal brown pigment cap. Asci: 60 x 17 - 20 µm, narrowly clavate to clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid in water, swelling at septum in K, 16 - 20 x 8 - 11 µm, Mischoblastia type, 8 per ascus. Chemistry: medulla I-; thallus K+ faintly yellow, C-, KC-, P-, UV+ very faint orange. Photobiont: green, cells globose, 8 - 15 µm diameter. Photobiont layer: 20 - 35 µm thick, ±continuous but rather irregular.

Fairly well characterised by the presence of atranorin (at least in small amounts), the Mischoblastia type ascospores, and the ecology.

Eastern half of Greece, never very far from the sea. On siliceous rock at altitudes 0 - 1000 m. Southern and south-central Europe. Also Macaronesia, Asia (Turkey, Armenia, Georgia), N. Africa (Morocco).

Rinodina tunicata H. Mayrhofer & Poelt (1979)


Description: Giralt (2001, 2010).

Crete, Evia and the east coast of the mainland. On calcareous rock at altitudes 50 - 1000 m. Southern and central Europe to as far north as Belgium. Also western Asia (Turkey), N. Africa (Algeria, Tunisia).
Rinodinella H. Mayrhofer & Poelt (1978)


Literature: The best descriptions are in Giralt (2001, 2010), but Clauzade & Roux (1985) also treat the genus. Four species, two of which occur in Europe. The genus is distinguished from Rinodina by its ascospores, which have an unusually narrow septum for Physciaceae.

11 Thallus distinct, thick, areolate, grey to dark brown. Apothecia more than 0.5 mm diameter. Thalline margin thick, usually persistent. R. controversa

1 Thallus indistinct, often endolithic; if epilithic, then whitish. Apothecia to 0.5 mm diameter. Thalline margin thin, soon excluded. R. dubyanoides


Thallus: crustose, sometimes covering large areas (to 10 cm diameter), areolate, brown to dark brown, occasionally almost black, not pruinose, 350 - 500 µm thick. Areoles: contiguous, subangular, 0.35 - 0.8 mm wide, the marginal ones often the largest. Prothallus: sometimes present, 0.1 - 0.2 mm wide, black. Cortex: 25 - 60 µm tall, orange-brown in upper half, colourless below, formed of vertical hyphae, individual hyphae not always distinguishable in lower part which may appear cellular, tips of hyphae often reaching different levels, K-, pigment not soluble in K. Medulla: white. Apothecia: subsessile at first, later sessile, flat when young, convex later, 0.5 - 0.9 mm diameter, not pruinose. Disc: black. Thalline margin: well developed, but becoming almost excluded in many mature apothecia; in section: 50 - 120 µm thick, cortex 15 - 30 µm, formed of rather coarse cells about 7 µm wide. Excipule: sometimes visible externally, brown to black; in section: 15 - 30 µm wide, brown at the surface, colourless below, of radiating hyphae with elongated to broad lumina. Epithecium: brown to dark brown, K-. Hymenium: 55 - 80 µm tall, usually colourless, upper part sometimes with some epithelial pigment, sometimes with oil droplets, KI+ blue. Hypothecium: 50 - 110 µm tall, colourless, sometimes with oil droplets. Paraphyses: simple, 1 µm wide at base, apical cell 3 - 5 µm with thin internal cap of brown pigment. Asci: 40 - 42 x 15 - 17 µm, clavate, Lecanora type. Ascospores: very pale brown when mature, 1-septate, ±ellipsoid, often slightly constricted at septum, 10 - 15 x 5 - 7 µm, without wall thickenings; septum very thin (1 µm or less), 8 per ascus. Pycnidia: 100% immersed, 150 µm tall, 80 µm wide, colourless. Conidia: bacilliform to narrowly ellipsoid, 3 x 0.75 µm Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, UV-. Photobiont: green, cells globose, 9 - 15 µm diameter, forming a continuous, regular layer 40 - 60 µm thick.

This distinctive species is unlikely to be confused with any other.

Common on the mainland, Crete and Evia. On calcareous rock at all altitudes, but 70% of reports are from below 400 m.

Southern and south-central Europe. Also western Asia (Turkey, Syria, Russia, Iran), N. Africa (Morocco, Algeria, Tunisia).


Scattered in the southern half of Greece, on limestone at altitudes 0 - 950 m. Southern and central Europe. Also western Asia (Turkey), N. Africa (Morocco, Algeria).

Roccella DC. (1805)


Literature: Tehler et al. (2004) is a monograph of the European and Macaronesian species, and is the best starting point. Clauzade & Roux (1985) do cover the widespread European species, but the information is dated and potentially misleading.

About 32 species, most of which occur on rock near the sea in tropical or warm humid areas. About 6 occur in Europe.

11 Soralia C+ red.

22 Cortex and subcortex C-. Branches smooth. (R. fuciformis)

2 Surface of cortex C- but subcortex C+ red. Branches smooth or with pits or dimples. (R. tinctoria) Greek reports
doubtful.
1 Soralia C-.
22 Cortex and subcortex C+ red. **R. phycopsis**
2 Surface of cortex C-, but subcortex C+ red. (R. tuberculata)

**Roccella phycopsis** (Ach.) Ach. (1810)
Lichenogr. Universalis 440; Parmelia phycopsis Ach. (1804), Arch. syst. Naturges. 1(1): 110; Roccella fucoides Vain.;
Roccella fucoides var. corticola Sambo; Roccella fucoides var. farinosa Delise ex Sambo.

Thallus: fruticose, about 3 cm diameter from a single holdfast but several thalli often growing close together, pale grey, matt. Branches: erect, to 5 cm long, solid, ± rounded to slightly flattened, 1.5 - 2 x 0.7 - 1 mm in cross-section; lower parts of old branches often with numerous pits, 0.2 - 0.3 mm diameter; attached by basal holdfast from which several branches emerge. Holdfast: ± circular, about 5 mm diameter, externally same colour as branches, internally with orange-yellow medulla. Soralia: frequent, white-grey, paler than thallus, delimited, convex, usually ± circular, occasionally slightly elongate, 0.8 - 2 x 0.8 - 1 mm, present along branches but not at tip. Cortex: 25 - 50 µm thick, of hyphae perpendicular to surface of thallus; hyphae clearly septate, tips forming a surface that is distinctly irregular on a scale of a few µm. Medulla: white, except in holdfast where it is orange-yellow, of loosely interwoven hyphae oriented preferentially but not exclusively ± longitudinally; hyphae 2.5 - 3 µm wide, without visible septa. Chemistry: medulla K- (in white and orange-yellow parts), C-, KC-, P-; soralia usually K+ very pale red, sometimes K-, C-, KC+ red fading to persistent pale red, P-; thallus K- C+ red fading to persistent orange-red, KC+ red, P-. Photobiont: Trentepohlia, present in a layer apparently 0 - 50 µm thick.

The medulla reacts KC-, but if care is not taken K can mobilise cortical substances, resulting in a spurious KC+ red reaction.

This species can not be confused with any other.
Common in the southern Aegean, rather scarce elsewhere. Always coastal. Most commonly on rock (calcareous or siliceous), but not rare on bark or wood. At altitudes 0 - 700 m, but usually below 400 m. The lichenicolous taxa Rhymbocarpus boomii and Lecanographa grumulosa have each been recorded once on this host.

Warm to temperate coastal areas of Europe (to as far north as southern Scandinavia). Also Macaronesia, Asia (widespread), Africa (widespread). Reports for N. America are incorrect, so those for Caribbean and S. America are doubtful. A report for Pacific (New Caledonia), seems too disjunct to be plausible.

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**Roccellographa J. Steiner** (1902)


Literature: For R. circumscripta see any of the standard Floras; until recently it was treated as Peterjamesia circumscripta or Sclerophyton circumscriptum.

The genus has two species, only one of which occur in Europe.

**Roccellographa circumscripta** (Leight.) Ertz & Tehler (2011)
Fungal Diversity 49: 58; Sagedia circumscripta Leight. (1851), Brit. Angiocarp. Lich. 24; Sclerophyton circumscriptum (Leight.) Zahlbr.


Santorini, and probably Crete, on siliceous rock at an altitude of 200 m.

Common throughout southern coastal areas of Europe, and ranging as far north as Scotland and southern Scandinavia. Also Macaronesia, Africa (Morocco, Tunisia; S. Africa, St Helena), perhaps N America, perhaps Caribbean, C. America (Mexico), S. America (Brazil, Galapagos Is), Australasia (Lord Howe Is, NSW).

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**Romjularia Timdal** (2007)


Literature: Nash et al. (2007).

The genus has only one species.

**Romjularia lurida** (Ach.) Timdal (2007)

in Nash et al., Lich. Sonoran Desert 3: 288; Lecidea lurida Ach. (1803), Methodus 77; Biatora lurida (Ach.) Stenh.; Lecidea lurida f. pallescens (Grognot) Szatala; Mycobilimbia lurida (Ach.) Hafellner & Türk; Psora lurida (Ach.) DC.

Thallus: squamulose, to 5 cm diameter, sometimes forming small clumps, without vegetative propagules.

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Lichen Flora of Greece version 17-Sep-2020
Squamules: ± rounded, never distinctly elongate, 1.5 - 2.5 x 0.7 - 2 mm, 350 - 400 µm thick, ± flat, adpressed or not, irregularly distributed, sometimes overlapping, margins smooth. Upper surface: usually brown to dark brown, sometimes olive or pale brown, not pruinose, sometimes with elongate linear depressions (not cracks). Lower surface brown to black, sometimes ± white at margins, sometimes obscured by rhizines. Rhizoidal hyphae: often present on lower surface (in section), colourless, 70 - 100 x 4 µm, sometimes aggregating into rhizines. Rhizines: white, fluffy, short, usually discrete, in section resembling a network of hyphae. Cortex: 50 - 85 µm thick, formed of two distinct layers, upper layer of thick-walled horizontal hyphae, lower layer appearing cellular, cells with long axis vertical; mostly colourless, sometimes pale brown to brown near surface or at interface between two layers; sometimes overlain by colourless epinecral layer 5 - 10 µm thick. Medulla: white; in section: distinctly cellular, individual hyphae usually not apparent; cells small, about 3 µm diameter. Lower cortex: present, 30 - 50 µm thick, pale brown, of horizontal hyphae. Apothecia: common, usually marginal on squamules, sessile, flat to slightly convex, 0.3 - 1.5 mm diameter, not pruinose. Disc: usually black, sometimes very dark red-brown. Thalline margin: absent. Exciple: black, sometimes slightly shiny, persistent or not, 0.05 - 0.1 mm diameter, sometimes not very distinct from disc; in section: 70 - 200 µm wide, colourless to pale brown in inner part, brown to black in outer part, clearly formed of radiating hyphae with prominent large lumina, sometimes giving a rather cellular appearance. Epithecium: brown, occasionally purple-brown, K-, pigment not soluble in K. Hymenium: 55 - 100 µm tall, colourless to very pale brown or very pale orange-brown, KI+ blue, I+ green > (slowly) orange-brown. Subhymenium: sometimes distinguishable from hymenium and hypothecium, 100 µm tall, pale brown. Hypothecium: 200 - 250 µm thick in central part, with deep "root", colourless to orange-brown or brown. Paraphyses: rather variable, 1 - 4 µm wide at base, 3 - 5 µm at apex, slightly capitate, apical cell with clearly visible septum; paraphyses in young or immature apothecia often very robust, wide at base, and resembling hyphae of exciple, those in mature apothecia narrower at base and of more normal appearance. Ascii: 20 - 30 µm, acellular to narrowly clavate, Pseudopilid type. Ascospores: colourless, simple, ellipsoid, 10 - 16 x 5 - 9 µm, 8 per ascus. Chemistry: medulla K-, C-, KC-, P-, I+ brownish; thallus K-, C-, KC-, P-, UV- (or almost). Photobiont: green; cells globose, 5 - 10 µm diameter. Photobiont layer: 100 - 150 µm thick, usually continuous, lower edge often rather irregular.

Superficially resembles some species of *Psora*, but in that genus the hymenium reacts I-, KI-, and the epityphecium reacts K+ red or purple.

Fairly common throughout Greece at all altitudes. On calcareous soil or calcareous rock, or occasionally overgrowing bryophytes on those substrates.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), C. America (Mexico). A report for Pacific (Marquesas) seems doubtful to me.

**Rosellinula R. Sant. (1986)**


Literature: There is no monograph. Clauzade, Diederich & Roux (1989) remains the best starting point.

*Rosellinula* has four species, three of which are European. Only one is likely to occur in Greece.

**Rosellinula haplospora** (Th. Fr. & Almq.) R. Sant. (1986)


Perithecia: entirely immersed in thallus of host, resembling apothecia (so easily overlooked); in section 470 µm tall, 410 µm wide. Exciple: brown. Paraphyses: clearly visible. Ascospores: brown, simple, 6 - 9 x 4 - 5 µm, at least 32 per ascus (difficult to count accurately).

Unlikely to be confused with any other species. In the common genus *Muellerella*, paraphyses disappear early. Peloponnese, on *Aspicilia supreoglaucia* at an altitude of 1750 m.

Western and Mediterranean Europe. Also Asia (Turkey, southern Siberia, Uzbekistan), N. America (Yukon).

**Rostania Trevis. (1880)**


Literature: Carvalho (2012) discusses the two southern European species, under *Collema*.

*Rostania* is a segregate from *Collema* s. lat. for a group of species with small thalli and ± rectangularly shaped, muriform ascospores. It has six species. Three occur in Europe, but one is distinctly northern. The other two are present in Greece.
11 Thallus to 3 mm diameter. **Rostania occultata** s. lat.

22 Thallus minutely granulose. **Rostania occultata var. occultata**

2 Thallus subcrustose-lobate or subfoliose. (Rostania occultata var. populina)

1 Thallus more than 3 mm diameter. **Rostania multipunctata**

**Rostania multipunctata** (Degel.) Otálora, P. M. Jørg. & Wedin (2013)


Thallus: foliose but lobes inconspicuous, to 1.5 cm diameter, homoiomerous. Lobes: 0.5 - 1 mm wide, becoming very contorted. Upper surface: black. Lower surface: grey. Isidia: absent. Rhizines: white, fasciculate. Upper and lower cortex: absent; thallus mostly of loosely interwoven hyphae, 2.5 - 3 µm wide, branched but not obviously anastomosed, without visible septa. Apothecia: abundant, urceolate to strongly concave, 0.2 - 0.25 mm diameter, not pruinose. Disc: dark brown. Thalline margin: present but rather indistinct; in section: about 50 µm wide. Exciple: not visible externally; in section: 20 µm wide, subcellular. Epithecium: pale orange-brown, K-, most pigment soluble in K.


The small, immersed apothecia, the unusual shape of the ascospores, and the K-soluble epithecial pigment are distinctive, and this species is unlikely to be confused with any other.

Scattered, but usually avoiding strongly inland localities. On bark at altitudes 0 - 900 m.

Southern and south-central Europe. Also Macaronesia.

**Rostania occultata** (Bagl.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009), all under *Collema*.

Scattered, on Crete and the mainland, on bark at altitudes 0 - 1100 m. All Greek report refer to var. *occultatum*.

Present in most of Europe. Also Asia (Turkey, Iran, Russia, Mongolia), Africa (Morocco, Algeria, Namibia), N. America (widespread).

**Sagedia** Ach. (1809)

The name is not in current use, as *Aspicilia* has been conserved against it.

**Sagedia pyrenophora var. arenaria** Hepp (1853)

Flecht. Eur. no. 98.

Included in Abbott (2009) as a name of uncertain application. The name has been combined into other genera, including *Arthopyrenia*, *Spermatodium* and *Thelidium*, but the proper placement of this taxon is not clear to me. Apart from Hepp's protologue I have not seen a description. Hepp described the ascospores as colourless, 3-septate, 26 - 50 µm long, with aspect ratio 2.5 - 3, and 8 per ascus, but unfortunately he did not describe the ascomata. The material was on sandstone.

Reported in the 19th century for Kefallonia. No altitude or substrate was stated.

**Sagiolechia** A. Massal. (1854)

Geneac. Lich. 11. Type: *S. protuberans* (Ach.) A. Massal., the only species originally included. Family: *Sagiolechiaceae*.

Literature: There is no monograph. For the only Greek species, see below.

Five species, three of which occur in Europe. Only one is likely to occur in Greece.

**Sagiolechia protuberans** (Ach.) A. Massal. (1854)

Geneac. Lich. 11; *Sagiolechia protuberans* Ach. (1810), Lichenogr. Universalis 328; *Sagiolechia protuberans var. mamillata* (Hepp) Körb.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Very scattered, with no clear pattern. On calcareous rock at altitudes 700 - 1800 m.

Throughout Europe, though in the south restricted to the uplands. Also Asia (widespread in Russia), N. America (widespread).
Sarcogyne Flot. (1851)

*Bot. Zeit.* 9: 753, 759. The 1851 name is listed as conserved against *Sarcogyne* Flot. (1850) in *Bot. Zeit.* 8: 382, but may not be validly published. Type: listed in the Code as *S. corrugata* Flot., but that name is not validly published, so can not be the type of any generic name. (The nomenclature will be discussed elsewhere.) Family: *Acarosporaceae.*

Literature: The only species likely to occur in southern Europe are discussed in Smith et al. (2009) and Nash et al. (2007). Seppelt, Nimis & Castello (1998) discuss the circumscription of the genus.

Thallus crustose, often poorly developed or immersed. Apothecia dark brown to black; in section: all pigments K-.

Thalline margin absent. Exciple very dark brown to black in outer part, colourless to pale brown in inner part; of radiating hyphae, at least in inner part. Epithecium brown or orange-brown. Paraphyses: simple, often with visible septa. Ascii: cylindrical to clavate, wall distinctly thickened at apex, apex K-.

Ascospores: colourless, ellipsoid, about 5 µm long in Greek species, many per ascus. Photobiont: chlorococcoid, not Trebouxia.

Chemistry: thallus C-, K in section diffusing yellow pigment (?atranorin) into solution.

1 Exciple not carbonised, dark brown to colourless in section. Apothecia pruinose or not. On calcareous or siliceous rock.

2 Hypothecium brown to dark brown. Apothecia 1 - 3 mm diameter. Exciple at first thick and irregularly cracked or warded, eventually excluded. If present in Greece, probably restricted to high mountains. (S. clavus)

3 On siliceous rock, or parasitic on crustose lichens on siliceous rock. Apothecia not pruinose. Ascospores 4 - 6 x 1 - 2.5 µm.

4 On calcareous rock. Apothecia often pruinose. Ascospores 3 - 5 x 1.5 - 2 µm. *S. regularis*

53: 475; *Lecanora hypophaea* Nyl. (1870), *Flora* 53: 34; *Sarcogyne privigna* auct., non (Ach.) A. Massal.

Thallus: crustose, pale brown, not pruinose, cracked to areolate, 150 - 300 µm thick. Cortex: 20 µm thick, brown in outermost 5 µm, colourless in lower part, of irregularly oriented but predominantly ±horizontal hyphae. Apothecia: sessile to sessile, flat to convex, 0.6 - 1.4 mm diameter, sometimes fusing and forming aggregates to 2 mm diameter, not pruinose. Disc: black, sometimes slightly shiny in young apothecia. Thalline margin: absent. Exciple: black, shiny, thin, smooth to wavy, only becoming distinctly irregular in large old apothecia, eventually almost excluded; in section: with ±black outer part and colourless inner part, inner part hyphal, structure of outermost part obscured by pigment, K-, pigments not soluble in K. Epithecium: orange-brown to dark brown, K-, pigments not soluble in K. Hymenium: 100 - 125 µm tall, colourless, KI+ blue. Hypothecium: 100 µm tall, colourless to pale brown, obviously divided into upper 60 - 70 µm that could be called a subhymenium, and a lower hypothecium proper. Paraphyses: simple, 1 µm wide at base, 2 - 3 µm at apex, sometimes with visible septa, sometimes slightly moniliform, sometimes capitiate. Ascii: 90 x 25 µm, clavate, apical part with thick wall (to 10 µm), apical part K-.

Ascospores: colourless, simple, ellipsoid, 5 x 2.5 µm, many per ascus (at least 100). Chemistry: thallus C-, K in section diffusing yellow pigment (?atranorin) into solution. Photobiont: green, not Trebouxia, of globose cells 6 - 10 µm diameter, often occurring in clumps to 80 µm diameter; photobiont layer somewhat irregular as a result.

Scattered in the southern half of Greece, on rock, usually siliceous, at altitudes 150 - 1100 m.

Widespread in Europe, though in the south confined to the uplands. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread), C. America (Mexico), S. America (Brazil), Australasia (Western Australia), Pacific (Hawaii), Antarctica (continental Antarctica, Antarctic Peninsula).
Sarcogyne regularis Körb. (1855)

Syst. Lich. Germ. 267; Biatorella pruinosa (Schaer.) Mudd; (? Biatorella pruinosa f. nuda (Nyl. ex Lamy) H. Olivier; Sarcogyne pruinosa (Schaer.) A. Massal.; (?) Sarcogyne pruinosa f. atrosanguinea H. Magn.; Sarcogyne pruinosa var. decipiens sensu H. Magn.; Sarcogyne pruinosa var. macrocarpa de Lesd.; Sarcogyne pruinosa var. minuta A. Massal.; (?) Sarcogyne pruinosa f. nuda (Nyl. ex Lamy) H. Magn.; (?) Sarcogyne pruinosa var. ochracea H. Magn.; Sarcogyne pruinosa var. platycarpoides (Anzi) H. Magn.; Sarcogyne regularis var. intermedia (Körb.) N. S. Golubk.

Thallus: immersed. Apothecia: subimmersed in substrate, ±flat, 0.5 - 0.6 mm diameter, slightly white pruinose. Disc: black. Thalline margin: absent. Exciple: black, persistent; in section: 45 - 70 µm wide, pale brown in inner part, very dark brown to black in outer part, the two parts not sharply distinguished, of radiating hyphae in inner part, anatomy of outer part obscured by pigment, K-. Epithecium: orange-brown, K- orange pigment soluble in K, brown pigment not soluble. Hymenium: 110 µm tall, colourless, K+ blue. Hypothecium: 35 µm tall, colourless. Paraphyses: simple, 1 µm wide in lower part, 1.5 µm at apex, often with visible septa, not capitate. Asci: 40 - 75 x 12 - 15 µm, cylindrical to clavate, wall at apex thickened (to 5 µm), apex K-. Ascospores: colourless, simple, narrowly ellipsoid, 5 x 1.5 - 2 µm, many per ascus (at least 100). Photobiont: green.

The calcareous substrate and pruinose apothecia easily separate S. regularis from other Greek species of Sarcogyne. Throughout Greece, though not very common. On calcareous rock at all altitudes. Probably throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside tropics), N. America (widespread), C. America (Mexico), S. America (Argentina, Bolivia, Uruguay), Australasia (widespread).

Sarcogyne similis H. Magn. (1935)


Description: Nash et al. (2007).

Reported from a single locality in Attica, where it occurred on siliceous rock at an altitude below 1100 m. Otherwise known only from N. America, where it is widespread.

Sarcopyrenia Nyl. (1858)

According to Smith et al. (2009) Sarcopyrenia gibba (Nyl.) Nyl. is present in Greece. No further information was given, and no reference was cited.

Schaereria Körb. (1855)


Literature: Kantvilas (1999) has a key to all known species.

About 12 species, of which 6 occur in Europe, mostly in northern regions. Only one is likely to occur in Greece.

Schaereria fuscocinerea (Nyl.) Clauzade & Cl. Roux (1985)


The earliest name is Urceolaria cinerea δ (= var.) atrocinerea Schaer. (1826). It was raised to species rank, as Aspicilia atrocinerea (Schaer.) Massal. in Ric. Auton. Lich. Crost. 39. (June - Dec. 1852). The name Lecidea fuscocinerea was published Nov. - Dec. 1852, and it is unknown which epithet has priority. I follow the common usage.

Description: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern. On siliceous rock at altitudes 400 - 1100 m. Widespread in northern and central Europe, but in the south almost restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan, Nepal), Africa (S. Africa), N. America (widespread), S. America (Falkland Is, Colombia), Australasia (widespread), Antarctica (subantarctic islands).

Schismatomma Flot. & Körb. ex A. Massal. (1852)


Literature: Schismatomma has been the source of much confusion. Torrente & Egea (1989c) and Tehler (1993a) are good starting points, but many species have since been placed elsewhere. For recent generic concepts see Ertz & Tehler (2011b) and Ertz et al. (2014).

As now defined, Schismatomma has 19 species, of which 4 occur in Europe. Two of those are western, and will not
occur in Greece

11 Apothecia circular to elongated, sometimes slightly pruinose when immature. Thallus with a reddish tinge.
Inconspicuous soredia present. (S. pericleum) Greek report needs confirmation.

1 Apothecia elongate to lirelliform with pointed ends, not pruinose. Thallus white. Soredia absent. **S. graphidioides**

**Schismatoma** *graphidioides* *(Leight.) Zahlbr. (1919)*


The nomenclature needs to be clarified. The cited basionym is a provisional name and invalid. It was validated by Lettau, in Hedwigia 52(3-4): 122. 1912 (though there may be earlier validations that I have not seen), so authorship appears to be (Lettau) Zahlbr. Also, the name *Lecanactis ricasolii* A. Massal. (1852) may be synonymous, and would have priority, in which case the correct name would be *Schismatoma ricasolii* (A. Massal.) Egea & Torrente. If priority of *graphidioides* at the rank of species does dates only from 1912, then two other epithets also have priority.

Description: Clauzade & Roux (1985); Smith et al. (2009); Tehler (1993a).

Athos Peninsula, on bark at an altitude of 1200 m.
Widespread in Europe to as far north as British Is and southern Scandinavia. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco). Reports for S. America are incorrect.

**Sclerococcum** Fr. (1825)


Literature: Information is scattered, and there is no unified, modern treatment. Etayo & Calatayud (1998) give a key to the species with black sporodochia in Spain.

Originally a genus of anamorphic fungi, *Sclerococcum* has now been recognised as the correct name for *Dactylospora*, and many species formally placed there have been transferred to it. It now contains about 65 species, of which 41 have been reported for Europe. Many new species have been described in recent years, and our knowledge of the genus is probably still very incomplete. Five species are reported for Greece, but there are few records.

The distribution of most species is poorly known, so at present the key includes many species. It may be possible to exclude some of them when distributions are better known. *Sclerococcum verruculosum* is not included in the key, as I have insufficient information.

11 Ascomata present.

22 Ascospores strictly 1-septate.

33 Ascii with more than 8 spores. (S. microsporum)
3 Ascii with 8 spores.

44 Hypothecium red-brown, same colour as exciple.

55 Apothecia becoming convex and immarginate. On Lobaria. (S. lobariellum)
5 Margin of apothecia persistent. On other hosts. **S. rimulicola**

4 Hypothecium colourless to brownish, paler than exciple.

55 Ascospores 7 - 11 x 3 - 5 µm. (S. acarosporica), (S. homoclinellum)
5 Most ascospores larger than 11 x 5 µm.

66 Apothecia arising from black spots on thallus of host. Ascospores not constricted at septum.

(Abrothallus mairei)
6 Apothecia not associated with black spots. Ascospores sometimes constricted at septum.

77 Apothecia 0.2 - 0.7 mm diameter, superficial at least when mature. **S. saxatile**
7 Apothecia 0.1 - 0.3 mm diameter, remaining at least partly immersed in thallus of host. (S. tegularum)

2 At least some ascospores more than 1-septate.

33 Parasic or commensalistic on Ochrolechia or Pertusaria.

44 Ascospores 1 - 3 -septate. Hypothecium black-brown. Often on Ochrolechia parella. (S. parellarium)
Greek report doubtful.


3 On other hosts. (Some of species may be saprophytic or perhaps weakly lichenised, not all are parasitic or commensalistic.) (S. attendendum), (S. crassum), (Dactylospora mediterranea), (Dactylospora pseudourceolata)

1 Ascomata absent.

222 Conidia mostly simple. (Cladophialophora cladoniae), (S. simplex)
22 Conidia mostly 1-septate. (S. acarosporae), (S. montagnei) (Cladophialophora parmeliae)
2 Conidia irregularly shaped, with 2 - 14 cells.  
333 Sporodochia dark red-brown. (S. epiphytorum)  
33 Sporodochia grey or grey-mauve. (S. griseisporodochium), (Cladophialophora normandinae)  
3 Sporodochia ±black.  
4 Wall of conidia smooth.  
55 Sporodochia 60 - 180 µm diameter. Conidia with 2 - 14 (20) cells. Conidia with irregular, well-delimited darker regions due to unevenly thickened cell wall. S. serusiauxii  
5 Sporodochia 170 - 500 µm diameter. Conidia with 2 - 6 (9) cells. Conidia without well-delimited darker regions. (S. sphaerale)  
4 Wall of conidia ornamented. (S. leuckertii), (S. tephromelarum)  

**Sclerococcum parasiticum** (Flörke) Ertz & Diederich (2018)  
in Diederich et al., *Bryologist* 121(3): 399; *Lecidea parasitica* Flörke (1819), Deutsche Lichenen Fasc. 6, page 3, no. 101; *Dactylosporopsis parasitica* (Flörke) Arnold; *Lecigrapha inspersa* (Tul.) A. Massal.  
Apothecia: sessile on thallus of host, flat, 0.2 - 0.4 mm diameter, not pruinose. Disc: black, matt. Exciple: black, sometimes slightly shiny, persistent; in section: 30 - 55 µm wide, pale brown in inner part, darker brown in outer part, of radiating hyphae that develop large lumina (5 µm or more) in outer part. Epithectum: not very distinct from hymenium, brown to black, K-, pigment not soluble in K. hymenium: 40-70 µm tall, mostly colourless, upper part sometimes with patches of epithelial pigment. Hypothecium: 30-100 µm tall, brown to purple-brown, K-, pigment not soluble in K but purple tinge disappearing. Paraphyses: simple. Ascospores: pale brown eventually, 3-septate when mature, 1-septate and 2-septate ascospores often present, ends rounded, ±ellipsoid, sometimes slightly curved, 10 - 13 x 3 - 4.5 µm, 8 per ascus.  
Scattered, but never far from the sea, at altitudes 0 - 850 m, on *Pertusaria heterochroa* and *P. hymenea*.  
Widespread in Europe. Also Macaronesia, Asia (Turkey, Russia), N. America (California, Minnesota, Washington), Australasia (NZN).  

**Sclerococcum rimulicola** (Müll. Arg.) Ertz & Diederich (2018)  
Description: Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Etayo & Sancho (2008), all as *Dactylospora rimulicola*.  
Chios and eastern Peloponnese, at altitudes 20 - 670 m. Reported from *Aspicilia intermutans*, *Protoparmeliopsis muralis* and *Squamarina cartilaginea*.  
Scattered over much of Europe, from the Faeroe Is to Sicily and Greece, though the rather few records show no clear pattern. Also Asia (southern Siberia), S. America (southern Chile).  

**Sclerococcum saxatile** (Schaer.) Ertz & Diederich (2018)  
Description: Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Nash et al. (2004), all as *Dactylospora saxatilis*.  
Samothraki at an altitude of 10 m, apparently (the text is unclear) parasitic on *Caloplaca c.f. crenularia*.  
Widespread in Europe. Also Macaronesia (CVI), Asia (Turkey, Iran, Russia), N. Africa (Algeria, Tunisia), North America (widespread), S. America (Argentina, Chile), Australasia (Australia).  

**Sclerococcum serusiauxii** Boqueras & Diederich (1993)  
*Mycotaxon* 47: 428-430.  
Description: See the protologue.  
Naxos, on *Parmelia tiliacea*, at an altitude of 500 m. The host is an expected one for this species.  
Southern and south-central Europe. I have not seen any reports from outside Europe.  

**Sclerococcum verruculosum** (Hafellner) ined.  
Description: See the protologue.  
Corfu and western Crete to Corfu, at altitudes 20 - 1070 m.  
Known only from Greece.
Scoliciosporum A. Massal. (1852)


Literature: There is no monograph and information is scattered. Between them, Clauzade & Roux (1985) and Smith et al. (2009) treat all the well-understood Greek species.

About 17 species, of which 10 occur in Europe. The genus is poorly represented in Mediterranean regions. Although its species are inconspicuous and easily overlooked, they do seem to be genuinely uncommon in Greece.

11 Ascospores 1-septate On leaves. (S. curvatum)
1 Ascospores usually 3 or more septate. Not on leaves
22 Soralia green-yellow, C+ red (use squash preparation). S. sarothamni
2 Soralia absent or not green-yellow.
33 Most ascospores less than 22 µm long. Apothecia not exceeding 0.3 mm diameter.
44 Ascospores strongly curved, spirally twisted in ascus, 3 - 7-septate, 14 - 20 x 1 - 2 µm. Apothecia 0.1 - 0.3 mm diameter, dark brown. S. perpusillum
4 Ascospores straight or slightly curved, 3-septate, 15 - 22 x 2.5 - 3.5 µm. Apothecia 0.3 mm diameter, pale brown to dark brown. (S. gallurae)
3 Ascospores 20 - 40 µm long. Apothecia more than 0.3 mm diameter in some species.
44 Ascospores strongly curved, spirally twisted in ascus, 2 - 3 µm wide.
5 Hypothecium pale. Apothecia 0.3 - 0.8 mm diameter, pale brown to dark grey or blackish. S. umbrinum
5 Hypothecium dark. (No data available on apothecia.) S. rhodi
4 Ascospores straight or slightly curved, 4 - 5 µm wide. Apothecia 0.2 - 0.3 mm diameter. S. chlorococcum

Scoliciosporum chlorococcum (Graewe ex Stenh.) Vězda (1978)


Ikaria and Thessaly, close to sea level, on bark. The only phorophyte explicitly reported is Arbutus unedo, an unusual substrate for lichens.

Widespread in Europe to as far north as the Arctic Circle, but uncommon in the south. Also Asia (widespread), N. America (widespread).

Scoliciosporum perpusillum J. Lahm ex Körb. (1861)
Parerga Lichenol. 241­242; Scoliciosporum umbrinum var. corticcola (Anzi) Clauzade & Cl. Roux, often cited as corticola.

Description: Clauzade & Roux (1985).

Scattered, with no clear pattern. On bark at altitudes 600 - 1200 m.

Widespread in middle latitudes of Europe, reaching southern Sweden; rare in the south. Also Asia (Turkey, southern Siberia). An old report for N. America (Newfoundland) may be unreliable.

Scoliciosporum rhodi (Szatala) ined.

Description: See the protologue. According to Şenkardeşler et al. (2014), who had seen the type, this species belongs in Scoliciosporum. Judging from the protologue, it seems close to S. umbrinum and may be synonymous.

Rhodes, on bark of Celtis sp. at about 1100 m altitude. Known only from the type collection.

Scoliciosporum sarothamni (Vain.) Vězda (1978)

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Islands of the southern Aegean, on bark. An altitude (750 m) was reported for only one of the records.

Widespread in central Europe, reaching southern parts of British Is and Scandinavia; rare in the south. Also N. America (California), C. America (CR).

Scoliciosporum umbrinum (Ach.) Lojka (1869)
Verh. k. k. zool.-bot. Ges. Wien 19: 488; Lecidea umbrina Ach. (1810), Lichenogr. Universalis 183; Bacidia umbrina var. compacta (Körb.) Th. Fr.; Catillaria denigrata f. synothea (Ach.) Vain.; Scoliciosporum umbrinum var. compactum
(Körb.) Clauzade & Cl. Roux.

Thallus: crustose, warted, brown to green, not pruinose, to 0.2 mm thick (said to be thicker sometimes), sometimes poorly developed and then very thin and discontinuous, without vegetative propagules, forming patches to about 2 cm diameter. Cortex: true cortex absent; layer above photobiont cells 0 - 20 µm thick, colourless to pale brown, without distinct structure, K-. Medulla: poorly developed. Apothecia: subsessile, moderately to strongly convex, (0.2) 0.3 - 0.8 mm diameter, not pruinose. Disc: pale red-brown to dark brown or black. Thalline margin: absent. Excircle: brown, thin, excluded early; in section: 50 - 60 µm wide, mostly colourless, sometimes pale brown at outer margin, of narrow, well-separated, anastomosed hyphae. Epithecium: almost colourless, brown, dull green, blue, blue-green, green-blue or green-black, K-, N+ intensifying blue > slowly violet, pigments at least partly soluble in K, slightly soluble in N. Hymenium: 60 - 70 µm tall, colourless to very pale yellow, C-, Ki+ blue. Subhymenium: 50 µm tall, ±colourless. Hypothecium: 50 - 60 µm tall, colourless to very pale yellow. Paraphyses: anastomosed, 1 - 1.5 µm wide in lower part, 1.5 - 2.5 µm at apex, not capitate or moniliform. Ascii: 40 x 15 µm, ±clavate, Lecanora type. Ascospores: colourless, multi-septate, strongly curved (usually C-shaped) when outside ascus, sometimes S-shaped, spirally twisted in ascus, 20 - 25 x 2 - 3 µm, one end often broader than other, 8 per ascus. Chemistry: medulla C-, P-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green; cells ±globose, 10 - 12 µm diameter, forming (when thallus well developed) a rather irregular and sometimes discontinuous layer 40 - 100 µm thick.

Well-developed ascospores have many septa, but usually septa are indistinct and hard to observe, even in K.

The spiral twisting of the ascospores in the asci is distinctive, and excludes most other species. For separation from S. perpusillum see the key.

Scattered rather thinly throughout Greece at altitudes 150 - 1200 m, on bark, wood or siliceous rock. The commonest species of the genus in Greece.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Socotra), N. America (widespread), C. America (Mexico, Guatemala), S. America (Brazil), Australasia (SE Australia, NZN, NZS), Antarctica (Marion Is).

**Scutula Tul. (1852)**


Literature: For the current circumscription of the genus see Bendiksby et al. (2018). Many of the parasitic species are discussed in Clauzade & Roux (19885), and Clauzade, Diederich & Roux (1989)

About 13 species, 11 of which occur in Europe. Most are non-lichenised, lichenicolous fungi, but two lichenised species, formerly placed in *Bacidia*, were recently transferred to *Scutula*. The lichenicolous species have a generally northern distribution; none has yet been reliably reported for Greece, but some might occur in the uplands.

11 Parasitic on other lichens.

22 Hypothecium colourless or very pale brown. (S. dedicata), (S. epiblastemica), (S. heeri), (S. tuberculosa)

2 Hypothecium distinctly coloured.

33 Epithecium green-blue. On Peltigera. (S. miliaris)


1 On bark, not parasitic.

22 Epithecium blue-green, K-, N+ purple-violet, often with precipitate of blue crystals. **S. circumspecta**

2 Epithecium orange to brown, K+ purple, N+ orange-red. **S. effusa**

**Scutula circumspecta** (Nyl. ex Vain.) Kistenich et al. (2018)


Descriptions: Ekman (1996); Llop (2007a); Nash et al. (2004); Smith et al. (2009).

Islands of the Aegean, including Crete, and adjacent coast of the mainland. On bark at altitudes 0 - 660 m. Reported from Juniperus oxycedrus subsp. macrocarpa, Platanus orientalis and Quercus macrolepis.

Widespread in Europe, to as far north as southern Scandinavia. Also Asia (Turkey, Russia, Taiwan), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico).

**Scutula effusa** (Auersw. ex Rabenh.) Kistenich et al. (2018)

*Taxon* 67(5): 896; *Bilimbia effusa* Auersw. ex Rabenh. (1855), Lich. Eur. Exs. no. 32; *Bacidia auerswaldii* (Hepp ex Stizenb.) Mig.

Thallus: crustose, of green-grey granules, forming small patches to about 2 cm diameter, not pruinose. Granules: 0.04 - 0.1 mm diameter, usually ±spherical, rarely elongated. Medulla: white. Apothecia: sessile, flat, 0.2 - 0.5 mm

Naxos and western Peloponnese, on bark at altitudes 0 - 600 m. The only phorophyte explicitly reported is Juniperus phoenicea.

Widespread in Europe to as far north as southern Sweden, but nowhere common. Also Macaronesia, western Asia (Turkey), N. America (BC, Montana).

Scytinium (Ach.) Gray (1821)


Thallus: foliose in most species, subfruticose, small squamulose or ±crustose in a few, homoiomerous, to 7 cm diameter in larger species but often much less, usually red-brown, brown, brown-grey or grey, less commonly dark brown or almost black, not pruinose. Lobes: most species with small lobes, less than 2 mm wide, a few with lobes to 6 mm wide; some species with very divided margins; lower surface grey to brown, without rhizines or hairs. Isidia: present in some species. Cortex: present or absent, if present usually 1-cell thick, a few species cellular throughout; corticate species with both upper and lower cortex, K-. Apothecia: common in some species, 0.25 - 0.8 mm diameter, sessile, concave to flat, not pruinose. Disc: brown, red-brown, orange-brown, dark brown or almost black. Thalline margin: present, brown, red-brown or dark brown, persistent; in section: 30 - 100 µm wide. Exciple: usually difficult to distinguish from disc in external view; in section: 15 - 60 µm wide, usually colourless, sometimes red-brown at surface, cellular or of hyphae with large elongated lumina. Epithecium: orange-brown to brown, K-, pigment sometimes partly soluble in K. Hymenium: 70 - 200 µm tall, colourless. Hypothecium: 20 - 90 µm tall, colourless to very pale yellow-brown, sometimes cellular. Paraphyses: simple, or sparingly branched in upper part, or with occasional anastomoses, 1 - 2 µm wide at base, 1 - 2 µm at apex, sometimes slightly widening upwards, sometimes with visible septa. Ascii: ±clavate, ±Collema type, KI+ blue in a band around top, walls sometimes weakly KI+ blue. Ascospores: colourless, muriform or submuriform, ±ellipsoid or with slightly pointed ends, medium sized (15 - 50 µm long), 8 per ascus. Chemistry: all spot test reactions negative. Photobiont: Nostoc; cells globose, 3 - 8 µm diameter, usually in chains.

Scytinium was resurrected for a group of 47 species formerly placed in Collema and Leptogium. They are morphologically variable, but most have muriform ascospores and rather small thalli. About 29 species occur in Europe. The genus is well represented in Greece.

11 Thallus without distinct cortex.

22 Isidia present.

33 Lobes tomentose, at least at tips. S. fragile

3 Lobes smooth.

44 Thallus to 1.5 cm diameter. Lobules 0.1 - 0.4 mm wide. Isidia to 0.1 mm diameter. S. parvum

4 Thallus larger. Lobules wider. Isidia larger. S. euthallinum

2 Isidia absent.

33 Thallus crustose to subfoliose. On rock. S. callopismum

3 Thallus foliose.

44 Lobes elongated and narrow, flat or convex (not concave). On calcareous rock. 55 Thallus to 1 cm diameter. Lobules 0.2 - 0.5 mm wide, ±pubescent. (S. leptogoides) Greek report doubtful.

5 Thallus to 5 cm diameter. Lobules wider, smooth. S. euthallinum

4 Lobes not as above. Thallus small, to 3 cm diameter but usually less. Usually on bark. S. fragrans

1 Thallus with cortex that is one cell thick or, rarely, thallus cellular throughout.

2222 Thallus foliose, with large lobes 1 - 20 mm wide.

33 Upper surface of lobes with isidia. Thallus olive-brown. Upper surface of lobes without distinct ridges (but
may have fine wrinkles). *S. subaridum*

3 Upper surface of lobes without isidia. (Lobes in some species have marginal extensions which may resemble isidia, but there are few or none laminally.)

44 Thallus ±cushion-forming (Note 1); of ±densely crowded lobes at least some of which are erect. Lobes usually red-brown, sometimes grey in sheltered situations. Note 2.

55 Lobe surfaces, especially below, with raised, narrow, ±vertically oriented rib-like wrinkles. Lobe margins with outgrowths (Note 3) that are cylindrical to flattened cylindrical, sometimes branched; outgrowths sometimes also laminal. Apothecia uncommon; margins isidiate (sometimes obscurely so, especially in young apothecia).

66 Lobes 2 - 6 mm long, lead grey, brown-green or blue-green, densely grouped but not forming convex cushions. *S. lichenoides*

6 Lobes 0.5 - 2 mm long, dark brown, in very convex cushions.

77 Outgrowths true isidia, with dark pit at apex; sometimes also laminal. *S. subaridum*

7 Outgrowths not true isidia, without dark pit at apex; never laminal. *S. pulvinatum*

5 Lobe surfaces smooth to wrinkled, rarely with a few raised ribs. Lobe margins smooth to deeply divided; outgrowths, if present, distinctly flattened, never laminal. Apothecia common or not; margins smooth.

66 Lobes with downturned margins that form tube-like structures. *S. palmatum*

6 Lobes not forming tube-like structures.

77 Lobes mostly erect. Apothecia common. *S. gelatinosum*

7 Lobes often horizontal. Apothecia uncommon. *S. aragonii*

4 Thallus not cushion-forming; lobes adpressed or upturned, but not erect.

55 Lobes 3 - 6 mm wide. Usually on bark, or overgrowing bryophytes on bark. See *Leptogium* key.

5 Lobes to 3 (4) mm wide. On rock or soil.

66 Thallus to 2 cm diameter. (S. subtorulosum) Greek reports doubtful.

6 Thallus 2 - 10 cm diameter. *S. plicatile*

222 Thallus foliose, with small lobes less than 1 mm wide.

33 Lichen forming dense, fruticolous cushions.

44 Lobes 0.1 - 0.2 (0.3) mm wide.

55 Thallus cellular ±throughout (Note 4). Horizontal lobes (not isidia) to 0.2 mm wide. On various substrates. *S. teretiusculum*

5 Thallus not cellular throughout. Horizontal lobes (not isidia) to 0.1 mm wide. On bark. *S. quercicola*

4 Lobes 0.3 - 1 mm wide.

55 Isidia absent or few, globose or squamulose if present. Terricolous in calcareous grassland.

66 Ascospores 15 - 26 x 6 - 9 µm. Apothecia 0.2 - 1.7 mm diameter. *S. ferax*

6 Ascospores 30 - 33 x 10 - 12 µm. Apothecia 0.2 - 0.4 mm diameter. *S. schraderi*

5 Isidia frequent, cylindrical to coralloid, often with distinct dark apical pit. Usually on bark, but it can occur on other substrates. *S. subaridum*

3 Lichen not forming dense, fruticolous cushions.

44 Lobes erect, almost entirely covered with isidia. *S. microphylloides* (Nyl.), non auct. Note 5.

4 Lobes forming radiating, flat thalli. Isidia absent.

55 Branches glossy, smooth (but outer branches grooved), with distinct upper cortex. On exposed calcareous rock, not aquatic. *S. massiliense*

5 Branches dull, roughened, upper surface uneven, with indistinct cortex (pseudocortex). On rocks in river banks. (S. subtorulosum) Greek reports doubtful.

22 Thallus small-squamulose.

33 Thallus smooth, without distinct wrinkles, cellular throughout.

44 Squamules with shiny, blackish, erect isidia-like structures along margins. Usually on bark. *S. microphylloides* auct., non Nyl.

4 Squamules marginally lacerated or with nearly cylindrical, horizontal blue-brown marginal lobes. Usually terricolous.

55 Apothecia numerous, globose, 0.2 - 0.5 mm diameter. Thallus minute, squamules often stellately arranged around apothecia, 0.1 mm wide. On debris or rotting bark. *S. subtilis*

5 Apothecia few, concave, to 1.2 mm diameter. Thallus better developed, lobes to 2 mm wide. Among bryophytes on calcareous ground. *S. tenuissimum*

3 Thallus distinctly wrinkled, not cellular.

44 Thallus strongly wrinkled when dry. Medulla swelling much when wet. *S. intermedium*
4 Thallus weakly wrinkled when dry. Medulla not swelling much when wet.
55 Lobes to 3 mm wide, very thick. Upper surface matt, uneven. Without a distinct cortex (pseudocortex only). Usually on seepage rocks. **S. plicatile**
5 Lobes to 1 mm wide, thinner. Upper surface shiny. With a distinct cortex. In calcareous grassland. **S. schraderi**

2 Thallus ± crustose.
33 Thallus of blackish, discrete, placoid areoles, often forming radiating patterns. On dry calcareous rocks or walls.
See **Pseudoleptogium diffractum**
3 Thallus less well developed, crustose or sub-squamulose, without radiating marginal lobes. On rock or soil. **S. biatorinum**

(1) Some specimens form unambiguous cushions that are distinctly convex and compact. Others are more open, but still have a distinctly "three dimensional" character, at least in most places.
(2) Species in this branch are sometimes difficult to separate and have often been confused. It is advisable to weigh carefully all available characters.
(3) The outgrowths are sometimes described as isidia, but usually they look more like narrow extensions of the lobes. They do not have the dark-coloured apical pit found in the true isidia of some related species.
(4) One can often recognise a distinct, 1 cell thick, upper and lower cortex which lacks photobiont cells, as in other related species. However, the interior of the lobes is unambiguously cellular everywhere, not hyphal.
(5) The only description of S. macrophyloides that I have seen is the one in Clauzade & Roux (1985). It is brief and inadequate, and as a result the species may be incorrectly placed in these keys.

**Scytinium aragonii** (Otálora) Otálora, P. M. Jørg. & Wedin (2013)
Description: See the protologue.
Chios and NW Epiros, on moss. Reported from moss on limestone and moss on *Platanus orientalis*. At altitudes 350 - 880 m. Perhaps more common, but may have been reported as *S. lichenoides* in the past.
Southern Europe and temperate western Europe. Not reported for other continents.

**Scytinium biatorinum** (Nyl.) Otálora, P. M. Jørg. & Wedin (2013)
Thallus: forming a discontinuous black crust, or of scattered black to red-brown squamules 0.04 - 0.07 mm wide, without vegetative propagules, not pruinose. Apothecia: frequent, sessile, concave, 0.25 - 0.4 mm diameter, not pruinose on upper surface, sometimes with slight white pruina on lower surface of thalline margin. Disc: brown. Thalline margin: present, red-brown, smooth, persistent, 0.05 mm wide; in section: 50 µm wide, cortex cellular. Exciple: not visible externally; in section: 60 µm wide, colourless, cellular. Epitheicum: orange-brown, K-, pigment not soluble in K. Hymenium: 70 µm tall, colourless. Hypothecium: 60 µm tall, colourless to very pale yellow-brown. Paraphyses: simple or sparingly anastomosed, 1 µm wide, not broadening at apices. Asci: 65 x 17 - 18 µm, clavate, KI+ blue on wall and in a band at apex, apex also with a KI+ blue central tube. Ascospores: colourless, submuriform when mature but long remaining simple, ± ellipsoid though ends sometimes pointed, 24.5 x 13 µm, 8 per ascus. Photobiont: blue-green.
Crete and Peloponnesse. On calcareous, or at least not strongly acidic, rock at altitudes 50 - 700 m.
Widespread in Europe, but uncommon south of the Alps. Also Macaronesia, Asia (Turkey, southern Siberia), N. America (BC, Saskatchewan, California, Oregon), perhaps C. America.

**Scytinium callopismum** (A. Massal.) Otálora, P. M. Jorg. & Wedin (2013)
*Fungal Diversity* 64(1): 290; *Collema callopismum* A. Massal. (1856), Misc. Lichenol. 23-24; *Leptogium callopismum* (A. Massal.) Harm.
Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Carvalho (2012); Nash et al. (2004); Smith et al. (2009), all as *Collema callopismum*.
Scattered, mostly in the Aegean and adjacent coasts of the mainland, never very far from the sea. On calcareous or siliceous rock or on soil at altitudes 0 - 1100 m.
Present in most of Europe, but nowhere common. Also Asia (widespread), N. America (Alaska, Alberta, BC, Arizona), perhaps C. America.
Scytinium euthallinum (Zahlbr.) Otálora et al. (2013)


Description: Clauzade & Roux (1985) as _Collema euthallinum_.

Skyros, on calcareous rock at an altitude of 225 m.

Southern Italy, Balkans, Greece and Russian Caucasus only.

Scytinium ferax (Durieu & Mont.) Otálora, P. M. Jørg. & Wedin (2013)


Description: Clauzade & Roux (1985) as _Leptogium ferax_.

Crete, on rock at an altitude of 50 m.

A rather poorly known species of southern Europe. Also Macaronesia, N. Africa (Algeria).

Scytinium fragrans (Sm.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009); all as _Collema fragilis_.

Scattered thinly throughout Greece, on calcareous rock at altitudes 0 - 1200 m. Degelius (1956) remarked that in Greece _S. fragrans_ is found in the lowlands and lower mountains.

Southern and western Europe, to as far north as Scotland. Also Africa (Socotra), N. America (California).

Scytinium fragrans (Sm.) Otálora, P. M. Jørg. & Wedin (2013)

_Fungal Diversity_ 64(1): 290; _Lichen fragrans_ Sm. (1808) in Smith & Sowerby, Engl. Bot. 27, tab. 1912; _Collema fragrans_ (Sm.) Ach.

Descriptions: Carvalho (2012); Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009), all as _Collema fragrans_.

Western Crete, on bark of _Platanus_ at altitudes 300 - 600 m.

Throughout Europe. Also Asia (Turkey, Russia, Mongolia), N. Africa (Morocco, Algeria), N. America (eastern half of USA), C. America (Mexico). Reports for Australasia (NZ) are incorrect.

Scytinium gelatinosum (With.) Otálora, P. M. Jørg. & Wedin (2013)


Thallus: foliose, to 7 cm diameter, usually dark red-brown, sometimes tinged grey in shaded habitats, not pruinose. Lobes: 2.5 - 6 mm wide, 0.05 - 0.1 mm thick, often erect, smooth to uneven but without prominent raised wrinkles; margins smooth to deeply divided, lobe extensions flattened. Lower surface: grey, without white hairs. Isidia: absent. Disk: dark red-brown. Thalline margin: present, pale red-brown to red-brown, smooth, persistent; in section: 25 - 40 µm wide, red-brown near surface, colourless elsewhere, ±cellular or of hyphae with large elongated lumina. Epithecium: pale orange-brown, K- Hymenium: 200 µm tall, colourless. Hypothecium: 20 - 25 µm tall, colourless, often cellular, sometimes distinctly so. Paraphyses: usually simple, rarely branched in upper part, ±cylindrical, 1 - 2 µm wide, often with visible septa. Ascospores: colourless, muriform, ±ellipsoid but with elongated ends, 35 - 50 x 12 - 17 µm, ends rounded or pointed, 8 per ascus. Photobiont: Nostoc, cells ±globose, 5 - 8 µm diameter, in chains.

The species with which _L. gelatinosum_ is most easily confused are not usually fertile.

Throughout Greece, at altitudes from sea level to about 2000 m, though commonest below 1500 m. Usually overgrowing bryophytes, sometimes directly on bark or limestone. Some reports may be unreliable owing to confusion with other species.

Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread).

Scytinium intermedium (Arnold) Otálora, P. M. Jørg. & Wedin (2013)

_Fungal Diversity_ 64(1): 290; _Leptogium minutissimum_ a (= indefinite rank) _intermedium_ Arnold (1867), _Flora_ 50: 122; _Leptogium intermedium_ (Arnold) Arnold.

Descriptions: Ahti, Jørgensen et al. (2007); Nimis & Martellos (2004); Smith et al. (2009), all as _Leptogium intermedium_.

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*Leptogium intermedium* (Arnold) Otálora et al. (2013)


Description: Clauzade & Roux (1985) as _Collema intermedium_.

Southern Italy, Balkans, Greece and Russian Caucasus only.


Descriptions: Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009); all as _Collema scoparium_.

Scattered thinly throughout Greece, on calcareous rock at altitudes 0 - 1200 m. Degelius (1956) remarked that in Greece _S. scoparium_ is found in the lowlands and lower mountains.

Southern and western Europe, to as far north as Scotland. Also Africa (Socotra), N. America (California).
Rare and scattered, with no clear pattern, at altitudes 400 - 1200 m. Reported from soil, calcareous rock, and bark of Platanus orientalis.

True distribution not well known, owing to confusion with other species. Probably throughout much of Europe, but less common in the south. Also Asia (Turkey, Russia), N. America (widespread).

Scytinium lichenoides (L.) Otálora, P. M. Jorg. & Wedin (2013)  
Fungal Diversity 64(1): 290; Tremella lichenoides L. (1753), Sp. Pl. 1157. (Spencer et al. (2009) claim that the basionym is not validly published, but I disagree.); Collema lacerum DC.; Leptogium lacerum Gray, nom. superfl.; Leptogium lichenoides (L.) Zahlbr.; Leptogium lichenoides f. ateleum (Ach.) Zahlbr.; Leptogium lichenoides f. fimbriatum (Hoffm.) Zahlbr.; Leptogium lichenoides var. lophaeum (Ach.) Zahlbr.; Leptogium scotinum var. lacerum Harm.

Thallus: foliose, 2 - 4 cm diameter, grey to red-brown, not pruinose. Lobes: 3 - 4 x 0.8 - 2 mm, often wrinkled, erect at least at margins, 60 - 75 µm thick. Lobe margins: very divided, extensions flattened to branched-cylindrical. Lower surface: grey, without rhizines, with distinct, raised, longitudinal or reticular ridges that are often white. Isidia: absent, though extensions on lobe margins may resemble isidia. Upper cortex: brown, 5 - 7 µm thick, one cell thick; lower cortex similar but paler in colour. Apothecia: usually absent. Photobiont: Nostoc, distributed throughout entire thallus except for cortical layer; cells globose, 6 - 7 µm diameter, forming short chains.

The grey colour is usually enough to avoid confusion with other species, which are usually uniformly red-brown. L. gelatinosum is usually fertile. L. pulvinatum is a much more compact, cushion-forming species. L. subaridum has isidia with have a black dot at the apex, which lobe outgrowths lack, and it usually occurs directly on bark.

Common throughout Greece, at all altitudes, though some reports may be unreliable owing to confusion with other species. Usually overgrowing bryophytes, but sometimes directly on bark, soil, or calcareous rock.

Most of Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tanzania), N. America (widespread), C. America (Mexico), S. America, Australasia (NSW).

Scytinium massiliense (Nyl.) Otálora, P. M. Jorg. & Wedin (2013)  

Thallus: foliose to almost subfruticose, to 1 cm diameter, ±homoiomeres. Lobes: elongate and narrow, 3 x 0.1 - 0.2 mm, not ascending (but not strongly adpressed either), usually ±dichotomously branched, rounded in cross-section, 225 µm diameter; margins smooth. Upper surface: brown to dark brown, not pruinose, sometimes with longitudinal wrinkles. Lower surface: brown, ±same colour as upper surface. Isidia: absent. Rhizines: absent. Upper and lower cortex: present, 1 cell thick, 6 - 8 microns thick, cells square. Hyphae in interior of lobes: 3 - 5 µm wide, rarely with visible septa. Apothecia: uncommon, slightly concave at first, becoming flat later, 0.4 - 0.7 mm diameter, not pruinose. Disc: brown, paler than thallus. Thalline margin: present, becoming almost excluded; in section: 70 - 100 µm wide. Exciple: visible externally only in very mature apothecia, then appearing as a very thin, pale brown ring, paler than disc; in section: 25 µm wide, cellular. Epithecium: very pale brown, K-, pigment partly soluble in K. Hymenium: 125 µm tall, colourless. Hypothecium: 90 µm tall, colourless, cellular. Paraphyses: 1 µm wide at base, 2 µm at apex. Photobiont: Nostoc; cells subglobose to globose, 3 - 6 microns diameter; in chains, not forming a distinct layer, but absent from cortex.

The elongate, very narrow, adpressed, almost radiating lobes with smooth margins clearly distinguish this species from most others.

Throughout much of Greece. On ±calcareous rock at all altitudes. Jørgensen (1994a: 20) maps the European distribution. Predominantly southern, but known as far north as Scotland. Also Asia (Turkey, southern Siberia).

Scytinium microphylloides auct., non (Nyl.)  
Leptogium microphylloides auct., non Nyl.

This is the taxon treated as a growth form of Leptogium teretiusculum at couplet 10 in the key in Jørgensen (1994a). It is distinct from Leptogium microphylloides Nyl., and I follow Christensen & Svane (2007) in regarding it as distinct from L. teretiusculum.

Description: See Jørgensen (1994a).

Scattered, on bark at altitudes 200 - 700 m. Recorded from Platanus orientalis and Quercus pubescens. Only Croatia and Greece.

Scytinium microphylloides (Nyl.) ined.  
Leptogium microphylloides Nyl. (1858), Flora 41: 337-338, non auct.

Description: Clauzade & Roux (1985) as Leptogium microphylloides. Crete and SE Peloponese, on bark of Platanus orientalis.

Southern and south-central Europe. Also western Asia (Turkey, Syria). However, there has been much confusion
around the names \textit{S. microphyllodes} auct., \textit{S. microphyllodes} Nyl. and \textit{S. teretiusculum}, and many published reports may be unreliable.

\textbf{Scytinium palmatum} (Huds.) Gray (1821)


Unfortunately, the name is illegitimate. The correct name is probably \textit{Scytinium corniculatum} (With.) ined.

Thallus: foliose, 4 - 7 cm diameter, \pm homoiomereous. Lobes: rather elongate, lateral margins often revolute, sometimes strongly so, lobe then forming a tube, 1 - 6 mm wide, sometimes finely wrinkled, 75 - 110 \(\mu\)m thick when wet. Lobe margins: smooth to wavy, never lacerate. Upper surface: usually red-brown, grey when shaded (e.g. by other lobes), often shiny towards margins of lobes, not pruinose. Lower surface: pale grey to white, without hairs or rhizines. Isidia: absent. Upper cortex: present, 1 cell thick, 10 \(\mu\)m thick, brown; cells rectangular when viewed transversely; when viewed from above: squareish to polygonal, 8 - 10 \(\mu\)m wide, forming a closed network. Lower cortex: present, 1 cell thick, 10 \(\mu\)m thick, colourless; cells rectangular when viewed transversely. Hyphae in central part of lobes: 1 \(\mu\)m wide. Apothece: frequent but often immature, laminal, sessile, 0.3 - 0.8 mm diameter, not pruinose. Disc: orange-brown. Thalline margin: present, brown, darker than disc. Exciple: cellular. Ascospores: colourless, muriform, ellipsoid with pointed ends, 30 - 40 x 17 - 18 \(\mu\)m. Photobiont: Nostoc; cells subglobose to globose, 3 - 6 \(\mu\)m diameter, in chains, not confined to a distinct layer, but absent from upper and lower cortex.

This species is easily recognised by the rolled-up, tube-like form of the lobes.

Rather thinly scattered through much of Greece, but apparently avoiding the NW. Usually overgrowing bryophytes on calcareous rock or calcareous soil, sometimes directly on soil, at altitudes 450 - 1200 m. This distinctive and fairly large species is not easily overlooked, and the scarcity of records implies that it is genuinely uncommon.

Present in most of Europe, but rare in continental eastern parts. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (west coast, from southern California to Alaska panhandle), S. America (Venezuela), Australasia (a single island off the south coast of Western Australia).

\textbf{Scytinium parvum} (Degel.) Otáílora, P. M. Jorg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009), all as \textit{Collema parvum}.

Rare, in northern Greece, at altitudes 1000 - 1100 m, on rock.

Mainly northern and central Europe; south of the Alps it is rare and confined to the mountains. Also western Asia (Turkey, Syria).

\textbf{Scytinium plicatile} (Ach.) Otáílora, P. M. Jorg. & Wedin (2013)

\textit{Fungal Diversity} 64(1): 291; \textit{Lichen plicatilis} Ach. (1795), \textit{K. Vet. Acad. Nya Handl.} 16: 11-12 (and Tab. 1, fig. 2); \textit{Collema hydrocharum} (Ach.) Ach.; \textit{Collemodium plicatile} (Ach.) Nyl.; \textit{Leptogium plicatile} (Ach.) Leight.

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009), all as \textit{Leptogium plicatile}.

Throughout Greece, though not very common. Usually on calcareous rock, occasionally on calcareous soil or on bark. At all altitudes according to published reports. However, Degelius (1956) states that it is widespread in Greece up to 1000 m, which suggests that reports from high altitudes may be unreliable.

Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), perhaps C. America, Australasia (NZN, NZS).

\textbf{Scytinium pulvinatum} (Hoffm.) Otáílora, P. M. Jorg. & Wedin (2014)


Thallus: foliose but usually appearing almost fruticose, 1.5 - 3 cm diameter, forming compact, convex, cushion-like clumps. Lobes: 1 - 2.5 x 1 - 2 mm but individual lobes often hard to discern because of the marginal extensions, red-brown to brown, rarely grey (in shade specimens), not pruinose, surface finely wrinkled, erect, 80 - 120 \(\mu\)m thick when wet. Lobe margins: finely divided, extensions usually flattened. Lower surface: grey, sometimes with distinct, rib-like wrinkles, without hairs. Isidia: absent, but marginal extensions may resemble isidia. Cortex: present, brown, 10 \(\mu\)m thick, consisting of a layer 1 cell thick. Lower cortex: present, colourless, 5 - 16 \(\mu\)m thick, consisting of a layer usually 1 cell thick, rarely 2 cells in places. Photobiont: Nostoc; cells subglobose to globose, 3 - 7 \(\mu\)m diameter, forming short chains.

The compact, brown cushions are distinctive. \textit{L. lichenoides} is more open, and is often grey. \textit{L. gelatinosum} has less finely divided lobes, and is usually fertile. \textit{L. subaridum} has true isidia that are sometimes laminal and have a black dot
at the apex; it usually occurs directly on bark.

Throughout Greece. Usually overgrowing bryophytes, sometimes directly on bark, calcareous rock or calcareous soil. At all altitudes.

Throughout Europe, except eastern regions with distinctly continental climate. Also Macaronesia, Asia (Turkey, Iran), N. Africa (Morocco, Algeria, Tunisia), N. America (apparently widespread, but many reports old).

**Scytinium quercicola** (Otálora et al.) ined.


Description: See the protologue.

Scattered on the mainland, on bark of *Platanus orientalis*, at altitudes 75 - 1125 m. Elsewhere known only from Spain, where it prefers bark of *Quercus*.

**Scytinium schraderi** (Bernh.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009), all as *Leptogium schraderi*.

Fairly common in the SE half of Greece, never very far from the sea, on calcareous rock or soil at altitudes 0 - 1400 m. Present in much of Europe. Also Macaronesia, Asia (Turkey, Syria, Iran, southern Siberia), N. Africa (Morocco, Algeria), perhaps N. America (BC), perhaps Australasia (NZS).

**Scytinium subaridum** (P. M. Jørg. & Goward) P. M. Jørg. & Wedin (2013)


Thallus: foliose, homoiomerous. Lobes: 0.5 - 2 mm wide; margins rounded, not lacerate, but often obscured by isidia. Upper surface: grey, dark brown or dark red-brown, not pruinose, sometimes finely wrinkled. Isidia: frequent, marginal and sometimes laminal, ±cylindrical but swelling rather abruptly at apex; apex with a distinct, dark-coloured pit (x50) in mature isidia. Upper and lower cortex: present, 1 cell thick. Photobiont: blue-green, cells in chains.

At first glance, *L. subaridum* resembles a diminutive and rather aberrant form of *L. pulvinatum*. However, the lobe margins are not lacerate and they bear true isidia. The isidia are sometimes also laminal. Unlike the lobe outgrowths of *L. pulvinatum* and similar species, the isidia have a dark pit at the apex when fully mature. In the limited material seen to date, the thallus is also noticeably darker in colour than is usual in *L. pulvinatum*.

Scattered, in the western half of Greece, at altitudes 20 - 1280 m. Usually on bark, and reported from from *Castanea sativa*, *Olea europaea*, *Platanus orientalis*, *Quercus macrolepis* and *Q. pubescens*. Occasionally directly on calcareous soil.

Southern Europe from Spain to Greece. Also Macaronesia, Asia (Turkey, Morocco, Algeria), perhaps N. America (BC), perhaps Australasia (NZS).

**Scytinium subtilis** (Schrad.) Otálora, P. M. Jørg. & Wedin (2013)


Descriptions: Ahti et al. (2007); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009), all as *Leptogium tenuissimum*.

Scattered, mainly in the southern half of Greece. On bark, bryophytes on bark, or soil at altitudes 0 - 1400 m, but usually below 800 m.

Widespread in Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps Caribbean (Bermuda), C. America (Mexico).
Scytinium teretiusculum (Wallr.) Otálora, P. M. Jorg. & Wedin (2013)

Thallus: foliose but appearing small fruticose, ±homoiomerous. Lobes: often elongate, 0.2 - 3 x (0.05) 0.15 - 0.2 (0.3) mm, ±adpressed until margins start to become lacerate, not radiating, 50 - 70 µm thick when wet. Lobe margins: strongly grey to grey-brown, not pruinose. Isidia: absent, but extensions from lobe margins resemble isidia. Upper and lower cortex: present, 1 cell thick, 8 - 10 µm thick; cells usually ±rectangular. Interior of lobes: paraplectenchymatous, usually distinguishable from upper and lower cortex by the more irregular, polygonal cells, 7 - 12 µm wide and by the presence of photobiont cells. Apothecia: sessile, flat, 0.15 - 0.3 mm diameter, not pruinose. Disc: brown. Thalline margin: present, sometimes with small outgrowths; in section: 35 µm wide. Exciele: 15 µm wide, cellular. Epitheicum: pale orange-brown. Hymenium: colourless, 125 µm tall. Hypothecium: colourless, 60 µm tall. Ascospores: colourless, muriform, 17 - 23 x 10 - 11 µm. Photobiont: Nostoc, not forming a distinct layer, but absent from upper and lower cortex.

The cushion-forming growth habit and the paraplectenchymatous lobes clearly separate this species from others in the genus.

Probably throughout much of Greece. Usually on bark (80% of records) with a distinct preference for Platanus orientalis, but also on rock (usually non-calcareous), occasionally overgrowing bryophytes on rock. At altitudes 0 - 1500 m, but scarce above 1000 m.

Widespread in Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps C. America.

Seirophora Poelt (1983)

Literature: The species in the key below are all treated in Clauzade & Roux (1985), under Teloschistes.

As originally described by Poelt, the genus was a misinterpretation based on a mixture of two different lichens. However, following a re-typification by Frödén & Lassen (2004) the genus is sensibly circumscribed, and refers to a groups of species formerly included in Teloschistes.

About 10 species, of which 3 occur in Europe.

11 Thallus K+ purple. S. contortuplicata
1 Thallus K- (or almost).
22 Branches of thallus not very rigid, 1 - 4 mm wide. Branches to more than 10 cm long. Usually corticolous, rarely terricolous. S. villosa
2 Branches of thallus very rigid, to 13 mm wide. Branches rarely more than 5 cm long. Terricolous. (S. lacunosa)

Seirophora contortuplicata (Ach.) Frödén (2004)

Thallus: a few cm diameter, small fruticose, orange, sometimes slightly white pruinose, ±erect, much branched lobes 0.1 mm wide, to 1.2 mm long. Cilia, rhizines and soralia all absent. A few small, globose, isidia-like structures present. Thallus K+ purple.

This very distinctive species is unlikely to be confused with any other. Scattered, with no clear pattern. On calcareous and siliceous rock at altitudes 900 - 2000 m.

Mostly northern and central. Rare south of the Alps and probably confined to the uplands. Also Asia (widespread), perhaps N. Africa, N. America (widespread in western half).

Seirophora villosa (Ach.) Frödén (2004)
in Frödén & Lassen, Lichenologist 36(5): 297; Parmelia villosa Ach. (1803), Methodus 254; Anaptychia ciliaris f. solenaria (Ach.) Nádv.; Anaptychia ciliaris var. solenaria (Ach.) Kremp.; Anaptychia intricata f. solenaria (Ach.) Zahlbr.; Borrera solenaria (Ach.) Ach.; Teloschistes villosus (Ach.) Norman.

Description: Clauzade & Roux (1985) as Teloschistes villosus.

Scattered, in the islands of the southern half of Greece. On bark at altitudes 700 - 1600 m.

Southern Europe, from Portugal to Greece, Crimea and Caucasus. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa), S. America (Chile, perhaps elsewhere). Reports for southern Africa (Namibia, S. Africa) are incorrect, and an old report for Reunion Is seems doubtful to me.
Solenopsora A. Massal. (1855)

Framm. Lichenogr. 20. Type: S. requienii A. Massal., the only species originally included. Family: Catillariaceae.

Literature: There is no monograph, but all except one of the taxa included in the key below are covered in Clauzade & Roux (1985) and/or Smith et al. (2009). Guttová et al. (2014) has brief, but good descriptions of all European species. Solenopsora placioid to squamulose, never very large (to a few cm diameter). Apothecia sessile, small to medium sized (0.3 - 1.3 mm diameter), with a thalline margin at least when young. Epithecium: colourless to brown; pigment K-, N-, soluble in K but not in N. Paraphyses: simple. Asci: Catillaria type. Ascospores: colourless, 1-septate with thin septum, a few becoming 3-septate, yellow, orange or red in some species. Photobiont: green.

Differs from Catillaria in having a placodioid to squamulose, rather than strictly crustose, growth form and in possessing a thalline exciple at least in young apothecia.

About 18 species, usually on rock or soil; 9 species occur in Europe, many of them restricted, or almost restricted to southern Europe. Solenopsora appears to have a centre of diversity around the Mediterranean, and the low level of lichenological study in this region means that the genus is not especially well known. It is well represented in Greece, but almost restricted to sites not far from the sea.

The key is based on that in Guttová et al. (2014). Keys in earlier publications are apt to be misleading.

1 Thallus placodioid or crustose or with small granular squamules. Vegetative propagules present or absent. Rhizines present.

2 Thallus forming continuous, irregular patches, not rosettes. Often with blastidia or granular soralia. S. grisea

3 Thallus brown to brown-green, not pruinose, marginal lobes usually well developed. In sheltered situations. S. candidans

4 Soralia absent. Apothecia commonly present. Usually in open sites. S. olivacea subsp. olivacea

5 Thallus white, pruinose. Lobes flat, adpressed to substrate. Central part of thallus persistent. In sheltered or open situations. S. olivacea s. lat.

6 S. olivacea s. lat.

Solenopsora candidans (Dicks.) J. Steiner (1915)


Thallus: placodioid, to 2.5 cm diameter, 0.5 mm thick in central parts, strongly white pruinose everywhere, without vegetative propagules. Marginal lobes: well developed, 1.5 - 3 x 0.5 - 0.8 (1.6) mm, usually ±flat, sometimes slightly convex. Cortex: 20 - 40 µm thick, colourless, structure obscured by abundant crystals, K-, N-, crystals not soluble in K or N. Medulla: white, of rather broad hyphae, 3 - 4 µm wide, without visible septa, with a few external crystals; hyphae oriented predominantly horizontally in most of medulla, those in upper part (which is not sharply delimited from algal layer) predominantly vertical. Apothecia: subsessile, flat, 0.8 - 1.3 mm diameter, slightly grey pruinose. Disc: dark brown to grey-black, sometimes slightly white pruinose. Thalline margin: present, sometimes obscurely so, becoming excluded. Exciple: pale to black, persistent; in section: 60 - 110 µm wide, brown to grey-brown in outer part, colourless in inner part, of anastomosed hyphae on an overall radiating trend; pigment as in epithecium; crystals abundant. Epithecium: brown to brown-grey, K-, N-, pigment not soluble in K or N; crystals absent, partly or slowly soluble in K. Hymenium: 50 - 90 µm tall, colourless, Kl+ blue. Hypothecium: 75 - 150 µm tall, colourless. Paraphyses: 1 µm wide in lower part, 2 - 2.5 µm at apex, not capitate or moniliform. Asci: 35 - 40 x 11 - 12 µm, narrowly clavate, Catillaria type. Ascospores: colourless, 1-septate with thin septum, a few becoming 3-septate, narrowly ellipsoid to almost acicular, sometimes slightly curved, 12.5 - 16 x 3 - 5 µm, 8 per ascus. Chemistry: medulla...
K, C-, KC-, P+ orange or red-orange, I-; thallus UV+ grey or pale green. Photobiont: green, cells globose, 8 - 12 µm diameter, forming a continuous, regular layer 25 - 100 µm thick.

This is a distinctive species that is not likely to be confused with any other. Diploicia canescens, which has a similar distribution, has soralia and is rarely fertile.

Moderately common in coastal areas throughout Greece, on calcareous rock. Usually at altitudes below 800 m, occasionally higher.

Widespread in southern Europe, and occasional further north to Scotland. Also western Asia (Turkey, Israel), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America, perhaps Australasia (NSW).

Solenopsora cesatii (A. Massal.) Zahlbr. (1919)


Islands of the Aegean, including Crete. (There is also an anomalous, but probably reliable, report for Meteora, in Thessaly.) On calcareous rock or, less commonly, calcareous soil, at altitudes 0 - 900 m.

Southern and south-central Europe. Also Macaronesia, western Asia (Turkey, Jordan).

Solenopsora grisea (Bagl.) Kotlov (2004)


Description: Clauzade & Roux (1985) as Solenopsorn cesatii var. grisea; Guttová et al. (2014).

Islands of the southern Aegean, on calcareous rock and soil at altitudes 50 - 700 m.

Southern Europe, from Iberian Peninsula to Cyprus, Macaronesia, western Asia (Israel, Jordan).

Solenopsora holophaea (Mont.) Samp. (1921)


Easily distinguished from other species of the genus by the P- medulla and by not forming regular rosettes. Collections in which the thalline exciple is excluded very early could be a source of confusion, but the genera which it might then be confused are either corticolean (Wayne) or have darker apothecia (darker brown to black).

Islands of the Aegean, and adjacent coast of the mainland. On soil or rock near the coast at altitudes 0 - 500 m.

Spain to Greece, and along the Atlantic margin to SW Norway. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco), perhaps N. America, perhaps S. America (Argentina), perhaps Australasia (NSW).

Solenopsora liparina (Nyl.) Zahlbr. (1919)

Öst. Bot. Z. 68: 304; Lecanoria liparina Nyl. (1876), Flora 59: 305-306; Solenopsorna cesatii f. liparina (Nyl.) Clauzade & Cl. Roux; Solenopsoma cesatii f. olivacea (Bagl.) Zahlbr.

Descriptions: Clauzade & Roux (1985) as Solenopsorn cesatii f. liparina; Guttová et al. (2014); Smith et al. (2009).

Scattered, with no clear pattern, but rarely far inland. On calcareous rock at altitudes 50 - 350 m.

Southern and south-central Europe, with a disjunct occurrence in SW England (Cornwall). Also western Asia (Turkey), N. Africa (Algeria).

Solenopsora marina (Zahlbr.) Zahlbr. (1928)


Description: Guttová et al. (2014), or see the protologue of Placolecania marina.

Samothraki and western Crete, on siliceous rock at altitudes 10 - 125 m.

Italy (Basilicata), Croatia, Montenegro and Greece. Also western Asia (Turkey).

Solenopsora olivacea (Fr.) H. Kiliás (1981) subsp. olivacea

Herzogia 5(3-4): 399; Biatora olivacea Fr. (1825), Syst. Orb. Veg. 1: 285; Biatora ungeri Hepp; Catillaria olivacea
1 Asci with 4 ascospores. Thallus 2 - 5 cm diameter. 
2 Asci with 1 - 2 ascospores. Thallus less than 1 cm diameter.

Fertile specimens can not be confused with any other genus. They usually occur in cool to arctic regions. The genus is rare in Greece.

**Biatora ungeri** was listed as an independent species by Abbott (2009), but Arnold (1887a), who had probably seen Hepp's material, considered it to be a synonym of *Ricasolia olivacea*.

Thallus: crustose, brown to brown-green, not pruinose, forming rosettes to 4 cm diameter, central part of convex warts.

Marginal lobes present but not well developed, usually ±flat, 0.3 - 0.5 x 0.3 - 0.5 mm, 250 - 300 µm thick. Soralia: absent. Cortex: 12 - 27 µm thick, inner part colourless, outer part colourless to brown, variable in structure from weakly cellular with subrounded cells to 4 µm wide, to ±hyphal with predominantly horizontal hyphae; pigment K-, N-, soluble in K but not in N. Medulla: white. Apothecia: often abundant, sessile, flat, 0.3 - 0.55 mm diameter. Disc: pink-brown to brown, sometimes slightly white pruinose. Thalline margin: present at least in section, excluded early.

Exciple: pale pink-brown to brown, paler than disc (when disc not pruinose), persistent; in section: 20 - 30 µm wide, colourless in inner part, colourless to brown in outer part, usually of radiating hyphae, sometimes with a cellular texture. Epithecium: colourless to pale brown or pale orange-brown, not well delimited from hymenium, K-, N-, pigment soluble in K but not in N. Hymenium: 45 - 60 µm tall, mostly colourless, upper part sometimes with epithelial pigment, KI+ blue. Hypothecium: to 120 µm tall at centre of apothecia, colourless. Paraphyses: simple, 2 - 3 µm wide at base, 4 µm at apex, clavate, not (or scarcely) capitate. Ascii: 35 x 8 µm, narrowly clavate, ±Catillaria type but apex sometimes with small KI- central region that does not reach top of ascus. Ascospores: colourless, 1-septate with thin septum, oblong with rounded ends, 5 - 7.5 x 2.5 - 4 µm, 8 per ascus. Pycnidia: brown, 0.1 mm diameter; in section: 90% immersed, globose, 150 µm diameter, without distinct wall. Conidia: colourless, bacilliform, 3 x 0.75 µm. Chemistry: medulla K-, C+, KC-, P+ yellow > orange, I-; thallus UV-.

Photobiont: green, cells globose, 9 - 15 µm diameter, forming a continuous, regular layer 50 - 75 µm thick.

The dark coloured rosettes can not be confused with any other species of the genus.

Fairly common throughout Greece in sites close to the sea. On calcareous rock at altitudes 0 - 900 m, but about half of all records are from below 200 m.

Southern Europe, from Iberian Peninsula to Cyprus. Also Macaronesia, western Asia (Turkey, Syria), N. Africa (Morocco).

**Solenopsis olivacea subsp. obiensis** (Nyl.) Clauzade & Cl. Roux (1982)

Like subsp. olivacea, but with delimited, green, rounded soralia. Apothecia usually absent.

Macedonia and island of Alonisos, on calcareous rock at altitudes 200 - 1000 m. Never very far from the sea.

Southern Europe, from southern France to Greece. Also western Asia (Turkey).

**Solenopsis vulturiensis** A. Massal. (1856)
*Lotos* 6: 75.

Descriptions: Clauzade & Roux (1985, 1989); Guttová et al. (2014); Smith et al. (2009).

Islands of the southern Aegean, including Crete, at altitudes 0 - 500 m. Apparently rather indifferent as to substrate, and reported from rock (calcareous and siliceous), non-calcareous soil, and bark of *Juniperus phoenicea*.

Mediterranean Europe and the Atlantic coast to as far north as Norway. Also Macaronesia, western Asia (Turkey), N. Africa (Tunisia), Australasian (NSW, Western Australia).

**Solorina Ach.** (1808)


Literature: Clauzade & Roux treat all the European species, while Smith et al. (2009) treat all except the arctic-alpine *S. octospora*. There are also good descriptions of some species in Burgaz & Martínez (2003).

Nine species, six of which occur in Europe. Most are tericolous, or occur on rock near the ground, and they usually occur in cool to arctic regions. The genus is rare in Greece.

The laminal apothecia clearly distinguish *Solorina* from *Peltigera*, in which the apothecia are always marginal. Fertile specimens can not be confused with any other genus

11 Asci with 1 - 2 ascospores. Thallus less than 1 cm diameter. *S. bispora* s. lat.
22 Asci with 90 x 40 µm. *S. bispora subsp. bispora*
2 Asci with 110 x 45 - 60 µm. *S. bispora subsp. macrospora*
1 Asci with 4 ascospores. Thallus 2 - 5 cm diameter. *S. saccata*
Solorina bispora  Nyl. (1860) subsp. bispora

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).

Known from several localities on Mt. Olympus (though some reports might refer to subsp. macrospora). On soil, less often rock, at altitudes 1250 - 2600 m.

Widespread in northern and central Europe; south of the Alps restricted to the mountains. Also Asia (widespread), N. America (widespread). Some reports might refer to subsp. macrospora.

Solorina bispora subsp. macrospora  (Harm.) Burgaz & Martínez (1998)
in Martínez & Burgaz, Ann. Bot. Fenn. 35: 140; Solorina macrospora Harm. (1909), Lich. Fr. 4: 661; Solorina bispora var. macrospora (Harm.) H. Olivier.

Descriptions: Burgaz & Martínez (2003); Clauzade & Roux (1985) as var. macrospora; Nimis & Martellos (2004); Smith et al. (2009) as var. macrospora.

Mt. Olympus, at an altitude of 1950 m. The substrate was not reported.

Central and northern Europe, with a very few reports from high mountains of the south. I have not seen reports from other continents.

Solorina saccata  (L.) Ach. (1808)


Very scattered on the mainland. Usually on calcareous soil, sometimes on calcareous rock, at altitudes 700 - 1800 m. The Peloponnesian collection was from the base of a limestone outcrop at 900 m altitude, at the bottom of a steep, north-facing slope in a deep valley that was oriented roughly east-west. About half a dozen thalli were scattered over a small patch of rock, and a careful search of the surrounding area did not reveal any more thalli. It was clear, from the species of vascular plant present, that the site is rather cool for its altitude, but it did not appear to be unusual in any other respect. An overhanging limestone outcrop a few hundred metres away yielded the only Peloponnesian record of Seirophora contortuplicata, another montane species occurring here at a rather low altitude. The few thalli seen could not have constituted a viable population, and were presumably a temporary colony sourced from some larger population elsewhere. The situation is reminiscent of the very disjunct find of S. saccata near Peterborough in England, described in Gilbert (2000: 149). The species had vanished from the site a decade later.

Throughout Europe, but uncommon in the south. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread).

Sphaerellothecium  Zopf (1897)


About 34 species of lichenicolous fungi, 21 of which occur Europe. The genus is rare in Greece.

11 Ascomata growing mainly in ascomata of host. On corticolous Lecanora. (S. propinquellum)
1 Ascomata growing in thallus of host.

22 Ascospores colourless, rarely pale brown when mature.

33 Perithecia with hairs. On Parmeliaceae. (S. reticulatum)
3 Perithecia without hairs. On various hosts.

44 Infected areas of host becoming blackish. Ascospores 1-septate, 8.5 - 10 x 3 - 4 µm. On Parmelia saxatilis and P. sulcata. (S. parmeliae)
4 Infected areas of host not becoming blackish. Ascospores various. Not on Parmelia.

5555 On Physcia. (S. pumilum)
555 On Placidium. (S. breussii)
55 On Aspicilia, Lecanora and Ochrolechia. (S. araneosum)
5 On Cladonia. (S. cladoniae)
2 Ascospores brown.
333 Usually on Xanthoria parietina. S. parietinarium
33 On Cladonia. (S. cinerascens)
3 On saxicolous lichens.
44 Ascospores mostly 9.5 - 10.5 µm long; lower cell globose. S. abditum
4 Ascospores mostly 11.5 - 14 µm long; lower cell oblong. (S. contextum)

Sphaerellothecium abditum Triebel (1989)

Biblioth. Lichenol. 35: 72-76.
Description: See the protologue, or Nash et al. (2004).
Macedonia, at about 2000 m altitude on Lecidea atrobrunnea. The precise locality has not been identified.
Scattered in cold parts of Europe, from Norway to high montane Greece. Also Asia (Russia, Nepal), N. America (widespread in western half).

Sphaerellothecium parietinarium (Linds.) Hafellner & V. John (2006)

Herzogia 19: 168; Microthelia parietinaria Linds. (1869), Trans. R. Soc. Edinb. 25(2): 541; Endococcus parietinarium (Linds.) Clauzade & Cl. Roux.
Description: Clauzade, Diederich & Roux (1989) as Endococcus parietinarium.
Amorgos, at an altitude of 260 m. No host was reported.
Most of Europe, except regions with distinctly continental climate. Also Macaronesia, Asia (Turkey, Israel, Syria), Australasia (widespread in NZ).

Sphinctrina Fr. (1825)

Fries originally only included a single species S. turbinata Fr., a superfluous name for Hypoxylon sphinctrinum Bull. (1791). However, in the sanctioning environment he mentioned Calicium turbinatum Pers., though he did not combine Persoon’s name into Sphinctrina. The typification by Clements & Shear is thus acceptable.
Literature: Löfgren & Tibell (1979) monographed the European species. There are more recent treatments of most of them in Ahit et al. (1999), Muñiz & Hladun (2011) and Smith et al. (2009).
A distinctive genus of about 16 species of stalked, mazediate, lichenicolous fungi. Six species occur in Europe; all are rare. The hosts of European species are crustose lichens, most commonly species of Pertusaria.

11 Ascospores almond-shaped, 10 - 15 µm long. (S. tubaeformis)
1 Ascospores aglobe to ellipsoid, less than 12 µm long.
22 Ascospores 4 - 7 µm long.
33 Apothecia sessile, or with stalk much shorter than width of head. Surface of ascospores ornamented with small warts (visible at x400). Apothecia K+ purplish or +reddish in section or squash. S. turbinata
3 Apothecia distinctly stalked; stalk about as long as, or longer than width of head. Surface of ascospores not ornamented. Apothecia K-. S. leucopoda
2 Ascospores 7 - 12 µm long.
33 Apothecia stalked. Ascospores with distinct dotted ornamentation. Exciple brown to dark brown in section, very hard. (S. anglica)
3 Apothecia sessile. Ascospores smooth or with regularly ridged ornamentation. Exciple colourless to pale brown in section, not very hard. (S. paramerae)

Sphinctrina leucopoda Nyl. (1859)

Flora 42: 44-45.
Descriptions: Ahit et al. (1999); Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Muñiz & Hladun (2011); Nash et al. (2004); Smith et al. (2009).
Santorini, on Pertusaria flavicans at an altitude of 200 m.
Most of Europe to as far north as southern Sweden. Also Macaronesia, Asia (Turkey, Russia, Japan), N. America (widespread in USA), C. America (Mexico), S. America (Peru), Australasia (Queensland, Tasmania), Pacific (Hawaii).
Sphinctrina turbinata (Pers.) De Not. (1846)


Unfortunately, the name is illegitimate, being a later homonym of S. turbinata Fr. (1825). Although the basionym is sanctioned, that does not protect combinations based on it. A nomen novum is required.

Thallus: absent, not lichenised. Ascomata sessile or shortly stalked, to 0.2 mm tall (including stalk), head to 0.12 mm diameter, asci disintegrating eventually to form a spore mass, all parts black; rather obscurely K+ reddish in squash.

Ascospores: dark brown when mature, simple, broadly ellipsoid, 6 x 4.5 µm, warted ornamentation clearly visible at x400, 8 per ascus, clearly uniseriate in ascus.

Scattered thinly throughout Greece on species of Pertusaria at altitudes 0 - 1400 m. Reported from P. flavida, P. hymenea, P. leucostoma, P. pertusa. A report from Lecanora rupicola subsp. sulphurata is difficult to assess. That is an unexpected host, but the material was determined by Julius Steiner, usually a reliable worker.

Widespread in Europe, but uncommon in the south. Also Macaronesia, Asia (Turkey, Syria, Russia, Japan), Africa (Morocco, Algeria, Libya, S. Africa), N. America (widespread), Australasia (Tasmania), Pacific (Hawaii).

Spilonema Bornet (1856)


Literature: The two European species are discussed in all the standard floras Four species, of which two occur in Europe.

11 Thallus prostrate. S. paradoxum
1 Thallus of erect filaments. (S. revertens)

Spilonema paradoxum Bornet (1856)


Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).

Known from a single site in Epiros, where it occurred on serpentine rock at an altitude of about 950 m.

Throughout temperate Europe. Probably absent from truly Mediterranean regions and from the High Arctic. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco), N. America (Alabama, Maine, Massachusetts), South America (widespread), Australasia (Western Australia).

Sporastatia A. Massal. (1854)

Geneac. Lich. 9. Type: S. testudinea (Ach.) A. Massal., the only species originally included. Family: Sporastatiaceae.

Literature: There is no monograph, but Yakovenko & Davydov (2018) give a key to all species. The two widespread European species are treated in all the standard Floras.

A small genus of 6 species, 3 of which occur in Europe.

11 Thallus grey, matt, without elongated marginal areoles. Prothallus not visible between areoles, usually only visible at margin of thallus. S. polyspora
1 Thallus brown or brown-black, shiny, with elongated radiating marginal areoles. Prothallus usually clearly visible between areoles. S. testudinea

Sporastatia polyspora (Nyl.) Grummann (1963)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in northern Greece, on siliceous rock. Reported altitudes 1860 - 2500 m, but at lower altitude on Samothraki.

Widespread in northern and central Europe, very rare south of the Alps. Also Asia (Turkey, Russia), N. America (widespread), Antarctica (subantarctic islands).

Sporastatia testudinea (Ach.) A. Massal. (1854)

The correct name is *Sponastatia morio* (DC.) Körb., if the synonymy is confirmed. Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Known from a single site in Epiros, where it occurred on calcareous rock at an altitude of 2100 m.

Throughout northern and central Europe, very rare south of the Alps. Also Asia (widespread), N. America (widespread), S. America (Argentina, Bolivia, Peru, Venezuela), Australasia (NSW, NZS), Antarctica (subantarctic islands, Antarctic Peninsula).

**Squamarina Poelt (1958)**


Literature: Apart from Poelt's original paper, information is very scattered. There is no good, modern treatment that includes all, or even many, of the species of southern Europe.

Thallus: to several cm diameter, of rather robust squamules, usually some shade of green or green-brown, sometimes white pruinose. Apothecia: sessile, usually fairly large (typically 1 - 2 mm diameter). Disc: pale brown or similar. Thalline margin: present, excluded early in some species. Exciple: inconspicuous but often visible externally as a thin rim slightly differentiated from disc. Epithecium: brown, K-, pigment soluble in K. Hymenium: generally less than 100 µm tall, usually colourless, upper part sometimes with epithelial pigment. Paraphyses: simple, slightly clavate, not capitate. Asci: narrowly clavate, Bacidia or Lecanora type. Ascospores: colourless, simple, ellipsoid to narrowly ellipsoid, medium sized (10 - 20 µm long), 8 per ascus. Chemistry: medulla P+ yellow in some species; other reactions usually negative. Photobiont: green, trebouxioid.

*Squamarina* has always been problematic. Poelt regarded it as a segregate from *Lecanora*, characterised by a squamulose thallus, but in that sense it is artificial. Some species may indeed belong in *Lecanoraceae*, but the type species has an ascus of *Bacidia* type and is not closely related to *Lecanora*. In addition, many species are rather variable, published keys are all rather inadequate, and determination of collections is sometimes difficult. *Squamarina* is an important component of the flora of Mediterranean regions, and a modern revision is desirable.

As presently delimited, *Squamarina* has 20 species, 15 of which occur in Europe. They generally occur on soil or rock, usually calcareous, in warm, dry places. The genus is well represented in Greece, and *S. cartilaginea* is ubiquitous. The Mediterranean appears to be a centre of diversity for the genus.

Some species could be confused with *Protoparmeliopsis*, but most species of that genus have a P- medulla, whereas the common species of *Squamarina* usually react P+ yellow.

11 Isidia present. *S. concrescens*

1 Isidia absent.

22 Thallus with distinct marginal lobes, contrasting with centre of thallus which is squamulose-areolate or verrucose.

33 Thallus forming very regular rosettes, with radiating marginal lobes, 0.5 - 2 mm wide, much longer than wide (2 - 8 times longer). Medulla P-. Thallus sometimes pruinose. On soil or overgrowing bryophytes. *S. lentigera*

3 Thallus not forming regular rosettes; marginal lobes 2 - 3 mm wide, ±elongated but not much longer than wide (1.5 - 3 times longer). Medulla P+ yellow. Thallus pruinose or not. On rock or overgrowing bryophytes.

44 Thallus usually densely white pruinose. On rock or overgrowing bryophytes. *S. stella-petraea*

4 Thallus greenish, not pruinose. On rock; not associated with bryophytes. See *Lecanora graeca*

2 Thallus ±squamulose everywhere, without distinct marginal lobes, marginal parts not very different from centre.

33 Thallus of discrete convex squamules, not or only slightly overlapping. Thalline margin thick, irregularly crenulate, persistent.

44 Thallus very pale brown, with abundant white pruina. Medulla P+ yellow. Apothecia uncommon, disc pale brown. Strictly montane. (S. lamarkii)

4 Thallus white-green, with only a little white pruina. Medulla P-. Apothecia very common, disc green. At all altitudes. *S. periculosa*

3 Squamules discrete or overlapping; if discrete then not markedly convex. Thalline margin sometimes present in young apothecia, but usually becoming excluded later.

44 Ascospores 14 - 20 µm long, with subrounded to pointed ends. Squamules foliose, often overlapping. Medulla P+ yellow. On rock. *S. oleosa*

4 Ascospores 10 - 15 µm long, with rounded ends. Squamules various. Medulla usually P+ yellow, rarely P+ red or P-. On rock or soil.

55 Thallus of discrete squamules, not or only slightly overlapping, sometimes concave, sometimes with white, upturned margin (Note 1). Thalline margin thin, excluded very early. Medulla P+ yellow. *S. gypsacea*

5 Thallus of ±foliose, often overlapping squamules (Note 1). Thalline margin fairly well developed in young
the rank of form. The combination was made at the rank of variety by Hawksworth, but does not seem to have been validly published at western Asia (Israel), N. Africa (Tunisia). Squamarina crassa

Likenoj de Okcidenta E

Squamarina cartilaginea f. iberica (Mattick) Clauzade & Cl. Roux (1985)

Likenoj de Okcidenta E

Squamarina cartilaginea f. pseudocrass

(1) S. cartilaginea and S. gypsacea are very variable, and all thallus characters can overlap.

Squamarina cartilaginea (With.) P. James (1980) f. cartilaginea

in Hawksworth et al., Lichenologist 12(1): 107; Lichen cartilagineus With. (1776), Bot. Arr. Veg. Gr. Brit. 708; Lecanora cartilaginea (With.) Ach.; Lecanora crassa Ach.; Lecanora crassa f. caespitosa (Schaer.) J. Steiner; Lecanora crassa var. caespitosa (Schaer.) Rabenh.; Lecanora crassa f. dealbata (A. Massal.) Hepp; Lecanora crassa var. dealbata (A. Massal.) J. Steiner; Lecanora crassa f. dufourei (Fr.) Schaer.; Lecanora crassa var. imbricata (A. Massal.) Hepp; Placodium crassum Link; Placodium crassum var. cetrarioides (A. Massal.) Müll. Arg.; Placodium crassum var. dufourei (Fr.) Müll. Arg. (sometimes as ‘dufourei’; Psoroma crassum f. caespitum (Schaer.) Arnold; Psoroma crassum f. dealbatum A. Massal.; Squamaria crassa var. caespitosa (Schaer.) Anzi; Squamaria crassa var. cetrarioides (A. Massal.) H. Olivier; Squamaria crassa var. dealbata (A. Massal.) Flagey; Squamaria crassa var. liparia (Ach.) Nyl.; Squamaria crassa var. melaloma (Ach.) Duby; Squamaria crassa Poelt.

Thallus: squamulose, forming irregular patches to many cm diameter. Squamules: pale green to dark green (when fresh), often white pruinose, 1 - 5 mm wide, usually not elongated, flat to convex, sometimes ascending at margins, sometimes overlapping, not (or scarcely) radiating at margins of thallus, 250 - 1000 µm thick. Lower surface: grey to black in central parts, often white at margin. Cortex: 50 µm thick, colourless to pale brown, K-, N-, pigment not soluble in N. Medulla: white, massive and coherent, chalky; in section: of loosely interwoven hyphae 3.5 - 5 µm wide encrusted with abundant small crystals 0.5 - 2 µm diameter. Apothecia: often present, immersed to sessile, slightly concave to slightly convex, 0.8 - 3 mm diameter. Disc: orange-brown to brown, not pruinose. Thalline margin: often present in young apothecia, sometimes white pruinose, usually excluded eventually but persisting on lower surface of apothecia. Exicle: pale orange-brown to brown, visible when thalline exciple excluded but less apparent before, thin; in section: 50 - 125 µm wide, pale orange-brown to brown, of radiating hyphae with small rounded lumina in outer part. Epithecium: orange-brown to brown, K-, pigment soluble in K. Hymenium: 60 - 90 µm tall, colourless in lower part, upper half usually with some epithelial pigment, K+ blue. Hypothecium: 100 - 150 µm thick, colourless, of randomly oriented hyphae, more loosely packed in lower part. Paraphyses: simple, 1.5 - 2 µm wide at base, 2.5 - 4 µm at apex, not capitate, not pigmented. Asci: 50 - 55 x 8 - 10 µm, cylindrical, apex K+ blue. Ascospores: colourless, simple, narrowly ellipsoid, 9 - 13 x 4 - 6 µm, 8 per ascus. Chemistry: medulla K-, C-, KC- P+ yellow (reaction always strong and distinct), I-; thallus K-, C-, KC-, (P reaction misleading as reaction of medulla usually shows through), UV-. Photobiont: green, cells globose, 8 - 15 µm diameter. Photobiont layer: continuous, regular, 50 - 80 µm thick.

The ascal apex is difficult to study because the asci are narrow, but asci are definitely not Lecanora type. They are said to be Bacidia type, but I can not (yet) confirm this from my own observations.

Sometimes difficult to separate from S. gypsacea, as both species are rather variable. The squamules in S. gypsacea are, typically, more adpressed than those of S. cartilaginea, and are more discrete with much less tendency to overlap, but some collections are difficult to place.

Very common throughout Greece. On calcareous soil or calcareous rock at all altitudes. The lichenicolous lichen Buellia badia and the non-lichenised lichenicolous fungi Chyphococcus psoromatis (twice), Lichenostigma rouxi (3 times) and Sclerococcus rimulicola have been reported from this host.

Widespread in Europe to as far north as southern Scandinavia, but commonest in the south. Also Macaronesia, Asia (widespread), Africa (throughout northern Africa; also S. Africa), N. America (Quebec, Saskatchewan, Nebraska), perhaps S. America (Argentina, Peru - old reports).

Squamarina cartilaginea f. iberica (Mattick) Clauzade & Cl. Roux (1985)

Likenoj de Okcidenta E

Squamarina cartilaginea f. pseudocrass

The combination was made at the rank of variety by Hawksworth, but does not seem to have been validly published at the rank of form. Lecanora lentigera var. pseudocrass Mattick (1940), Ber. Deutsch. Bot. Ges. 58: 351.
Differs from \textit{f. cartilaginea} only in having a medulla that reacts P-, rather than P+ yellow..

Only reported from a few sites in the Peloponnese, at altitudes 30 - 1400 m. Probably more common but under-recorded. Reports to date are from calcareous, or at least base-rich rock, or overgrowing bryophytes on such rock.

Southern Europe, from Provence to Greece. Also Macaronesia, western Asia (Turkey, Israel), N. Africa (Tunisia, Egypt).

\textbf{Squamarina concrescens} (Müll. Arg.) Poelt (1958)


Southern half of Greece, never very far from the sea. On calcareous soil, or less commonly calcareous rock. At altitudes 0 - 1000 m, but 60% of reports are from below 200 m. The lichenicolous fungus \textit{Clypeococcum psoromatis} has been reported once from this host.

Southern and south-central Europe. Also Macaronesia, Asia (widespread as far east as Tajikistan), N. Africa (Morocco, Algeria, Tunisia).

\textbf{Squamarina gypsacea} (Sm.) Poelt (1958)


Thallus: squamulose, to several cm diameter, green (when fresh), sometimes slightly white pruinose in places, without vegetative propagules. Squamules: often rather adpressed but ascending at margins, usually not overlapping, flat or slightly concave, often with prominent white margin where medulla visible, \(\pm\)isodiametric or slightly broader than long, 2 - 3.5 x 2 - 5 mm, not radiating, 300 - 500 \(\mu\)m thick; lower surface white to black. Epicortex: 5 - 30 \(\mu\)m thick, colourless, of horizontal hyphae (or hyphal remnants)), compact. Cortex: 80 - 100 \(\mu\)m thick, pale brown to brown in upper part, colourless, in lower part, of anastomosed but predominantly vertical hyphae, looser than epicortex; K-, pigment soluble in K. Medulla: white, opaque in section (unless section \(\pm\)thin), formed of a network of hyphae, each hypha densely covered in crystals. Apothecia: sessile to very shortly stalked, flat to slightly convex, 0.9 - 2 mm diameter, sometimes slightly white pruinose. Disc: pale brown. Thalline margin: \(\pm\)absent. Exclere: inconspicuous but usually visible as a thin ring slightly darker than disc and sometimes slightly raised; in section: 100 \(\mu\)m wide, pale brown, formed of overlapping hyphae on an overall \(\pm\)radial trend, sometimes with small but distinct elongated lumina in outer part; K-, K+, most pigment soluble in K leaving a very pale yellow-brown residue. Epitheicum: brown, K-, pigment soluble in K. Hymenium: 70 - 85 \(\mu\)m tall, colourless, K+ blue. Hypothecium: colourless, to 200 \(\mu\)m thick, of anastomosed hyphae, K-. Paraphyses: sparingly branched, 1 \(\mu\)m wide at base, 1.5 - 2.5 \(\mu\)m at apex, clavate, not usually capitate, often with visible septa. Asci: 60 x 11 \(\mu\)m, narrowly clavate, usually \(\pm\)Bacidia type (though few mature ones seen appeared \(\pm\)Lecanora type). Ascospores: colourless, simple, narrowly ellipsoid, 10 - 13 x 4 - 5 \(\mu\)m, ends rounded, 8 per ascus. Chemistry: medulla K-, C-, KC-, P+ yellow, I-; thallus UV-. Photobiont: green; cells globose, 8 - 13 \(\mu\)m diameter, forming a continuous but rather irregular layer 45 - 65 (150) \(\mu\)m thick.

Unlikely to be confused with any species except \textit{S. cartilaginea}, for separation from which see above.

Widespread in the southern half of Greece, but in the northern half absent from strongly inland localities. On calcareous rock or calcareous soil at all altitudes.

Widespread in Europe to as far north as southern Scandinavia, but commonest in the south. Also Asia (widespread), Africa (Morocco, Algeria, Tunisia, perhaps Somalia).

\textbf{Squamarina lentigera} (Weber) Poelt (1958)


Descriptions: Clauzade & Roux (1985); Nash et al.(2002); Nimis & Martellos (2004); Smith et al. (2009).

Scattered, mostly in the southern half of Greece, usually fairly close to the sea. On calcareous soil at altitudes 0 - 800 m, but commonest below 200 m.

Much of Europe outside truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (widespread in western half), perhaps Pacific (New Caledonia).

\textbf{Squamarina oleosa} (Zahhlbr.) Poelt (1958)


Thallus: squamulose, to 6 cm diameter, dull green, sometimes white pruinose near margins of squamules, without vegetative propagules. Squamules: not adpressed, flat, overlapping, 5 x 3 mm, 400 - 500 \(\mu\)m thick; lower surface black, slightly tomentose. Cortex: 12 \(\mu\)m thick, of \(\pm\)horizontal hyphae. Medulla: white, rather chalky, of loosely interwoven
hyphae. Apothecia: sessile, slightly concave to flat, 1.2 - 2.5 mm diameter, occasionally slightly white pruinose. Disc: pink-brown to orange-brown. Thalline margin: present in young apothecia, but becoming excluded. Exciple: usually visible externally as a thin, slightly raised rim, ±concolourous with disc; in section: 100 µm wide, basically of radiating hyphae, but developing an almost cellular texture though individual hyphae still discernible; with abundant small crystals soluble in K but not in N. Epithecium: pale brown, K-, N-, pigment soluble in K but not in N; with abundant small crystals soluble in K but not in N. Hymenium: 75 µm tall, colourless in lower part, upper part sometimes with epithelial pigment, KI+ blue. Hypothecium: 80 - 100 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, 2 - 2.5 µm at apex, not capitulate. Asci: 50 - 55 x 10 µm, narrowly clavate to almost cylindrical, ±Baccidia type. Ascospores: colourless, simple, narrowly ellipsoid, 15 - 17.5 x 4.5 - 5 µm, ends subrounded to pointed, 8 per ascus. Chemistry: medulla K-, C-, KC-, P+ yellow, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green; cells globose, 6 - 7 µm diameter, forming a continuous, regular layer 50 - 70 µm thick.

Resembles S. cartilaginea, but easily separated microscopically by the longer ascospores with more acute ends.

Southern Europe, from Spain to Greece: with a few reports from further north in France and Belgium. Also Macaronesia, Asia (Turkey, Yunnan).

**Squamarina periculosula (Dufour ex Schaer.) Poelt (1958)**


Description: Clauzade & Roux (1985).

Scattered in the islands. On calcareous rock and calcareous soil at altitudes 60 - 1100 m. Southern Europe, from Spain to Greece. Also western Asia (Syria), N. Africa (Tunisia).

**Squamarina stella-petraea Poelt (1958)**


Thallus: squamulose, to 8 cm diameter, brown to green, but surface obscured almost everywhere by dense white pruina, without vegetative propagules. Squamules: adpressed, usually isodiametric to slightly elongate, distinctly radiating at margins of thallus, 0.4 - 0.8 mm thick. Marginal squamules 4 - 4.5 x 1.5 - 2.5 mm. Cortex: 80 - 90 µm thick, colourless to pale grey-brown, outermost 10 - 15 µm structureless, elsewhere of broad, mostly vertical hyphae, but structure obscured by abundant fine crystals, about 1 µm wide, not soluble in K, slightly soluble in N. Medulla: white, chalky, formed of a dense network of broad hyphae, 4 - 6 µm wide, almost opaque in section because of abundant fine crystals about 1 µm wide, not soluble in K, slightly soluble in N. Apothecia: subsessile to sessile, slightly concave to flat, 0.6 - 1.5 mm diameter. Disc: pale yellow-brown. Thalline margin: present in young apothecia, strongly white pruinose, becoming excluded. Exciple: sometimes visible externally as a thin ring ±concolourous with disc & often slightly raised; in section: 80 - 120 µm wide, colourless to pale brown, structure obscured by abundant fine crystals. Epithecium: brown to grey-brown, K-, pigment soluble in K, with abundant fine crystals. Hymenium: 60 µm tall, colourless in lower part, upper part often with epithelial pigment and fine crystals. Hypothecium: 80 - 100 µm tall, colourless to very pale yellow-brown, most parts without crystals, but crystals sometimes abundant in lower part in centre of apothecium. Paraphyses: simple, 1 - 2 µm wide in lower part, scarcely broadening towards apex, not capitulate or moniliform, sometimes with visible septa. Ascospores: colourless, simple, ellipsoid, 15 x 5 µm, ends usually slightly pointed (sometimes one more than the other). Chemistry: medulla K-, C-, KC-, P+ yellow, I-; thallus K-, C-, KC-, P-, UV+ orange. Photobiont: green, cells globose, 8 - 12 µm diameter, forming a continuous, ± regular layer 40 - 70 µm thick.

Well characterised by the radiating but not elongated marginal lobes, and the dense white pruina. Could perhaps be confused with *Lecanora pruinosa* but that is C+ orange.

Attica and Peloponessse. On rock or soil, usually calcareous, or overgrowing bryophytes on those substrates, at altitudes 20 - 1200 m.

Southern and south-central Europe. Also western Asia (widespread to as far east as Iran), N. Africa (Morocco, Tunisia).

**Staurolemma Körb. (1867)**

* Verh. k. k. zool.-bot. Ges. Wien 17: 618. Type: *S. dalmaticum* Körb., the only species originally included. Family: *Pannariaceae*.


*Staurolemma* may contain up to 5 species, but only one occurs in Europe. The other four are rather poorly known. Superficially resembles many species of *Collemataceae*, but differs markedly from that group in the structure of the
ascus and in the epithecial pigment. The simple ascospores, with a prominent wall are also not characteristic of Collemataceae.

**Staurolemma omphalarioides** (Anzi) P. M. Jorg. & Henssen (1993)


Thallus: foliose but lobes often indistinct except near margin of thallus, to 1 cm diameter, homeiomerous. Lobes: when well-developed (at margins of thallus) 2 - 5 mm wide, rounded, weakly adpressed but with ascending margins, thin (about 50 µm); in central parts of thallus they are irregular, 100 - 270 µm thick when dry (270 - 450 µm when wet). Upper surface: black. Lower surface: black. Isidia: present, initially fine and subcylindrical, 0.05 mm diameter, later coarsening and becoming globose, to 0.2 mm diam, laminal and marginal on lobes, sometimes present on thalline exciple. Upper and lower cortex: absent, but hyphae much more concentrated near surface; in centre of lobes hyphae 1.5 - 4 µm wide, anastomosed, without visible septa. Apothecia: frequent, ±flat, (0.25) 0.55 - 0.8 mm diameter, sessile or shortly stalked, laminal and marginal, not pruinose. Disc: black, matt. Thalline margin: present, brown, clearly contrasting in colour with disc and most of thallus, thin but persistent, eventually becoming slightly discontinuous; in section: 35 µm wide. Exciple: not visible externally; in section: 30 µm wide, cellular, cells less distinct towards surface. Epithecium: dark brown with very faint purplish tinge, K-, but becoming dull grey in K. Hymenium: 100 µm tall, ±colourless. Hypothecium: 100 - 140 µm tall, of two distinct layers; upper layer (?subhymenium): very pale yellow, 50 - 80 µm tall, formed of small, rather obscure cells, 2 - 3 µm wide, with long axis predominantly horizontal; lower part (?true hypothecium): colourless, of large cells, 15 - 17 x 10 - 11 µm, with long axis predominantly vertical. Paraphyses: 1 µm wide at base, 2 µm wide at apex, usually without visible septa; in K with a hemispherical, dull grey cap of pigment, which appears to be internal. Ascii: 55 - 67 x 15 - 23 µm, narrowly clavate to clavate, wall KI+ blue, but no apical structures visible in KI. Ascospores: colourless, simple, ellipsoid, 15 x 9 - 10 µm, with prominent wall 1 µm thick, 8 per ascus. Chemistry: no lichen substances. Photobiont: Nostoc; cells globose, 3 - 5 µm diameter, in chains, not forming a distinct layer.

Difficult to separate from species of Collemataceae until the apothecia are sectioned. However, the simple ascospores and other microscopic characters of the apothecia prevent any confusion.

Scattered throughout those parts of Greece with a climate that is not too continental. On bark at altitudes 0 - 850 m. Recorded from a wide range of phorophytes, but avoiding strongly acidic and strongly nutrient enriched bark.

Southern Europe, and Atlantic margin to as far north as Norway (map in Jørgensen & Henssen 1993). Also Macaronesia, Asia (Turkey, Israel, Syria, Iran), N. Africa (Morocco, Algeria, Tunisia).

**Staurothele Norman** (1852)


Literature: There is no monograph, and information is scattered. Useful publications include: Clauzade & Roux (1985), Nash et al. (2002), Smith et al. (2009), and Thomson (1991).


Differs from Verrucaria in having algal cells in the hymenium. Differs from Endocarpon, the other genus in Verrucariaceae with this character, in having a crustose, not squamulose thallus.

**Staurothele** is poorly understood, and its species are often difficult to separate. The shape of the hymenial algae has been used as a major character, but it varies during development; it is also not obvious (at least to me) that it is a sensible character to use to delimit species of fungi, at least not without a lot more evidence than is yet available. About species are presently referred here, 35 of them European, but many are doubtful taxa, and the number of good species is unclear. Most species are saxicolous, a few are terricolous. Staurothele is not often collected in Greece, and the scarcity of material for study compounds the difficulty of understanding the genus. The present account is very provisional.

*S. orbicularis* var. *orientalis* J. Steiner is not included in the key, as I have insufficient information.

11 Asci with 1 or 2 ascospores.

22 Thallus and perithecia entirely immersed in calcareous rock. Thallus whitish or brownish. Involucrellum absent.

**S. orbicularis**

2 Thallus superficial (though it may be thin). Perithecia immersed in thallus or at least partly emergent from substrate; never wholly immersed in substrate. Thallus ±dark brown. Involucrellum present.

33 Hymenial algal cells globose or slightly ellipsoid (Note 1).

44 Thallus fairly well developed. Perithecia not in pits in rock. On frequently submerged siliceous rock. (S. fissa)
4 Thallus very thin, inconspicuous. Perithecia in shallow pits in rock. On calcareous rock, not aquatic. If present in Greece, probably restricted to high altitudes. (S. rufa)

3 Hymenial algal cells distinctly elongated when mature (may be globose when young) (Note 1).

44 In depressions in rocks that are often wet. (S. drummondii) Greek reports doubtful.

4 On dry rock, usually calcareous. (S. areolata)

1 Ascii with (2) 4 or more ascospores.

22 On soil or amongst bryophytes and on plant debris. Ascospores colourless.

33 Ascospores 28 - 33 µm long. Hymenial algal cells globose or ±cuboid (Note 1). (S. geoica)

3 Ascospores 36 - 43 µm long. Hymenial algal cells distinctly longer than wide when mature (young cells often globose or cuboid) (Note 1). (S. terricola)

2 On rock. Ascospores colourless or brown.

33 Perithecia immersed in pits in rock. Thallus endolithic (or almost) in calcareous rock. Hymenial algal cells globose or ±cuboid. 44 Perithecia 0.2 - 0.3 mm diameter. Ascospores brown from an early stage, (2) 4 per ascus, 40 - 60 µm long. (S. rupestris)

4 Perithecia 0.4 - 0.6 mm diameter. Ascospores colourless or eventually becoming pinkish or yellow-brown, 4 - 8 per ascus, length various.

55 Mature ascospores colourless or with a pink or page green tinge, 4 - 8 per ascus, 25 - 60 µm long. S. immersa

5 Mature ascospores yellow-brown, usually 8 per ascus, 25 - 40 µm long. (S. caesia) Greek reports doubtful.

3 Perithecia not immersed in pits in rock. Thallus, substrate and hymenial algal cells various.

44 Hymenial algal cells globose or ±cuboid, 3 - 4 µm diameter (Note 1). Thallus superficial. Perithecia half emergent. Mature ascospores brown. (This is a doubtful taxon: don't record it without further investigation.)

S. sienae

4 Hymenial algal cells distinctly longer than wide when mature (young cells often globose or cuboid) (Note 1). Perithecia at least half emergent. Involucrellum present and well developed.

555 Involucrellum joined to exciple only at very top of perithecium. Thallus white or pale to medium grey (sometimes with a greenish tinge), thin, often rather inapparent. Perithecia half to two-thirds emergent, usually pruinose. Ascospores 20 - 35 x 9 - 21 µm. S. hymenogonia

55 Involucrellum incurved under base of perithecium. Thallus pale grey to black (sometimes with a greenish tinge), thin but superficial, continuous to irregularly cracked. Perithecia half to three-quarters emergent, not pruinose. Ascospores 31 - 56 x 12 - 29 µm. (S. succedens)

5 Involucrellum completely merged with exciple. Thallus pale yellow-grey or green-grey to brownish, thick, cracked-areolate or verrucose-areolate. Perithecia half emergent, not pruinose. Ascospores 25 - 35 x 12 - 18 µm. (S. rugulosa) Greek report needs confirmation.

(1) The shape of the algal cells is an unsatisfactory character, but I can not yet construct a better key. Unless many algal cells are obviously elongated it is advisable to try both branches.

Staurothele hymenogonia (Nyl.) Th. Fr. (1865)


The earliest name is thought to be _Polyblastia ventosa_ A. Massal. (1855), in which case the correct name would be _S. ventosa_ (A. Massal.) P. Syd.

Thallus: crustose, superficial but thin, grey-white or inconspicuous, to a few cm diameter, without vegetative propagules. Perithecia: black, 0.35 - 0.5 mm diameter, not pruinose (in material seen); in section: 50% immersed, 300 - 400 µm tall, 370 - 450 µm wide, pyriform, with algal cells 6 - 7.5 x 2.5 µm when mature (but often immature and then smaller and ±cubical). Exciple: colourless in lower part, darker in upper part, 25 - 40 µm thick, formed of hyphae parallel to wall. Involucrellum: present, well developed, 700 µm diameter, attached only at uppermost part of exciple. Paraphyses: disappearing early. Periphyses: abundant in upper half of perithecium, simple, 15 - 20 µm long, 1 µm wide at base, 1 - 2 µm at apex, sometimes slightly capitate, sometimes with visible septa. Asci: 90 x 30 µm, narrowly pyriform (widest part quite close to base). Ascospores: colourless, muriform, ellipsoid, 27 - 37 x 13 - 15 µm, 8 per ascus. Photobiont: green, not _Trebouxia_.

Best recognised by the 8-spored asci and the widely spreading involucrellum. Scattered, rather thinly, throughout Greece. On calcareous, or at least base-rich rock at altitudes 50 - 1600 m.

Widespread in Europe to about the Arctic Circle. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). Its status in N. America has been disputed.
Staurothele immersa  (A. Massal.) Dalla Torre & Sarnth.  (1902)
Thallus: immersed, inapparent or forming a very pale brown stain, to 4 cm diameter. Perithecia: black, 0.25 - 0.3 mm diameter, with flat or dimpled top, immersed in pits in substrate; in section: 360 - 400 \( \mu \)m tall, 350 - 460 \( \mu \)m wide, containing algal cells. Exciple: black throughout. Involucrellum: poorly developed, not very distinct from exciple. Paraphyses: disappearing early. Ascospores: colourless to very pale green, muriform, 28 - 38 x 11 - 17 \( \mu \)m. Photobiont: green; cells in hymenium globose to square, 2.5 - 3 \( \mu \)m diameter.

The immersed thallus, and perithecia in pits in the substrate are fairly distinctive. For separation from other species with those characters see the key.

Scattered, in southern and western Greece, on calcareous rock at altitudes 100 - 1300 m.
Southern Europe, from Iberian Peninsula to Greece. I have not seen any reports for other continents.

Staurothele orbicularis  (A. Massal.) Th. Fr.  (1865) var. orbicularis
Description: Clauzade & Roux (1985).
Amorgos, on calcareous rock at an altitude of 600 m.
Southern and south-central Europe. I have not seen any reports for other continents.

Staurothele orbicularis var. orientalis  J. Steiner  (1910)
Annls Mycol. 8: 212.
Description: Apart from the protologue (not seen), there are a few brief remarks in Rechinger (1915), but they are not particularly helpful.
Corfu and Samos, on calcareous rock at altitudes 900 - 1200 m.
Known only from Greece and Iran.

Staurothele sienae  de Lesd.  (1939)
Description: Clauzade & Roux (1985).
Crete, on sandstone at an altitude of 100 m.
Southern Europe, from Spain to Greece. I have not seen any reports for other continents.

Stereocaulon Hoffm.  (1796)

Literature: Clauzade & Roux (1985) and Smith et al. (2009) are adequate for most purposes. Lamb (1977) is a partial monograph, but does not include keys or full descriptions.

Stereocaulon has about 146 species, of which 35 occur in Europe. Most occur on acidic rock in cold climates. Stereocaulon is poorly represented in Mediterranean regions, where it is almost restricted to volcanic substrates. Only one species is likely to be present in Greece.

The single Greek species is polymorphic, and numerous infra-specific taxa have been recognised. The status of most of them is unclear, but those relevant to Greece may be determined as follows:

11 Podetia well developed.

22 Podetia simple or branched, forming compact tufts, usually without an apical soralium. S. vesuvianum var. vesuvianum

2 Podetia simple, loosely clustered, each terminated with a small, globose soralium. S. vesuvianum var. nodulosum

1 Podetia poorly developed. S. vesuvianum f. santorinense

Stereocaulon vesuvianum Pers.  (1810)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Reports without an infra-specific epithet are all from Santorini, on lava.
Subcosmopolitan outside deserts and humid tropics.
**Stereocaulon vesuvianum var. nodulosum (Wallr.) I. M. Lamb (1969)**


Description: Clauzade & Roux (1985); Smith et al. (2009).

Santorini, at an altitude of 50 m. No substrate indicated, but presumably lava.

Similar distribution to var. *vesuvianum*, but less often recorded.

**Stereocaulon vesuvianum f. santorinense (J. Steiner) I. M. Lamb (1969)**


Description: See the protologue.

Santorini and Methana Peninsula of Peloponnese, on lava. The Peloponnese collection was from an altitude of 430 m.

Only Greece and Azores.

**Stigmidium Trevis. (1860)**

Consp. Verruc. 17. Type: *S. schaereri* (A. Massal.) Trevis., the only species originally included. Family: (?) *Mycosphaerellaceae* in *Capnodiales* or (?) incertae sedis in *Verrucariales*.

Literature: The genus needs a monographic treatment. At present, good descriptions do not exist for many species, the taxonomy is largely host-based, and some species presently treated here might be better placed elsewhere. Information is scattered. Clauzade, Diederich & Roux (1989) is a basic, but now inadequate starting point. Triebel (1989), and Roux & Triebel (1994) treat several species in detail, and Calatayud & Triebel (2003) describe three new species and have some additional background information. Nash et al. (2004) also treat a few species.

Over 90 species of lichenicolous ascomycetes, at least 56 of which have been reported for Europe.

111 Fungus forming galls on thallus of host. (*S. ephebes*)

11 Fungus causing spots but not galls on thallus of host.

22 Ascospores 8 - 12 µm long. (*S. hageniae*), (*S. peltideae*), (*S. ramalinae*)

2 Ascospores 12 - 20 µm long.

333333 On Acaeospora. Ascospores 14.5 - 18 x 6 - 9 µm. (*S. rouxianum*)

333333 On Circinaria calcarea. Ascospores 22 - 30 x 4.5 - 9 µm. (*S. aggregatum*)

333333 On Dermatocarpon. Ascospores 17 - 20 x 4.5 - 5 µm. (*S. stygnospilum*)

3333 On Graphis scripta. Ascospores 14 - 19 x 3 - 5 µm. (*S. microspilum*)

333 On Pardeljaceae.

44 Hymenial gel I+ violet. Ascospores 12 - 15 x 5 - 6 µm. On Neofuscelia. (*S. neofusceliae*)

4 Hymenial gel I-. Ascospores 13 - 16 x 4.5 - 5 µm. On Xanthoparmelia. *S. xanthoparmeliarum*

33 On Pertusaria (s. lat.). Ascospores 11.5 - 18 x 4.5 - 6 µm. (*S. eucline*)

1 Fungus not causing galls or spots on the thallus of the host. Any species ±confined to apothecia of host belongs here.

22 Perithecial wall colourless or pale in lower part.

33 Ascomata growing mostly on host thallus. (*S. degelii*), (*S. gyrophorarum*), (*S. marimum*), (*S. psorae*), (*S. rouxianum*), (*S. squamarinicolae*)

3 Ascomata restricted to apothecia of host.

444 On Pleurosticta acetabulum. (*S. acetabuli*)

44 On Physcia. (*Sphaerellothecium pumilum*)

4 On other hosts.

55 Ascospores 3 - 3.5 µm wide, sometimes becoming 3-septate. *S. congestum*

5 Usually some ascospores more than 3.5 µm wide, remaining 1-septate.

66 Ascomata 60 - 100 (140) µm diameter. Short, pendent interascal filaments present. Hymenium gel I+ violet. On Squamarina cartilaginea. (*S. cartilagininea*)

6 Ascomata not exceeding 75 µm diameter. Pendent interascal filaments absent or poorly developed. Hymenial gel I-. On Protoparmeliopsis or on Lecanora polypatra. *S. squamariae*

2 Perithecial wall brown everywhere.

33 Most ascospores 5 or more µm wide. (*S. aggregatum*), (*S. cerinae*), (*S. collematis*), (*S. epixanthum*), (*S. humidum*), (*S. johnnii*)

3 Most ascospores less than 5 µm wide.
444 Ascospores to 12 µm long. If does not key out below, see also next branch.

5555555 On Acaulospora, especially A. fuscata. S. fuscatae
5555555 On Anapychia ciliaris. (S. hageniae) Greek report needs confirmation.
55555 On Peltigera. (S. pseudopeltideae)
5555 On Placynthium nigrum. (S. placynthii)
55 On Ramalina. (S. ramalinae)
55 On Solorina. (S. solorinarium)
5 On Toninia, especially T. tristis, or Thalloidima. S. tabacinae

Some ascospores exceeding 12 µm long but not normally exceeding 15 µm.

55 Cells of ascospore approximately the same.

666 In thallus of Bilimbia lobulata or Bilimbia sabuletorum. (S. mycobilimbiae)
66 On Toninia, especially T. tristis, or Thalloidima. Ascospores 1-septate. S. tabacinae

6 In apothecia of Lecidella elaeochroma s. lat. S. lecidellae
5 Cells of ascospores often of unequal thickness. Ascospores 1 (3) -septate.
66 On Lepraria neglecta. (S. leprariae)
6 In apothecia or thallus of a wide range of host species. S. congestum

4 Many ascospores more than 15 µm long.

55 On Cirrhinaria calcarea (and perhaps related species). Perithecia sometimes aggregated in dense groups of 3 - 12. (S. aggregatum)
55 On Arthonia, especially A. radiata. (S. arthoniae)
5 On Lecania, especially L. cyrtella. (S. punctillum)

Stigmidium congestum (Körb.) Triebel (1991)
in Triebel et al., Mycotaxon 42: 290; Pharcidia congesta Körb. (1865), Parerga Lichenol. 470; Pharcidia epicymatia (Wallr.) Arnold; Stigmidium schaereri auct., non (A. Massal.) Trevis.

Perithecia: black, 0.03 - 0.12 mm diameter, 50 - 100% immersed in thallus or apothecia of host, sometimes several in one apothecium, often turning apothecia black; in section: subglobose, 53 - 110 µm tall, 40 - 100 µm wide. Exciple: uniformly dark brown. Paraphyses: disappearing early. Asci: 28 - 40 x 8 - 13 µm, a distinct ocular chamber visible in water mounts. Ascospores: colourless, (0) 1 (3) -septate when mature (often simple when immature), septum thin, the two cells usually with slightly different widths, ±ellipsoid but sometimes slightly constricted at septum, 8 - 15 x 2.5 - 4 µm, 8 per ascus.

Scattered throughout Greece at altitudes 550 to about 2000 m. Recorded on Collema flaccidum, Lecanora carpinea, Lecanora chlorotera and Lecidella elaeochroma.

Throughout Europe, though commoner in northern and western regions. Distribution elsewhere uncertain owing to confusion with other species, but reported for Macaronesia, Asia (widespread) N. Africa (Morocco, Egypt), Australasia (NZN, NZS). Reports for N. America (USA) are said to be incorrect, so those for C. America (Mexico) may also be unreliable.


Thunbergia 6: 17; Pharcidia lichenum f. fuscatae Arnold (1872), Flora 55: 572.

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004).

Chios, on Acaulospora nitrophila at an altitude of 450 m.

Throughout Europe. Also Asia (Iran, Ural Mts), Africa (S. Africa), N. America (widespread in USA), C. America (Mexico).

Stigmidium lecidellae Triebel, Cl. Roux & Le Coeur (1995)


Perithecia: 80 - 100% immersed in apothecia of host, several per apothecium, black, about 0.05 mm diameter; in section: ellipsoid, 75 - 100 µm tall, 50 - 65 µm wide; wall brown, cellular. Ascospores: colourless, 3-septate when mature, 15 x 3 µm.

From the limited material seen to date, it is unclear to me whether the ascospores "septa" are true septa, i.e. continuous with the ascospores wall, or are merely discontinuities in the ascospore contents.

Kefallonia and Peloponnese. The Peloponnesian collection was on Lecidella elaeochroma, itself on bark of Abies cephalonica, at an altitude of 1160 m. No substrate or altitude was reported for Kefallonia.

Scattered throughout Europe, from Scotland to Greece. I have not seen any reports for other continents.
Stigmidium squamariae (de Lesd.) Cl. Roux & Triebel (1994)
Description: Nash et al. (2004).
Attica, on *Protoparmeliopsis muralis*. The altitude, though not stated, must have been fairly close to sea level.
Central and southern Europe. Also Macaronesia, Asia (Turkey, Iran, Russia), N. Africa (Morocco), N. America (scattered in western half), C. America (Mexico).

Stigmidium tabacinae (Arnold) Triebel (1989)
*Biblioth. Lichenol.* 35: 236; *Pharcidia tabacinae* Arnold (1881), *Flora* 64: 176; *Arthopyrenia glebarum* Arnold; *Sphaerulina tabacinae* (Arnold) Vouaux.
Islands of the southern Aegean, including Crete, plus an old report for Corfu. At altitudes 0 - 1500 m on *Toninia diffracta* and *Toninia sedifolia*.
Southern and western Europe. Also Macaronesia, Asia (Turkey, Iran, Russia, Kashmir), N. America (widespread in western half).

Stigmidium xanthoparmeliarum Hafellner (1994)
Thessaly, on *Xanthoparmelia stenophylla* at an altitude of 320 m.
Central and southern Europe. Also Asia (Turkey, Iran), N. America (California).

Strangospora Körb. (1860)
Parerga Lichenol. 173. Type: *S. pinicola* (A. Massal.) Körb., the only species originally included. Family: Strangosporaceae.
Literature: Smith et al. (2009) treat all the European species except the distinctly northern *S. torvula*.
Seven species, 5 of which occur in Europe; two of them are northern and will not occur in Greece. The genus is very rare in Greece.

11 Apothecia scarlet-red. Ascospores globose, 4 - 4.5 µm diameter. **S. microhaema**
1 Apothecia brown-red, brown or black. Ascospores globose or ellipsoid, less than 4 µm long.
22 Apothecia red-brown at first, darkening with age and eventually ± black. Epithecium yellow to red-brown. N+ pale brown or olive brown. Paraphyses 1.5 - 2 µm wide. (S. pinicola)
2 Apothecia ± black even when young. Epithecium usually blue-grey or olive grey, rarely pale brown or violet, usually N+ mauve or purple. Paraphyses 0.5 - 1 µm wide. **S. moriformis**

Strangospora microhaema (Norman) R. A. Anderson (1975)
Present in Macedonia according to Nimis (1993); the source of the information was not stated.
Thinly scattered throughout Europe, but rare south of the Alps. Also Macaronesia, Asia (Turkey, Ural Mts, Mongolia), N. America (widespread), perhaps S. America (Uruguay).

Strangospora moriformis "(Ach.)" Stein (1879)
On page 5, Acharius cited *Sphaeria moriformis* Pers., but with "?", so he must be treated as introducing a new species, not making a new combination. On page 333 of the Addenda, he included the name *Schizoxylon sepincola* Pers. as a synonym, thus making *Arthonia moriformis* Ach. a superfluous name and illegitimate. Depending on what Stein wrote (not yet seen), conservation may be required.
Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).
Known from two sites in Macedonia, on wood at altitudes 1200 - 1540 m.
Widespread in northern and central Europe, very rare in the south. Also Asia (widespread), N. America (widespread).
Strigula Fr. (1823)


Literature: The standard monograph is Roux & Sérusiaux (2004). About 90 species, best developed in tropical regions. About 21 are present in Europe, but many are strongly oceanic or have a restricted distribution, and will not occur in Greece, where the genus is rare.

11 On bark.
222 Ascospores 1-septate, 19 - 27 x 4 - 9 µm. S. zizyphi
22 Ascospores usually 3-septate, 14 - 20 x 4.5 - 6 µm. S. affinis
2 Ascospores with more than 3 septa.
33 Ascospores 26 - 36 x 5.5 - 7 µm. (S. brevis), (S. stigmatella)
3 Ascospores 22 - 26 x 5 - 6 µm. (S. glabra)
1 On calcareous rock.
222 Ascospores 3-septate. (S. calcarea)
2 Ascospores submuriform. (S. porinoides)

Strigula affinis (A. Massal.) R. C. Harris (1980)
in Hawksworth et al., Lichenologist 12(1): 107; Sagedia affinis A. Massal. (1853), Mem. Lichenogr. 138; Porina affinis (A. Massal.) Zahlbr.

Description: Clauzade & Roux (1985). The description under this name in Purvis et al. (1992) does not refer to this species.

Western Crete, on bark of Pistacia at an altitude of 500 m, and NW Epiros on bark (unspecified) at an altitude of 730 m.

Widespread in southern and central Europe. Also western Asia (Turkey), perhaps Australasia (NZS). Said not to be present in N. America.

Biblioth. Lichenol. 90: 55; Sagedia zizyphi A. Massal. (1856), Misc. Lichenol. 30; Porina zizyphi (A. Massal.) Zahlbr.; Strigula mediterranea Etayo.

Description: Clauzade & Roux (1985) as Porina zizyphi.
Islands of the southern Aegean, including Crete, on bark at altitudes 350 - 700 m.
Scattered in Europe, mainly in warmer and more humid parts. Also Macaronesia, western Asia (Turkey, Syria).

Synalissa Fr. (1825)

Syst. Orb. Veg. 1: 297. Type: S. ramulosa (Hoffm. ex Bernh.) Fr., the only species originally included. Family: Lichinaceae.

Literature: The only widespread European species is treated in Clauzade & Roux (1985). Synalissa is not very well known; it may have as many as 6 species, all saxicolous, of which up to 3 may occur in Europe. Only one is likely to occur in Greece.

Synalissa symphorea (Ach.) Nyl. (1857)

Possibly synonymous with S. ramulosa (Hoffm. ex Bernh.) Fr., which would then be the correct name.
Scattered, with no clear pattern. On calcareous, or at least base rich rock, or on soil at all altitudes.
Most of Europe. Also Macaronesia, Asia (widespread), northern Africa (Morocco, Algeria Tunisia, Socotra), N. America (widespread).

Teloschistes Norman (1852)

Conatus Praem. Gen. Lich. 16-17. The name is Greek, and there is no corresponding form in classical Latin. Some authors skilled in the classical languages, including Vainio, treated the name as of feminine gender, and are probably correct as far as Ancient Greek usage is concerned. However, Norman himself treated it as of masculine gender, and his
usage should be followed. There is no justification for spelling the name *Theloschistes*, as has sometimes been done. Type: *T. flavicans* (Sw.) Norman, designated by Almborn, Nordic J. Bot. 8: 523. 1989. Family: *Teloschistaceae*.

Literature: Smith et al. (2009) cover the two European species.

A number of segregates from *Teloschistes* s. lat. have recently been proposed, including *Seirophora* and *Xanthoanaptychia*. *Seirophora* seems to be well founded, but the status of *Xanthoanaptychia* is not clear to me, and for the moment I do not take up the name (for *T. chrysophthalmos*). With this newer circumscription *Teloschistes* contains 22 species, of which 2 occur in Europe. Most species prefer regions with warm, slightly humid climates.

11 Thallus pendent or forming loose, entangled mats, to 10 cm diameter. Branches rounded, to 1 mm diameter. Soralia present. Apothecia usually absent. **T. flavicans**

1 Thallus erect, forming compact clumps to 2 cm diameter. Branches flattened, often exceeding 1 mm in width. Soralia absent. Apothecia usually present. **T. chrysophthalmos**

**Teloschistes chrysophthalmos** (L.) Th. Fr. (1861)

It is both acceptable and desirable to change the 't' of the epithet into 'th', to conform with the usual convention for transliterating Ancient Greek into Latin characters. However, there is no justification for changing Linnaeus's epithet to *chrysophthalmus*, or for altering its form in genera of different gender; and it is incorrect to do so. The epithet is a noun: it means 'a golden eye'; a reference to the distinctive apothecia of this species.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Rare, in northern Greece including Corfu. On bark at altitudes 20 - 150 m. The only phorophyte explicitly reported was *Olea*.

Mainly western Mediterranean and mild, oceanic regions of western Europe; rare in eastern Mediterranean. Also Macaronesia, Asia (Turkey, Iran), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (widespread), perhaps Pacific (Tahiti).

**Teloschistes flavicans** (Sw.) Norman (1852)
Conatus Praem. Gen. Lich. 17; *Lichen flavicans* Sw. (1788), Prodr. 147. (The name is conserved against the earlier *L. flavicans* Lam.); *Tornabenia flavicans* (Sw.) A. Massal.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Very rare. Lefkada (19th century) and Ikaria, on bark.

Mainly western Mediterranean and mild, oceanic regions of western Europe; rare in eastern Mediterranean. Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (widespread S. of Sahara), N. America (widespread), Caribbean (widespread), C. America (widespread), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Tonga).

**Tephromela M. Choisy** (1929)

*Bull. Soc. Bot. Fr.* 76: 522. Type: *T. atra* (Huds.) Hafellner, the only species originally included by Choisy (as *Lecanora atra*, though he did not combine the epithet into *Tephromela*). Family: *Tephromelataceae*.

Literature: The only widespread species, *T. atra*, is discussed in all the standard Floras.

About 52 species. Only 6 occur in Europe, and in southern Europe only one is widespread.

11 Lichenicolous on *Lecanora*. (T. campestricola)
1 Not lichenicolous; usually saxicolous.
22 Soralia present. (T. grumosa)
2 Soralia absent. **T. atra** s. lat.
33 Thallus thick, chalky. On calcareous rock. **T. atra var. cypria**
3 Thallus not thick and chalky. Usually on calcareous or siliceous rock, less commonly on bark or wood. **T. atra var. atra**

**Tephromela atra** (Huds.) Hafellner (1983) var. atra

Tephromela atra var. cypria (Körb.) Nimis (1993)

Lich. Italy 683; 
Lecanora cypria Körb. (1862), 
Pft. Abth. Naturwiss. 1861: 31; 
Lecanora atra var. pachythallina (Th. Fr.) Szatala.

Several infra-specific taxa have been described within T. atra s. lat. It is not clear to me that any of them really merit recognition. Var. cypria may be merely an ecological response to a strongly calcareous substrate.

Description: Discussed briefly in Nimis (1993).

Islands of the Aegean and adjacent coasts of the mainland, on rock at altitudes 100 - 1400 m.
Southern and western Europe. Also Macaronesia, Asia (Turkey, southern Siberia).

Thallinocarpon Å. E. Dahl (1950)


Literature: The best introduction to the genus is Ahti et al. (2007).

Two species, but one is only known from Greenland.

Thallinocarpon nigritellum (Lettau) P. M. Jorg. (2007)
in Ahti et al., Nordic Lichen Flora 3: 145; 
Thyrea nigritella Lettau (1942), 
Lichinella nigritella (Lettau) P. Moreno & Egea.


Crete and Paros, on siliceous rock at altitudes 40 - 375 m. This is usually a northern or alpine species, and confirmation of the Greek reports is desirable. Confusion with Gonohymenia or Lempokemma seems possible.

Scattered throughout Europe, in regions where the climate is not too continental. Also Macaronesia, Asia (widespread as far E as southern Siberia), Africa (Socotra), N. America (widespread), C. America (Mexico).
Thalloidima A. Massal. (1852)


The generic name has often been written incorrectly as Thalloedema.

Literature: Timdal (1991) treats all species, under Toninia. The genus was defined using molecular data, and is not particularly well characterised by morphology or chemistry. All species have sedifolia grey pigment in the apothecia, but so too do some species than remain in Toninia.


Thalloidima was resurrected for 10 species formerly placed in Toninia. Eight are reported for Europe.

11 Not lichenised. Parasitic on species of Collemataceae. (T. leptogii)
1 Lichenised. Usually not parasitic.
22 Pseudocyphellae present (Note 1).
33 Hypothecium and inner part of exciple colourless to pale brown. Thallus dark grey-green to dark brown, usually pruinose. Ascospores 11 - 19 x 3.5 - 5 µm. T. physaroides
3 Hypothecium and inner part of exciple brown. Thallus olive-brown to red-brown, not or scarcely pruinose. Pseudocyphellae large, punctiform. Ascospores 15 - 25 x 2.5 - 3.5 µm. See Toninia toepfferi
2 Pseudocyphellae absent.
333 Thallus entirely covered by dense white pruina. Hypothecium colourless to brown.
44 Pruina farinose (to 0.02 mm; Note 2). Thallus regularly rosette-shaped. On calcareous rock. T. candidum
4 Pruina granular (often obviously so, 0.03 - 0.07 mm), at least in places (Note 2). Thallus various. On calcareous rock or soil. See Toninia
33 Thallus partly pruinose. Hypothecium brown or red-brown in upper part, colourless to paler brown in lower part (Note 3).
44 Squamules weakly concave to weakly convex, deeply cracked, margin usually densely white pruinose. Upper cortex 70 - 500 µm thick. See Toninia abilibabra
4 Squamules weakly convex to vertically flattened, smooth or with shallow cracks, margin various. Upper cortex 20 - 90 µm thick
55 Squamules convex and with blister-like swellings (‘bullate’) when young, later partly vertically flattened and ±overlapping. T. opuntioides
5 Squamules weakly convex to bullate, but not vertically flattened, not overlapping. T. sedifolium
3 Thallus entirely without pruina. Hypothecium colourless to brown.
44 Hypothecium pale brown to colourless. Ascospores 16 - 24 µm long. See Toninia taurica
4 Hypothecium brown to dark red-brown. Ascospores 10 - 17 µm long. T. massatum

(1) Pseudocyphellae may be scarce and/or inconspicuous. It is advisable to examine many squamules before concluding that they are absent.
(2) Species with granular pruina sometimes have patches of thallus, perhaps eroded, where the granular nature of the pruina is not very apparent. These patches can give the impression of a farinose pruina. It is advisable to examine the whole thallus before concluding that the pruina is not granular. In T. candidum, diligent search may reveal an occasional grain of pruina that is considerably larger than 0.02 mm, but the pruina is clearly farinose overall.
(3) Some collections also have a thin zone with little pigment immediately below the hymenium.

Thalloidima candidum (Weber) A. Massal. (1852)

Thallus: squamulose, 1 - 4 cm diameter, entirely covered in dense, white or blue-white, farinose pruina; pruina soluble in N but not in K. Squamules: adpressed, convex, 1.5 - 4 mm wide, 240 - 400 µm thick. Cortex: 25 - 30 µm
Thalloidima sedifolium (Scop.) Kistenich et al. (2018) (widespread as far east as Nepal), N. Africa (Morocco, Tunisia), N. America (South Dakota).

Lotos

Thalloidima physaroides (Opiz) Opiz (1857)

Lotus 7: 251 as 'Thalloidium'; Lecidea physaroides Opiz (1856), Lotus 6: 158; Toninia physaroides (Opiz) Zahlbr.

Descriptions: Nimis & Martellos (2004); Smith et al. (2009); Timdal (1991), all as Toninia physaroides.

Chios, on limestone at an altitude of 1280 m. Also reported for Crete in Timdal (1991), but with no details.

Widespread in Europe to as far north as southern Scandinavia, but commonest in the south. Also Asia (Turkey, Iran, Kirgizstan, Russia), N. Africa (Morocco, Algeria, Tunisia), N. America (northern and western Canada).

Thalloidima physaroides (Opiz) Opiz (1857)

Lotus 7: 251 as 'Thalloidium'; Lecidea physaroides Opiz (1856), Lotus 6: 158; Toninia physaroides (Opiz) Zahlbr.

Descriptions: Nimis & Martellos (2004); Smith et al. (2009); Timdal (1991), all as Toninia physaroides.

Chios, on limestone at an altitude of 1280 m. Also reported for Crete in Timdal (1991), but with no details.

Widespread in Europe to as far north as southern Scandinavia, but uncommon south of the Alps. Also Asia (widespread as far east as Nepal), N. Africa (Morocco, Tunisia), N. America (South Dakota).

Thalloidima sedifolium (Scop.) Kistenich et al. (2018)

Taxon 67(5): 897; Lichen sedifolius Scop. (1772), Fl. Carniol. Ed. 2, 2: 395-396; Biatora vesicularis (Hoffm.) Hepp;
There seem to be no clear morphological differences between T. inductula and T. modesta.

**Thelenella Nyl. (1855)**


Literature: Information is scattered. Between them, Clauzade & Roux (1985) and Smith et al. (2009) treat all the widespread European species, though sometimes under different generic names. Swinscow (1960a and Morgan-Jones & Swinscow 1965) give detailed treatments of some of these species. Nash et al. (2002) is also helpful. When seeking information, note that many taxa presently placed here were formerly treated in *Microglaena* or *Chromatochlamys*.

A rather poorly known genus of about 27 species, of which 11 are known in Europe. It is rare in Greece.

11 Ascospores 60 - 110 µm long. Overgrowing bryophytes. **T. muscorum**

1 Ascospores less than 50 µm long. On bark or rock.

22 Exciple greenish in upper part, lower part colourless. On bark. (T. melanospora), (T. vezdae)

22 Exciple brown or dark brown in upper part, lower part colourless or pale brown. On bark or rock.

33 Mature ascospores colourless (only brown sometimes when dead).

44 On rock. Note 1. (T. inductula)

4 On bark. Note 1. **T. modesta**

3 Mature ascospores brown. On bark. (T. hassei), (T. melanospora)

2 Exciple almost entirely colourless (may be pale brown around ostiole). On bark. **T. justii**

(1) There seem to be no clear morphological differences between T. inductula and T. modesta.
Thelenella justii (Servít) H. Mayrhofer & Poelt (1987)
in Mayrhofer, Biblioth. Lichenol. 26: 42; Microglaena justii Servít (1934) in Zschacke, Rabenh. Krypt. Fl. 9 (1.1): 665.
Description: Clauzade & Roux (1985).
NW Peloponnese, on bark of Abies cephalonica at an altitude of 1200 m.
Southern Europe, from Spain to Cyprus. Also western Asia (Syria), N. Africa (Algeria).

Thelenella modesta (Nyl.) Nyl. (1855)
The reference in 1855 to the supposed basionym is not at all clear. The 1855 name could be regarded as a new name validated by a descriptio generico-specifica.
Descriptions: Clauzade & Roux (1985, 1989); Nash et al. (2002); Smith et al. (2009).
Scattered, with no clear pattern. On bark at altitudes 0 - 550 m. Recorded from Ficus carica, Pistacia lentiscus, and three species of Prunus.
Widespread in southern and central Europe, to as far north as southern Scandinavia. Also Asia (Turkey, Israel, Russia, Chagos Is), N. Africa (Morocco, Algeria), N. America (California), C. America (Guatemala), perhaps S. America, Australasia (Queensland).

Thelenella muscorum "(Fr.) Vain. (1899)"
Term. Füz. 22: 341; Verrucaria muscorum Fr. (1825), Syst. Orb. Veg. 1: 287; Chromatochlamys muscorum (Fr.) H. Mayrhofer & Poelt.
The nomenclature needs to be clarified. The basionym is illegitimate (unless sanctioned, but I have not found it in any sanctioning publication), being a later homonym of V. muscorum F. H. Wigg. (1780). The first legitimate name at the rank of species appears to be Microglaena muscicola Lönnr. (1858), Flora 41: 633-634. The epithet muscorum was not used legitimately until 1860.
Descriptions: Clauzade & Roux (1985); Nash et al. (2002) both as Chromatochlamys muscorum; Smith et al. (2009).
Crete, on bryophytes at an altitude of 1100 m.
Widespread in Europe to as far north as Svalbard, but rare south of the Alps. Also Macaronesia, Asia (Turkey, Iran, Russia, Taiwan), N. Africa (Morocco, Tunisia), N. America (widespread), C. America (Mexico), Antarctica (S. Sandwich Is)

Thelidium A. Massal. (1855)
Framm. Lichenogr. 15-16. Type: Usually cited as T. amylaceum A. Massal., but in the protologue that was a nomen nudum, and is not acceptable as type. The genus does not appear ever to have been typified. Family: Verrucariaceae.
Literature: There is no monograph. The best starting point for the species of southern Europe is still Clauzade & Roux (1985).
As presently delimited, differs from Verrucaria in having septate rather than simple ascospores, but this distinction is artificial and generic limits in the crustose Verrucariaceae will have to be revised.
Thelidium is very poorly understood. Worldwide it may contain about 100 species, but many are poorly known. Most are saxicolous. About 80 species have been reported for Europe.
T. brachysporum (Zschacke) Servít is not included in the key, as I have insufficient information.

11 Punctiform soralia present. (T. rimosulum)
1 Soralia absent.
22 Thallus ± immersed in calcareous rock. Perithecia ± entirely immersed in pits in rock. Involucrellum present or absent.
33 Involucrellum present. Ascospores 10 - 15 (16) x 6.5 - 8.5 µm. T. impressum
3 Involucrellum absent. Ascospores more than 20 µm long.
44 Mature ascospores 3-septate (but long remaining simple or 1-septate), 25 - 35 x 13 - 17 µm. T. incavatum
4 Mature ascospores remaining 1-septate, 25 - 33 x 11 - 15 µm. T. decipiens
2 Thallus superficial or immersed. Part of perithecia distinctly raised, or perithecia immersed in raised thalline warts. Involucrellum present (though sometimes inconspicuous in those species in which it merges with the dark-coloured exciple).
33 Thallus brown to black.
44 Most ascospores less than 15 µm long. Thallus brown. T. minimum
4 Most ascospores more than 15 µm long. Thallus colour various.
  555 Thallus black. Ascospores 21 - 30 x 9 - 13 µm. (T. obscurum)
  55 Thallus rust-brown or ochre yellow. Ascospores 25 - 45 x 14 - 18 µm. (T. methorium)
  5 Thallus green-brown. Ascospores 15 - 25 x 76 - 10 µm. (T. olivaceum)
3 Thallus white or pale grey, often inconspicuous.
  44 Ascospores 3-septate, 35 - 50 x 14 - 19 µm. Perithecia often in thalline warts. T. papulare
  4 Ascospores 1-septate (septum sometimes indistinct), less than 35 µm long.
  555 Ascospores 10 - 15 (16) x 6.5 - 8.5 µm. Probably restricted to the uplands. T. impressum
  55 Ascospores 16 - 20 x 9 - 11 µm. At low altitudes. T. creticum
  5 Ascospores 19 - 32 x 10 - 14 µm. T. pyrenophorum

Thelidium brachysporum (Zschacke) Servit (1946)
Mt. Olympus, on calcareous rock at altitudes around 2000 m.
Only Germany, Slovakia and Greece.

Thelidium creticum J. Steiner (1917)
Description: See the protologue.
Crete, at altitudes 50 - 300 m. No substrate was reported.
Known only from Crete.

Thelidium decipiens (Hepp ex Nyl.) Kremp. (1861)
The nomenclature needs to be clarified. At species rank, the epithet *decipiens* has priority only from 1861. Earlier names that may be synonymous include *Verrucaria crassa* Eschw. (1833) and *Amphoridium amylaceum* A. Massal. (1854). The name *Sagedia umbrosa* Hepp (1860) may also thought be synonymous, but the epithet *umbrosum* is not available in *Thelidium*.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered, in the northern half of Greece, with no clear pattern. On calcareous rock at altitudes 1100 to about 2000 m.
Widespread in Europe to about the Arctic Circle. Also Macaronesia, Asia (Turkey, Russia, Tajikistan, Mongolia), N. Africa (Algeria), N. America (widespread), perhaps S. America (synonymy uncertain), Australasia (NSW).

Thelidium impressum (Müll. Arg.) Zschacke (1920)
Thallus: crustose, immersed, inconspicuous, to 2 cm diameter. Perithecia: black, 0.15 - 0.2 mm diameter, partly or entirely immersed in pits in substrate; in section: 220 x 220 µm (excluding involucrellum). Exciple: colourless or pale brown in lower part, dark brown to black in upper part which merges with involucrellum. Involucrellum: present, 300 µm diameter. Paraphyses: disappearing early. Ascospores: colourless, 1-septate when mature (sometimes simple when immature), ellipsoid to tadpole shaped, 14 - 16 x 5 - 8 µm, 8 per ascus. Photobiont: green.
The small, 1-septate ascospores and perithecia in pits in the substrate are distinctive. This species is unlikely to be confused with any other.
Mountains of the Peloponnese. On limestone at altitudes 1300 - 2000 m.
Mainly middle latitudes of Europe, but reaching Finland in the north and the Mediterranean mountains in the south. I have not seen any reports for other continents.

Thelidium incavatum (Nyl.) Mudd (1861)
Both Nylander's and Mudd's publications appeared in 1861, but it is not known which was published first. I have treated Nylander's as the earlier.
Thallus: crustose, immersed. Perithecia: black, 0.35 - 0.4 mm diameter, 80 - 100% immersed in pits in substrate; in section: 600 µm tall, 450 µm wide. Exciple: black everywhere. Involucrellum: absent. Paraphyses: disappearing early. Ascospores: colourless, 3-septate when mature, but long remaining simple or 1-septate, ellipsoid, 35 x 15 µm.
The 3-septate ascospores and perithecia immersed in pits in the substrate are distinctive. However, easily confused with *T. decipiens*, as the full ascospore septation is late to develop.

Scattered on the mainland and Corfu. On calcareous rock at all altitudes, but commonest in the uplands. Three quarters of records are from above 1000 m. Scattered throughout Europe to about the Arctic Circle. Also western Asia (Turkey), perhaps N. America, perhaps S. America, Antarctica (Signy Is), and perhaps elsewhere.

**Thelidium minimum** (A. Massal. ex Nyl.) Arnold (1871)


Descriptions: Clauzade & Roux (1985); Nash et al. (2002).

Mt. Olympus, on calcareous rock at an altitude of 2300 m. Mainly middle latitudes of Europe, reaching southern Scandinavia in the north, and the high Mediterranean mountain sin the south. Also Asia (Israel, Japan), perhaps N. America, C. America (Mexico).

**Thelidium papulare** (Fr.) Arnold (1885)


Thallus: crustose, grey, inconspicuous, very thin in most places, thickening to 0.25 mm near perithecia, where it forms ±hemispherical warts. Prothallus: absent. Cortex: absent or poorly developed. Medulla: white. Perithecia: black, 0.5 - 0.6 mm diameter, 50% immersed in thalline warts; in section: 420 µm tall, 500 µm wide, ±subglobose but top slightly flattened. Exciple: 25 - 50 µm wide, dark brown everywhere. Involucrellum: present, but easily overlooked as it merges with exciple and may appear just as a thickening of exciple in upper part of perithecium. Paraphyses: disappearing early. Periphyses: present. Ascospores: colourless, usually 3-septate when mature, occasionally submuriform (immature ones often appearing simple or 1-septate), ellipsoid, 40 - 47 x 17 - 19 µm, 8 per ascus.

Chemistry: medulla *K*-. Thallus *K*-. Photobiont: green, not trebouxioid; cells globose, 5 - 7 µm diameter, not forming a distinct layer; cells scattered in small clumps in upper part of thallus.

The combination of large, prominent perithecia in prominent thalline warts, with large, 3-septate ascospores is fairly distinctive. Scattered, on the mainland, Corfu and Evia, with no clear pattern. On calcareous rock at altitudes 100 to about 2000 m. Throughout Europe except for the High Arctic. Also Asia (Turkey, Russia), N. Africa (Morocco), N. America (widespread), Australasia (SE Australia, NZS).

**Thelidium pyrenophorum** (Ach.) Massal. (1855)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, in the northern half of Greece, never very far from the sea. On calcareous rock at altitudes 0 - 1000 m. Throughout northern and central Europe; rare south of the Alps. Also Macaronesia, Asia (Russia, Tajikistan, perhaps elsewhere), N. America (widespread), Antarctica (Marion Is, Antarctic Peninsula).

**Thelocarpon** Nyl. (1853)


Literature: The monographed by Salisbury (1966) is still helpful, though now a bit dated. Clauzade & Roux (1985) and Smith et al. (2009) are also useful. For the recently described *T. macchiae* see Nimis & Martellos (2004).

About 24 species, 3 of which are lichenicolous and several of which are lichenised. All are inconspicuous and rarely encountered. There is only a single report for Greece.

11 Paraphyses branched.

22 Thallus with distinct yellow pruina. **T. laureri**

2 Thallus not pruinose.

33 Thallus superficial. (T. robustum)
3 Thallus endolithic. (Thelocarpella gordensis)
1 Paraphyses not branched.
22 Perithecia with yellow pruina. Ascospores simple, ± oblong or ellipsoid-cylindrical.
33 Ascospores about 50 per ascus, 4 - 6 (10) x 2 µm. Lichenicolous. (T. epibulum)
3 Ascospores 12 - 16 per ascus, 9.5 - 12 x 5 - 6.5 µm. Terricolous. (T. macchiae)
2 Perithecia not pruinose. Ascospores at first simple, finally 1-septate, 11 - 17 x 5.5 - 9 µm. On limestone. (T. albidum)

Thelocarpon laureri  (Flot.) Nyl. (1854)
Descriptions: Clauzade & Roux (1985); Salisbury (1966); Smith et al. (2009).
Mt. Olympus, on wood at an altitude of about 1000 m.
Widespread in northern and central Europe; in the south probably confined to the mountains. Also Macaronesia, Asia (Russia), N. America (widespread), S. America (Chile), Australasia (Tasmania).

Thelomma A. Massal. (1860)

Thelomma siliceum  (Fée) Tibell (1976)
Islands of the southern Aegean, on siliceous rock at altitudes 50 - 700 m.
Southern Europe, from Portugal to Greece, plus a few reports for further north in France. Also western Asia (Israel).

Thelopsis Nyl. (1855)

Thelopsis isiaca  Stizenb. (1895)
The combination of perithecial ascomata and Trentepohlia photobiont is unusual in Greece, and this species is unlikely to be confused with any other.
Scattered in the southern half of Greece, never far from the sea, on bark at altitudes 0 - 250 m. Usually on species of Juniperus, but reported once from Quercus macrolepis.

Southern Europe from Portugal to Greece, and Atlantic margin as far north as England. Also Macaronesia, eastern Asia (HK), Africa (widespread outside humid tropics), N. America (California), C. America (Mexico) Australasia (Victoria).

**Thelotrema Ach. (1803)**


Literature: Clauzade & Roux (1985) and Smith et al. (2009) are sensible places to start. Other useful references by European authors are Salisbury (1972a), for members of the *lepadinum* group worldwide, and Bailey & James (1977), who discuss and map the British species and also give some wider distributional information. There is a key to all species in Rivas Plata et al. (2010).

About 118 species of predominantly tropical, corticolous lichens. Only 4 occur in Europe, and most of them are strongly western. Only one, *T. lepadinum*, has a broad range in Europe.

11 Most ascospores more than 50 µm long. **T. lepadinum**

1 Most ascospores less than 50 µm long. (T. suecicum)

**Thelotrema lepadinum** (Ach.) Ach. (1803)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Central Peloponnese, on bark of a deciduous species of *Quercus* (either *Q. pubescens* or *Q. frainetto*) at an altitude of 400 m. Also present in northern Greece (unlocalised) according to Bailey & James (1977).

Widespread in northern and central Europe, though absent from the far north; less common in the south. Also Macaronesia, Asia (widespread), Africa (Rwanda, S. Africa; St Helena), N. America (widespread), C. America (CR, Guatemala, Mexico, Panama), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Kermadec Is).

**Thrombium Wallr. (1831)**


Literature: There is no monograph. For *T. epigaeum*, see Clauzade & Roux (1985) and Smith et al. (2009).

Ten names at species rank are presently referred to *Thrombium* in Europe, but several denote poorly known taxa. According to Nash et al. (2002) the genus has about five species worldwide. It is not very well known.

11 On soil. Ascospores 5 - 10 (12) µm wide. (T. epigaeum)

1 On calcareous rock. Ascospores 8 - 14 µm wide. **T. melaspermizum**

**Thrombium melaspermizum** J. Steiner (1898)


Description: See the protologue.

Only known from the type collection, on limestone from Mt. Giona in Sterea Ellada.

This species does not appear to have been mentioned in the literature since it was described, except for a combination into *Phaeothrombium* by Clements. The description of the paraphyses' 'Paraphyses ... distinctae sed molles' is reasonably consistent with *Thrombium*, though the qualifier 'sed molles' does give cause for doubt. The simple ascospores are also consistent, but they were described as 'mox fuscae', whereas all other species of *Thrombium* known to me have colourless (or, rarely, blue-green) ascospores. The thallus was described as endolithic.

**Thyrea A. Massal. (1856)**

Sched. Crit. 75. Type: *T. plectopsora* A. Massal., the only species originally included. Family: Lichinaceae.

Literature: Moreno & Egea (1992b) is the best starting point. Also helpful are Clauzade & Roux (1985) (but note that the species there called *T. pulvinata* is in fact *T. confusa*), Ahti et al. (2007) and Nash et al. (2002).

*Thyrea* is not well known. About 13 names at species rank are presently referred here, but the number of species is probably fewer. About 6 names refer to European taxa.
11 Thallus squamulose.  (T. plectopsora)
1 Thallus umbilicate foliose,
   22 Lobes narrow, branched, erect.  T. confusa
2 Lobes broad, not branched, adpressed or erect.
   33 Thallus often more than 2 cm diameter.  Surface very uneven.  Lobes adpressed, with downcurved margins.  (T. pachyphylla)
3 Thallus to 2 cm diameter.  Surface smooth or granular, but not very uneven.  Lobes adpressed or erect; margins not downcurved.
   44 Thallus with blue-grey pruina.  Lobes adpressed or erect.  T. girardii
4 Thallus not pruinose.  Lobes erect.  (T. plicatissima)

Thyrea confusa  Henssen  (1990)
in Henssen & Jørgensen, Lichenologist 22(2): 146;  Omphalaria pulvinata auct. graec.; Thyrea pulvinata auct. graec.
Descriptions:  Ahti et al. (2007); Moreno & Egea (1992b); Nash et al. (2002), or see the protologue.
Scattered, with no clear pattern.  On calcareous rock and soil at altitudes 0 - 2300 m.
Widespread in southern and central Europe, reaching southern Scandinavia.  Also Asia (widespread), northern Africa (Egypt, Socotra), N. America (widespread), C. America (Mexico), Australasia (NSW).

Thyrea girardii  (Durieu & Mont.) Körb.  (1865)
Parerga Lichenol. 431; Collema girardii Durieu & Mont. (1846) in Durieu, Expl. Sci. Algérie 199-200.
Description:  Clauzade & Roux (1985).
Known from a single site in Thrace, on limestone at altitude of 50 m.
Southern Europe, from Spain to Greece.  Also Asia (Turkey, Mongolia), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America (USA), Australasia (Queensland, Victoria).

Tomasellia  A. Massal.  (1856)

Literature:  Clauzade & Roux (1985) treat the two species included in the key.
About 17 species of non-lichenised ascomycetes, 4 of which occur in Europe.  They occur in habitats which are often seen by lichenologists, who have sometimes studied the genus as a result.

11 Ascospores 7 - 9 x 3 - 4 µm.  T. arthonioides
1 Ascospores 18 - 27 x 7 - 10 µm.  (T. gelatinosa)

Tomasellia arthonioides  (A. Massal.) A. Massal.  (1856)

The name Melanotheca arthonioides (A. Massal.) Nyl. is a synonym of Melaspilea arthonioides (A. Massal.) Nyl., a poorly known taxon that has not been reliably reported for Greece.  The Greek report under that name may belong here.  The two basionyms involved, Abrothallus arthonioides A. Massal. and Arthopyrenia arthonioides A. Massal., were published simultaneously, so there is scope for confusion.
Description:  Clauzade & Roux (1985).
Scattered, in the northern half of the mainland.  On bark of Fraxinus ornus at altitudes 400 - 1200 m.
Southern and south-central Europe, but absent from truly Mediterranean vegetation.  Also western Asia (Turkey).

Toninia  A. Massal.  (1852)

Thallus: squamulose in most species, less commonly crustose, immersed or absent, without vegetative propagules.  Cortex: present in species with well-developed thallus, K-.  Medulla: present in species with well developed thallus, white, of loosely interwoven hyphae.  Apothecia: always present.  medium sized (0.3 - 2 mm diameter).  Disc: black.

*Toninia* has about 48 species, of which about 23 occur in Europe. It is well represented in Greece. Most species grow on rock or soil, usually on calcareous substrates; a few are parasitic. The genus was not well understood before the publication of Timdal’s monograph, and all early records must be interpreted carefully.

The keys are based on those in Timdal (1991). *T. acarmanica* (Harm.) Zahlbr. is not included in the key, as I have insufficient information.

**Key to *Toninia* main groups:**

11 Epithecium grey, K+ violet (Sedifolia grey pigment). Ascospores 1-septate (in Greek species). Group 1

1 Epithecium green or brown, K- or K+ red. Ascospores (0) 1 - 3 (5) -septate.

22 Not lichenised. Parasitic. Group 2

2 Lichenised. Parasitic or not.

33 Thallus squamulose, dark brown, not pruinose, with punctiform impressions or pores. Epithecium N+ violet (reaction sometimes faint). Ascospores simple or 1-septate. *T. tristis* s. lat. Group 3

3 Thallus of various forms and colours, pruinose or not, without impressions or pores. Epithecium N- or N+ violet. Ascospores (0) 1 - 7 -septate. Group 4

**Key to *Toninia* group 1:** Epithecium grey, K+ violet.

11 Not lichenised. Parasitic on species of Collemataceae. See (*Thalloidima leptogii*)

1 Lichenised. Usually not parasitic.

22 Pseudocyphellae present (Note 1).

33 Hypothecium and inner part of exciple colourless to pale brown. Thallus dark grey-green to dark brown, usually pruinose. Pseudocyphellae small, often irregular. Ascospores 11 - 19 x 3.5 - 5 µm. See *Thalloidima physaroides*

3 Hypothecium and inner part of exciple brown. Thallus olive-brown to red-brown, not or scarcely pruinose. Pseudocyphellae large, punctiform. Ascospores 15 - 25 x 2.5 - 3.5 µm. *T. toepfferi*

2 Pseudocyphellae absent.

333 Thallus entirely covered by dense white pruina. Hypothecium colourless to brown.

44 Pruina farinose (to 0.02 mm; Note 2). Thallus regularly rosette-shaped. On calcareous rock. See *Thalloidima candidum*

4 Pruina granular (often obviously so, 0.03 - 0.07 mm), at least in places (Note 2). Thallus various. On calcareous rock or soil.

55 Hypothecium colourless or pale brown. Subalpine to alpine levels (above tree limit). *T. rosulata*

5 Hypothecium medium brown to dark red-brown in upper part. Not confined to high altitude. *T. diffRACTA*

33 Thallus partly pruinose. Hypothecium brown or red-brown in upper part, colourless to paler brown in lower part (Note 3).

44 Squamules weakly concave to weakly convex, deeply cracked, margin usually densely white pruinose. Upper cortex 70 - 500 µm thick. *T. albilabra*

4 Squamules weakly convex to vertically flattened, smooth or with shallow cracks, margin various. Upper cortex 20 - 90 µm thick. See *Thalloidima*

3 Thallus entirely without pruina. Hypothecium colourless to brown.

44 Hypothecium pale brown to colourless. Ascospores 16 - 24 µm long. *T. taurica*

4 Hypothecium brown to dark red-brown. Ascospores 10 - 17 µm long. See *Thalloidima massatum*

(1) Pseudocyphellae may be scarce and/or inconspicuous. It is advisable to examine many squamules before concluding that they are absent.

(2) Species with granular pruina sometimes have patches of thallus, perhaps eroded, where the granular nature of the pruina is not very apparent. These patches can give the impression of a farinose pruina. It is advisable to examine the whole thallus before concluding that the pruina is not granular. In *T. candida*, diligent search may reveal an occasional grain of pruina that is considerably larger than 0.02 mm, but the pruina is clearly farinose overall.

(3) Some collections also have a thin zone with little pigment immediately below the hymenium.
**Key to Toninia group 2**: epithecium green or brown, K- or K+ red; not lichenised, lichenicolous.

11 Ascospores simple. On various species of crustose lichens. **T. verrucariae**
11 Ascospores 1-septate. On Circinaria calcarea. **T. episema**
   1 Ascospores (3) 5 -septate. On various hosts.
      22 Ascospores 18.5 - 29 μm long. On Pectenia plumbea. **T. plumbina**
      2 Ascospores 9.5 - 16 μm long. On Lecanora and Lecidella. **T. subfuscae**

**Key to Toninia group 3**: Epithecium green or brown, K- or K+ red; thallus lichenised, with punctiform impressions or pores. This is the *Toninia tristis* group.

11 Ascospores simple. Epithecium blue-green or brown.
   22 Squamules scattered to contiguous, not forming cushions. Epithecium blue-green or brown. Usually on soil. **T. tristis** subsp. **pseudotabacina**
   2 Squamules contiguous, often forming cushions. Epithecium blue-green. On rock. **T. tristis** subsp. **thalloideaemiformis**
11 Ascospores mainly 1-septate. Epithecium brown, sometimes with a blue tinge.
   2 Hypothecium and lumina of many paraphyses, asci and spores containing orange (K+ red) and yellow (K-) pigments. **T. tristis** subsp. **asiae-centralis**
   2 Hypothecium and lumina without orange and yellow pigments. (T. tristis subsp. tristis)

**Key to Toninia group 4**: epithecium green or brown, K- or K+ red; thallus lichenised, without punctiform impressions or pores.

11 Thallus pale rose. (T. toniniana)
1 Thallus differently coloured.
   22 Epithecium red-brown, K+ red. See **Bibbya**
   2 Epithecium dull brown to bright or dark green, K-.
      33 Hypothecium and inner part of exciple pale brown to colourless.
         44 Ascospores 3 - 7 -septate, 23 - 41 x 2.5 - 4.5 μm. Margin of squamules same colour as upper surface. **T. squailda**
         4 Ascospores 1 - 3 -septate, 13.5 - 30.5 x 3 - 4.5 μm. Margin of squamules often darker than upper surface. **T. cinereovirens**
   3 Hypothecium and inner part of exciple dark brown.
      44 Thallus mainly immersed. Ascospores 1-septate. On rock. **T. athallina**
      4 Thallus superficial. Ascospores 1 - 7 -septate. On rock or soil.
         55 Thallus crustose, areolate. On rock.
            66 Ascospores 1-septate. **T. philippea**
            6 Ascospores 3-septate. See (Toniniopsis mesoidea)
      5 Thallus subsquamulose to squamulose. On rock or soil. See **Toniniopsis**

**Toninia acarnanica** (Harm.) Zahlbr. (1926)

Description: See the protologue, which unfortunately is inadequate. Timdal was unable to locate the type, and the name is of uncertain application.

Sterea Ellada, near the west coast, on calcareous rock at an altitude of 1100 m. Known only from the type collection.

**Toninia albilabra** (Dufour) H. Olivier (1911)


Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On calcareous rock or soil at altitudes 0 - 700 m.

Commonest in southern Europe, but scattered to as far north as southern Scandinavia. Also Macaronesia, western Asia (widespread to as far east as Oman), N. Africa (Morocco, Algeria, Tunisia, Egypt).
Toninia athallina (Hepp Timdal) (1991)


Thallus: immersed, usually not visible, occasionally superficial and very thin, white. Apothecia: usually sessile, flat to convex, 0.3 - 0.6 mm diameter, usually not pruinose, occasionally with slight white pruina on disc. Disc: black. Thalline margin: absent. Exciple: black, sometimes becoming excluded; in section: 80 - 100 μm wide, dark red-brown to dark purple-brown, sometimes with some blue-black pigment, formed of hyphae on an overall radiating trend. Epitheicum: blue-green, blue-black, green-black; sometimes brown or purple-brown pigment predominating, K-, N+ violet or red-violet. Hymenium: 40 - 60 μm tall, colourless or with epithelial pigment in upper part. Hypothecium: 50 - 120 μm tall, red-brown to purple-brown. Paraphyses: simple or branched, 2 - 3 μm wide at base, 5 - 6 μm at apex, sometimes with visible septa, sometimes capitulate, apical cell with diffuse dark pigment. Asci: 38 x 10 μm, clavate, ±Bacidia type. Ascospores: colourless, ellipsoid, 1-septate (when mature), 9 - 13 x 3 - 6.5 μm, 8 per ascus. Photobiont: green.

Easily separated by its ascospores from other species with endolithic thallus and black, lecideine apothecia. Ciaucadea immersa has simple ascospores. Rinoidea immersa has brown ascospores.

Scattered throughout Greece, but uncommon in the north. On calcareous rock at altitudes 250 m and above.

Widespread in Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (BC, Colorado).

Toninia cinereovirens (Schaer.) A. Massal. (1852)


Thallus: squamulose, to 4 cm diameter, to 0.6 mm thick where squamules overlap. Squamules: brown to dark brown, sometimes almost black at margins, not pruinose, 0.6 - 2 mm wide, slightly concave to convex, sometimes slightly ascending at margins, sometimes overlapping, 0.3 mm thick. Cortex: 75 μm thick (including epinecral layer), mostly colourless (epinecral layer sometimes brownish), of svertical hyphae. Medulla: white. Apothecia: sessile, flat to convex, 0.7 - 1 mm diameter, sometimes with slight white pruina on disc. Disc: black. Thalline margin: absent. Exciple: black, often becoming excluded; in section: 40 - 50 μm wide, colourless in inner part, dark brown in outer part, of hyphae on an overall radiating trend. Epitheicum: blue-black, K-, N+ brown-red to violet. Hymenium: 70 μm tall, colourless or with epithelial pigment in upper part. Hypothecium: 75 μm, colourless. Paraphyses: 1.5 - 2 μm wide at base, 2.5 - 3 μm at apex, slightly capitulate, apical cell with external pigment layer. Ascospores: colourless, 1 - 3 -septate, 21 - 29 (32) x 3 μm, straight, ends ±rounded. Chemistry: medulla K-, C-, KC-, P-, I-; thallus UV-. Photobiont: green, trebouxioid (though many cells of a cyanobacterium are also closely associated with the thallus), cells globose, 6 - 12 μm diameter.

May be difficult to separate from T. squalida when ascospores are in the range of overlap of the two species. However, in T. squalida the squamules are said not to have a dark margin and to be more adpressed.

Scattered, with no clear pattern. At altitudes from sea level to 900 m, but uncommon above 600 m. On calcareous or siliceous rock. There is also a single report from soil on serpentine.

Mainly southern and central Europe, reaching southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (Arizona), C. America (Mexico), S. America (Chile, Peru).

Toninia diffracta (A. Massal.) Zahlbr. (1901)


Thallus: squamulose, 1 - 3 cm diameter, covered everywhere by dense, white, granular pruina soluble in N but not in K. Squamules: sometimes discrete when young, contiguous later, 1.5 - 3.5 mm diameter, adpressed, convex, 800 - 900 μm thick. Cortex: 20 - 30 μm thick, mostly colourless to very pale brown, sometimes grey to brown near surface, basically cellular (though individual hyphae can sometimes be discerned), cells vertically elongated; N-. Medulla: white; in section: of loosely interwoven, broad (2.5 - 4 μm) hyphae, with a few small crystals (to 1 μm). Apothecia: sessile, concave to flat, 0.5 - 1 mm diameter, entirely covered (but not totally obscured) by white pruina. Disc: black. Thalline margin: absent. Exciple: present, prominent, persistent, black, 0.1 - 0.15 mm wide; in section: 100 μm wide, brown to purple-brown, formed of hyphae on an overall radiating trend. Epitheicum: grey to blue-black, K+ violet, N+ violet to red-violet. Hymenium: 70 - 75 μm tall, colourless or almost. Hypothecium: 75 - 125 μm tall, brown to red-brown. Paraphyses: not coherent, 1.5 μm wide at base, often with visible septa, not capitulate. Ascospores: colourless, 1-septate, fusiform with rounded ends, 18 - 20 x 4 - 5 μm. Chemistry: thallus UV+ whiteish (?) reflection. Photobiont: green, cells globose, 8 - 12 μm diameter, forming a continuous, regular layer 40 - 60 μm thick.

Distinguished from Thalloidima candidum by the coarser pruina and the uniformly strongly pigmented exciple. The rather rare T. rosalata differs in having a ±colourless hypothecium.
Scattered in the southern half of Greece, at all altitudes. On soil or bryophytes or overgrowing (perhaps parasitic on) *Placynthium nigrum*. Rarely directly on calcareous rock. The lichenicolous fungus *Stigmidium tabacinae* has been recorded once from this lichen.

Widespread in Europe to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Algeria).

**Toninia episema (Nyl.) Timdal (1991)**


Thallus: absent. Apothecia: subimmersed to sessile on host thallus, flat, 0.2 - 0.35 mm diam, not pruinose. Disc: black. Exciple: black, thin, becoming almost excluded; in section: 50 µm wide, dark red-brown, almost opaque. Epithecium: blue-black, K-, N+ violet. Hymenium: 50 µm tall, colourless. Hypothecium: 120 µm tall, brown to red-brown. Paraphyses: 2 µm wide at base, 5 µm at apex, often capitulate, apical cell pigmented. Asci: 35 - 45 x 12 µm, clavate. Ascospores: colourless, 1-septate, ellipsoid, 12 x 3.5 µm, 8 per ascus.

This species is unlikely to be confused with any other.

Widely distributed in the southern half of Greece, at altitudes 0 - 600 m. Usually parasitic on *Circinaria calcarea* or *C. contorta*, though there is a single 19th century report from *Rinodinella controversa*, and a single report apparently directly on calcareous rock.

Widespread in Europe to as far north as British Is. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia).

**Toninia philippea (Mont.) Timdal (1991)**


Reliably reported for Mt. Olympus, on calcareous rock at altitudes 1700 - 2300 m. A report for Crete, on siliceous rock at 150 m, is doubtful.

Widespread, but generally avoiding maritime climates. Mostly central Europe, but present south of the Alps and scattered reports as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Algeria), N. America (widespread).

**Toninia plumbina (Anzi) Hafellner & Timdal (1991)**


Epiros, on *Pectenia atlantica* and *P. plumbea* at altitudes 630 - 735 m.

Southern Europe, and Atlantic margin to as far north as southern Scandinavia. Also Macaronesia, western Asia (Turkey), perhaps S. America (Chile).

**Toninia rosulata (Anzi) H. Olivier (1911)**


Menalo Mts of Peloponnese, and Mr. Olympus, on soil at altitudes 1700 - 2650 m. The Peloponnesian site appears to be the most southerly one recorded for this species.

Mainly central and northern Europe; in the south confined to high mountains. Also Asia (Turkey, Iran, eastern Siberia).

**Toninia squalida (Ach.) A. Massal. (1852)**


Chios and Crete, on rock (calcareous and non-calcareous) at altitudes 350 - 480 m.

Widespread in Europe. Also Macaronesia, Asia (Turkey, Russia, Nepal), N. Africa (Morocco), N. America (widespread in western half), C. America (Mexico), Australasia (NZS), Pacific (Hawaii).

**Toninia subfuscae (Arnold ex Zwackh) Timdal (1991)**


Reported for Samos in Timdal (1991), but with no further information.
Widespread in Europe to as far north as mid Scandinavia. Also western Asia (Turkey).

**Toninia taurica** (Szatala) Oxner (1968)


- Chios and Crete, on non-calcareous rock at all altitudes.
- Southern and central Europe, with scattered reports to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Algeria).

**Toninia toepfferi** (Stein) Navas (1913)


- Thallus: squamulose, 2 x 1 cm (in only collection seen), dark green when fresh, becoming brown in herbarium, sometimes slightly white pruinose at margins of squamules. Squamules: contiguous or discrete, 0.8 - 1.5 mm wide, convex, sometimes with a network of lines (fissures) at a scale of about 0.1 - 0.2 mm (these are not pseudocyphellae). Pseudocyphellae: infrequent, present on fewer than 1 squamule in 10, circular, 0.1 - 0.2 mm diameter, white or with prominent white margin. Cortex: 35 µm tall, colourless, cellular except for outermost 5 µm which lacks structure; cells 5 - 10 x 2 - 4 µm, long axis vertical. Medulla: white. Apothecia: sessile, rounded to slightly irregular, convex, 0.5 - 1.2 mm diameter, not pruinose. Disc: black, matt. Thalline margin: absent. Exciple: excluded early. Epithecium: grey, K+ violet. Hymenium: 70 µm tall, colourless or with some epithecial pigment in upper half. Hypothecium: dark brown. Ascospores: colourless, 1-septate when mature but long remaining simple, ± fusiform but usually with one ± rounded and one more pointed end, 17 - 25 x 2.5 µm. Chemistry: thallus UV-. Photobiont: green, cells globose, 12 - 15 µm diameter, forming a continuous layer 50 - 80 µm thick, top surface regular, lower surface less so.

- Provided that the (rather infrequent) pseudocyphellae are noticed, this species can not be confused with any other. If the pseudocyphellae are overlooked it could key out as *T. sedifolia* (but that is usually more pruinose and its squamules usually lack fissures) or as *T. massata* (which has shorter ascospores).
- Scattered in the southern half of Greece, never very far from the sea. On soil or siliceous rock at altitudes 80 - 825 m.

- Southern Europe, from Spain to Cyprus. Also Macaronesia, Asia (Turkey, perhaps Kuwait).

**Toninia tristis** (Th. Fr.) Th. Fr. (1874) subsp. tristis

Abbott (2009) listed under this subspecies, by default, all those reports of *Toninia tristis* for which a subspecies was not indicated. However, subsp. *tristis* has never been explicitly reported for Greece, and the map in Timdal (1991) suggests that Greece is outside its expected range.

**Toninia tristis** subsp. asiae-centralis (H. Magn.) Timdal (1991)


- Crete, at an altitude of 900 m. The substrate was not reported.

- Widespread in southern and central Europe, with some rather disjunct reports for Greenland. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread in western half), S. America (Bolivia, Peru).

**Toninia tristis** subsp. pseudotabacina Timdal (1991)


- Thallus: squamulose, dark brown, not pruinose, to 5 cm diameter. Squamules: 0.3 - 2.5 mm diameter, convex, usually discrete, with punctiform impressions, to 0.8 mm tall, sometimes almost hollow, sometimes with black margin. Hypothallus: sometimes present, black. Epicortex: well developed, colourless, structureless, 25 - 30 µm thick, swelling to 40 - 60 µm in K. Cortex: 90 - 120 µm thick, usually pale orange-brown, cellular to rather indistinctly hyphal (when the latter, hyphae broad with distinct lumina), cells/lumina with no strongly preferred orientation. K-. Medulla: white, of loosely interwoven hyphae 3 - 3.5 µm broad, almost without crystals. Apothecia: 0.5 - 2.1 mm diameter, soon becoming convex, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, becoming excluded; in section: red-brown in outer part, sometimes colourless in inner part. Epithecium: blue-black to brown, sometimes with a green tinge, K-, N+ violet. Hymenium: 50 - 100 µm tall, colourless or with some epithelial pigment in upper part. Hypothecium: 45 µm tall, colourless to pale brown. Ascospores: colourless, simple, ellipsoid to pyriform, one end sometimes pigmented, wall distinct, 13 - 16 x 5 - 6 µm. Pycnidia: sometimes present, black, 0.05 mm diameter. Chemistry: medulla K-, C-, KC-, P-, I-; thallus UV-. Photobiont: green, cells globose, 10 - 12 µm diameter. Photobiont layer: 50 - 90 µm thick, continuous,
Thallus crustose.

It contains 8 species, all of which have been reported for Europe. Southern and central Europe. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia).

**Toninia tristis subsp. thalloedaemiformis** (Szatala) Timdal (1991)


Thallus: squamulose, to 5 cm diameter, brown to dark brown, not pruinose. Squamules: 0.7 - 3 mm wide, convex, contiguous, sometimes overlapping, with distinct punctiform impressions 0.03 mm diameter that are often associated with early stages of pycnidia; 400 μm thick (excluding black hypothallus that is visible in section). Epicortex: 30 - 50 μm thick, swelling slightly in K, colourless, structureless, merging rather gradually into underlying cortex. Cortex: colourless to pale orange-brown, usually with distinct branched to anastomosed hyphae with broad elongated lumina, only rarely appearing cellular; hyphae + vertical in upper half, more randomly oriented in lower half; K-. Medulla: white, of loosely interwoven hyphae 3.5 - 4 μm wide, without crystals. Lower cortex: absent, medulla underlain by a layer of loosely interwoven, very dark brown hyphae that are too poorly organised to be called a cortex; it is better termed a hypothallus. Apothecia: sessile, flat to convex, 0.55 - 1.2 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, thin, 0.05 mm, becoming excluded; in section: 75 - 130 μm wide, red-brown to purple-brown, sometimes with some blue-green pigment in inner part, almost opaque, formed of a network of anastomosed hyphae on an overall radiating trend (best observed after mild bleaching in dilute C); K+ purple intensifying, N+ reddish. Epitheicum: blue-green, K-, N+ violet. Hymenium: 45 - 85 μm tall, colourless or with epithelial pigment in upper part. Hypothecium: 75 μm tall, colourless to brown or red-brown. Paraphyses: rather broad, 2 - 2.5 μm at base, 4 - 5 μm at apex, ± clavate to slightly capitate, apical cell with thin crescent of pigment. Ascospores: colourless, simple, ellipsoid to pyriform, ranunculiform or irregular, 10 - 12 x 4.5 - 5 μm, ends rounded. Pycnidia: laminal on squamules, black, 0.12 mm diameter; in section: 150 μm tall, 165 μm wide, colourless to pale brown in lower part, dark brown in upper part. Conidium: colourless, 16 - 22 x 1.5 μm, usually curved. Chemistry: medulla K-, C-, KC-, C+, ± l; thallus UV+. Photobiont: green, cells globose, 10 - 13 μm diameter. Photobiont layer: 60 - 125 μm thick, continuous, with very regular upper surface, lower surface somewhat diffuse and irregular.

Differs from subsp. *pseudotabacina* in its substrate and in having more contiguous squamules.

- Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On calcareous rock at altitudes 0 - 900 m, but rare above 500 m.
- Only southern France, Croatia and Greece.

**Toninia verrucariae** (Nyl) Timdal ex Rambold & Triebel (1992)


Description: Clauzade, Diederich & Roux (1989) as *Lecidea verrucariae*.

Southern Crete, close to sea level. Parasitic on species of *Verrucariaceae* (reported as *Bagliettoa parmiigera* and *Verrucaria* sp.).

Southern Europe, and Atlantic margin to as far north as Ireland. Not reported for other continents.

**Toniniopsis Frey** (1926)


Literature: Most species are discussed in Timdal (1991), under *Toninia*. For the circumscription of the genus see Kistenich et al. (2018).

The genus was defined using molecular data, and its species have rather few characters in common.


*Toniniopsis* is a recent segregate from *Toninia*, also incorporating two species formerly placed in *Bacidia*. It contains 8 species, all of which have been reported for Europe.

11 Thallus crustose.

222 Terricolous or overgrowing bryophytes or plant debris on calcareous substrates. Ascospores 25 - 45 x 2 - 2.5
Trapeliopsis granulosa

1 Thallus squamulose. On rock or soil.
2 Thallus of densely proliferating granules or squamules. Ascospores 3 - 7 -septate.

Toninia aromatica (Sm.) Kistenich, Timdal, Bendiksby & S. Ekman (2018)

**T. bagliettoana**

22 On bark. Ascospores 20 - 36 x 2.5 - 3.5 µm, 3 - 7 -septate, ends usually blunt. **T. subincompta**

2 Thallus of densely proliferating granules or squamules. Ascospores 3 - 7 -septate.

T. aromatica

33 Epithecium dark olive-brown to bright green. Squamules pale grey to dark brown, often with a green tinge, usually with irregular maculae. Epithecium distinctly N+ violet. Free-living or, when young, parasitic on a wide range of lichens (not restricted to lichens with blue-green photobiont). **T. verrucarioides**

2 Thallus of densely proliferating granules or squamules. Ascospores 3 - 7 -septate. **T. cretica**

Toniiopsis aromatica (Sm.) Kistenich, Timdal, Bendiksby & S. Ekman (2018)

**T. bagliettoana**

22 On bark. Ascospores 3 - 7 -septate, ends pointed or blunt. **T. subincompta**

2 On rock, usually maritime. Ascospores 13 - 17.5 x 5 - 6.5 µm, 3-septate, ends rounded or blunt. (T. mesoidea)

1 Thallus squamulose. On rock or soil.
Toniniopsis cretica (Timdal) Timdal (2018)
Description: See the prologue.
Crete, on calcareous rock at altitudes 600 to about 2000 m,
Known only from Crete.

Toniniopsis subincompta sensu (Nyl.) Kistenich et al. (2018)

*Taxon* 67(5): 898.; *Lecidea subincompta* sensu Nyl. (1865), *Flora* 48: 147; *Bacidia affinis* (Stizenb.) Vain.; (?) *Bacidia affinis* var. *incrassata* Vain.; *Bacidia affinis* var. *separabilis* (Nyl.) Vain.; *Bacidia subincompta* sensu (Nyl.) Arnold.

*Lecidea subincompta* Nyl. is a nomen novum for *Biatora atrosanguinea* (Schaer.) Hepp, the epithet *atrosanguinea* being unavailable in *Lecidea*. Unfortunately, Hepp's name is a synonym of *Bacidia incompta*. To preserve current usage of the name *Toniniopsis subincompta* it will be necessary to conserve the name *Lecidea subincompta* Nyl. with a conserved type.

Descriptions: Llop (2007a); Smith et al. (2009), both as *Bacidia subincompta*.
Scattered, with no clear pattern. On bark at altitudes 0 - 1250 m. Reported from *Fagus* and *Platanus*.
Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread).

Toniniopsis verrucarioides (Nyl.) Kistenich, Timdal, Bendiksby & S. Ekman (2018)


Thallus: squamulose, forming small patches to 1.5 cm diameter, orange-brown, sometimes white pruinose. Squamules: adpressed, ± rounded, slightly convex, without maculae (but sometimes with well-defined, long, thin depressions), 0.3 - 1.5 mm diameter, 0.3 mm thick. Epinecral layer: often present, 5 - 15 µm thick, colourless, structureless. Cortex: 45 - 65 µm thick, mostly colourless, sometimes very pale brown in places, formed of anastomosed hyphae with rather broad lumina, sometimes appearing almost cellular. Apothecia: sessile, often convex, 0.3 - 1 mm diameter, not pruinose. Disc: black. Thalline margin: absent. Exciple: black, 0.05 mm wide, becoming almost excluded; in section: 50 - 60 µm wide, red-brown, formed of hyphae with visible lumina, on an overall radiating trend. Epithecium: brown, sometimes slightly red-brown or purple-brown, never green, K-, N-. Hymenium: 70 - 80 µm tall, colourless to pale orange-brown in lower part, upper part sometimes with some epithecial pigment. Hypothecium: about 170 µm tall, not clearly differentiated from a 'root' of darkly pigmented tissue that extends deep into underlying thallus, orange-brown to dark purple-brown. Ascospores: colourless, 1 - 3 -septate, usually ± ellipsoid, sometimes slightly ranunculiform, 12 - 13 x 4 - 4.5 µm. Chemistry: thallus UV-. Photobiont: green, cells 9 - 11 µm diameter, forming a continuous, regular layer 50 - 80 µm thick.

Easily recognised when parasitic on *Placynthium* species. The absence of maculae on the squamules and the N-reaction of the hypothecium distinguish it from *T. aromatica*.

Peloponnese, and perhaps Attica. A 19th century report from near sea level in Attica is doubtful, and may refer to *T. aromatica*, but there is now a recent confirmed collection from the Peloponnese. It was parasitic on *Placynthium nigrum*, at an altitude of 1230 m.

Widespread in northern and central Europe; rare in the south. Also Asia (Turkey, Russia), N. Africa (Morocco, Algeria), N. America (widespread in western half).

**Topelia** P. M. Jørg. & Vězda (1984)


A rather poorly known genus of 10 species, 3 of which occur in Europe.

11 Ascospores 18 - 20 µm long, with perispore. Perithecia black. On rock. **T. heterospora**
1 Ascospores 20 - 30 µm long, without perispore. Perithecia pale, except near ostiole. On bark or rock.
22 Thallus pink or reddish. Perithecia not completely immersed, pink to brown-yellow. Hypothecium and hymenium with few or no oil droplets. On rock. **T. rosea**
2 Thallus dark green. Perithecia completely immersed, appearing green owing to photobiont. Hypothecium and lower part of hymenium with many oil droplets. On bark. (T. nimisiana)
Topelia heterospora (Zahlbr.) P. M. Jørg. & Vězda (1984)
Islands of the southern Aegean, including Crete. On calcareous rock at altitudes 5 - 300 m.
Only southern Europe, from Portugal to Cyprus.

Topelia rosea (Servit) P. M. Jørg. & Vězda (1984)
Amorgos and Corfu, on calcareous rock at altitudes 0 - 600 m.
Mainly southern Europe and the Atlantic margin to as far north as Norway. Also Macaronesia, western Asia (Israel), Australasia (Lord Howe Is, NZS).

Tornabea Østh. (1980)
Literature: Nimis & Tretiach (1997) is a brief monograph, but the single species is treated in all the standard Floras.

Tornabea scutellifera (With.) J. R. Laundon (1984)
Descriptions: Clauzade & Roux (1985) as *Tornabea atlantica*; Nash et al. (2002); Smith et al. (2009).
Islands of the southern Aegean, including Crete, at altitudes 200 - 900 m. Reported from bark of *Juniperus* and *Pinus brutia*, and from siliceous rock.
Southern Europe, and Atlantic margin to as far north as British Isles. Also Macaronesia, Asia (widespread as far east as Afghanistan), Africa (widespread in northern half), N. America (California), C. America (Mexico) S. America (Chile, Peru).

Trapelia M. Choisy (1929)
Literature: Smith et al. (2009) treat all the species that are likely to occur in Greece. Orange (2018) clarifies the status of some species.
*Trapelia* contains 24 species, 9 of which occur in Europe. The genus is not common in Greece.
Because *Trapelia* and *Trapeliopsis* are closely related, this key covers both genera (with abbreviation "T." for *Trapelia*). All species treated here have at least some part that is C+ red.

11 Thallus distinctly squamulose. *Trapeliopsis wallrothii*
1 Thallus crustose; some species with a ± lobed margin.
22 Thallus with irregular orange-red patches that are K+ purple. (*Trapeliopsis pseudogranulosa*)
2 Thallus without orange-red patches, everywhere K-.
333 Thallus areolate; areoles not granular.
44 Soredia present.
  55 On bark or mosses over bark. (T. corticola)
  5 On siliceous rock or on plant debris. (T. obtegens) Greek report doubtful.
4 Soredia absent.
  55 Areoles not overlapping. Thallus thinning to margin. Margin not lobed, areoles indistinct there. *T. coarctata*
  5 Areoles sometimes overlapping, ± convex. Thallus with ± abrupt margin. Margin slightly lobed, areoles distinct there. (T. glebulosa), (T. involuta)
33 Thallus of granular areoles.
44 Soralia grey-green to dark green. Ascospores 7 - 9.5 x 2.4 - 4 μm. *Trapeliopsis flexuosa*
4 Soralia white to brown-yellow, sometimes with a grey-green tinge. Ascospores 9 - 14 x 4 - 6 μm. *Trapeliopsis granulosa*
3 Thallus entirely granular. (*Trapeliopsis viridescens*)
Trapelia coarctata (Sm.) M. Choisy (1932)


The combination of rather pale apothecia, and a C+ red thallus formed of scattered areoles is fairly distinctive and this species is unlikely to be confused with any other.

Scattered in the southern half of Greece, never very far from the sea. On siliceous rock or siliceous soil at altitudes 30 - 600 m.

Throughout Europe, but uncommon in areas with Mediterranean climate. Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (widespread outside tropics), N. America (widespread), Caribbean (PR), C. America (CR, Guatemala, Mexico), S. America (widespread) Australasia (widespread), Pacific (Hawaii), Antarctica (subantarctic islands).


Literature: Clauzade & Roux (1985) treat all the European species. Smith et al. (2009) treat all those that are likely to occur in Greece.

About 20 species, of which 10 are known from Europe. They prefer moist, acidic substrates, so are uncommon in regions with a Mediterranean climate, and the genus is rare in Greece.

Trapeliopsis has not been satisfactorily delimited from Trapelia, and may prove to be synonymous. For the key to species, see under Trapelia.

Trapeliopsis flexuosa (Fr.) Coppins & P. James (1984)
Lichenologist 16(3): 258; Biatora flexuosa Fr. (1826), Nov. Sched. Crit. page 11, no. 221; Lecidea sapinea (Fr.) Zahlbr.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009). Scattered in northern Greece, on bark or wood at altitudes 250 - 1200 m. Reported phorophytes include Castanea and Olea.

Throughout northern and central Europe, but uncommon in the south. Also Macaronesia, Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread), C. America (CR, Mexico), S. America (Bolivia, Brazil), Australasia (widespread), Pacific (Hawaii). Some reports may be unreliable, owing to confusion with other species.

Trapeliopsis granulosa (Hoffm.) Lumbsch (1983)
in Hertel, Lecideaceae Exsiccatea. Fasc. 5, no. 99; Verrucaria granulosa Hoffm. (1791), Descr. Pl. Cl. crypt. 2(1): 21; Bacidia muscorum (F. H. Wigg.) Mudd; Lecanora granulosa (Hoffm.) Ach.; Lecidea decolorans (Hoffm.) Flörke; Lecidea granulosa (Hoffm.) Ach.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009). Scattered, with no clear pattern, on bark and bryophytes, at altitudes 300 m and above. Reports from calcareous rock seem doubtful to me.

Most of Europe, but uncommon in the south. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, S. Africa, Madagascar), N. America (widespread), Caribbean (PR), C. America (CR), S. America (widespread), Australasia (widespread), Antarctica (Antarctic Peninsula).

Trapeliopsis wallrothii (Flörke ex Spreng.) Hertel & Gotth. Schneid. (1980)

Sprengel ascribed the name Lecidea wallrothii to “Flörke, ms.” but did not ascribe the description to Flörke. Aptroot & Schumm (2012a) claimed that Flörke wrote the description, and that the name should therefore be cited with Flörke alone as author, but that is reading into the protologue more than is actually there.

Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).
Islands of the Aegean. On rock and soil at altitudes 150 - 1070 m. Throughout Europe, but uncommon in the south. Also Macaronesia, Asia (Siberia, HK), perhaps S. America (Brazil). Reports for N. America probably refer to *T. californica*.

**Tremella Pers. (1794)**


Literature: Lichenicolous species are monographed in Diederich (1996). About 250 species of basidiomycetes, none lichenised. About 60 lichenicolous species have been formally described; at present it is unclear whether they should be segregated into a different genus. About 27 of the lichenicolous species have been reported for Europe, where work on the genus has been most intense. There are few reports for Greece, but these fungi were generally overlooked until the appearance of the monograph by Diederich. At least some of the lichenicolous taxa may prove to be widespread and common.

It is inadvisable to attempt to determine these fungi without studying Diederich (1996), which includes many helpful diagrams as well as descriptions. The key here is a simplified version of Diederich’s key, with the addition of a few recently described species. Species reported only from outside Europe are not normally included, but the distribution of these fungi is very poorly known and some of them might in fact be present in Europe. In case of difficulty, consult Diederich’s key.

11 Basidia growing on or in ascomata of host, causing galls or not.

22 Basidia eventually causing galls. On *Lecanora chlarotera*. Mature basidia 2 - 4 -celled, with transverse, oblique or longitudinal septa. *(T. macrobasidiata)*

2 Basidia not causing galls. On other hosts. Septa various.

33 Basidia with longitudinal septa.

44 Basidia 2 -celled (i.e. with one longitudinal septum). On *Physcia. T. christiansenii* 4 Basidia 2 - 4 -celled. On other hosts. *(T. pertusariae)*

3 Basidia usually with one transverse septum, rarely also with one longitudinal septum.

44 Basidia 29 - 39 μm long. On *Protoparmelia*. *(T. protoparmeliae)*

4 Basidia not exceeding 26 μm long. On other hosts.

55 On crustose *Teloschistaceae*. *(T. caloplacae)*

5 On *Rinodina*. *(T. rinodinae)*

1 Basidia growing on thallus of the host, often causing galls.

22 Basidiospores ±lemon-shaped, 6.5 - 8 x 4 - 4.5 μm. On *Cetraria* and related genera. *(T. cetrariicola)*

2 Basidiospores subspherical to ellipsoid. On various hosts.

33 Basidia (1) 2 -celled.

44 Basidia mainly with transverse septa. *(T. cladoniae), (T. hypogymniae), (T. lobariacearum), (T. phaeographidis), (T. phaeophysciae)*

4 Basidia mainly with longitudinal septa.

55 Mature basidial cells not much longer than septum. *(T. hypogymniae), (T. lichenicolica), (T. lobariacearum), (T. macroceratis), (T. normandinae), (T. phaeographidis)*

5 Mature basidial cells elongate, much longer than septum.


3 Basidia 2 - 4 -celled.

44 Basidia 3 - 4 -celled, with at least one transverse septum and one longitudinal septum. On *Ramalina*. *(T. ramalinae)*

4 Basidia with longitudinal septa; rarely with oblique or transverse septa, but never with 1 - 2 transverse and 1 longitudinal septa. On various hosts. *(T. candelariellae), (T. coppinsii), (T. lichenicolica), (T. parmeliarum), (T. pertusariae), (T. wirthii)*


Description: Diederich (1996) as *Tremella* sp. 1.

Eastern Crete, on *Caloplaca aurantia* at altitudes around 800 m.

Probably widespread in Europe; there are reports from Greenland to Greece. Also western Asia (Turkey), N. Africa
(Algeria), N. America (BC).

**Tremella christiansenii** Diederich (1996)
Description: See the protologue.
Epiros, on *Physcia leptalea* at an altitude of 1200 m.
In Europe, only Denmark, Austria and Greece. Also Asia (Wrangel Is in arctic Russia), N. America (Saskatchewan).

**Tremella ramalinae** Diederich (1996)
Description: See the protologue, or Nash et al. (2004).
Epiros, on *Ramalina fraxinea* at an altitude of 830 m.
Probably widespread in Europe. Also Macaronesia, Asia (Iran), N. America (California), C. America (Mexico), Australasia (NZS).

**Tremolecia** M. Choisy (1953)

Literature: The single species is discussed in all the standard Floras.

**Tremolecia atrata** (Ach.) Hertel (1977)
The nomenclatural situation needs to be investigated, as the correct name appears to be *T. dicksonii.*
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Chios, on metal-rich siliceous rock at an altitude of 670 m.
Throughout cold and temperate Europe; rare in the south. Also Macaronesia, Asia (widespread), Africa (Morocco, Tanzania), N. America (widespread), S America (Argentina, Bolivia, Chile, Venezuela), Australasia (widespread), Antarctica (widespread).

**Tuckermannopsis** Gyeln. (1933)

Literature: The only species that is likely to occur in Greece is discussed in all the standard Floras.

**Tuckermannopsis chlorophylla** (Willd.) Hale (1987)
in Egan, *Bryologist* 90: 164; *Lichen chlorophyllus* Willd. (1793) in Humboldt, Fl. Friberg. 20; *Cetraria chlorophylla* (Willd.) Vain.
Descriptions: Clauzade & Roux (1985) as *Cetraria chlorophylla*; Nash et al. (2004); Smith et al. (2009); Thell & Moberg (2011).
Very scattered, with no clear pattern. On bark, often of conifers, at altitudes 1100 - 1450 m.
Throughout Europe, but in the south restricted to the uplands. Also Macaronesia, Asia (widespread), Africa (S. Africa), N. America (widespread), C. America (Mexico), southern S. America (Argentina, Chile, Falkland Is), Australasia (Tasmania, NZN), Antarctica (Antarctic Peninsula).

**Umbilicaria** Hoffm. (1789)
*Descr. Pl. Cl. Crypt.* vol. 1, part 1, fasc. 1: 8. The name is conserved against *Omphalodes* Mill. (1754) and *Umbilicaria* Heist. ex Fabr. (1759). Type: *U. hyperborea* (Ach.) Hoffm. The type is conserved. Family: *Umbilicariaceae.*

Literature: Clauzade & Roux (1985) treat all the widespread European species, which includes all those likely to occur in Greece. There are better descriptions of some of them in Smith et al. (2009) and Nash et al. (2004).
About 92 species, 42 of which have been reported for Europe. Most occur on hard, siliceous rock in regions with a cool or cold climate, so the genus is well represented in northern Europe, but fewer species are present in the south. The
genus is uncommon in Greece, although 8 species are reliably reported.

1111 Isidia present. **U. deusta**
111 Isidia absent. Soralia present.
   22 Rhizines frequent. (U. hirsuta)
   2 Rhizines absent or very few. **U. grisea**
11 Isidia and soralia absent. Microscopic vegetative propagules (thalloconidia) present on lower surface of lobes or on rhizines.
   22 Rhizines frequent.
      33 Lower surface very dark brown. Thallus usually of several lobes. (U. polyrrhizos)
      3 Lower surface grey or brown-grey. Thallus a single lobe. **U. vellea**
   2 Rhizines absent.
      33 Upper surface with network of veins, except near margin. **U. nylanderiana**
      3 Upper surface without veins.
         44 Upper surface brown, at least in outer part.
            55 Upper surface dull. Thallus a single lobe or multi-lobed. Central part of thallus, over the umbo, raised and white areolate. (U. subpolyphylla)
            5 Upper surface shiny. Thallus multi-lobed. Central part of thallus not raised, not white areolate. **U. polyphylla**
   4 Upper surface grey in outer part, generally white in centre. **U. subglabra**
1 Vegetative propagules absent.
   22 Lobes with marginal cilia. **U. cylindrica**
   2 Marginal cilia absent.
      33 Thallus usually less than 2 cm diameter. Lower surface yellowish. (U. corsicae)
      3 Thallus usually more than 2 cm diameter. Lower surface pale grey, pink-grey, grey-brown or black.
         44 Lower surface grey-brown to black, coarsely warded-areolate. **U. spadochroa**
         4 Lower surface pale-grey, often with a pink tinge, smooth or slightly warded-areolate. **U. crustulosa** s. lat. Two subspecies are sometimes distinguished.
            55 Apothecia abundant. Pycnidia scarce or absent. **U. crustulosa subsp. crustulosa**
            5 Apothecia very few or poorly developed. Pycnidia abundant. (U. crustulosa subsp. punctata)

**Umbilicaria crustulosa** (Ach.) Lamy (1880)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, from Crete to northern Greece, with no clear pattern. On rock, usually siliceous, at altitudes 400 - 2050 m. Greek reports are presumed to refer to subsp. *crustulosa*. Subsp. *punctata* (which may not merit formal recognition) has never been reported for Greece.

Widespread in northern and central Europe; uncommon south of the Alps. According to Nimis (1993), southern populations may represent a distinct taxon. Also Macaronesia, Asia (widespread), perhaps N. America.

**Umbilicaria cylindrica** (L.) Delise (1830)
In Duby, Bot. Gall. 2: 595; *Lichen cylindricus* L. (1753), Sp. Pl. 1144-1145. The name has a conserved type; *Gyrophora cylindrica* (L.) Ach.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered in northern Greece. On siliceous rock at altitudes 1070 - 2500 m.

Widespread in Europe, but south of the Alps restricted to the uplands. Also Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), Australasia (SE Australia, NZN, NZS). Reports for S. America and Antarctica may be incorrect.

**Umbilicaria deusta** (L.) Baumg. (1790).
*Fl. Lips.* 571; *Lichen deustus* L. (1753), Sp. Pl. 1150. The name has a conserved type.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered in northern Greece, on siliceous rock at altitudes 1100 - 1800 m.

Most of Europe, but in the south uncommon and confined to the uplands. Also Asia (widespread), N. America (widespread), Australasia (NZS).
Umbilicaria grisea Hoffm. (1796)
Deutschl. Fl. 2: 111; Gyrophora hirsuta var. grisea (Hoffm.) Th. Fr.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered in northern Greece. On siliceous rock in the uplands.
Widespread in Europe, though commonest in the west. Also Macaronesia, Asia (Turkey, Kazakhstan, southern Siberia, Mongolia), N. Africa (Morocco), Australasia (NZS). Reports for N. and S. America are incorrect.

Umbilicaria nylanderiana (Zahlbr.) H. Magn. (1937)
The correct name appears to be U. reticulata Bagl. & Car. (1867).
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Known from a single locality in Macedonia, where it occurred on granite rock at an altitude of 1600 m.
Widespread in northern and central Europe; in the south confined to high mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (Quebec, Arizona, Washington), S. America (Andes and cold regions), Australasia (SE Australia, NZ, NZS), Antarctica (Antarctic Peninsula and nearby islands).

Umbilicaria polyphylla (L.) Baumg. (1790)
Fl. Lips. 571; Lichen polyphyllus L. (1753), Sp. Pl. 1150; Gyrophora polyphylla (L.) Funck.
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Samothraki and northern Macedonia, on siliceous rock at altitudes 1070 to about 1800 m.
Widespread in Europe, but in the south confined to the mountains. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, S. Africa), N. America (widespread), S. America (widespread), Australasia (widespread), Antarctica (S. Georgia).

Umbilicaria spadochroa (Hoffm.) DC. (1805)
The epithet is not spodochroa.
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Lesvos and Naxos, on granite at altitudes around 1000 m. Not accepted by Abbott (2009), but a recent reliable report for Lesvos confirms its presence in Greece.
Throughout Europe as far south as the Alps and Pyrenees, but very rare in Mediterranean regions. Also Macaronesia, Asia (Turkey, Russia, Mongolia, China), North Africa (Morocco). Reports for N. and S. America are probably incorrect.

Umbilicaria subglabra (Nyl.) Harm. (1909)
Western Crete, on siliceous rock at an altitude of about 800 m.
Widespread in central Europe, but almost absent from northern and NW Europe, and very rare south of the Alps. Also Asia (widespread), Africa (Kenya, Tanzania, S. Africa), N. America (Arizona), Australasia (SE Australia, NZS).

Umbilicaria vellea (L.) Michx (1803)
Umbilicaria vellea Hoffm. (1791) is not a combination from Lichen velleus L., as Hoffmann included that name with "?". The existence of Hoffmann's name makes Michaux's name a later homonym. Unless Hoffmann's name can be typified in a way that is consistent with current usage of the name Umbilicaria vellea, conservation will be required.
Samothraki, on siliceous rock. The report was accepted by Abbott (2009), but confirmation is desirable since, according to Nimis (1993), older authors sometimes confused this species with U. spadochroa. Sipman (2014) suggested that the report may refer to Umbilicaria crustulosav var. badiofusca.
Widespread in Europe, but in the south confined to the uplands. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Uganda), N. America (widespread), S. America (at least Bolivia), Australasia (NZN, NZS).
Unguiculariopsis Rehm (1909)

Annls Mycol. 7(5): 400. Type: U. ilicincola (Berk. & Broome) Rehm. Family: Cordieritidaceae.

Literature: There is no monograph, and information is scattered. Diederich & Etayo (2000), and Hawksworth, Atienza & Coppins (2010) are helpful starting points.

About 30 species, of which about 15 are lichenicolous. Seven lichenicolous species have been reported for Europe. There are few Greek records.

11 Ascospores 5 - 7.5 x 1.8 - 2.2 µm. On Lecanora saligna. (U. lesdainii)
1 Ascospores more then 2.2. µm wide. On other hosts.
22 Marginal hairs absent. On crustose Teloschistaceae. (U. groenlandiae)
2 Marginal hairs present. On other hosts
33 Marginal hairs distinctly curved, with hooked apices, 10 - 25 µm long. On Evernia prunastri. U. lettaui
3 Marginal hairs straight, slightly curved, or wavy, more than 25 µm long.
44 Semi-mature ascis thickened at apex. On Acrocordia gemmata. (U. acrocoridiae)
4 Semi-mature ascis not thickened at apex. On other hosts.
55 Marginal hairs solid and refractive in upper part, 18 - 57 x 3.5 - 4.5 µm. On Bilimbia. (U. refractica)
5 Marginal hairs not solid or refractive. On other hosts.
66 Marginal hairs 15 - 35 x 2.3 - 3.5 µm. Ascospores 7 - 9 x 2.5 - 3.5 µm. On thallus of Lecanora (especially L. chlorotera and L. carpinea). U. thallophila
6 Marginal hairs 15 - 70 x 1.5 - 3 µm. Ascospores 4 - 5.5 x 2 - 2.5 µm. On lower surface of Lobaria scrobiculata. (U. manriquei)

Unguiculariopsis lettaui (Grummann) Coppins (1990)


Epiros, on Evernia prunastri at an altitude of 750 m.

Southern Europe, and western Europe to as far north as southern Scandinavia. Also Macaronesia, western Asia (Turkey), N. America (California, Oregon).

Unguiculariopsis thallophila (P. Karst.) W. Y. Zhuang (1988)

Descriptions: Clauzade, Diederich & Roux (1989); Hawksworth, Atienza & Coppins (2010).

Epiros, on undetermined species of Lecanora at altitudes 750 - 830 m.

Probably throughout Europe. Also Macaronesia, Asia (Wrangel Is in Russian arctic), N. America (California, Utah).

Usnea Dill. ex Adans. (1763)

Fam. Pl. 2: 7. The name is unusual for lichen genera, as it is very old but is not from the classical languages. It reached Europe in the late 15th century, via Arabic, but probably originated elsewhere, perhaps in Persian. Type: U. florida (L.) F. H. Wigg., designated by Clements & Shear, Gen. Fung. 322. 1931. Family: Parmeliaceae.

Literature: There has been much taxonomic confusion within this genus. Most publications dating from before the 21st century are best ignored; their use will lead only to frustration and incorrect determinations. There are good keys to European species in Randlane et al. (2009) and Roux (2007). The former includes helpful photographs and distribution maps. There are good descriptions of many of the species in Smith et al. (2009) and in those publications cited for that purpose by Randlane et al. (2009). Also helpful for some species, if used with care, are: Clerc (1997, 2006), Fos & Clerc (2000), James (2003), McCarthy & Mallett (2004), Swinscow & Krog (1979), and Swinscow & Krog (1988). Sipman (2012) is relevant to some of the Greek species.

Thallus: fruticose, usually green, erect or pendent, to more than 25 cm long in some pendent species, branches round in cross-section. Branches: always with a central axis of densely agglutinated hyphae that is distinct from the medulla; it provides mechanical strength and is easily seen if a branch is stretched and broken. Soralia and/or isidia present in some species. Apothecia: uncommon in most species, resembling those of Parmelia but generally flatter, thalline margin often ornamented with fibrils. Photobiont: green.

All species of Usnea share this easily recognised pattern, but there is great variability otherwise. The limits of many species have proved difficult to define, because species are often variable, and the best characters for separating
species are often different from those used in other genera. These unavoidable difficulties have been compounded by earlier workers, especially Motyka, who described large numbers of species, most of which can not be maintained.

Usnea has several hundred species, best developed in tropical regions. They are usually, but not always epiphytic. About 40 species occur in Europe, but the precise number is uncertain owing to taxonomic difficulties. In Greece the genus is quite common in the montane forests. Many species have been reported, but the number truly present is rather uncertain.

Although many species have been reported for the Greece, all determinations made before about 1995 must be regarded as possibly erroneous. Note also that although the synonymies indicated below are believed to be correct, names have probably often been misapplied.

The global distribution depends heavily on synonymy, some of which is uncertain. In some cases, it also depends heavily on old reports, many of which may be unreliable. The global distributions given below should be interpreted with caution.

My own repeated attempts to construct a key to this genus have never yielded satisfactory results, and I have been left with no option but to incorporate the work of specialists as summarised in the key in Randlane et al. (2009). The key here is based on theirs.

Species of Usnea are difficult to determine. If you are unfamiliar with this genus, note the following before starting to determine material, and also pay attention to the notes within the key.

Medullary substances are generally also present in the axis, and for spot tests it is easiest to test the axis. It may be necessary to measure the sizes of the cortex, medulla and axis, or to note the compactness of the medulla. These observations should be made on a transverse section of a branch mounted in water, not in K, as K distorts the structures greatly. If sections are cut freehand with a razor blade from un-embedded material, as is usual for routine examination, some distortion can occur in sectioning. If the axis does not appear to consist entirely of the ends of hyphae oriented parallel to the branch axis, i.e. if some axis hyphae appear to be extended across the plane of the section, then it has been distorted. If the distortion appears to be significant, try again with a fresh blade.

Juvenile material of species that are pendent when mature may be difficult to interpret. Recording which direction is 'up' when it is collected may help with determination later.

In the southern part of mainland Greece, only two species are common. Material with abundant, prominent, excavate soralia is likely to be U. perplexans. Distinctly pendent thalli without soralia, or with punctiform soralia, are likely to be U. barbata.

11 With many apothecia. Isidia and soralia absent.

22 Thallus ±pendent. Disc KC-, P-. Ascospores 7 - 8.5 µm long. U. intermedia

2 Thallus shrubby. Disc KC+ red P+ yellow. Ascospores 8.5 - 11 µm long. U. florida

1 Usually without apothecia, or with just a few apothecia. Isidia or soralia often present.

222 Cortex with orange-red pigment, giving much of thallus a distinctly orange-red tinge. (Occasionally pigment restricted to basal part of main branches.) Note 1. Medulla K+ yellow or red, P+ orange. U. rubicunda

2 Cortex without pigment (Note 1), but yellow, pink, orange or red pigment present in at least parts of medulla or central axis. Thallus green to grey.

33 Medulla ±uniformly pigmented.

44 Medulla and central axis pink, C+ yellow. Soralia at top of raised tubercles. U. ceratina

4 Medulla red, C-. Soralia flat or only slightly tuberculate. (U. mutabilis)

3 Medulla not uniformly pigmented

44 Outer part of medulla white, inner part pale yellow to yellow. Medulla loose. U. flavocardia

4 Orange or pink-red pigment confined to thin medullary layer below cortex. (U. subcornuta)

2 Cortex and medulla without pigment. Medulla and central axis appearing entirely white. Thallus green to grey.

33 Thallus distinctly pendent, several times longer than wide. Main branches ±parallel. Note 2.

444 Older parts of thallus forming inflated, sausage-like segments. U. articulata

44 Branches (including younger branches) divided almost everywhere into rounded segments by annular cracks. (U. chaetophora) Note 3.

4 Branches not divided into sausage-like segments, not regularly segmented everywhere by annular cracks. (Annular cracks may be regularly present in some older branches, and a few may be present irregularly in other parts of thallus.)

55 Branches uneven in thickness, often with foveoles or ridges. Note 4. Medulla loose (especially in inner part; individual hyphae may span most of distance between axis and photobiont layer without branching or touching other hyphae).

66 Branches with many foveoles and ridges. Fibrils absent or few. Papillae, soralia and isidia absent.

Medulla with salazinic acid (K+ red, P+ yellow or orange) (Note 5). (U. cavernosa) Greek report doubtful.
6 Branches with few to many foveoles and ridges. Fibrils few to numerous. Papillae absent to abundant. Soralia few to abundant. Isidia sometimes present. Medulla with or without salazinic acid (K+, P+, or K-, P-). Medulla very loose, especially in inner part; single hyphae often extend, straight and without branching, from axis almost to photobiont layer. **U. barbata**

5 Branches even in thickness, tapering gradually towards apices, without foveoles or ridges. Medulla usually compact (sometimes loose in **U. perplexans**).

66 Base blackened (Note 6). Medulla K+ yellow > orange (no crystals).

777 Soralia abundant, distinctly excavate when mature. Isidia absent. Both cortex and medulla thick. **U. perplexans**

77 Soralia transversely elliptical to irregularly rounded. Isidia present only on young soralia. Cortex thick, medulla very thin. (U. silesiaca)

7 Soralia sometimes present, usually remaining punctiform. Isidia often present. Both cortex and medulla thick. **U. dasopoga**

6 Base green or brown, but not blackened (Note 6). Medulla K- or rather weakly K+ yellow-brown.

77 Cortex matt. Papillae absent. (U. schadenbergiana)

7 Cortex shiny. Papillae absent to abundant. **U. subscabrosa**

3 Thallus ± shrubby, about as wide as long. Branches erect at base (apices may be pendent). Main branches parallel or not. **Note 2.**

44 Papillae absent. **Note 7.**

555 Isidia absent. Medulla very loose, K- or slightly K+ brownish. Secondary branches constricted at attachment point. **U. glabrata**

55 Isidia present only on soralia. Soralia punctiform to (especially on terminal branches) enlarged. Medulla compact, K+ yellow, orange or red.

66 Base without distinct annular cracks. Norstictic acid (K+ red, with crystals) present. **U. cornuta**

6 Base often with distinct annular cracks. Stictic acid (K+ yellow or orange, without crystals) present. **U. flammea**

5 Isidia present all along branches. Soralia punctiform. Medulla loose, K-. (Note 4) **U. hirta**

4 Papillae present on at least some branches.

55 Secondary branches distinctly constricted at base. Medulla loose.

66 Isidia absent. **U. esperantiana**

6 Isidia present. **U. cornuta**

5 Secondary branches not or only slightly constricted at base. Medulla loose or compact.

666 Isidia usually abundant on mature soralia.

77 Branches of uneven thickness, irregularly swollen, apical parts often sinuous. Soralia punctiform, usually not expanding, with ± tall isidia. (U. diplotypa)

7 Branches of even thickness, tapering gradually towards apices, apical parts regular. Soralia very small to expanded, with small isidia.

88 Base green or brown, often with distinct annular cracks. **U. flammea**

8 Base black, without annular cracks (though some transverse fissures may be present).

99 Norstictic acid (K+ red, with crystals) present. Soralia developing from base of eroded fibrils without a cortical rim; later coalescing, usually flat, sometimes developing isidia. **U. praetervisa**

9 Norstictic acid absent. Lichen substances reacting K-, K+ yellow or K+ orange, but without crystals. Soralia developing on cortex, initially delimited by raised cortical rim; later enlarging, becoming convex, frequently developing isidia. **U. subfloridana**

66 Isidia present on young soralia but usually not on mature soralia (as they are easily removed by abrasion).

77 Thickness of cortex 9 - 17 % of branch diameter. Thickness of medulla 6 - 14 % of branch diameter.

88 Base blackened. Fibrils present. Salazinic acid (K+ yellow > orange) present. (U. silesiaca)

8 Base pale green or brown, not blackened. Fibrils absent or few. Protocetraric acid (K- or K+ slightly yellow-brown) present. **U. subscabrosa**

7 Cortex thinner, medulla much thicker.

88 Branching mostly anisotomic. Branches of uneven thickness, sometimes with foveoles or depressions. Soralia often tuberculate.


9 Thallus shrubby to subpendent, apical parts often sinuose. Mature soralia punctiform. Soredia farinose. (U. diplotypa)

8 Branching mostly isotomic. Branches even, without foveoles. Soralia flat or slightly concave.
99 Soralia oblong-cylindrical. Chemistry various but without norstictic acid. Probably restricted to sites with maritime climate. **U. wasmuthii**

9 Soralia punctiform when young, later becoming rounded. Chemistry various, but norstictic acid usually present. Not restricted to sites with maritime climate. (U. glabrescens) Greek reports need confirmation.

6 Isidia entirely absent.

77 Soralia punctiform when young, later becoming rounded, remaining rounded and discrete. Fibrils absent or few. (U. glabrescens) Greek reports need confirmation.

7 Soralia becoming confluent and expanded. Fibrils often abundant.

88 Apical parts of branches very twisted. Soralia especially crowded at terminal parts of branches.

Soralia not concave. **U. esperantiana**

8 Apical parts of branches not strongly twisted. Soralia crowded or not, deeply concave when mature, and often surrounding the terminal branches.

99 Norstictic acid absent. Branches sometimes with foveoles and depressions. **U. perplexans**

9 Norstictic acid usually present Branches without foveoles and depressions. **U. fulvoreagens**

(1) In a thin section, the cortex in most species has a slight orange-brown tinge, at least in outer part. This is not the pigment referred to in the key.

(2) There is no sharp boundary between pendent and shrubby species, and some collections are ambiguous. Occasionally it will be necessary to try both branches of the couplet.

(3) U. chaetophora has a denser medulla than U. barbata, which may help with ambiguous specimens.

(4) In U. barbata, large parts of some branches may be quite regular, and entirely without ridges or foveoles. To avoid confusing this species with U. dasopoga it is advisable to examine many branches before reaching a decision. The two species also differ in the density of the medulla.

(5) Other chemotypes are known but are very rare and/or not expected to occur in southern Europe.

(6) A base that is clearly blackened is definitive. However, the blackening may occur only over a small distance from the base, sometimes less than 0.5 mm, and occasionally it is scarcely apparent at all. Also, the base may merge into the bark so that it is not obvious where the thallus ends and the (usually dark coloured) bark begins. Material that appears to lack blackening should be examined carefully, to see whether any trace can be detected.

(7) Eroded fibrils may resemble papillae, but are ecorcitate at their apex.

In the descriptions, thicknesses stated for cortex, medulla or photobiont layer refers to one side of the branch only. Thus the branch diameter = axis diameter + 2 x (cortex + medulla + photobiont layer).

**Usnea articulata** (L.) **Hoffm.** (1796)

Deutschl. Fl. 2: 133; **Lichen articulatus** L. (1753), Sp. Pl. 1156; **Usnea articulata** subsp. **mediterranea** Motyka; **Usnea barbata** var. **articulata** (L.) Ach.

Descriptions: Randlane et al. (2009); Smith et al. (2009).

Scattered in humid or upland sites, at altitudes 0 - 1600 m, but usually above 600 m. Usually on bark. A 19th century report from calcareous rock might refer to a detached thallus.

Widespread in southern and central Europe, reaching British Is. Also Macaronesia, Asia (widespread), Malesia (Java, PNG), Africa (widespread outside deserts and humid tropics), S. America (widespread), Australasia (SE Australia, widespread in NZ), Pacific (widespread), perhaps Antarctica (S. Georgia as **U. capillacea**). Apparently absent from N. America.

**Usnea barbata** (L.) **F. H. Wigg.** (1780)

Prim. Fl. Holsat. 91; **Lichen barbatus** L. (1753), Sp. Pl. 1155; (?) **Usnea barbata** var. **scabrosa** Müll. Arg.; **Usnea caucasica** Vain.; (?) **Usnea caucasica** var. **barbatiformis** Rääsänen; **Usnea dasopoga** var. **plicata** (L.) Cromb.; **Usnea pendulina** Motyka; **Usnea plicata** (L.) F. H. Wigg; **Usnea prostrata** Vain. ex Rääsänen; **Usnea scabrata** Nyl.; **Usnea tortuosa** De Not.

Thallus: green, rarely with slight red-brown tinge in oldest parts, distinctly pendent, to 26 cm long, often slightly bushy (i.e. not just a few parallel branches). Branches: fairly regular, but with some changes in cross-section in at least some places, with at least a few foveoles, folds or (less commonly) ridges; secondary branches not, or scarcely, narrowed at point of attachment. Base: blackened, but sometimes obscurely so. Axis: white. Fibrils: absent to abundant. Papillae: always present, sometimes abundant. Isidia: sometimes arising out of soralia. Soralia: usually absent; when present punctiform, inconspicuous, 0.05 mm diameter. Cortex: 4 - 7% of branch diameter, obscurely cellular, pale orange-brown, K-, pigment soluble in K. Medulla: white, 17 - 27% of branch diameter, very loose, especially in inner part (a single hypha may extend from axis almost to photobiont layer without crossing any other
hyphae and even without branching); hyphae 2.5 - 4 \(\mu\)m wide, sometimes encrusted with a few (never many) crystals. Apothecia: very rare, 4 mm diameter, rather thin, with green disc and a thalline exciple bearing fibrils. Chemistry: axis usually K+ orange or red-orange (no crystals), P+ yellow, much less commonly K-, P-; thallus UV- Photobiont: green, cells globose, 8 - 20 \(\mu\)m diameter, forming a layer 45 - 55 \(\mu\)m thick.

The absent or inconspicuous soralia easily distinguish this species from \textit{U. perplexans}. However, collections should be checked carefully against \textit{U. dasopoga}.

Fairly common on the mainland, and also known from a few islands. Recorded from altitudes 150 to at least 1800 m, but usually above 800 m. Always epiphytic. Two-thirds of reports are from conifers. This is the commonest species of \textit{Usnea} in Greece.

Most of Europe to as far north as southern Scandinavia, but in the south almost restricted to the uplands. Also Macaronesia, Asia (widespread), Africa (widespread outside tropics). Its status elsewhere is unclear, and depends on synonymy. Many reports from outside Europe are old, and may be unreliable.

**Usnea ceratina** Ach. (1810)

Lichenogr. Universalis 619-620.

Descriptions: Randlane et al. (2009); Smith et al. (2009).

Rare and scattered on the mainland, in the uplands. On bark at all altitudes.

Most of Europe to as far north as southern Sweden, but in the south restricted to the uplands. Also Macaronesia, Asia (widespread), Malesia (Philippines), Africa (widespread), N. America (widespread), C. America (CR, El Salvador, Guatemala, Mexico), S. America (widespread), Australasia (eastern Australia), Pacific (Marquesas, Tahiti).

**Usnea cornuta** Körb. (1859)

Parerga Lichenol. 2; \textit{Usnea dolosa} Motyka.

Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Islands of the southern Aegean, on bark at altitudes 800 - 850 m. A report for Thessaly (as \textit{U. dolosa}) is doubtful.

Widespread in parts of Europe with temperate to warm, maritime climate. Also Macaronesia, Asia (widespread), Malesia (Sabah, PNG), Africa (widespread), N. America (widespread), perhaps Caribbean (Guadeloupe, St Lucia), C. America (Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

**Usnea dasopoga** (Ach.) Nyl. (1876)

in Norrlin, Medd. Soc. Fauna Fl. Fenn. 1: 14 as dasypoga; \textit{Usnea plicata} \(\gamma\) U. (\(=\) var.) dasopoga Ach. (1803), Methodus 312; \textit{Usnea filipendula} Stirt.; \textit{Usnea muricata} Motyka; \textit{Usnea sublaxa} Vain.

For the spelling of the epithet, see Arcadia (2013).

Descriptions: Randlane et al. (2009); Smith et al. (2009) as \textit{U. filipendula}.

Scattered in the eastern half of the mainland, and also known from Evia and Crete. On bark at altitudes 50 - 1400 m.

Most of Europe to just north of Arctic Circle, but uncommon in the south. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, Socotra, S. Africa), N. America (widespread), C. America (Mexico), S. America (at least Colombia), Pacific (widespread). Reports for Australasia are incorrect.

**Usnea esperantiana** P. Clerc (1992)

Candollea 47: 514.

Thallus grey-green, subpendent, 3 cm long. Branches: to 0.5 mm diameter at base of main stems, secondary branches sometimes slightly constricted at point of attachment, but otherwise of uniform thickness, narrowing slowly and regularly towards apices, becoming very contorted and twisted towards apices, without foveoles or ridges; main branches blackened at base. Fibrils: present on main branches, generally absent from younger ones. Papillae: present on older parts of main branches. Isidia: absent. Soralia: abundant on younger branches, especially towards apices, absent from older parts of main branches; excavate, rounded and delimited when young, sometimes coalescing later, sometimes becoming slightly convex. Axis: white, 135 \(\mu\)m diameter. Cortex: 6 - 8\% of branch diameter, colourless to pale brown. Medulla: white, 27 - 30\% of branch diameter, loose. Chemistry: axis K+ orange, P+ yellow; thallus C-, UV-. Photobiont: green, cells globose, 8 - 10 \(\mu\)m diameter, forming clumps to about 30 \(\mu\)m diameter in outermost part of medulla, not forming a regular layer.

Many characters overlap with \textit{U. perplexans}, but the branches in that species are much straighter, and often much longer.

Known from three small islands of the Aegean, on bark at altitudes 280 - 800 m. Reported substrates include \textit{Acer} and \textit{Phillyrea}.

Few reports, but probably a species of the Atlantic margin to as far north as Scotland, and humid parts of the Mediterranean (with an outlier in Russian Caucasus). Also Macaronesia, western Asia (Turkey), N. Africa (Morocco),
western N. America (BC to California), C. America (Mexico), perhaps S. America.

**Usnea flammae** Stirt. (1881)


Descriptions: Randlane et al. (2009); Smith et al. (2009).

Islands of the Aegean, on bark at altitudes 700 - 850 m.

Mainly western Europe, to as far north as Norway, plus a few sites in the humid Mediterranean. Also Macaronesia, western Asia (Turkey), N. America (Nova Scotia, Maine).

**Usnea flavocardia** Räsänen (1936)

_Revista Univ. Santiago_ 21: 139;  _Usnea wirthii_ P. Clerc.

Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Macedonia, Ikaria and Karpathos, on bark at altitudes 150 - 1100 m.

Mainly Atlantic margin of Europe to as far north as British Is, plus a few sites in the humid Mediterranean. Also Macaronesia, N. Africa (Tunisia), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (NZN).

**Usnea florida** (L.) F. H. Wigg. (1780)


Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Scattered, but never far from the sea, at altitudes 0 - 1200 m. Most reports are from bark. A 19th century record from calcareous rock might refer to a detached thallus. There is only one recent report.

Much of Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread). Reports for the Malesia, Western Hemisphere, Pacific are incorrect or doubtful.

**Usnea fulvoreagens** (Räsänen) Räsänen (1935)


Description: Smith et al. (2009).

Macedonia and Ikaria, on bark at altitudes 400 - 750 m. Not accepted by Abbott (2009), who suspected confusion with _U. perplexans_, but since confirmed for Greece.

Mainly northern and central Europe; uncommon in the south. Also Macaronesia, Asia (widespread), N. America (widespread), perhaps C. America.

**Usnea glabrata** (Ach.) Vain. (1915)


Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Scattered in northern Greece, on bark at altitudes 100 - 1500 m. Not reported from conifers.

Widespread in Europe, to as far north as southern Scandinavia, but uncommon in the south. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread in western half), C. America (Mexico), perhaps Pacific (New Caledonia).

**Usnea hirta** (L.) F. H. Wigg. (1780)

_Prim. Fl._ Holsat. 91;  _Lichen hirtus_ L. (1753), _Sp. Pl._ 1155. The name has a conserved type.;  _Usnea florida_ var. _hirta_ (L.) Ach.

Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Scattered, on the mainland and Corfu, with no clear pattern. On bark at altitudes 0 - 1350 m. Not reported from conifers.

Throughout Europe except for truly arctic regions, but in the south mainly in the uplands. Also Macaronesia, Asia (widespread), Africa (widespread; most records as _U. leprosa_), N. America (widespread), C. America (Mexico), Pacific (New Caledonia). Reports for S. America are probably incorrect.

**Usnea intermedia** (A. Massal.) Jatta (1909)


Descriptions: Nash et al. (2007); Randlane et al. (2009).

Rare, in northern Greece. On bark at altitudes 150 - 1400 m.
Mostly central Europe, with a few reports from south of the Alps. Also Asia (Turkey, Russia), N. America (widespread in western half), C. America (Mexico).

**Usnea perplexans** Stirt. (1881)

*Scott. Nat.* 6(3): 103; *Usnea lapponica* Vain.; *Usnea perplexans* auct.

Thallus: green, subpendent to pendent, to 18 cm long. Branches: fairly regular; secondary branches not or scarcely narrowed at point of attachment. Base: blackened, sometimes obscurely. Fibrils: scarce to abundant. Papillae: always present, generally abundant on older parts of main branches. Isidia: always entirely absent. Soralia: always present and conspicuous though often confined to younger branches, excavate but not often reaching central axis, surrounding cortex often distinctly upturned, circular to elliptical, becoming less regular with age, usually discrete and well delimited, occasionally coalescing, usually about same diameter as branch, coarsely granular. Axis: white. Cortex: 9 - 13% of branch diameter, pale orange-brown, sometimes colourless in lower part. Medulla: white, 17% of branch diameter, of loosely interwoven hyphae about 2.5 µm wide. Chemistry: axis K+ orange to orange-red (no crystals), P+ yellow.

The abundant, prominent, excavate soralia with rather upturned margin are characteristic, and this species is unlikely to be confused with any other species that has been reliably reported for Greece. *U. esperantiana* has branches that are much more twisted. *U. fulvoreagens* is similar but has nostrictic acid.

Scattered, on the mainland, at altitudes 500 - 1400 m. Usually on bark, with a mild preference for conifers, but recorded once from wood of *Juniperus oxycedrus*.

Detailed distribution unclear, owing to confusion with other species, including *U. fulvoreagens*. Probably widespread in Europe. Also Macaronesia, Asia (widespread), N. Africa (widespread), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (Mexico), S. America (Chile, Brazil, Colombia), Australasia (eastern Australia).

**Usnea praetervisa** (Asahina) P. Clerc (2004)


Description: Nash et al. (2007); Randlane et al. (2009).

Rhodes, on bark of *Pyrus communis* at an altitude of 1200 m.

Southern Europe, from Portugal to Greece, and Atlantic margin to as far north as Scotland. Also Macaronesia, Asia (Japan), N. America (widespread).

**Usnea rubicunda** Stirt. (1881)


Island of Kassos, on bark at an altitude of 600 m.

Throughout Macaronesia, Mediterranean Europe, and western Europe to as far north as British Isles; rare in eastern Europe. Also Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), Caribbean (PR), C. America (widespread), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

**Usnea subfloridana** Stirt. (1882)


Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Scattered, with no clear pattern, at altitudes 50 - 1400 m. Usually on bark, but reported once from wood.

Most of Europe. Also Macaronesia, Asia (widespread), perhaps Malesia (Philippines), Africa (widespread), N. America (widespread), C. America (El Salvador, Mexico), S. America (widespread if *U. subcomosa* is synonymous).

**Usnea subscabrosa** Nyl. ex Motyka (1937)


Macaronesia and western Europe as far north as British Isles, with a few reports from the humid Mediterranean. Also western Asia (Turkey), N. Africa (Morocco), N. America (widespread), Caribbean (Cuba, Jamaica), C. America (Mexico), S. America (widespread), Pacific (Hawaii).

**Usnea wasmuthii** Räsänen (1931)


Rhodes, on bark of *Pyrus communis* at an altitude of 1200 m. Probably throughout Europe, except for Arctic regions. Also Macaronesia, Asia (Turkey, Russia, Japan), N. Africa (Morocco), N. America (widespread), perhaps C. America.

**Vahliella P. M. Jørg. (2008)**


Literature: Burgaz et al. (2010). Jørgensen (2008) introduced the genus, as a segregate from *Fuscopannaria*, and discussed its affinities. Jørgensen (2005b) has more information on some of the species.

Distinguished from *Pannaria* in the small-squamulose, rather than foliose, growth form, and in the absence of pannarin.

Eight species, of which 4 occur in Europe.

11 Isidia or similar present. Thallus ±crustose. On soil.

22 Thallus dark grey with rather shiny true isidia. Ascospores 15 - 25 x 6 - 8 μm. (V. atlantica) Greek report tentative.

2 Thallus entirely of blue-grey to grey-brown, coarse granules resembling isidia, 0.03 - 0.1 mm diameter, not shiny.

Ascospores 13 - 15 x 6 - 8 μm. See *Fuscopannaria nebulosa*

1 Isidia absent. Thallus usually squamulose (rarely appearing almost crustose). On bark or moist rock.

22 Thallus of very finely divided squamules, the divisions usually less than 1 mm wide (Note 1). Disc pale red-brown. Apothecia remaining flat. Thalline margin ± absent from the beginning. On bark. *V. saubinetii*

2 Squamules not very finely divided, more than 1 mm wide (Note 1). Disc brown to black. Apothecia sometimes becoming convex. Thalline margin sometimes present. Usually on moist rock; in very humid sites occasionally on other substrates. *V. leucophaea*

(1) The key in Jørgensen (2005b) implies that squamules of *V. saubinetii* are blue-grey and those of *V. leucophaea* are brown. However, all Greek material of *V. saubinetii* that I have seen has brown squamules. At least in Greece, thallus colour is not a useful character for separating these two species.

**Vahliella leucophaea** (Vahl) P. M. Jørg. (2008)

*Lichenologist* 40(3): 224; *Lichen leucophaeus* Vahl (1787), Flora Dan. 6, Fascicle 16: 8; *Fuscopannaria leucophaea* (Vahl) P. M. Jørg.; *Pannaria microphylla* (Lilj.) Delise ex Bory.

Descriptions: Burgaz et al. (2010); Jørgensen (2008); Smith et al. (2009).

Thrace, on granite at an altitude of 930 m, and Crete (substrate not reported) at an altitude of 1100 m.

Widespread in Europe, but nowhere common. Also Macaronesia, Asia (widespread), N. Africa (Algeria), N. America (widespread), C. America (Mexico). Reports for S. America, Antarctica are incorrect or doubtful.

**Vahliella saubinetii** (Mont.) P. M. Jørg. (2008)


Thallus: squamulose. Squamules: brown to grey-brown, without white felted margin, not pruinose, 0.1 - 0.2 (0.5) mm wide, without vegetative propagules; margin crenulate. Hypothallus: absent. Upper cortex: 40 μm thick, cellular; cells subrounded, 6 - 8 μm wide. Apothecia: common. 0.3 - 1.1 mm diameter, sessile, ±flat to slightly convex, not pruinose. Disc: pale brown-orange to red-brown. Thalline margin: absent or excluded early. Exciple: pale orange, paler than disc, persistent but sometimes becoming thin and irregular; in section: of hyphae with elongate lumina and thick walls, and appearing cellular. Epitheium: orange-brown to brown, K-, pigment not soluble in K. Hymenium: 70 - 120 μm tall, colourless to very pale yellow, I+ blue > slowly blue-green. Hypothecium: 100 μm tall, colourless. Ascospores: colourless, simple, ellipsoid, 12 - 17 x 4 - 6 μm; ends rounded. Photobiont: blue-green, cells single or in clusters, not in chains.

The very fine squamules of this species are a character which it shares only with *Fuscopannaria ignobilis*. It is easy to separate from that species provided that ascospores are examined carefully.

In the literature *V. saubinetii* is often described as having a grey thallus. My two Greek collections are unambiguously brown. A few squamules are grey-brown but hardly any are truly grey. Prof. P. M. Jørgensen kindly examined a specimen from one of these collections and confirmed that it does belong to *V. saubinetii*.

Scattered, with no clear pattern. On bark, usually of deciduous species of *Quercus*, at altitudes 100 - 1200 m.

South and south-central Europe, but avoiding regions with distinctly continental climate. Also Macaronesia, Asia (southern Siberia, Mongolia), N. America (BC, Washington).
**Varicellaria** Nyl. (1858)


_Type_: _V. microsticta_ Nyl., the only species originally included. _Family_: _Ochrolechiaceae_.

_Literature_: the species are treated in all the standard Floras, under _Pertusaria_.

This segregate from _Pertusaria_ s. lat. has 7 species, of which 5 occur in Europe. Three species occur in Greece. Species are keyed out under _Pertusaria_.

**Varicellaria hemisphaerica** (Flörke) I. Schmitt & Lumbsch (2012)

in Schmitt et al., _Mycokeys_ 4: 29; _Variolaria hemisphaerica_ Flörke (1815), Deutsche Lichenen Fasc. 2, pages 6-7, no. 29; _Pertusaria hemisphaerica_ (Flörke) Erichsen; (?) _Pertusaria hemisphaerica_ f. _saxicola_ Erichsen.

_Thallus_: crustose, to many cm diameter, pale grey to grey, cracked, often slightly warted, 150 - 250 µm thick. _Prothallus_: sometimes present, 0.8 - 1.5 mm wide, often zoned, white to black. _Soraila_: always present, ±rounded, 0.8 - 2 mm diameter when mature, sometimes smaller when immature, slightly to distinctly convex, discrete at first, often coalescing later, white to pale green-grey. _Cortex_: 25 - 35 µm thick, usually colourless, sometimes pale brown in outermost part, hyphal, orientation of hyphae variable, horizontal or vertical. _Medulla_: white. _Chemistry_: medulla _K_-, _C_-, _KC+ strongly red_, _P_-, _I_-, _UV_-; thallus _K_-, _C_-, _KC+ red_, _UV_-._Photobiont_: green; cells ±globose, 6 - 11 µm diameter. _Photobiont layer_ (away from soraila): regular, continuous, 20 - 30 µm thick.

_The large, convex, white soraila reacting C+ red are distinctive_. However, they are not always present in young material, which can be confused with _Pertusaria dalmatica_. In young material of _V. hemisphaerica_ the soraila are less regularly excavate than in _P. dalmatica_, and though they may have a slightly upturned thalline rim it is less well developed and less persistent than in _P. dalmatica_; the soraila also tend to become convex (at first rather irregularly convex) at an early stage.

Throughout Greece, at altitudes 0 - 1400 m. Usually on bark, rarely on wood or calcareous rock. Recorded from a wide range of phorophytes, but avoiding strongly acidic bark.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia). Reports for N. America are incorrect; those for S. America are doubtful.

**Varicellaria lactea** (L.) I. Schmitt & Lumbsch (2012)

in Schmitt et al., _Mycokeys_ 4: 31; _Lichen lacteus_ L. (1767), Mant. Pl. 132; _Pertusaria lactea_ (L.) Arnold.

_Thallus_: crustose, to several cm diameter, grey-white, not pruinose, cracked, thin in most places, occasionally to 250 µm thick. _Soraila_: frequent, discrete, white, distinctly paler than thallus, 0.4 - 0.5 mm diameter, usually distinctly convex with narrow base. _Cortex_: absent; pseudocortex: 10 - 12 µm thick, colourless, poorly structured. _Medulla_: white. _Chemistry_: soraila _K_-., _C+ faintly red_, _KC+ strongly red_, _P-, I-, UV+ green-white_; thallus _K-, C-, KC+, P-, UV-_. _Photobiont_: green; cells ±globose to slightly ellipsoid, 6 - 10 µm diameter. _Photobiont layer_ (away from soraila): regular, continuous, 20 - 30 µm thick.

_Well characterised by the small, white convex soraila, paler than the thallus, that are C+ red, and by the substrate_. Known from a single site in northern Peloponnese, a few km from the sea, on siliceous rock at an altitude of 700 m. The absence of other reports for Greece is surprising, as this species is widespread in Italy according to Nimis (1993).

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia), perhaps N. America (Alaska).

**Varicellaria velata** (Turner) I. Schmitt & Lumbsch (2012)


_Descriptions_: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009), all as _Pertusaria velata_.

_Chis_ and _Samothraki_, on siliceous rock at altitudes 440 - 600 m.

_Southern Europe, and the Atlantic margin to as far north as Scotland_. Also Macaronesia, Asia (widespread), Malesia (Philippines, PNG, Sabah) Africa (widespread), N. America (widespread), Caribbean (Cuba, Guadeloupe, PR), C. America (CR, Mexico), S America (widespread), Australasia (widespread), Pacific (widespread).

**Verrucaria** Schrad. (1794)

_Spic. Fl. Germ._ 108. The name is conserved against _Verrucaria_ Scop. (1777). _Type_: _V. rupestris_ Schrad., listed in Appendix of the ICN. _Family_: _Verrucariaceae_.

_Literature_: Information is very scattered. Clauzade & Roux (1985), Nash et al. (2007), and Smith et al. (2009) are probably the best starting point. Krzewicka (2012) is a good monograph of the genus in Poland, and is helpful for those
species that also occur in Greece. For a key to corticolous and lignicolous species see Lendemer & Breuss (2009). *Verrucaria* s. lat. is starting to be split into smaller segregates; for recent views on the phylogeny of the group see Gueidan et al. (2009).

Thallus: crustose, immersed to superficial. Perithecia: black, immersed in thallus or substrate or to about 50% emergent. Involucrellum: present in many species. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, small to medium sized (10 - 35 \( \mu m \) long), 8 per ascus. Chemistry: all reactions negative. Photobiont: green, not trebouxioid.

*Verrucaria* in the traditional sense contains crustose members of *Verrucariaceae* with simple ascospores. It is an artificial assemblage, but it will be many years before a more natural classification has been fully worked out. At present, some natural segregates have been recognised but *Verrucaria* itself remains heterogeneous. The group is difficult, as there are rather few characters available, and some species are variable. These unavoidable difficulties have been compounded by earlier workers who published far too many new names. Over 3200 names at species rank and below have been published in *Verrucaria*. The number of good species is uncertain, but estimates by competent authorities range from 200 to 500.

Most species of *Verrucaria* are saxicolous, a few are parasitic, and only a handful occur on other substrates. The genus is commonly encountered in Greece, but reliable determination of collections tends to be very difficult, and it will remain so until the genus has been adequately monographed in SE Europe. The present treatment has many imperfections. The reader is warned that parts of the keys may not work well. It is not clear (at least to me) to what extent names widely used in western Europe really are applicable to the species found in Greece.

If using keys published elsewhere, note that many are unsatisfactory. Measurements quoted for many characters are often unreliable. Ascospores size, in particular, is problematic, as it may vary greatly within a single species, and different authors may quote very different numbers. In the keys I have included estimates of ascospore size for some species, but they should be used with caution.

*V. werneri* is not included in the key, as I have insufficient information.

**Key to Verrucaria main groups**

11 On soil, bark or wood. Group 1.
   1 On rock, or parasitic on saxicolous lichens.
      222 Aquatic, on marine rocks. Ascospores 10 - 18 (20) \( \mu m \) long. See *Hydropunctaria*
      22 Aquatic, on freshwater rocks. Group 2.
   2 Not aquatic.
      33 Involucrellum present, with 3 - 6 fine radial cracks (x20). See *Bagliettoa*
      3 Involucrellum absent, or without fine radial cracks.
         44 Thallus superficial (Note 1). Collections that are distinctly areolate belong here.
         55 Ascospores mostly less than 20 \( \mu m \) long. Group 3
         5 Ascospores mostly 20 or more \( \mu m \) long. Group 4
   4 Thallus immersed or very thin (Note 1). Group 5.

(1) Unfortunately, there is no sharp distinction between "very thin" and "superficial" thalli. In case of difficulty it may be necessary to try both branches.

**Key to Verrucaria group 1:** Not saxicolous

11 On soil. *V. geophila*
   1 On bark or wood. (V. phloephila), (V. sorbinea)

**Key to Verrucaria group 2:** On freshwater rocks.

11 Thallus in section with discrete, densely pigmented areas. See *Hydropunctaria*
   1 Thallus without discrete, densely pigmented areas (except, sometimes, for a black basal layer).
      22 Ascospores 7.5 - 9 \( \mu m \) long. (V. aquatilis)
   2 Most ascospores more then 9 \( \mu m \) long.
      33 Thallus slightly gelatinous when wet.
         44 On limestone. (V. elaeomelaena) Greek report very doubtful.
         4 On siliceous rock. (V. hydrela)
      3 Thallus not gelatinous.
44 Involucrellum absent. (V. latebrosa)
4 Involucrellum present. (V. aethiobola)

Key to Verrucaria group 3: Saxicolous, not aquatic, thallus superficial, ascospores mostly less than 20 µm long.

If the thallus has +–elongated marginal areoles, consider Placopyrenium fuscumcellum. If parasitic on species of Caloplaca, consider Verrucula.

111 Thallus blue-grey.
   22 Thallus continuous. **Parabagliettoa disjuncta**
   2 Thallus cracked or cracked-areolate. **V. coerulea**

11 Thallus with a green or olive tinge.
   22 Thallus cracked or cracked-areolate.
      33 Perithecia ±central in areoles, not between areoles.
         44 Areoles white-grey pruinose, with black rim. Apex of perithecia often flattened.
            55 Ascospores 11 - 15 x 5 - 7 µm. **Verruculopsis lecideoides**
            5 Ascospores 17 - 22 x 7.5 - 9 µm. (V. beltramiana)
         4 Areoles brown, not pruinose, without black rim. Apex of perithecia not flattened. **Verruculopsis minuta**
      3 Perithecia ±central in areoles, not between areoles.
         44 Mature areoles with black margin. Perithecia entirely immersed.
            55 Marginal areoles not elongated, or thallus not areolate. (V. crustulosa) Greek report doubtful.
         4 Areoles without black margin. Perithecia immersed or not.
            55 Perithecia distinctly flat-topped, entirely immersed. Thallus grey, not white. **V. coerulea**
            5 Perithecia not flat-topped, immersed or not.
               66 Thallus continuous or only locally cracked. Involucrellum present. Perithecia about 50% immersed. **V. muralis**
               6 Thallus distinctly cracked or areolate. Involucrellum absent. Perithecia 50 - 100 % immersed. (V. ochrostoma)
            22 Thallus verrucose-areolate. (V. sphaerospora)
         2 Thallus squamulose-areolate. See Placocarpus schaereri)

1 Thallus brown to black. See note 1.
   22 Thallus thin, barely superficial, continuous or sometimes cracked in places but not areolate.
      33 Perithecia ±entirely immersed. Involucrellum absent. **V. attica**
      3 Perithecia not entirely immersed. Involucrellum present.
         44 Thallus brown, never very dark. **V. pinguicula**
         4 Thallus dark brown to black.
            55 Thallus black or blackish, slightly shiny; slightly gelatinous when wet. On ±calcareous or siliceous rock. **V. maculiformis**
            5 Thallus not gelatinous when wet. On siliceous rock. **V. fusconigrescens**
   2 Thallus distinctly superficial, usually ±areolate.
      33 Thallus irregularly granular-areolate. **V. fusca**
      3 Thallus cracked-areolate, or areolate.
         44 Ascospores subglobose; length/width ratio 1.5 or less. See Heteroplacidium.
         4 Ascospores ellipsoid; length/width ratio usually more than 1.5.
            55 Perithecia completely immersed. Black prothallus usually present. Ascospores 10 - 20 µm long. Surface of larger areoles often with network of fine black cracks. **V. polysticta**
            5 Perithecia not completely immersed. Prothallus present or absent.
               6 Perithecia 30 - 80 percent immersed. Ascospores 14 - 30 µm long. Basal part of exciple pale brown to black (Note 2). Prothallus absent. **V. nigrescens**
(1) If material does not key out in this branch, consider V. dolosa and V. floerkeana, which are said sometimes to lack a green tinge, and are then brown.

(2) In V. nigrescens the lower part of the exciple may occasionally be very pale brown, but some pigmentation is always present.

**Key to Verrucaria group 4:** Saxicolous, not aquatic, thallus superficial, ascospores mostly more than 20 µm long.

11 Thallus blue-grey. (V. cryptica) Greek report doubtful.

11 Thallus pale grey, whitish or white (sometimes yellowish), often not very apparent.

22 Involucrellum present.

33 Perithecia entirely immersed. **V. ruderum**

3 Perithecia at least one-quarter emergent.

44 Ascospores 15 - 25 (28) µm long. **V. muralis**

4 Ascospores 23 - 40 µm long. **V. viridula**

2 Involucrellum absent.

33 Thallus ±squamulose-areolate. See **Placocarpus schaereri**

3 Thallus clearly crustose.

44 Parasitic on Circinaria calcarea. See **Placopyrenium canellum**

4 Not parasitic.

55 Areoles with black margin. (V. crustulosa) Greek report doubtful.

5 Areoles without black margin.

66 Ascospores 18 - 24 x 10 - 13 µm. (V. ochrostoma)

6 Ascospores 25 - 36 x 11 - 15 µm. **V. periphysata**

1 Thallus grey-brown to dark brown or black (or, in a few species, sometimes with a green tinge).

222 Thallus thin, barely superficial; ±continuous (sometimes cracked in places).

33 Perithecia no more than 50% immersed. Involucrellum present. Ascospores 20 - 24 x 8 - 10 µm. Usually on siliceous rock. **V. fusconigrescens**


44 Lower part of perithecia colourless. **V. attica**

4 Perithecia entirely brown or black.

55 Hypothallus with oil cells (macrospheroids). **V. veronensis**

5 Hypothallus without oil cells. (V. umbrosa)

22 Thallus distinctly superficial, cracked-areolate or areolate, very thick (sometimes more than 0.5 mm).

33 Thallus grey-brown. **V. murorum**

3 Thallus yellow-brown to brown. Note 1.

44 Thallus ±isidiate. (V. furfuracea)

4 Thallus not isidiate.

55 Involucrellum extending to base of exciple. **V. apatela**

5 Involucrellum extending at most halfway down exciple. **V. macrostoma**.

2 Thallus distinctly superficial, cracked-areolate or areolate, but not very thick (distinctly less than 0.5 mm).

333 Thallus with distinct black basal layer below areoles, and often visible between areoles. On calcareous rock. **V. nigrescens**

33 Thallus with distinct brown basal layer. Fertile areoles distinctly larger than sterile ones. Pale spaces present between areoles. On calcareous rock. (V. cataleptoides) Greek report doubtful.

3 Thallus without distinct black or brown basal layer. On calcareous or siliceous rock.

44 Involucrellum ±flat, only present in upper part of peritheium. On calcareous rock. Perithecia often distinctly pear-shaped or bottle shaped.

55 Involucrellum clearly distinct from exciple. Thallus brown, without a green tinge. Ascospores 20 - 32 x 12 - 18 µm. (V. tabacina)

5 Involucrellum merged with exciple. Thallus brown to green-brown. Ascospores 28 - 35 x 14 - 20 µm. **V. viridula**

4 Involucrellum ±conical, present almost to base of peritheium. On calcareous or siliceous rock.

55 Perithecia entirely immersed. Periphyses broad, about 3 µm wide. Ascospores 20 - 26 x 8 - 11 µm. Usually on calcareous rock, occasionally on siliceous rock. (V. endocarpoides)

5 Perithecia not entirely immersed. Periphyses narrower. Ascospores often larger. On calcareous or siliceous rock.

66 On calcareous rock, especially if periodically damp. Thallus rather thin. (V. transiliens)
6 On siliceous or weakly calcareous rock. Thallus well developed. *V. fuscoatroides*

(1) The poorly known (*V. tectorum*) belongs somewhere in this branch.

**Key to Verrucaria group 5:** Saxicolous, not aquatic, thallus immersed.

111 Thallus pale pink to purple pink (red crystals in cortex). Perithecia completely immersed. Ascospores 18 - 28 x 10 - 12 µm. See *Bagliettoa*

11 Thallus green, brown, dark brown or black. Ascospores more than 30 µm long. Note 1.

- 22 Involucrellum absent, or almost absent. *V. veronensis*
- 3 Involucrellum fully fused with exciple. *V. viridula*
- 3 Involucrellum not fully fused with exciple. *V. cinereorufa*

1 Thallus pale grey, whitish or white (sometimes yellowish), often rather indistinct.

- 22 Perithecia ± entirely immersed.
- 33 Ascospores mostly more than 20 µm long.
  - 444 Perithecia pinkish in upper part, colourless in lower part. (*V. ionaspicarpa*)
  - 44 Perithecia mostly colourless, only ± black at top. *V. eggerthii*
  - 4 Perithecia entirely black *V. hochstetteri*
- 3 Involucrellum mostly less than 20 µm long.
  - 444 Involucrellum present, clearly different from exciple, which is pale at base. *V. muralis*
  - 4 Involucrellum absent, or not very distinct from exciple.
  - 55 Oil cells (macrophospheroids) present in medulla. See *Bagliettoa calciseda*
  - 5 Oil cells absent.
  - 66 Perithecia with white or blue pruina when young. (*V. caesiopsila*) Greek report tentative.
  - 6 Perithecia not pruinose. *V. interrupta*

2 Perithecia half-emergent.

- 33 Ascospores mostly less than 20 µm long.
  - 444 Exciple entirely black, not very distinct from involucrellum. *V. murina*
  - 4 Exciple colourless to brown, clearly distinct from involucrellum.
  - 55 Dark brown lines of prothallus visible crossing or surrounding thallus. See *Parabagliettoa*
  - 5 Thallus without dark brown prothallus lines. *V. muralis*
- 3 Ascospores mostly more than 20 µm long.
  - 444 Exciple colourless at base. Involucrellum present. *V. muralis*
  - 4 Exciple dark throughout. Involucrellum absent.
  - 55 Thallus grey, ± immersed. Ascospores 20 - 36 x 12 - 18 µm, ellipsoid. *V. foveolata*
  - 5 Thallus white-grey, sometimes cracked. Ascospores 21 - 42 x 10 - 21 µm, sometimes subglobose. *V. mortarii*

(1) If ascospores less than 30 µm long, see key to Group 3.

**Verrucaria apatela** (A. Massal.) Trevis. (1860)


Description: Pykälä (2010a).

Attica and Sterea Ellada, on rock (of unspecified kind) at altitudes 20 - 1150 m. Last reported in 1919, based on material collected in 1911.

Scattered through Europe, from Finland to Greece, but avoiding the Atlantic margin. Also N. Africa (Algeria). It may be under-recorded, having sometimes been regarded as a synonym of *V. macrostoma*.

**Verrucaria attica** (J. Steiner) J. Steiner (1911)


Description: Clauzade & Roux (1985).

Crete and the southern half of the mainland. On calcareous rock at altitudes 0 - 100 m. Last reported in 1919. Sicily, Croatia and Greece. Also western Asia (Syria), N. Africa (Egypt).
**Verrucaria cinereorufa** Schaeer. (1836)

Description: Clauzade & Roux (1985).

Attica, on limestone at an altitude of about 20 m. Abbott (2009) referred a Peloponnesian collection here, but that determination seems doubtful to me.

Scattered from Greenland to Greece; avoiding those parts of eastern Europe with very continental climate, but otherwise without any clear pattern. I have not seen any reports from outside Europe.

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**Verrucaria coerulea** DC. (1805)
in Lamarck & de Candolle, Fl. Franç., Ed. 3, 2: 318; Involucrothele plumbea (Ach.) Servít; Thelidium plumbeum (Ach.) Servít; Verrucaria coerulea f. fusca (Schaer.) Hayek; Verrucaria glauca Ach.; (?) Verrucaria glauca f. sublobulata Servít; Verrucaria plumbea Ach.

Thallus: crustose, grey, cracked (but not areolate), cracks same colour as thallus, forming small patches 0.5 - 2 mm diameter, patches often coalescing, 0.1 - 0.15 mm thick. Prothallus: conspicuous around each thallus patch, black, 0.2 mm wide. Perithecia: black, 80 - 100% immersed, 0.2 mm diameter, distinctly flat-topped; in section: 260 µm tall, 210 µm wide. Exciple: colourless throughout. Involucrellum: present, black, robust, flat-topped. Paraphyses: disappearing early. Ascospores: colourless, simple, 17.5 - 20 x 7 - 8 µm.

The grey, cracked thallus and the small, immersed, flat-topped perithecia are fairly distinctive. I do not know whether the delimiting prothallus, which was very distinctive in the single collection I have seen, is always present.

Scattered throughout Greece. On rock, usually calcareous, at all altitudes.

Widespread in Europe to about Arctic Circle. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (California, New Mexico), Australasia (Victoria, NZS).

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**Verrucaria eggerthii** J. Steiner (1911)

Description: Clauzade & Roux (1985).

Corfu, on calcareous rock at an altitude of 100 m. Last reported in 1911.

Only Sicily, Croatia, Montenegro and Greece.

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**Verrucaria floerkeana** Dalla Torre & Sarnth. (1902)
Fl. Tirol 4: 524.

Description: Nash et al. (2007).

Delos, on schist. Last reported in 1919.

Widespread in central Europe, reaching as far north as southern Scandinavia; very rare south of the Alps. Also Asia (Syria, Mongolia), N. Africa (Morocco), N. America (California), C. America (Mexico).

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**Verrucaria foveolata** (Flörke) A. Massal. (1852)

Thallus: crustose, ±immersed to superficial but very thin, continuous, pale grey or with slight brown tinge, to several cm diameter. Perithecia: black, 0.3 - 0.5 mm diameter, 50% immersed; in section: 400 - 500 µm tall, 400 µm wide, ±globose overall but centrum pyriform. Exciple: dark brown to black everywhere, 50 µm wide in lower part, upper part much thicker, about 100 µm. Involucrellum: absent (or so thoroughly merged with upper part of exciple as to be indistinguishable from it). Paraphyses: disappearing early. Periphysoids: present. Asci: 80 - 90 x 17 - 30 µm, clavate. Ascospores: colourless, simple, ellipsoid, 20 - 28 x 10 - 15 µm, 8 per ascus. Photobiont: green.

Differs from *V. hochstetteri* in having a better developed thallus and partly emergent perithecia. Some authors subsume it under that species.

Peloponnesse and Crete. Not common. On calcareous rock at altitudes 150 - 1200 m.

Widespread in Europe to about Arctic Circle. Also Asia (Israel, Syria, Russia).

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**Verrucaria fusca** Pers. ex Nyl. (1861)

Often cited with authorship Pers. ex Ach. (1810), from Lichenogr. universalis 291, but not validly published there. Nylander's name is a later homonym of *V. fusca* (Schaer.) Kremp. (1858). If this is a good species, a nomen novum is required.

Description: Nash et al. (2007).

Scattered, with no clear pattern. No substrate or altitude information is reported.

Scattered in central Europe, reaching as far north as southern Sweden. The Greek reports are the only ones that I
have seen from the south of the Alps. Also Asia (Turkey, southern Siberia), N. America (Saskatchewan, Arizona, California), C. America (Mexico).

**Verrucaria fuscoatrioides** Servit (1949)


Thallus: crustose, areolate, pale brown to dark brown, sometimes with a green tinge, 50 - 200 µm thick. Areoles: 0.2 - 0.5 mm wide. Medulla: white (no black or brown basal layer). Perithecia: frequent, black, 0.1 - 0.6 mm diameter; in section: about 50% immersed in thallus, 210 - 460 µm tall, 190 - 460 µm wide (including exciple). Exciple: brown to black, continuous below. Involucrellum: present, not radially cracked, not separating from exciple, ±hemispherical, extending at least halfway down perithegium, sometimes almost to base. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 23 - 35 x 11 - 15 µm, 8 per ascus.

Scattered, with no clear pattern, on calcareous or siliceous rock at altitudes 0 - 1150 m.

The few reports of this rather poorly known taxon are scattered from Finland to Greece. Also N. America (Arizona, California).

**Verrucaria fusconigrescens** Nyl. (1873)

*Bull. Soc. Linn. Normand.*, Sér. II, 6: 266 & 314 as fusco-nigrescens and in *Flora* 56: 203-204. It is not known which was published first.

Descriptions: Clauzade & Roux (1985); Krzewicka (2012); Smith et al. (2009).

Islands of the Aegean, on rock, usually siliceous, at altitudes 50 - 670 m.

Widespread in Europe to as far north as southern Scandinavia, but avoiding the continental climate of much of eastern Europe. Also Asia (Turkey, Taiwan), N. Africa (Morocco, Algeria), N. America, Australasia (southern Australia, NZS).

**Verrucaria geophila** Zahlbr. (1909)


The name is a later homonym of *V. geophila* Nyl., *Flora* 48: 356. 1856. Nylander's name is not synonymous. Nylander stated "Sit varietas *V. pyrenophorae*, i.e. he wondered whether his name might be a variety of *V. pyrenophora*, but he did not state that he definitely considered it to be a variety of that species. In other words, he did accept the name *V. geophila*, which is thus validly published, making Zahlbruckner's name illegitimate. If *V. geophila* Zahlbr. is to be retained in *Verrucaria* s. str. then conservation would be desirable.

Thallus: crustose, inconspicuous, to 2 cm diameter. Perithecia: black, 0.6 - 0.7 mm diameter, 50% immersed in soil, sometimes confluent in groups of 2 or 3; in section: subglobose, 600 µm tall, 700 µm wide. Exciple: black throughout, very variable in thickness, 30 - 120 µm wide but usually towards the upper end of this range. Involucrellum: absent (or poorly developed). Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 20 - 26 x 13 - 17 µm, 8 per ascus.

The terricolous habit is unique among *Verrucaria* species likely to be encountered in Greece.

Scattered in the southern half of Greece, on soil at altitudes 100 - 200 m. The Peloponnesian collection was on non-calcareous soil but the other Greek reports did not indicate soil type.

Southern and south-central Europe, with a disjunct report for Finland. Absent from maritime areas of western Europe and strongly continental parts of eastern Europe. Also western Asia (Turkey).

**Verrucaria hochstetteri** Fr. (1831)


Thallus: entirely immersed, grey (no pink tinge). Perithecia: black, 0.2 - 0.35 mm diameter, almost entirely immersed in deep pits in substrate; in section: 600 µm diameter. Exciple: dark brown to black everywhere. Involucrellum: ±absent, but exciple broadening significantly in upper part. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 20 - 30 x 11 - 14 µm.

The entirely immersed thallus, large immersed perithecia fairly large ascospores, and absence of involucrellum are fairly distinctive. *Bagliettoa marmorea* is similar but its thallus always has a pink tinge.

Scattered throughout Greece. On calcareous rock at all altitudes.

Throughout Europe to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), Australasia (NSW, S. Australia, Victoria), Pacific (New Caledonia).

**Verrucaria interrupta** "(Anzi ex Arnold) Zahlbr." (1919)

published first.; *Verrucaria calciseda* (indefinite rank) *interrupta* Anzi ex Arnold (1885), *Flora* 68: 78. The basionym cited here is a nomen nudum, and the nomenclatural situation needs to be clarified. Description: Clauzade & Roux (1985).

Scattered in the southern half of the mainland. On calcareous rock at altitudes 10 - 1150 m. Last reported in 1919. Switzerland, Austria, Lombardy in Italy, and Greece. Also western Asia (Turkey, Syria). Some authors regard the name as a synonym of *V. calciseda*, which may be why there are few reports.

**Verrucaria macrostoma** DC. (1805)
in Lamarck & de Candolle, Fl. Franç., Ed. 3, 2: 319; *Verrucaria thrombioides* A. Massal.

Description: Clauzade & Roux (1985); Crzewicka (2012); Nash et al. (2007); Smith et al. (2009).

Scattered, with no clear pattern, on calcareous rock or soil at altitudes 0 - 300 m. Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (Arizona, California, Michigan), C. America (Mexico), S. America (Chile), Australasia (NZN, NZS).

**Verrucaria maculiformis** Kremp. (1858)

*Flora* 41: 303.

Description: Clauzade & Roux (1985); Crzewicka (2012); Roux (2007).

Mountains of northern Peloponnese. On limestone at high altitude. Not reported since 1894. Scattered reports from Denmark to Greece. Also N. Africa (Morocco, Algeria). A report for Chagos Is seems very doubtful to me.

**Verrucaria mortarii** (Arnold) Leight. (1879)


*Verrucaria rupestris* var. *hypophaea* auct. graec.

Thallus: crustose, immersed, white (or almost), to 2 cm diameter. Prothallus: absent. Perithecia: black, 0.15 - 0.2 mm diameter; in section: 60 - 90% immersed, ±globose, 160 - 300 µm tall, 150 - 220 µm wide (excluding involucrellum). Exciple: colourless to pale brown. Involucrellum: present, 120 - 280 µm diameter, at top of perithecium, not extending far down sides, not separating from exciple. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 12 - 16 x 4 - 7 µm. Photobiont: green.

Material that keys out here is heterogeneous. To resolve the problem will require a monographic treatment of *Verrucaria* in SE Europe, and the development of better keys than I am able to prepare.

Scattered throughout Greece, usually not very far from the sea. On rock, usually calcareous, at altitudes 0 - 1500 m, but commonest at low altitude.

Throughout Europe to about Arctic Circle. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda), C. America (Mexico), S. America (Argentina, Bolivia, Brazil, Chile), Australasia (SE and southern Australia, NZS), Antarctica (S. Georgia).

**Verrucaria murina** Leight. (1851)


Thallus: immersed, grey, 1.5 cm diameter. Perithecium: black, 0.15 mm diameter; in section: 65% immersed, 200 µm tall, 175 µm wide. Exciple: dark in lower part. Ascospores: colourless, simple, 12 - 16 x 4 - 7 µm.

Characterised by the immersed thallus, partly emergent perithecium, dark exciple and small ascospores. Scattered throughout Greece, but not very common. On calcareous rock at all altitudes. Widespread in Europe to as far north as southern Scandinavia. Also western Asia (Syria).

**Verrucaria murorum** (A. Massal.) Lindau (1913)


Description: Clauzade & Roux (1985); Nash et al. (2007).

Crete, on soil at an altitude of 200 m. This is an unusual substrate for this species, which is normally saxicolous, but one of the co-authors of the paper in which it was reported was O. Breuss, a specialist in *Verrucariaceae*, so the
report may be assumed to be reliable. (Note that this species is not included in the terricolous section of the keys above.)

Southern and central Europe, though absent from the west (e.g. Iberian Peninsula, France), and from regions of eastern Europe with distinctly continental climate. Also Asia (Tajikistan), N. Africa (Morocco), N. America (Arizona), perhaps S. America (Argentina).

**Verrucaria nigrescens** Pers. (1795)  

Thallus: crustose, dark brown, not pruinose, areolate, to several cm diameter, 150 - 300 µm thick. Areoles: 0.15 - 1.9 mm wide, subrounded to angular, flat to slightly concave, contiguous. Prothallus: absent. Medulla: poorly developed. Hypothallus: black, forming a distinct black basal layer to areoles, sometimes visible between areoles. Cortex: 20 - 28 µm thick, brown in upper part, pale brown in lower part, cellular, cells subangular, about 5 µm diameter; cortex sometimes overlain by a non-cellular (?epinecral) layer about 3 µm thick. Perithecia: black, 0.1 - 0.35 mm diameter; in section: 40 - 80% immersed, 210 - 400 µm tall, 220 - 300 µm wide (excluding involucrellum), globose, subglobose or pyriform. Exciple: brown to pale brown, 20 - 25 µm wide (though in upper part sometimes obscured by involucrellum), formed of hyphae parallel to wall of perithecium; at least in upper half of perithecium hyphae often have distinct elongated lumina, giving a weakly cellular appearance. Involucrellum: present, robust, 250 - 500 µm diameter, not spreading, extending about halfway down perithecium. Paraphyses: disappearing early. Paraphyses: abundant in upper half of perithecium, with visible septa, moniliform, 4 - 5 µm wide. Ascospores: colourless, simple, ellipsoid, 13 - 30 x 7 - 15 µm, 8 per ascus. Conidia: (observed by chance) 5 x 1 µm, bacilliform. Photobiont: green, not trebouxioid (chloroplast not prominent), cells 5 - 7 x 5 µm. Photobiont layer: 10 - 50 µm thick, continuous (within an areole), 2 regular but sometimes cup-shaped and becoming thinner towards margins of areole, where upper margin of black basal layer rises closer to surface.

The small, dark brown areoles are fairly characteristic, but this species seems rather variable and more than one taxon may be involved. *V. viridula* has generally larger ascospores and is less dark in colour overall.

Common throughout Greece. On rock, usually calcareous, at all altitudes. The lichenicolous lichen *Caloplaca inconnexa* has been reported once parasitic on it.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread), perhaps Caribbean (Bahamas), C. America (Mexico), S. America (Chile), Australasia (SE Australia, NZS).

**Verrucaria periphysata** Zahlbr. (1919)  

Description: See the protologue.

Lefkada and Samos, on limestone at altitudes 50 - 200 m. Croatia, Montenegro and Greece. Also N. Africa (Tunisia).

**Verrucaria pinguicula** A. Massal. (1856)  
*Lotos* 80; *Verrucaria integra* (Nyl.) Nyl.

Thallus: crustose, superficial and thin (to 100 µm), brown (but not dark brown), smooth or slightly cracked, sometimes discontinuous. Perithecia: black, 0.2 - 0.3 mm diameter; in section: 40 - 50% immersed, ±globose, 200 - 350 µm diameter. Exciple: dark brown to black in upper part, colourless in lower part. Involucrellum: present, 380 µm diameter, sometimes extending well down sides of perithecium. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 10 - 17 x 8 - 10 µm.

Seems fairly well characterised by the thin, ±smooth, medium brown thallus, emergent perithecia, and small ascospores.

Scattered, with no clear pattern, on calcareous rock at altitudes 5 - 1400 m.

Probably throughout Europe. Also eastern Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (scattered in cooler parts).

**Verrucaria polysticta** Borrér (1834)  

Thallus: crustose, dark brown, superficial and well developed, to 400 µm thick, areolate, larger areoles sometimes with a network of fine black cracks. Perithecia: 100% immersed. Ascospores: colourless, simple, ellipsoid, 10 - 20 x 5
The network of fine black cracks on the surface of the areoles is distinctive when present.

Scattered, mainly in the southern half of Greece, at altitudes 0 - 1400 m. Apparently rare, but possibly under-recorded. Usually on calcareous rock. Old reports of this species parasitising Circinaria spp. may refer to Heteroplacidium fusculum.

Mainly in northern and central Europe; rare in the south. Also Asia (Turkey, Jordan, southern Urals), N. Africa (Morocco), perhaps the Americas.

Verrucaria ruderum DC. (1805)

Description: Clauzade & Roux (1985).

Crete and Ikaria, on calcareous rock at altitudes 0 - 50 m.

Mainly western half of Europe, from southern Scandinavia to Sicily; in central Europe, no further east than Slovakia. A report for Caribbean (Bermuda) seems doubtful to me.

Verrucaria veronensis A. Massal. (1852)

Description: Clauzade & Roux (1985).

Scattered on the mainland, with no clear pattern. On calcareous rock at altitudes from sea level to montane levels. Last reported in 1919.

Southern and south-central Europe. Probably absent from the Atlantic margin, and from regions of eastern Europe with distinctly continental climate. Also Asia (southern Siberia, Tajikistan), N. Africa (Morocco, Tunisia).

Verrucaria viridula (Schrad.) Ach. (1803)
Methodus (Suppl.) 16; Endocarpon viridulum Schrad. (1794), Spic. Fl. Germ. 192; Lithoicca controversa f. viridula (Arnold) Arnold; Lithoicca controversa var. viridula Arnold; Verrucaria integra var. obductilis Nyl.; (?) Verrucaria margacea var. latericola J. Steiner; Verrucaria obductilis (Nyl.) Zschacke; (?) Verrucaria polygonia var. latericola (J. Steiner) J. Steiner.

Thallus: crustose, to 5 cm diameter, pale brown to dark brown, areolate, 100 - 200 (400) µm thick. Areoles: 0.2 - 0.4 mm diameter, ±flat, subrounded to subangular. Medulla: white (no black or brown basal layer). Perithecia: frequent, black, 0.25 - 0.35 mm diameter; in section: about 50% immersed in thallus, 300 - 500 µm tall, 200 - 500 µm wide (including exciple), centrum often pyriform. Exciple: brown to dark brown, sometimes paler brown in lower part, continuous below. Involucrellum: present in at least upper half of perithecium, sometimes extending lower, not radially cracked, not separating from exciple. Ascospores: colourless, simple, ellipsoid, occasionally with ends slightly pointed, 22 - 35 x 9 - 20 µm, 8 per ascus.

Scattered, mainly in the southern half of Greece but also reported from Corfu. On calcareous rock at all altitudes.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (apparently widespread, but many reports old), perhaps C. America, Australia (NSW, Tasmania, both as V. papillosa).

Verrucaria werneri Breuss (1994)

Description: Discussed briefly in Spribille et al. (2006), but no adequate description seen.

Crete, on calcareous rock at an altitude of 350 m.

Known only from Greece and Morocco.

Verrucula J. Steiner (1896)


Literature: Navarro-Rosínés, Roux & Gueidan (2007) is a monograph, and includes a key...

About 23 species, most of which are not well known. About 21 are reported for Europe. The genus is a segregate of Verrucaria s. lat. for a group of species parasitic on members of Teloschistaceae.

11 Medulla ±I+ blue. (V. granulosaria), (V. tarracsonensis)
1 Medulla I-
22 Thallus with thick, crystalline white-grey pruina. (V. arnoldaria), (V. clauzadaria)
2 Pruina absent or, if present, not crystalline.
33 Ascospores narrowly ellipsoid; length/width ratio 2.1 - 3.4
44 Areoles small, 0.2 - 0.6 mm wide, 0.1 - 0.2 mm thick, often pruinose.
55 Perithecia entirely immersed. Not restricted to the coast. **V. polycarparia**
5 Mature perithecia 50 - 60 percent immersed. Probably restricted to the coast. *(V. hladuniana)*
4 Areoles 0.3 - 1.4 mm wide, 0.2 - 0.5 mm thick, not or scarcely pruinose.
55 Areoles ± continuous. On Caloplaca maritima (or similar) at or close to the sea. **V. maritimaria**
5 Areoles isolated or in small groups. On Caloplaca granulosa
3 Ascospores ellipsoid to broadly ellipsoid; length/width ratio 1.3 - 2.5 Several rather northern species that are unlikely to occur in Greece.

**Verrucula maritimaria Nav.-Ros. & Cl. Roux (2007)**
Description: See the protologue.
Crete, on *Caloplaca aff. maritima* at an altitude of 35 m.
Known only from the Netherlands, Spain (Catalonia) and Crete.

**Verrucula polycarparia Nav.-Ros. & Cl. Roux (2007)**
Description: Krzewicka (2012), or see the protologue.
Chios, on an undetermined species of *Caloplaca*, at an altitude of 15 m.
Scattered from Ireland to Greece. Only Europe.

**Verruculus Gueidan et al. (2007)**
in Navarro-Rosinés et al., *Bull. Soc. Linn. Provence* 58: 139. Type: *V. poeltiana* (Clauzade & Cl. Roux) Gueidan et al.,
Family: *Verrucariaceae*.
This recent segregate from *Verrucaria* has 5 species, most of which are parasitic. All occur in Europe.

11 On anthraquinone-containing species of Teloschistaceae. *(V. flavescentaria), (V. irrubescentis), (V. poeltiana)*
1 Saxicolous, or parasitic on other species.
22 Most ascospores more than 15 µm long. Areoles brown. **V. lecideoides** s. lat.
33 Areoles white-grey pruinose. Apex of perithecia often flattened. **V. lecideoides var. lecideoides**
3 Areoles not pruinose. Apex of perithecia not flattened. **V. lecideoides var. fraudulosa**
2 Ascospores 11 - 15 x 5 - 7 µm. **V. minuta**

**Verruculopsis Gueidan & Cl. Roux (2007) var. lecideoides**
Description: Clauzade & Roux (1985) as *Verrucaria lecideoides*; Krzewicka (2012); Nash et al. (2007) as *Verrucaria lecideoides*.
Scattered, with no clear pattern, at altitudes 350 - 2250 m. Most reports are from calcareous rock, but reported once parasitic on *Rinodinella controversa*.
Southern and central Europe, to as far north as Belgium. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria), N. America (Saskatchewan, scattered in western USA), C. America (Mexico).

**Verruculopsis lecideoides var. fraudulosa (Nyl.) Nav.-Ros. et al. (2007)**
Description: Nash et al. (2007) as *Verrucaria fraudulosa*.
Peloponnese and Ios. On calcareous and siliceous rock at altitudes around 100 m.
Scattered thinly from Bjørnøya to Greece. Also N. America (California).

**Verruculopsis minuta (A. Massal.) Krzew. (2012)**
(A. Massal.) Zschacke nom. illeg. (later homonym); Verrucula lecideoides f. minuta (A. Massal.) J. Steiner.


Scattered, with no clear pattern. Parasitic on Caloplaca variabilis, or directly on calcareous rock, at altitudes 15 - 1400 m.

Southern and central Europe. Also Asia (Syria, Iran), N. Africa (Morocco, Tunisia), N. America (Arizona), Australasia (NSW, S. Australia, Tasmania).

**Vouauxiella Petr. & Syd. (1927)**


Literature: Clauzade, Diederich & Roux (1989); Hawksworth (1981b).

This genus of lichenicolous coelomycetes has just two species, both present in Europe. They are probably fairly common, but are inconspicuous and there are few Greek reports.

11 Conidia smooth-walled. *V. lichenicola*

1 Conidia with distinct ornamentation. *V. verrucosa*

**Vouauxiella lichenicola** (Linds.) Petr. & Syd. (1927)


Pycnidia: black, 0.05 - 0.1 mm diameter, ostiole eventually opening widely; in section: 80 - 90% immersed in apothecia of host, black, pyriform to almost conical, 100 - 170 µm tall, 90 - 130 microns wide. Conidia: forming in chains but soon separating, almost colourless but with faint greenish or brownish tinge, ± ellipsoid to rectangular with rounded ends, 8 x 3 µm, usually simple with 2 guttules, rarely (fewer than 1% of conidia) with very thin septum that is easily overlooked; wall smooth, without ornamentation (at x400).

*Lichenodiplis lecanorae* is similar but has unambiguously 1-septate conidia.

Scattered, at altitudes 50 - 1120 m, with no clear pattern, but never very far from the sea. In the apothecia of *Lecanora* species, especially *L. chlarotera*. but also reported from *L. horiza* and *L. strobilina*.

Widespread in Europe. Also Macaronesia, Asia (Turkey, Israel, Kashmir), N. Africa (Morocco, Tunisia), N. America (widespread in USA), C. America (Mexico), S. America (Uruguay).

**Vouauxiella verrucosa** (Vouaux) Petr. & Syd. (1927)


Pycnidia: black, 0.06 - 0.12 mm diameter, with prominent open ostiole when mature, 1 - 7 in apothecia of host; in section: 75 - 150 µm tall, 75 - 150 µm wide, ostiole 30 µm diameter, brown, purple-brown or almost black, wall distinctly cellular. Conidia: pale brown (usually very pale), simple, ellipsoid or barrel shaped (i.e. with blunt ends), in chains, 7.5 - 10 x 4.5 - 7 µm, with distinct ornamentation at a scale of 0.5 - 1 µm.

Characterised by the ornamented conidia.

Peloponese, at an altitude of 765 m, on *Lecanora horiza*.

Widespread in western half of Europe to as far north as Scotland. Also Macaronesia, Asia (Pakistan), N. Africa (Morocco), N. America (Virginia).

**Vulpicida J. E. Mattsson & M. J. Lai (1993)**


Literature: European species are treated by Smith et al. (2009), and Clauzade & Roux (1985) under Cetraria. Also useful are Brodo et al. (2001), Nash et al. (2002) and Thell & Moberg (2011).

Six species of cetrarioid lichens, four of which occur in Europe. Only one is likely to occur in Greece.

**Vulpicida pinastri** (Scop.) J. E. Mattsson & M. J. Lai (1993)


Descriptions: Clauzade & Roux (1985) as *Cetraria pinastri*; Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Scattered in northern Greece. On acidic bark and on wood at altitudes 1100 - 2300 m.

A conspicuous species of acidic bark in montane and boreal forests. European distribution rather northerly but
there are a few southern outliers (e.g. Sardinia, Calabria). Also Asia (widespread), N. America (widespread).

**Waynea Moberg (1990)**


Literature: There is a short summary of the European species in Llop (2006b).

Six species, four of which occur in Europe.

11 Soredia present. Ascospores to 3-septate.

22 Ascospores 3-septate, 20 - 33 µm long. Squamules ascending. Cortex hyphal. (W. adscendens)

2 Ascospores 1-septate, 9 - 13 µm long. Squamules flat to ascending. Cortex cellular. **W. stoechadiana**

1 Soredia absent. Ascospores various.

22 Ascospores 1 - 3 -septate, 12 - 18 µm long. **W. giraltiae**

2 Ascospores (3) 5 - 7 -septate, 30 - 45 µm long. **W. cretica**

**Waynea cretica** Llop (2006)


Description: see the protologue.

Crete, on bark of *Acer sempervirens* at an altitude of about 150 m.

Known only from Portugal and Crete.

**Waynea giraltiae** van den Boom (2009)

*Lichenologist* 42(1): 30-33.

Description: See the protologue.

Skyros, on bark of *Quercus coccifera* at an altitude of 420 m.

Only Portugal, Spain and Greece.


Ikaria, on bark at an unspecified altitude.

Southern Europe from Portugal to Greece. Also Macaronesia, Africa (Algeria, St Helena). Reports for N. America are incorrect.

**Xanthoparmelia** (Vain.) Hale (1974)


Literature: Formerly most European publications had a broad or erroneous concept of several species, and so are apt to be confusing. The safest starting point is Giordani et al. (2002), who give a key to the species occurring in Italy. Their descriptions are brief, however, and can be supplemented by information in Brodo et al. (2001) and Nash et al. (2004), which between them treat many of the European species. See also Blanco, Crespo & Elix (2005).

*X. taractica* (Kremp.) Hale is not a European species, but the name, or its synonym *Parmelia taractica* Kremp., has sometimes been misapplied to European species. Most such usages by continental authors refer to *X. stenophylla*. Some British authors have used the name for *X. conspersa* (Coppins 2004a).

Thallus foliose, heteromerous, to several cm diameter. Upper surface: yellow-green or green, not pruinose. Lobes: to 5 mm wide but usually narrower, usually at least moderately adpressed. Lower surface: brown to black, attached by rhizines. Isidia: present in some species. Pseudocyphellae: absent. Soralia: present in only one European species. Rhizines: simple, brown to black. Photobiont: green.

Differs from *Parmelia* in the colour of the upper surface. Differs from other genera with a yellow-green upper surface in: the shape of the lobes, which are always fairly narrow; the adpressed lobes; and the preferred substrate, siliceous rock.

Around 700 species are recognised at present, though this number may be artificially high as some species have been delimited on very narrow chemical grounds. That practice, when other distinguishing characters are absent, seems to me as unsound as the old taxonomists’ habit of giving formal recognition to every trivial variation in morphology.
Xanthoparmelia has suffered from it more than most genera. The genus is best represented in the Southern Hemisphere, especially South Africa and Australia, and the European flora is comparatively poor, with only 22 species. Its species usually occur on siliceous rock, occasionally on soil overlying such rock, mainly in regions with a fairly dry, warm or hot climate. The genus has a complex chemistry.

Closely related species with a brown thallus are treated under Neofuscelia.

111 Soralia present. Isidia absent. **X. mougeotii**

1 Isidia present.

22 Thallus vagrant, free-growing on soil. (X. isidiovagans)

2 Thallus saxicolous, attached to substrate.

33 Lower surface everywhere pale brown or mottled. These species are rare in Europe.

44 Medulla K+ yellow > dark red (salazinic acid). (X. mexicana)

4 Medulla K+ yellow or orange (stictic acid). **X. plittii**

3 Lower surface brown, dark brown or black, except sometimes at margin which may be paler. Some species very common.

44 Medulla K+ (yellow >/= deep red or dark red (salazinic acid). Isidia various, but often globose.

55 Isidia very slender (0.04 - 0.08 mm wide), scattered, short, subglobose becoming cylindrical, simple or sparingly branched. Norstictic acid absent. (X. isidiigera)

5 Isidia not very slender, usually ±globose, sometimes becoming cylindrical, simple. Norstictic acid sometimes present in small amounts. **X. tinctina**

4 Medulla K+ yellow, orange or pale red, but never strongly K+ deep red (stictic or norstictic acid). Isidia cylindrical (may be globose when young and may become coralloid when old).  

55 Medulla K+ yellow > pale red. Norstictic acid present. **X. conspersa**

5 Medulla K+ yellow. Norstictic acid absent.

66 Lower surface brown to dark brown, never black. Isidia sometimes becoming coralloid-branched. (X. subverrucigera)

6 Lower surface black, at least away from margins (may be brown to dark brown at margins). Isidia simple to sparingly branched. **X. verrucigera**

1 Soralia and isidia absent.

22 On soil. (X. camtschadalis), (X. desertorum), (X. pseudohungarica), (X. subdiffuens)

2 On rock.

33 Lower surface black, at least in places. If present in Greece then probably restricted to uplands.

44 Lobes in central part of thallus with flat, overlapping lobules. Lobes at margins of thallus 0.8 - 1.5 mm wide.

Medulla K+ yellow-orange. Rhizines moderately dense, simple. (X. angustiphylla)

4 Lobes in central part of thallus with dense, ascending lobules. Lobes at margins of thallus 1 - 3 mm wide.

Medulla K+ yellow > red. Rhizines sparse, occasionally branched and tufted at apices. (X. vicentii)

3 Lower surface pale brown or mottled. Not restricted to uplands.

444 Medulla K- or K+ yellow-brown. **X. protomatrae**

44 Medulla K+ yellow or yellow > pale red (stictic acid). **X. cumberlandia**

4 Medulla K+ yellow > dark red (salazinic acid).  

55 Upper surface with prominent white maculae. **X. stenophylla**

5 Upper surface without maculae. (X. sublaevis)

Xanthoparmelia conspersa (Ehrh. ex Ach.) Hale (1974)


Thallus: foliose, to 6 cm diameter, pale green, not pruinose. Lobes: 0.5 - 1 mm wide, often convex, 200 - 250 µm thick; upper surface smooth when young, often wrinkled or folded later; lower surface black, sometimes brown at margins. Isidia: rather sparse, cylindrical, occasionally becoming coralloid, 0.1 - 0.3 x 0.1 mm, concolorous with thallus except for black tip. Soralia: absent. Cortex: 20 µm thick. Medulla: white. Lower cortex: 15 - 20 µm thick, pale brown to brown, inner part cellular, cells 4 µm wide, outer part formed of expanded hyphal tips. Pycnidia: sometimes abundant, laminal, black, 0.07 - 0.1 mm diameter; in section: 100% immersed, ±globose, 200 µm tall, 160 µm wide, ±colourless. Conidia: colourless, bacilliform to bifusiform, 5 - 6 x 0.75 µm. Chemistry: medulla K+ yellow > red-orange (norstictic acid), C-, P+ orange-yellow, I-; thallus UV-. Photobiont: green, cells globose, 10 - 12 µm diameter, forming a continuous, regular layer 30 - 40 µm thick.

Apparently throughout Greece, though some older records might refer to other species of the genus. On siliceous
rock at altitudes 0 - 1600 m.
Widespread in Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), perhaps Caribbean (St Lucia), C. America (CR, Guatemala, Mexico), S. America (widespread) Pacific (Hawaii, Marquesas, New Caledonia). Reports for Australasia are incorrect.

**Xanthoparmelia cumberlandia** (Gyeln.) Hale (1974)
Description: Nash et al. (2004).
Island of Samothraki, on siliceous rock at an altitude of 870 m.
In Europe reported only for Corsica, Italy and Greece, but perhaps overlooked. Also western Asia (Turkey), Africa (S. Africa), N. America (widespread), Caribbean (DR), C. America (Guatemala, Mexico), S. America (Brazil, Uruguay, Venezuela).

**Xanthoparmelia mougeotii** (Schaer. ex D. Dietr.) Hale (1974)
Descriptions: Clauzade & Roux (1985) as *Parmelia mougeotii*; Nash et al. (2004); Smith et al. (2009).
Chios, on siliceous rock at an altitude of 525 m.
Throughout cold and temperate Europe, rare in the south. Also western Asia (Turkey), Africa (South Africa), N. America (widespread), Caribbean (DR), perhaps C. America, S. America (widespread), Pacific (Hawaii), Antarctica (Marion Is).

**Xanthoparmelia plittii** (Gyeln.) Hale (1974)
Descriptions: Nash et al. (2004); Thell & Moberg (2011).
Island of Samothraki, on siliceous rock at an altitude of 440 m.
Scattered throughout Europe but not common. Also Macaronesia, southern Africa (widespread), N. America (widespread), Caribbean (Cuba, DR, Guadeloupe), C. America (Guatemala, Mexico, Nicaragua), S. America (widespread).

**Xanthoparmelia protomatrae** (Gyeln.) Hale (1974)
Easily separated from other Greek species by the absence of isidia, and the weak medullary reaction with K.
Scattered, with no clear pattern, on siliceous rock and on soil at altitudes 100 - 500 m.
Widespread in warmer parts of Europe, but present to as far north as southern Norway. Also Asia (widespread), Africa (S. Africa).

**Xanthoparmelia stenophylla** (Ach.) Ahti & D. Hawksw. (2005)
Ahti & Hawksworth (2005) show that the correct epithet is *stenophylla*, not *somloensis*.
Fairly common in the northern half of Greece, uncommon in the south. Usually on siliceous rock, but also reported once each from bark of *Quercus* and overgrowing bryophytes on soil. At altitudes 0 - 2050 m. The lichenicolous fungus *Stigmidium xanthoparmeliarum* has been reported once from this host.
Much of Europe, except for the far north. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, perhaps elsewhere), N. America (widespread), perhaps Caribbean (St Lucia), C. America (Mexico), S. America (widespread).

**Xanthoparmelia tinctina** (Maheu & A. Gillet) Hale (1974)
Thallus: foliose, to 19 cm diameter. Lobes: 1.2 - 5 mm wide, about 1.5 - 2 times as long as wide (never strongly elongated), 185 - 270 µm thick near margins, to 350 µm in older parts of thallus, flat, sometimes overlapping, usually moderately (but never tightly) adpressed; margins smooth to moderately crenulate, never deeply incised; older parts
sometimes becoming wrinkled, warded or deeply cracked. Upper surface: pale yellow-green, yellow-green or green at margin, usually slightly darker or with a brown-green tinge in central parts, mostly matt, shiny only at extreme margins (last 0.2 mm), not pruinose, usually smooth but sometimes wrinkled or cracked in central parts. Lower surface: black, sometimes pale brown or brown at margin, smooth, attached by rhizines. Rhizines: simple, black, sometimes brown when young. 0.15 - 0.5 x 0.05 - 0.07 mm, formed of ±parallel agglutinated hyphae. Isidia: always present, often abundant in central part of thallus, sometimes also present on thalline margin of apothecia, absent from lobe margins, sometimes eroding and leaving distinct depressions in thallus surface, usually crowded, less commonly rather dispersed, lower part concolourous with thallus, upper part concolourous with thallus or brown-green, usually globose, sometimes shortly cylindrical, simple, 0.1 - 0.3 (0.45) x 0.08 - 0.15 mm, containing photobiont cells. Pseudocyphellae: absent. Soralia: absent. Upper cortex: 10 - 15 µm thick, colourless, without distinct structure (even in K); K-, N-. Medulla: usually white, in some specimens very pale orange in upper part, 125 - 200 µm thick, of loosely interwoven hyphae; hyphae 4 µm wide, without visible septa, covered in small (0.5 µm) crystals; crystals present everywhere in medulla but distinctly more abundant in pigmented parts, if present; these crystals are clearly the source of the K+ red medulla reaction, as they turn deep red in K. Lower cortex: 10 - 15 µm thick, orange-brown, cellular; cells rounded, 5 µm diameter, with fairly thick wall; K-, N-. Apothecia: sometimes present, sessile to shortly stalked, very concave (disc almost obscured by infolded thalline exciple), 1.25 - 4.5 mm diam, not pruinose. Disc: pale brown to brown. Thalline margin: present, sometimes isidiate, smooth, persistent; in section: 100 - 160 µm wide in upper part, of which cortex 20 - 30 µm. Exciple: not visible externally. Epitheicum: colourless to brown, K-. Hymenium: 40 - 55 µm tall, colourless, Kl- or almost. Subhymenium: ±colourless, 25 µm tall, of anastomosed hyphae on a general horizontal trend (best seen in K). Hypothecium: 40 - 50 µm tall, colourless, of anastomosed hyphae (best seen in K), more loosely packed than in subhymenium, on an overall vertical trend. Paraphyses: simple, 2.5 - 4 µm wide, ±cylindrical, with distinct septa, not or very slightly capitiate, not moniliform, upper part of apical cells sometimes with thin crescent of brown pigment. Ascii: 40 x 17 - 20 µm, broadly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 12 x 5 - 6.5 µm, wall not prominent, 8 per ascus. Chemistry: medulla K+ strongly red (diffusing orange solution in section; irregular red crystals to 2.5 µm wide often forming (said to be salazinic acid), sometimes also small amounts of norstictic acid crystals), C-, P+ yellow > orange, I-, UV+ blue-white; thallus K-, C-, KC-, P-, UV+ pale green in marginal parts, UV- in central part. Photobiont: green, cells globose, 10 - 13 µm diameter. Photobiont layer: 30 - 45 µm thick, usually continuous and regular, sometimes discontinuous and irregular in older, warded or cracked parts of thallus.

Easily recognised by the globose isidia and the K+ deep red reaction of the medulla.

Throughout Greece. On siliceous rock, occasionally on (presumably leached) calcareous rock, at altitudes 0 - 1250 m. The lichenicolous fungus Nesolechia oxyspinon has been reported once from this host.

Widespread in warmer parts of Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (Arizona), C. America (Mexico), perhaps S. America (Argentina). Reports for Australasia are incorrect.

Xanthoparmelia verrucigera (Nyl.) Hale (1990)

Thallus: foliose, to 4 cm diameter, pale green, not pruinose. Lobes: 1 - 2 mm wide, 200 - 225 µm thick, often convex; lower surface black, sometimes brown at margins. Rhizines: black, usually simple, sometimes forked, 0.3 - 0.5 x 0.06 - 0.08 mm; in section formed of ±parallel or wavy agglutinated hyphae. Pseudocyphellae: absent. Soralia: absent. Isidia: sparse to very abundant, sometimes entirely obscuring thallus surface, usually cylindrical, sometimes branched, 0.15 - 0.5 x 0.1 mm, usually brown to dark brown at apex, elsewhere same colour as thallus. Cortex: 12 µm thick, colourless to grey-brown. Medulla: white. Lower cortex: 15 µm thick, brown, formed of expanded hyphal tips and sometimes appearing obscurely cellular. Chemistry: medulla K+ yellow or pale orange-yellow (no crystals), C-, P+ rather faintly yellow, I-.

Scattered, with no clear pattern. On siliceous rock or on bark of Olea europaea at altitudes 10 - 400 m.

Southern and south-central Europe. Also Macaronesia, western Asia (Turkey), Africa (Kenya, widespread in southern Africa), perhaps N. America (Saskatchewan), perhaps Caribbean (Guadeloupe, St Thomas Is), Pacific (Easter Is).

Xanthoria (Fr.) Th. Fr. (1860)


Literature: There are good descriptions of many species in Smith et al. (2009). Several southern species not included there are discussed by Wasser & Nevo (2005). Nash et al. (2004) is also useful. For the remaining taxa, it is

*Xanthoria* is used here in the traditional sense to mean species of *Teloschistaceae* with a foliose growth habit, or subcrustose but with a lower cortex. It is being subdivided, but the new taxonomy is not yet stable. As for *Caloplaca*, I indicate for each species the new genus that some authors have used (or one such genus, where there are conflicting views), for the benefit of those who wish to adopt them.

Because the genus as circumscribed here is artificial, a detailed description would be inappropriate. All species have a yellow, orange or orange-red, foliose (or ±foliose) thallus that reacts *K*+ purple; yellow, orange or orange-red apothecia, also *K*+ purple; and colourless, polariiloculic ascospores.

In this sense, *Xanthoria* contains about 51 species, of which about 21 occur in Europe. They occur on most substrates except leaves, but show a preference for slightly nutrient enriched habitats.

*X. parietina* subsp. *ectanea* is not distinguished in the key, but is discussed briefly below.

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111 Isidia or isidia-like projections present. Usually on calcareous rock, less commonly on mossy soil.

22 Thallus with broad lobes; apices 1 - 7 mm across. Thallus usually without a reddish tinge.

**X. calcicola**

33 Isidia cylindrical or coralloid, to 0.5 (0.7) mm tall. **X. stiligera**

3 Isidia granular or cylindrical, 0.1 - 0.3 mm tall. **X. mediterranea**

2 Thallus with narrow lobes; apices to 1 mm across. Thallus with or without a reddish tinge.

33 Isidia soon breaking down into soredia. Thallus yellow or orange, without a red tinge. **X. (Rusavskia) sorediata**

3 Isidia not breaking down into soredia. Thallus sometimes with a reddish tinge.

44 Medulla with bundles of dense hyphae. Isidia granular, restricted to central part of thallus. On coastal rock, especially siliceous volcanic rock. (X. (Martinjahnsia) resendei)

4 Medulla without bundles of dense hyphae. Isidia cylindrical, not restricted to central part of thallus. On calcareous rock or soil, or overgrowing bryophytes thereon. **X. (Zeroviella) papillifera**

11 Isidia absent. Soralia or marginal blastidia (that superficially resemble soralia) present.

22 Lower surface with well-developed rhizines (Note 1).

33 Thallus very small, to 3.5 mm diameter. (X. (Gallowayella) fulva), (X. (Xanthomendoza) oregana)

3 Thallus larger, generally at least 10 mm diameter.

44 Lobes 3 - 5 mm long. **X. (Oxneria) fallax**

4 Lobes 5 - 8 mm long. **X. ulophyllodes**

2 Lower surface ±without rhizines (Note 1).

33 Thallus to 3 (5) mm diameter. (X. (Massjukiella) ucrainica)

3 Thallus larger, usually at least 10 mm diameter.

44 Thallus rosette-forming; lobes adpressed. **X. (Rusavskia) sorediata**

4 Thallus cushion-forming; lobes ascending. **X. (Polycauliona) candelaria**

1 Isidia, soralia and blastidia absent.

22 Thallus poorly developed, forming small cushions. (X. (Polycauliona) polycarpa)

2 Thallus well-developed, distinctly foliose.

3 Lobes strongly convex. Nearly always on rock.

44 Medulla with bundles of dense hyphae. On coastal rock, especially siliceous volcanic rock. (X. (Martinjahnsia) resendei)

4 Medulla without bundles of dense hyphae. Not usually present at sea-level. **X. elegans**

3 Lobes ±flat. On various substrates.

44 Lower surface with rhizines (Note 1). Lobes to 2 mm wide. On bark.

555 Thallus pale brown or pale yellow-brown, becoming green-yellow when wet. (X. steineri)

55 Thallus yellow to orange-yellow, not warty in central part (except for pycnidia, which occur in red-orange warts). Lobes densely branched at ends. Apothecia numerous. Disc without a red tinge. **X. (Gallowayella) aphrodites**

5 Thallus yellow-orange to red-orange, uneven to undulate or warty in central part. Lobes not densely branched at ends. Apothecia said to be rare (Note 2). Disc red-orange. **X. (Xanthomendoza) hermonii**

4 Lower surface ±without rhizines (Note 1). Lobes sometimes more than 2 mm wide. On bark or rock.

55 Upper surface finely roughened (Note 3), sometimes with faint yellowish pruina. Apothecia usually absent or few, rarely abundant. On rock, usually close to the sea. **X. aureola**

5 Upper surface often smooth, less commonly finely roughened, usually without pruina. Apothecia usually
abundant. Very common on bark, sometimes found on other substrates; not restricted to maritime habitats. 66 Lobes rounded, (1) 2 - 4 (7) mm wide at the tips. Thallus entirely covering substrate. Common. X. parietina

6 Many lobes distinctly elongated, 0.5 - 1 mm wide at the tips (though some rounded and broader ones may also be present). Gaps present between the elongated lobes, so thallus not entirely covering substrate. Not common. X. monofoliosa

(1) Many species are attached by hapters, not rhizines. Rhizines are usually much longer than wide. Hapters are usually wider than long, or have length and width about equal. Immature hapters, or hapters not in contact with the substrate, sometimes resemble rhizines, but they are generally few in number whereas true rhizines are usually numerous. In species with rhizines, rhizines may also occur on the lower surface of the apothecia, but hapters never occur there.
(2) My only collection, referred tentatively to this species had many apothecia.
(3) The roughening is subtle and on a very small scale. It is best seen in a binocular microscope at a magnification of x30. Comparison with cortical material of Xanthoria parietina may be helpful, though a few collections of X. parietina also have a surface that is finely roughened in at least a few places.

Xanthoria (Gallowayella) aphoridites Kalb et al. (1997)

Thallus: foliose, forming rosettes to 5 cm diameter, orange to orange-yellow, not pruinose, without vegetative propagules. Lobes: 6 - 10 x 1 - 2 mm, sometimes overlapping, tips and sometimes margins dissected into small lobules, not strongly adpressed but usually close to surface even at tips. Lower surface: white. Rhizines: abundant, white, 0.25-0.7 x 0.05 mm, simple; in section: mostly colourless, occasionally with a little orange-brown pigment, of closely-packed, parallel, straight or slightly wavy hyphae. Cortex: 20 - 25 µm thick, pale orange-brown, zcellular, cells 5 - 7 x 5 µm, not strongly oriented; K+ purple-red. Medulla: white. Lower cortex: 20 - 35 µm thick, colourless, cellular. Apothecia: common, 0.7 - 1.2 mm diameter, sessile to almost stalked, concave, not pruinose. Disc: orange. Thalline margin: orange-yellow, paler than disc, persistent; in section: 80 - 125 µm wide at sides of apothecia, to 200 µm on lower surface. Exciple: not visible externally; in section: 20 - 30 µm wide, colourless in inner part, orange-brown near surface. Hyphal, a few lumina sometimes visible in outermost part. Epithecium: orange-brown, K+ purple-red. Hymenium: 70 - 75 µm tall, colourless. Hypothecium: 70 - 90 µm tall, colourless. Paraphyses: simple, 1 - 1.5 µm wide at base, 1.5 - 3 µm at apex, not capitate or moniliform, usually without visible septa. Ascii: 50 - 55 x 17 - 20 µm, ± clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 13 - 15 x 7 - 7.5 µm, septum 7 - 7.5 µm, 8 per ascus. Chemistry: thallus K+ purple, UV+ orange. Photobiont: green; cells globose, 8 - 13 µm diameter.

Superficially resembles X. parietina, but easily distinguished by its abundant rhizines and distinctly indented, not smooth, lobe tips.

Scattered in the western half of Greece. On bark or on lichens, at altitudes 200 - 400 m. Recorded from Castanea sativa, Olea europaea and Quercus pubescens. As a parasite, recorded from Physconia perisidiosa and Physconia venusta.

Calabria, Greece and Cyprus. Also western Asia (Turkey).

Xanthoria aureola (Ach.) Erichsen (1930)

Thallus: foliose, to 7 cm diameter, yellow-orange to dark orange, without vegetative propagules. Lobes: 1.5 - 3 mm wide, rounded, ±adpressed to slightly ascending, flat to slightly concave, surface not quite smooth, sometimes yellow pruinose at tips; 150 - 280 µm thick near margin, 400 - 800 µm in older parts. Lower surface: pale yellow near margins, almost white in central parts, sometimes very irregular, attached by hapters. Hapters: 200 - 250 µm long, 400 - 600 µm wide, colourless, without a cortex, formed of hyphae ± parallel to axis. Cortex: 15 - 30 µm thick, orange in upper part, colourless in lower part, structure obscured by pruina; K+ purple-red, diffusing purple-red pigment into solution, where it eventually forms minute crystals. Lower cortex: 10 - 22 µm thick, mostly colourless, initially formed of vertical hyphae, these later broaden giving a weakly cellular texture. Medulla: formed of two distinct populations of hyphae; the first forms long bundles, 20 - 40 µm, wide of densely agglutinated parallel hyphae, the bundles are oriented ± parallel to axis of lobes; the second population consists of loose, irregularly oriented anastomosing hyphae. Chemistry: thallus K+ purple. Photobiont: green, of globose cells 10 - 12 µm diameter, forming a continuous layer 25 - 50 µm thick.

This species can be mistaken for Xanthoria parietina, but that species is usually abundantly fertile. Doubtful cases can be resolved by examining the upper surface of the lobes, which is smoother in X. parietina than in X. aureola. X. calcicola differs in having abundant isidia. X. aureola is probably restricted to nutrient enriched rock close to the sea. All the material that I have seen was from siliceous rock, but there are reports in the literature for calcareous rock too.
It remains unclear to me whether \textit{X. aureola} and \textit{X. calcicola} should be regarded as synonymous. I have seen material with intermediate characters.

Fairly common and widely distributed in the southern half of Greece, uncommon in the north. On calcareous or siliceous rock at altitudes 0 - 1400 m, but most reports are from below 200 m. Older authors may have misapplied the name \textit{X. aureola} to \textit{X. calcicola}, and reports from above 200 m, or from inland localities, may be unreliable.

Distribution slightly uncertain, owing to confusion with other species. Probably widespread in Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside tropics), perhaps S. America (Chile). Reports for Australasia are incorrect; those for N. America and Antarctica seem doubtful to me.

\textbf{Xanthoria calcicola} Oxner (1937)

Vviznachnik lishajnikiv URSS 302; (?) Parmelia parietina f. saxicola Hepp; Xanthoria parietina f. congranulata (Cromb.) de Lesd.

Thallus: foliose, forming rosettes to 6 cm diameter, mostly orange to dark orange, pale orange in a thin, marginal zone; 130 - 180 $\mu$m thick at marginal lobes. Lobes: 2 - 5 mm wide, weakly adpressed. Isidia: abundant in central part of thallus, eventually completely obscuring the lobes, usually ±globose, 0.2 - 0.4 mm diameter. Soralia: absent. Lower surface: yellow, attached by hapters. Hapters: 400 $\mu$m long, 450 $\mu$m wide, of colourless, agglutinated hyphae oriented along the hapter, without a cortex. Upper cortex: 20 - 30 $\mu$m thick, orange in outer 5 - 10 $\mu$m, colourless in inner part, of distinctly rounded (never angular) cells 6 - 8 $\mu$m diameter; K+ red, diffusing red pigment into solution where it forms minute crystals. Lower cortex: 15 $\mu$m thick, orange in outer 2 - 5 $\mu$m, colourless in inner part, of rounded cells 3 - 4 $\mu$m diameter; K+ red (as for upper cortex). Medulla: of loose, but not interwoven, hyphae oriented parallel to long axis of marginal lobes, sometimes with distinct gaps that lack hyphae. Apothecia: sometimes present, sessile, concave, 0.7 - 1.4 mm diameter, not pruinose. Disc: yellow to orange. Thalline margin: yellow to orange, persistent; in section: 125 - 160 $\mu$m, cortex cellular. Exciple: not conspicuous externally; in section: 20 - 40 $\mu$m wide, orange-brown at surface, colourless in inner part, hyphal, a few elongated lumina sometimes present in outermost part. Epithecium: orange-brown, K+ red, pigment diffusing into solution and forming minute crystals. Hymenium: 80 $\mu$m tall, colourless. Subhymenium: well differentiated, 50 - 60 $\mu$m tall, very pale yellow-grey. Hypothecium: 25 - 35 $\mu$m tall, colourless. Paraphyses: usually not moniliform. Ascii: 53 - 70 x 18 - 20 $\mu$m, clavate, Teloschistes type. Ascospores: colourless, polarilocular, lumina often hourglass shaped when young, ellipsoid, 12 - 12.5 x 7 - 8 $\mu$m, septum 5 - 6.5 $\mu$m, 8 per ascus. Pycnidia: sometimes frequent, arising on apex of isidia where they appear as dark orange dots, darker than rest of isidium, 0.1 mm wide; in section: 100% immersed in an isidium, ±globose, 250 $\mu$m tall, 200 $\mu$m wide, orange-brown in a surface layer 30 $\mu$m thick, colourless elsewhere, without an obvious wall. Conidia: colourless, ellipsoid, 2.5 x 1 $\mu$m. Chemistry: thallus K+ purple. Photobiont: green, cells globose, 10 - 15 $\mu$m diameter, forming a continuous layer 25 - 30 $\mu$m thick.

This is distinctive species is not likely to be confused with any other, but see the note under \textit{X. aureola}.

Throughout Greece, usually (but not always) in sites close to the sea. Usually on calcareous or siliceous rock, occasionally on bark, at altitudes 0 - 700 m.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Tunisia, Egypt). Reports for S. America (Argentina) may be unreliable.

\textbf{Xanthoria (Polycauliona) candelaria (L.) Th. Fr. (1861)}


Kondratyuk & Kärnefelt (1997) suggested that \textit{X. candelaria} var. discolor, the type of which is from Mt. Olympos, may be a synonym of \textit{X. oregana} (as \textit{X. poeltii}). If correct, it would be the only Greek record of that species. However, they had not seen the type of \textit{X. candelaria} var. discolor.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Mt. Olympus, on calcareous rock at an altitude of 2300 m.

Throughout Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), Africa (probably widespread), N. America (widespread), Caribbean (Cuba), C. America (Mexico), S. America (widespread), Australasia (NZN, NZS), Antarctica (widespread).

\textbf{Xanthoria elegans (Link) Th. Fr. (1860)}

Lich. Arct. 69; \textit{Lichen elegans} Link (1791), Annln Naturges. 1: 37; \textit{Caloplastic elegans} (Link) Th. Fr.; \textit{Gasparriina elegans} (Link) Th. Fr.; \textit{Gasparriina elegans var. tenius} (Wahlenb.) Stein; (?) \textit{Physcia elegans f. fasciata} Arnold; \textit{Placodium elegans} (Link) DC.

Thallus: foliose, dark orange, not pruinose, to 2.5 cm diameter, without vegetative propagules. Lobes: elongate, 2.5 (7) x 0.35 - 0.5 (1) mm, branching rather infrequently, convex, ±adpressed, 280 - 380 $\mu$m thick. Upper cortex: 15 - 20 $\mu$m thick, mostly orange, formed of vertical hyphae; these sometimes swell producing a weak cellular texture; K+ red, diffusing red pigment into solution. Lower cortex: 30 - 38 $\mu$m thick, orange in outermost 5 $\mu$m, elsewhere colourless,
structure as for upper cortex; pigmented part K+ red, as for upper cortex. Medulla: mostly of broad (3 - 4 µm wide), loose, anastomosing hyphae, often of irregular orientation but in other places tending to align along lobe axis; sometimes with distinct gaps almost devoid of hyphae. Apothecia: abundant, sessile, flat to slightly convex, not pruinose, 0.5 - 1 mm diameter. Disc: orange to dark orange. Thalline margin: orange, slightly paler than disc, smooth, persistent; in section: 100 - 200 µm wide, cortex 40 - 50 µm wide. Exciple: not apparent externally; in section: not well developed, 12 - 30 µm wide, hyphal. Epithecium: orange-brown to brown-orange, K+ red, diffusing red pigment into solution. Hymenium: 60 - 80 µm tall, colourless. Hypothecium: 40 - 50 µm tall, colourless, upper part forming a poorly differentiated subhymenium. Paraphyses: simple, 1 µm wide at base, 3 - 4 µm at apex, moniliform. Asci: narrowly clavate, 50 - 62 x 14 - 17 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 10 - 12 x 6 - 7 µm, septum 3.5 - 4 µm, 8 per ascus. Photobiont: green, cells globose, 10 - 17 µm diameter, aggregated into large clumps between which hyphae from medulla pass directly up to cortex; forming a discontinuous layer 60 - 120 µm thick.

The elongated, dark orange (almost red-orange), convex lobes easily distinguish this species from other Greek Xanthoria species. In doubtful cases, the presence of a lower cortex excludes Caloplaca.

Scattered with no clear pattern. On rock, usually calcareous, at altitudes 0 - 2800 m, but usually above 1500 m. Subcosmopolitan outside the tropics.

Xanthoria (Oxneria) fallax (Hepp) Arnold (1881)


Scattered in the northern half of the mainland, on bark at altitudes 700 - 1500 m. Reported from Prunus pseudarmeniaca and Ulmus.

Widespread in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, widespread in E. Africa), N. America (widespread), C. America (Mexico), S. America (Argentina, Uruguay, Brazil). Pacific (Hawaii).


Thallus: foliose, to 3 cm diameter, orange to dark orange, not pruinose, without vegetative propagules, central part with numerous warts. Lobes: 0.7 - 2 mm wide at margin of thallus, flat to slightly convex, 160 - 260 µm thick in marginal parts. Rhizines: frequent, white to pale yellow, simple, to 0.9 mm long, about 70 µm wide along much of their length, to 130 µm wide near base; they start development as downward bumps on lower cortex and are entirely cellular until they reach a length of 70 - 100 µm, thereafter they are clearly formed of agglutinated hyphae parallel to axis of rhizine; cortex absent. Upper cortex: 20 - 30 µm thick, orange in outer 5 - 10 µm, colourless elsewhere, cellular; cells isodiametric or slightly elongated with long axis vertical, 5 - 9 x 5 µm; K+ red, diffusing red pigment into solution where it forms minute crystals. Lower cortex: 25 - 50 µm thick, often entirely colourless, sometimes orange in outermost 5 µm, structure as for upper cortex. Medulla: of broad hyphae, 3 - 4.5 µm wide, forming a loose, anastomosed network. Apothecia: frequent, sessile, concave to flat, not pruinose, 0.7 - 2.1 mm diameter, lower surface often with rhizines to 0.5 mm long. Disc: red-orange. Thalline margin: present, distinctly paler than disc, persistent; in section: 70 - 120 µm wide, cortex cellular. Exciple: not apparent externally; in section: poorly developed, 15 µm wide. Epithecium: orange, K+ red. Hymenium: 70 µm tall, colourless. Hypothecium: 120 µm tall, colourless. Paraphyses: apex 3 - 4 µm wide, slightly moniliform. Asci: 50 - 60 x 16 - 17 µm, ± clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 13 - 16 x 7 - 8 µm, septum 8 - 9 µm, 8 per ascus. Pycnidia: fairly common, laminal, dark orange, sometimes with almost black central point, 0.1 - 0.15 mm diameter; in section: 70% immersed, ± globose, 230 µm tall, 270 µm wide, orange in a surface layer 15 µm thick, colourless elsewhere, without distinct wall. Conidia: colourless, bacilliform, 4 - 5 x 1 µm. Photobiont: green, cells globose, 10 - 13 µm, forming a continuous layer 40 - 60 µm thick.

The presence of rhizines separates this species from most others in Xanthoria. Separation from X. aphrodites is problematic at present, as the only Greek collection of X. hermonii has intermediate characters. X. hermonii is said to be warded in the central part of the thallus and to have few apothecia, whereas X. aphrodites lacks warts but has numerous apothecia. The Greek collection has warts and many apothecia. The two species are also said to differ in the degree of branching of the lobes, but this distinction is difficult to apply without having seen both taxa, or good photographs.

Peloponnese, on bark of Quercus pubescens at an altitude of 1280 m. Because of the uncertainty in the determination of the only collection, Abbott (2009) did not include this species on the Greek list.

Known only from Greece (tentatively) and Israel (from where it was described).

Xanthoria mediterranea Giralt et al. (1993)
Crete and Corfu, on siliceous rock at altitudes 20 - 100 m.
Southern and south-central Europe. Also Macaronesia, western Asia (Turkey, Israel, Jordan), N. Africa (Libya, Egypt).

**Xanthoria monofolisosa** S. Y. Kondr. & Kärnefelt (2008)
in Kondratyuk et al., *Sauteria* 15: 275-277, nom. inval. (no type designated).
This taxon was referred to in earlier versions of this Flora as "the narrow-lobed morph of *X. parietina*", and I remain uncertain whether it is a good species or merely an extreme morph of *X. parietina*. The difficulty is that although typical material does fit Kondratyuk & Kärnefelt's concept of *X. monofolisosa*, some collections have intermediate characters and are difficult to place. I have referred ambiguous collections to *X. parietina*, and the description here is based on a single, unambiguous specimen.

**Xanthoria parietina** (L.) Th. Fr. (1860)
*Lich. Arct. 67; Lichen paretinum* L. (1753), *Sp. Pl. 1143; Parmelia parietina* (L.) Ach.; *Xanthoria parietina* f. corticola Hepp; *Parmelia rutilans* (Ach.) Ach.; *Physcia parietina* (L.) De Not.; *Xanthoria contortuplicata* auct. graec. p.p.; *Xanthoria coralloidea* (Flot. ex Hillmann) Szatrala; *Xanthoria parietina* var. adpressa Mereschk.; *Xanthoria parietina* f. chlorina (Chevall.) H. Olivier; *Xanthoria parietina* var. chlorina (Chevall.) H. Olivier; *Xanthoria parietina* var. elegantissima Zalhib.; *Xanthoria parietina* f. imbricata (A. Massal.) Arnold; *Xanthoria parietina* var. imbricata (A. Massal.) Müll. Arg.; *Xanthoria parietina* f. livida (De Not.) Jatta; *Xanthoria parietina* var. livida (De Not.) Sambo; *Xanthoria parietina* var. lobulosa auct. graec.; *Xanthoria parietina* f. polyphylla (Flot.) Hillmann; *Xanthoria parietina* var. retigerosa J. Steiner ex Zalhib.; *Xanthoria parietina* f. virescens (Wedd.) Sandst.
Thallus: foliose, to 6 cm diameter, usually orange, sometimes yellow or orange-yellow (grey, yellow-grey or green-grey in shade), usually not pruinose, without vegetative propagules (but some collections have numerous small lobules, probably regrowth after damage). Lobes: ±flat, rounded, (0.7) 2 - 4 (5.5) mm wide at margins, usually rounded, sometimes with a few folds or wrinkles, usually smooth on a fine scale (rarely roughened by slight trace of pruina near lobe margins), often adpressed, 110 - 230 µm thick. Lower surface: pale yellow near margin, white in central part, attached by hapters. Upper cortex: 15 - 20 µm thick, orange in outer 5 µm, elsewhere colourless, of rounded cells 3 - 5 µm diameter; pigmented part K+ red. Lower cortex: 12 - 17 µm thick, mostly colourless, of rounded cells 3 - 5 µm diameter. Medulla: white, 60 - 80 µm thick, of loose hyphae oriented predominately parallel to lobe axis. Apothecia: nearly always abundant, slightly stalked, concave to flat, not pruinose, 0.6 - 2.5 mm diameter. Disc: orange. Thalline...
margin: yellow to orange, persistent but sometimes thin; in section: 90 - 150 μm wide; cortex 20 μm wide at sides of apothecium, broadening to 55 μm on lower surface, distinctly cellular, cells 8 - 10 x 5 - 10 μm. Exciple: usually not apparent externally; in section: 15 - 20 μm wide, basically hyphal, a few elongated lumina sometimes present in outermost part. Epithecium: orange, K+ red, pigment diffusing into solution and forming minute crystals. Hymenium: 70 μm tall, colourless. Subhymenium: well differentiated, 10 - 35 μm tall, very pale grey, slightly opaque, individual hyphae not apparent. Hypothecium: 15 - 35 μm tall, colourless, individual hyphae usually visible, oriented mainly horizontally. Paraphyses: simple, 1.5 μm wide in lower part, 3 μm at apex, slightly moniliform. Asci: 55 - 60 x 15 μm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12 - 13 x 7 - 8 μm, septum 7 - 8 μm, 8 per ascus. Pycnidia: often absent, but if present usually abundant, forming red-orange warts 0.1 mm diameter; in section: 40% immersed, ellipsoid, 250 - 260 μm tall, 150 - 180 μm wide, brown-orange in surface layer 10 - 20 μm thick, elsewhere colourless, without distinct wall. Conidia: colourless, ellipsoid to almost bacilliform, 2 x 1 μm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K+ purple, C-, P-, UV+ dull orange-red. Photobiont: green, trebouxioid, cells globose, 7 - 12 μm diameter, forming a continuous layer 25 - 100 μm thick.

Lumina in young ascospores are often rounded and joined together in an hourglass shape, later they move apart and the neck joining them narrows.

The absence of rhizines, the abundant apothecia, and the large, rounded lobes are distinctive. Very common throughout Greece at altitudes 0 - 1400 m, rarely higher. Usually on bark (85% of records), sometimes on rock or wood. Recorded from a wide range of phorophytes, with no strong preference. The lichenicolous fungi Cercidiospora epicarpheinea, Opegrapha physciaria and Xanthorhica physciae have been reported from this host.

Xanthoria parietina subsp. ectanea (Ach.) Clauzade & Cl. Roux (1985)

Likenoj de Ocidenta Eŭropo 830; Parmelia parietina B P. (= var.) ectanea Ach. (1810), Lichenogr. universalis 464; Physcia parietina f. ectanea (Ach.) Harm.; Xanthoria parietina var. ectanea (Ach.) Kickx.

It is not clear to me whether this is a good taxon. It is not included in the key, but is discussed here for the sake of completeness. For a description see Clauzade & Roux (1985). Their description seems close to X. monofolisosa. Scattered with no clear pattern. On bark or base-rich rock at attitudes below 900 m, usually below 600 m.

Most European reports are from south of the Alps, though it was described from Sweden and Switzerland. Also Macaronesia, N. Africa (Morocco, Algeria, Egypt). There are reports from further afield, but their status is not clear to me.

Xanthoria (Rusavskia) soreadiata (Vain.) Poelt (1954)


Scattered thinly throughout Greece. On calcareous rock at altitudes 1100 - 2150 m. (A report for Rhodes, from close to sea level, may refer to X. elegans.) Widespread in northern and central Europe; rare south of the Alps. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico). There are also a few reports from the Southern Hemisphere, but it is not clear to me whether they refer to the same taxon.

Xanthoria stiliger a Giralt et al. (1993)

in Giralt et al., J. Hattori Bot. Lab. 74: 281.

Rhodes, at close to sea level. The substrate was not reported.
Southern Europe, from Iberian Peninsula to Cyprus; also southern Russia. Also Asia (Israel, Iran, southern Siberia), N. Africa (Morocco, Tunisia, Egypt).

Xanthoria ulophyllodes Räsänen (1931)

Die Flechten Estlands 105; Xanthomendoza ulophyllodes (Räsänen) Soöthing et al.

Descriptions: Nash et al. (2004) as Xanthomendoza ulophyllodes; Smith et al. (2009).
Macedonia, at an unknown altitude on bark of Populus.

Mainly central Europe, but reaching as far north as southern Sweden; rare south of the Alps. Also Asia (widespread), N. America (widespread).
Xanthoriicola D. Hawksw. (1973)


The genus has only one species.

**Xanthoriicola physciae** (Kalchbr.) D. Hawksw. (1973)


Conidia: pale brown, simple, globose, 4 - 5 µm diameter, forming an amorphous mass on the surface of the disc of *Xanthoria parietina*.

This fungus cannot be confused with any other.

Reported only from Peloponnese and Naxos, but probably much more widely distributed. Always on apothecia of *Xanthoria parietina*. At altitudes 20 - 160 m, and perhaps confined to truly Mediterranean vegetation.

Widespread in Europe. Also Macaronesia, Asia (Turkey, Israel, Iran), Australasia (Australia, NZN, NZS).

**Xylographa** (Fr.) Fr. (1836)


Literature: Spribille et al. (2014) monograph the genus.

About 23 species, 11 of which occur in Europe. Most occur on wood. All species have a rather northern distribution, and the genus is rare in Greece.

11 Soralia (or similar) present.

- 22 Soralia convex. Thallus fairly well developed, with convex areoles. (*X. vitiligo*)
- 2 Soralia concave. Thallus indistinct, areoles absent or poorly developed. (*X. soralisfera*)

1 Soralia absent.

- 22 Apothecia elliptical to linear; length usually more than 3 times width.
  - 33 Mature apothecia forming star-like clusters. (Immature ones may be linear.) **X. pallens**
  - 3 Mature apothecia ±linear. **X. parallela**
- 2 Apothecia rounded to narrowly elliptical; length usually less than 3 times width.
  - 33 Mature apothecia forming star-like clusters. (*X. lagoi*)
  - 3 Mature apothecia ±linear, forming chains. **X. trunciseda**

**Xylographa pallens** (Nyl.) Malmgren (1861)


Description: Spribille et al. (2014).

There is a single, unlocalised report for Thessaly.

Mainly northern and Central Europe; very rare south of the Alps. Also Asia (Turkey, Tibet), N. Africa (Morocco), N. America (widespread).

**Xylographa parallela** (Ach.) Behlen & Desberger (1835)


Thallus: crustose, very thin, pale grey to pale brown, forming patches elongated along grain of the wood, to 4 x 1 cm, sometimes delimited by black prothallus, 0.05 - 0.1 mm wide; in section: superficial part of thallus 15 - 35 µm thick, colourless, without distinct structure, immersed part of thallus extending about same distance into substrate. Apothecia: elongated along grain of the substrate, 0.35 - 2 x 0.1 - 0.2 mm, Disc: very dark brown to black. Thalline margin: absent. Exciple: dark brown to black, persistent; in section: 15 µm wide, colourless to pale brown, not closed below, of densely packed hyphae oriented in all directions, sometimes appearing obscurely cellular, K-, most pigment soluble in K. Epithecium: brown, sometimes with irregular upper surface, K-, pigment, except for that within paraphyses, soluble in K. Hymenium: 50 µm tall, colourless, K+ blue. Hypothecium: 25 µm tall, colourless, individual hyphae usually not visible. Paraphyses: sometimes anastomosed, 1 µm wide at base, 3 µm at apex, slightly moniliform, last couple of cells with green-black pigment (best seen after K has removed other epithecial pigments). Asci: 45 x 13 -
17 µm, wall thickened in upper part (to 8 µm), clavate, outer part of wall in upper half of ascus K+ blue, without apical apparatus. Ascospores: colourless, simple, ellipsoid, 11 - 13 x 5.5 - 6 µm, 8 per ascus. Chemistry: thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 10 - 12 µm diameter, forming clusters 25 - 45 µm diameter; photobiont layer discontinuous as a result.

The thallus is said to contain stictic acid (K+ yellow or orange, P orange), but this is hard to demonstrate in spot tests because the thallus is so thin. It is sometimes possible to observe an obscure K+ yellow, P+ orange reaction where the thallus is well-developed, but it is so faint that it would be recorded as K-, P- if the observer was not specifically seeking it.

Externally, the slightly brown tinge to the apothecia helps separate this species from superficially similar genera such as Opegrapha. Internally, the simple ascospores and chlorococcoid photobiont are diagnostic.

A rarely recorded species restricted to wood in the uplands. Recorded altitude range 1000 - 1150 m, but probably present at all altitude in montane forests. The only phorophytes explicitly recorded were Juniperus drupacea and J. oxycedrus.

Widespread in Europe, but south of the Alps restricted to the mountains. Also Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread), S. America (Argentina, Chile, perhaps elsewhere) Australasia (NZN, NZS).

Xylographa trunciseda (Th. Fr.) Minks ex Redinger (1938)
Deutschlands Kryptogamenflora 9(2.1): 216; Lecidea trunciseda Th. Fr. (1874), Lichenogr. Scand. 467.
Description: Spribille et al. (2014).
Known from a single site in Epiros, on wood of Pinus nigra at an altitude of 965 m.
Mainly northern and Central Europe; very rare south of the Alps. Also Asia (Siberia, Yunnan, Taiwan), North America (widespread).

Xylopsora Bendiksby & Timdal (2013)
Literature: The species are treated in the standard floras, under Hypocenomyce.
A group of two species, formerly placed in Hypocenomyce, but not closely related to that genus.

11 Squamules bullate or irregularly ascending, dull. Apothecia uncommon. Ascospores ellipsoid-fusiform, 0 - 1 (3) -septate, 7 - 15 µm long. X. caradocensis
1 Squamules usually adpressed, shiny. Apothecia usually present. Ascospores ellipsoid, simple, 4 - 8 µm long. X. friesii

Xylopsora caradocensis (Leigt. ex Nyl.) Bendiksby & Timdal (2013)
Descriptions: Clauzade & Roux (1985, 1989); Smith et al. (2009), both as Hypocenomyce caradocensis.
Crete, on wood of Cupressus sempervirens, at 1100 m altitude.
Mainly Alps to southern Scandinavia; very rare further south. Also Asia (Turkey, western Siberia).

Xylopsora friesii (Ach.) Bendiksby & Timdal (2013)
For more extensive descriptions see: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009), all as Hypocenomyce friesii.
A rare species, know from two sites in the Peloponnese and one in Epiros, at altitudes 700 - 1750 m, on bark (the only phorophyte explicitly reported was Pinus laricio) and on wood of Crataegus pycnolo b a.
Mainly Alps to northern Norway; rare south of the Alps. Also Macaronesia, Asia (Russia, Japan), N. Africa (Morocco), N. America (widespread), perhaps C. America, perhaps Australasia.
Zahlbrucknerella Herre (1912)


Literature: Henssen (1977) is a world monograph.

Eleven species, two of which occur in Europe. Only one is likely to be present in Greece, where the genus is rare.

**Zahlbrucknerella calcarea** (Herre) Zahlbr. (1924)


Known from a single site in Epirus, on calcareous rock at an altitude of 1100 m.

Widespread in Europe, though nowhere common. Also Asia (Tajikistan, Sichuan), Africa (Lesotho), N. America (widespread in western half), Australasia (Tasmania, NZN, NZS).

Zwackhiomyces Grube & Hafellner (1990)


Literature: Grube & Hafellner (1990). There is a more recent key to all species in Calatayud et al. (2007).

About 35 species of lichenicolous fungi, of which about 22 occur in Europe. Many are rarely reported, their distribution is not well known, and they key below might not include some that could occur in Greece. In case of difficulty, consult the full key in Calatayud et al. (2007), on which the key here is based.

11 On foliose lichens.

22 On Xanthoria. *Z. coepulonus*

2 Not on Xanthoria. *(Z. enchinulatus)* known from Physconia distorta. *(Z. melanohalae)* known from Melanohalea, *(Z. turcicus)* known from Physcia. Some other species that do not seem very likely to occur in Greece would also key out here.

1 On crustose or squamulose lichens. (Note 1)

22 Perithecia usually pyriform. Wall composed of a clear inner layer and dark outer layer.

33 On Lecanora campestris. Ascospores distinctly ornamented. *Z. sphinctrinoides*

3 On Romjularia lurida. Ascospores only slightly ornamented. *(Z. sphinctriniformis)*

2 Perithecia usually globose to pyriform. Wall not clearly layered.

333 Ascospores frequently more than 30 µm long. On Acarospora cervina. *(Z. cervinae)*

33 Ascospores mostly 19 - 30 µm long.

44 On Circinaria hoffmaniana (and perhaps related taxa). *(Z. aspiciliae)*

4 On Protoblastenia rupestris. *(Z. dispersus)*

3 Ascospores mostly less than 19 µm long. On other hosts.

44 Perithecia mostly 90 - 170 µm diameter in section.

55 Perithecia sunken, ± gall-forming. Ascospores 11 - 17 x 3 - 5.5 µm. On Porpidia. *(Z. martiniatus)*

5 Perithecia sessile to half immersed, not gall-forming. Ascospores (2) 4 - 6 per ascus, 15 - 20 x 5 - 7.5 µm.

On Verrucaria nigrescens group. *(Z. lithoicæae)*

4 Perithecia mostly 170 - 270 µm diameter in section.

55 Ascospores often 6 per ascus. Ascospores 15 - 21 x 5.5 - 8.5 µm. On Teloschistaceae. *Z. coepulonus*

5 Ascospores 8 per ascus.

66 Ascospores 11 - 17 x 4 - 7 µm. On Myriolecis dispersa. *Z. inconspicuus*

6 Ascospores 15 - 20 x 6 - 7 µm. On Circinaria calcarea. *(Z. calcariae)*

(1) If on Aspicilia s. lat., consider also the poorly known "Didymella" sphinctrinoides var. aspiciliicola


Scattered, on Crete and the mainland, at altitudes 1100 - 2000 m, on crustose species of *Teloschistaceae*.

Scattered in Europe, mostly in cool to cold regions. Also Macaronesia, Asia (widespread), Africa (Ethiopia), N.
America (BC, Saskatchewan, California).

Zwackhiomyces inconspicuus Grube & Hafellner (1990)

*Nova Hedwigia* 51(3): 320-322.

Description: See the protologue.

Crete, at an altitude of 1600 m, on *Myriolecis dispersa*.

Known only from Germany, Austria, Croatia, Italy and Greece.

Zwackhiomyces sphinctrinoides (Zwackh) Grube & Hafellner (1990) s. lat.

*Nova Hedwigia* 51(3): 327; *Endococcus sphinctrinoides* Zwackh (1864), *Flora* 47: 88; *Cercidospora sphinctrinoides* (Zwackh) J. Steiner.

*Z. sphinctrinoides* s. str. is said to be restricted to *Lecanora campestris*. For what amounts to a brief description of *Z. sphinctrinoides* s. str. see the key in Calatayud et al. (2007).

Abbott (2009) used the name in a broad sense, and his Peloponnesian collections do not belong to *Z. sphinctrinoides* s. str. However, the collections are rather scanty and I have been unable to determine them with certainty.

Reports under this name are scattered on the mainland, at all altitudes. Reported hosts: *Caloplaca* sp. (undetermined), *Collema* sp. (undetermined), *Lecidella elaeochroma*.

Scattered, but apparently fairly widely distributed, in Europe. Also Asia (Turkey, China).
References

I have seen all the publications listed here, except for the schedae to Vězda's Lichenes Selecti Exsiccati, for which I have seen a partial transcript prepared by Dr. A. Şenkardesler. These references are extracted semi-automatically from a larger set of references in a database. To minimise the risk of error, I have retained, unchanged, any alphabetical suffix that is appended to the year of publication in that larger set. This means that a year may here have an alphabetic suffix that appears to be unnecessary, or there may be gaps in a sequence of alphabetic suffixes.


Agüerre-Hudson, B. (2013). Xanthoparmelia stenophylla, the correct name for X. somloensis, one of the most widespread usnic acid containing species of the genus. Lichenologist 37(4): 363-366


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Hue, A. M. (1910b). Lichenes morphologique et anatomie disposuit. (Suite) (1). Nouvelles Archives du Muséum d'Histoire Naturelle, Cinquième Série 2(1): 1-120. The cover of part 1 of volume 2 bears the date 1910, and that is the date quoted by Staflou & Cowan for this publication. However, some authors consider that part 1 of volume 2 was published in 1912. (Part 2 of volume 2 was published in 1912.)


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Krzewicka, B. (2012). A revision of Verrucaria s. l. (Verrucariaceae) in Poland. Polish Botanical Studies 27: 3-143


Massalongo, A. (1856d ['1855']). Schedulae criticae in Lichenos exsiccatos Italiae. (Fascicles 2 - 10). 41-188pp., Typis Antonellianis, Verona. Pages 1 - 40, comprising fascicle 1, were published in 1855.


delimitation in black-fruited, endolithic *Caloplaca*: high genetic and low morphological diversity. *Mycological Research* 112: 36-49


Glossary and Abbreviations

"When I use a word," Humpty Dumpty said, in a rather scornful tone, "it means just what I choose it to mean - neither more nor less."
"The question is," said Alice, "whether you can make words mean so many different things."
"The question is," said Humpty Dumpty, "which is to be master - that's all."

(Lewis Carroll; Alice Through the Looking Glass)

This glossary is to help readers use this Flora effectively, but it is not a substitute for a mycological or other dictionary. In addition to technical terminology, it includes some terms where there is scope for confusion, and some where my own usage may be unconventional. It also includes a few terms relevant to technique, with hints that may help inexperienced users.

Abbreviations include geographical ones that I have employed to keep statements of the distribution of species concise, as well as a few others that may not be found in a standard English dictionary.

The glossary does not include the specialised terminology relevant to nomenclatural matters, for which consult the most recent version of the International Code of Nomenclature for Algae, Fungi and Plants.

**acervulate.** Refers to conidiomata of parasitic fungi that are saucer-shaped and which develop below the surface of the host.

**ACT.** Australian Capital Territory.

**Africa.** Includes the mid-Atlantic islands (Ascension Is, Saint Helena, Tristan Da Cunha), and the islands of the western Indian Ocean (Aldabra, Comoro Is, Madagascar, Mauritius, Reunion Is, Rodrigues Is, Seychelles, Socotra). Also includes the Egyptian past of the Sinai Peninsula, but excludes the rest of the Arabian Peninsula. See also East Africa, North Africa.

**algia.** (pl. algae). Algae are a large group of eukaryotes, probably not all closely related, some of which are photosynthetic, and a few species of which are photobionts in lichens. Algae that occur as lichen photobionts belong to the group known as green algae.

**anastomosed.** Formed of a true network of hyphae. (The hyphae are not merely branched. The apices of some hyphae grow into, and fuse with, the side walls of other hyphae.)

**Antarctica.** Includes the subantarctic islands of Bouvet Island, Crozet Island, Heard Island, Kerguelen, Macquarie Island, Marion Island, South Georgia, South Orkney Islands, South Sandwich Islands, South Shetland Islands and Saint Paul Island.

**anthraquinones.** A group of pigments that are orange or red in colour and which react K+ purple.

**apothecium.** (pl. apothecia). A kind of ascoma in which the spore-bearing layer is mostly exposed to the air.

**areole.** A unit of lichenised tissue in the thallus of a crustose lichen, that is separated from other such units by a divide (which may be anything from a narrow crack to a wide expanse) that does not contain lichenised tissue. Areoles are primary features. They are not formed by cracking of an initially non-areolate thallus.

**areolate.** Possessing areoles.

**ascoma.** (pl. ascomata). The structure within which the sexual processes of ascomycetes take place and which consequently contain asci and related organs.

**ascomycete.** A large group of fungi, characterised by forming sexual spores within asci. Most lichenised fungi are ascomycetes.

**ascospore.** The sexual spore of an ascomycete.

**ascus.** (pl. asci). A sack- or bag-like structure within which ascospores are formed.

**Asia.** Includes the Arabian Peninsula (but not the Egyptian part of Sinai, or the island of Socotra, both of which are treated under Africa), Turkey east of the Bosphorus, Russia east of and including the Ural Mountains. Also includes the Caucasus states of Armenia, Azerbaijan and Georgia. It does not include any part of Malesia, as Malesia is sufficiently different botanically that it is best regarded as distinct. (Because of the way the country of Malaysia is constituted, this has the slightly unfortunate result that peninsular Malaya has to be regarded here as not part of Asia.)

**aspicilioid.** Having apothecia that resemble those of the genus Aspicilia. The term does not necessarily imply any taxonomic relation with that genus.

**atranorin.** A substance present in some lichens. It reacts K+ yellow in spot tests. In solution it diffuses a yellow
pigment in K, without formation of any crystals. The yellow colour in spot test is often faint, and can be overlooked. It tends to be clearer when the spot has dried out. It is said that dried spots are strongly UV+ yellow, even when the concentration of atranorin is low.

**axil.** The indentation from which two lobes, or two segments of the same lobe, diverge.

**Australasia.** Australia and New Zealand only.

**Australia.** When used without qualification, this includes Tasmania, Lord Howe Island and Norfolk Island. It does not include the subantarctic Macquarie Island.

**basidiomycete.** A large group of fungi, characterised by forming sexual spores (basidiospores) on the external surface of a spore-bearing structure (a basidium). Most "mushrooms" are basidiomycetes, but only a few species of lichens contain these fungi.

**Bacidia type.** Asci with apex staining KI+ blue except for a narrow KI- central region. The KI- region does not cut completely through the KI+ blue region and does not reach the upper surface of the ascus. In section the staining regions thus appears as one piece. In practice it may be difficult to distinguish between Bacidia and Biatora type.

**bacilliform.** A long narrow shape with the long edges ± straight and ± parallel. Ends may be rounded or not.

**BC.** British Columbia.

**Biatora type.** Asci similar to Bacidia type, but between the KI- central region and the exterior KI+ blue region there is a narrow zone staining more intensely KI+ blue. In practice it may be difficult to distinguish between Biatora and Bacidia type.

**blastidium.** (pl. blastidia). A kind of vegetative propagule. They have a cortex (unlike soralia, which they may superficially resemble). A blastidium first forms by budding from the thallus, and subsequent blastidia may form by budding from the previous one. They are usually ± globose, rather small, and easy to overlook. Isidia are also corticate but they form as more regular outgrowths from the thallus and they do not proliferate by budding (though they may be branched, sometimes densely), and they are usually larger and more conspicuous. Poelt (1980) introduced the term and has a good discussion.

**bryicolous.** Occurring on bryophytes.

**Buellia type.** In Physciaceae, refers to ascospores without internal wall thickenings.

**C.** A solution of calcium hypochlorite in water. Ordinary domestic bleach (which usually contains sodium hypochlorite, not calcium hypochlorite) is just as good, provided that it is not one of the brands that contain a thickening agent. It deteriorates in storage, and should be renewed every few months. Keep C out of your eyes and mouth, and wash any spillages off your skin promptly with water, but C is not dangerous when used sensibly and in small quantities. **Caution: always keep bottles of bleach out of the reach of small children** - some brands look like soft drinks, and C causes very serious injury if ingested in quantity. Any colour change with C is instantaneous. It is sometimes necessary to test the reaction of a thin section to C. This requires care, as the reaction is usually fleeting. Prepare a normal water mount, but use plenty of water, so that the cover slip is floating, not firmly adpressed. With the slide on the microscope stage, place a drop of C at the side of the cover slip, so that it is in capillary contact with the water. (Do not let any C get onto the microscope objective, as it may damage it, so it is best not to use too high a magnification.) Usually the C will diffuse through the preparation, and any reaction will be seen as a front of colour moving across the specimen. If necessary, flow of C can be promoted by soaking up water at the opposite side, with a tissue. Even if no colour change occurs, the arrival of C at the specimen is obvious, as the oxidation that it causes produces many bubbles.

**Candelaria type.** Asci that are similar to Lecanora type, but the central core stains weakly KI+ blue rather than KI. In practice, the two types of ascus are hard to distinguish.

**capitate.** With one end swollen. Most commonly used to describe paraphyses possessing a swollen apical cell.

**capitulum.** The head of a stalked apothecium, i.e. the part where the asci and ascospores occur.

**Caribbean.** Includes Bermuda.

**catathecium.** A flattened ascoma with an upper wall that is ± radial in structure, surrounding an ostiole. There is also a lower wall, which may be very thin.

**catenulate.** Forming a chain.

**Catillaria type.** Asci staining uniformly KI+ blue in a hemispherical region at the apex.

**cellular.** Used to describe a tissue in which hyphae have broad, rounded lumina, giving a superficial resemblance to the cells of vascular plants. However, true cells are not present and the adjective paraplectenchymatous is used for this tissue by those who like long words. In this tissue it is often difficult to trace individual hyphae.

**Central America.** (Usually as C. America). The group of countries from Mexico to Panama inclusive, and the Cocos Is of the Pacific. The islands of the Caribbean are excluded, except for those islands close to the coast that are are politically part of one of the countries of Central America.

**centrum.** That part of a perithecium consisting of the exciple and everything within it. The involucrellum is not
corticolous. A part of the thallus that is lichenised with an entirely unrelated photobiont (usually with a cyanobacterium if the main thallus has an alga, and vice versa). Cephalodia are usually morphologically distinct from the main thallus.

chlorococcoid. Used in this Flora to denote a green alga other than Trentepohlia.

cilium. (pl. cilia). A hair-like protrusion from the upper surface or the side of a lichen thallus. The term usually denotes structures formed of more than a single hypha. A hair-like structure formed of a single hypha is usually just called a hair. Cilia do not contain photobiont cells.

clavate. Club shaped. (Start with an elliptical shape, then make one end broader than the other; the narrow end is usually then cut square, not rounded.)

clypeus. A tissue overgrowing and surrounding a group of perithecia.

Collema type. A typical Collema type ascus has a prominent KI+ dark blue plug at the centre of the apex. From this central plug there extends to each side (when viewed in section) a sandwich-like structure consisting of a KI+ blue inner and outer layer, both thin, between which is a thin KI-layer. (In three dimensions the KI-layer thus forms an annulus.) This sandwich may be fairly short or may extend a little way down the side of the ascus. However, there may be some variation around this general type.

colours. I have tried to used only a limited palette of basic colour terms, namely: black, blue, brown, green, grey, mauve, orange, pink, purple, rust red, red, violet, and white. Colours between these basic ones are indicated by hyphenated combinations, e.g. red-orange: this indicates a single colour that is between red and orange but which is closer to orange than to red. In ordinary English one might call this colour reddish orange, but formation of the forms in -ish is irregular (consider green/greenish, red/reddish, white/whitish) and a regular syntax facilitates data handling. (Note that although, psychologically, the phrase 'red-orange' may at first suggest the colour 'red', the colour intended is 'orange' somewhat modified in the direction of 'red'.) A range of colours is indicated by the word 'to'. Thus 'red to orange' means a range of colours from red to orange: it is not the same as 'red-orange', which refers to a single colour. Colours may be preceded by a simple qualifier, e.g. bright, dark, dull, pale. To denote the absence, or near absence, of colour in microscopical thin sections I use 'colourless' (rather than 'hyaline'). To denote a colour that is eventually replaced by another colour in a spot test I use the symbol ‘>’: thus K+ yellow > red means that the application of K at first gives a yellow colour but that this is eventually replaced by red.

When noting colours under a dissecting microscope, it is best to use a light source that has a daylight spectrum. Light from ordinary light bulbs is biased towards long wavelengths, and will distort slightly the colour that you observe. In many cases this doesn't matter, but in some it does. If you can't obtain a daylight spectrum light source, or are not sure what kind of light source you have, observe the lichen outdoors using natural light. The lichens Caloplaca flavovirescens and C. flavorubescens provide a sensitive test of the nature of your light source: they look distinctly different under ordinary light bulbs and daylight spectrum bulbs.

conidioma. (pl. conidiomata). A structure giving rise to, and thus containing, conidia.

conidiophore. A hypha (simple or branched) bearing specialised cells (conidiogenous cells) from which conidia develop.

conidium. (pl. conidia). A kind of fungal spore that is not formed by a sexual process. Usually they are much smaller than ascospores. In lichens, conidia are usually formed within pycnidia. In lichenicolous fungi they may occur in pycnidia or elsewhere.

continent. For indicating the geographical range of each taxon in the taxonomic section, I have divided the world into a set of regions that are roughly analogous to, but not identical with, conventional continents. These regions are: Africa, Antarctica, Asia, Australasia, Central America, Caribbean, Europe, Macaronesia, Malesia, North America, Pacific, and South America. They are defined in such a way that any point on the land surface of the earth lines in one, and only one, of these regions. For the precise geographical limit of each of these 'continents', see the corresponding entry in the glossary.

coralloid. Richly branched, and usually with a "3 dimensional" appearance.

cortex. The outermost layer of a lichen thallus, if there is an outermost layer that is reasonably well-structured and reasonably well differentiated from any inner layer(s). (A pseudocortex is similar but not well structured.) Commonly it is formed of hyphae more closely packed than in the medulla, and/or with extra-cellular substances filling the spaces between the hyphae, and is probably much less permeable to air than the medulla. The anatomical structure of the cortex (and lower cortex, if present) may be an important character, and is best observed in a good (i.e. thin) thin section. Using a fresh blade always helps when trying to cut a good section. If all your sections seem to be too thick for good observations, try cutting a section slightly obliquely to the free surface, i.e. a slightly wedge-shaped section. At the thin end of the wedge the thickness of the section decreases almost to zero, and anatomical details are usually clearer there.

corticous. Occurring on bark.
CR. Costa Rica.

crenulate. Possessing an edge that, on a small scale, is not smooth, the irregularity being not merely "wavy" nor, at the other extreme, ragged and irregular. Sometimes defined as "possessing small, rounded teeth".

crustose. Refers to those lichens that form a crust that is firmly attached everywhere to the substrate. Usually they can not be detached from the substrate and must be collected together with it.

CVI. Cape Verde Islands.

cyanobacterium. (pl. cyanobacteria). Cyanobacteria are a large group of prokaryotes, some of which are photosynthetic, and a few species of which are photobionts in lichens. They were formerly called "blue-green algae", though they are not algae.

cyphella. (pl. cyphellae). A region of the lower surface of a generally corticate lichen where the cortex is absent, but is replaced by a structured tissue.

decumbent. Lying flat (relative to some surface) but with upturned ends or margins.

dichotomous. Branching into two.

Dirinaria type. In Physciaceae, refers to one of several kinds of ascospore with wall thickened at septum and apex.

disc. The uppermost part of an apothecium, excluding the exciple and thalline margin.

distoseptate. A distoseptate ascospore septum is formed within, and is distinct from, the ascospore wall.

DR. Dominican Republic.

East Africa. Ethiopia, Kenya, Tanzania and Uganda.

endolithic. Occurring within (rather than upon) a rock.

epicortex. A layer overlying the cortex.

epilithic. Occurring on the surface of a rock.

epithecium. The part of an apothecium above the tips of the asci. It is often a different colour from the hymenium.

exciple. (1) In an apothecium, a layer of non-lichenised tissue around the sides of an apothecium. It is adjacent to the hymenium, and is often continuous with the hypothecium. It is inside the thalline margin, if one is present. Some older publications used the term "proper exciple" for this tissue. (2) In a perithecium, the layer of tissue entirely surrounding, and often extending below and above, the hymenium.

Europe. Includes: Greenland, Iceland, Faeroe Islands, the arctic islands of Norway (Bjørnøya, Jan Mayen Island, Svalbard), Russia west of the Ural Mountains, Cyprus, Turkey west of the Bosphorus, Malta, all Greek islands including those near the Turkish coast. (Greenland is included merely for convenience: its lichens are most often discussed alongside those of the Nordic Countries.) It does not include the Caucasus states of Armenia, Azerbaijan and Georgia.

euseptate. A euseptate septum is continuous with the ascospore wall.

falcate. Curved like a narrow letter "C" or a very new moon.

family. A group of genera that are considered to be closely related, and which do not overlap with other such groups.

fasciculate. Resembling a bundle of rods. Sometimes used to describe rhizines in the case when individual rhizines can be discerned, but they tend to glue together to form composite structures.

filamentous. An uncommon lichen morphology in which the thallus consists of very fine threads

folicolous. Occurring on leaves.

foliaceous. Shaped like a leaf.

fruticose. Refers to the morphology of lichens that are "distinctly 3-dimensional" but not foliose. Typical forms include ribbons and tubes.

fungus. (pl. fungi). The non-photosynthetic organism in a lichen.

fusiform. Needle-shaped or spindle-shaped, i.e. straight, long and narrow in relation to length, with tapered or pointed ends. (From the Latin noun fusus, "a spindle").

FYROM. Former Yugoslav Republic of Macedonia.

genus. (pl. genera). A group of species that are considered to be closely related, and which do not overlap with other such groups.

gyrose. Intricately convoluted.

hamathecium. A generic term for all the components of a hymenium other than asci and their contents.

Hawaii. The entire group of Hawaiian Islands.

heteromerous. Used of a thallus that is differentiated into distinct layers (two of which are usually a medulla, formed exclusively of fungal hyphae, and a photobiont layer, consisting mainly of photobiont cells).

HK. Hong Kong.

homoiomerous. Used of a thallus that is not well differentiated into distinct layers.

horizontal. When used to indicate the orientation of hyphae or other structures, it means parallel to the surface of the
thallus or to the surface of the disc (or to whatever other surface is clearly implied), NOT at right angles to the force of gravity.

**hormocystangium.** (pl. **hormocystangia**). A specialised structure, occurring in the genus *Lempholemma* and presumably functioning for vegetative dispersal, containing hormocysts, each of which consists of a few algal cells associated with fungal hyphae.

**hymenium.** The layer of an apothecium that contains asci, or the central part of a perithecium that contains asci.

**hypha.** (pl. **hyphae**). The basic structural unit of most fungi. A hypha is basically a long, thin, thread-like structure. It expands by growth at the tip, not usually by broadening. However, hyphal tips may branch, or may grow into other hyphae, and so hyphae may form complex networks. In some such networks (e.g. those in the cortex of many lichens) the thread-like nature of the constituent hyphae may be obscured.

**hyphal.** Used to describe a tissue in which individual hyphae can clearly be discerned. The hyphae are often parallel, and there may be distinct gaps between them. Lumina of the hyphae are usually either indistinct or narrow and elongated. A more technical adjective for this kind of tissue is prosoplectenchymatous. Scleroplectenchyma is a related kind of tissue in which the hyphae have broad walls, and are less clearly visible individually as there is usually no space between the hyphae, but the lumina are distinct, narrow and elongate.

**hyphomycete.** A fungus that does not form sexual spores, or a state of an ascomycete or basidiomycete fungus not forming sexual spores.

**hyphophore.** An erect, stalked, asexual kind of spore.

**hypothallus.** A loosely organised structure of non-lichenised fungal hyphae below the main part of a lichen thallus.

**hypothecium.** Strictly speaking, this term refers to the lowermost part of an apothecium in which the tissue is continuous with the exciple. In species with a well-developed subhymenium it is best to use the term in its strict sense. In species which lack a subhymenium, or in which the subhymenium is poorly differentiated, it is often convenient to use the term hypothecium to denote all the apothecial tissue below the hymenium, whether that tissue is continuous with the exciple or not, and in this Flora it is often used in that sense.

**I.** A solution of Lugol's iodine. It is made by dissolving 0.5 g of iodine and 1.5 of potassium iodide in about 100 ml of water. For most purposes, the precise concentration is not critical. **I** is not dangerous (unless you really go out of your way to make it so), nor is potassium iodide.

**ICN.** International Code of Nomenclature for Algae, Fungi and Plants. Formerly ICBN.

**IM.** Meltzer's reagent. It is made by dissolving 1 g of iodine, 3 g of potassium iodide and 40 g of chloral hydrate in about 40 ml water. Chloral hydrate is nasty stuff, and best avoided whenever possible. For most purposes it is better to work with Lugol's iodine.

**involucrellum.** A layer of tissue, usually strongly pigmented, lying outside the exciple of a perithecium. If present it is usually restricted to the top, and sometimes the side of the perithecium, only occasionally extending more than halfway down the peritheicum.

**isidiate.** Possessing isidia.

**isidium.** (pl. **isidia**). A small structure formed on the surface of a lichen thallus, and presumed to function as a vegetative propagule. Isidia are typically cylindrical, but may be branched, coralloid, globose, or flattened squamules. In lichen species that have a cortex, the isidia are corticate, but the term isidium is also used in genera that lack a cortex, such as Collema. Isidia are always well-delimited (unlike soralia, which may be diffuse).

**JF.** Juan Fernandez Is (politically part of Chile).

**K.** A solution of potassium hydroxide in water. It is usually used at a strength of 10% molar. **Caution:** if making up a solution from solid potassium hydroxide and water, always add the crystals to water, not the other way round, and do so slowly; the hydration process is strongly exothermic. Keep **K** out of your eyes and mouth, and wash any spillages off your skin promptly with water, but a 10% solution of **K** is not dangerous when used sensibly and in small quantities. Do not let **K** on a microscope slide come into contact with the objective of your microscope, as it will dissolve the glass and very quickly ruin the optical quality. Some reactions with **K** are instantaneous but others may take up to several minutes to develop. When carrying out spot tests, remember that **K** can make the cortex transparent so that photobiont cells become visible, and in some species the spot where **K** was applied may look green until it dries out. This is **not** a K+ green reaction. (If this effect occurs, any K+ yellow reaction due to atranorin may not be apparent until the lichen has dried out.) When using **K** to test the reaction of a thin section, use as little reagent as possible. **K** dissolves many lichen substances and will carry them away in solution if a large quantity is used; a positive reaction may then be so diluted as to be unobservable. As well as noting any colour change in the thin section of the lichen itself, note whether the **K** solution itself becomes coloured. This will occur with some common lichen substances, including atranorin, norstictic acid and stictic acid, and is often easier to observe than colour changes in the lichen tissue. By far the best way to work with **K** is to hold it in draughtsmans pens, which permit very precise and economical application of the reagent. See Skinner (1985) for further details.
KC. Used to indicate the presence or absence of a colour when application of K is followed, a few seconds later, by application of C. It is usually used only for spot tests. With a thin section it may not work, as the K can send any lichen substance into solution, so none remain when the C arrives.

K1. Application of K followed by application if I. This combination is used when examining asci: the wall and/or parts of the apex may react blue (or, rarely, some other colour). The procedure is never easy to carry out successfully, though it does become easier with practice. For the best chance of good results, proceed as follows. First soak the thin section in K for several seconds; this removes substances that impede the penetration of I. Unfortunately, the I reaction will not occur in an alkaline solution, so it is necessary to remove all the K. Soak up as much K as possible with a tissue, then add water to flush out any remaining K, and then again remove as much liquid as possible with a tissue. Then add a drop of I. If no blue colour is seen, wait a few minutes - the reagent sometimes take several minutes to penetrate. If no colour is seen after several minutes - and assuming that one was expected - then the preparation may still be contaminated with K and require further washing. The opposite problem, an intense blueing that obscures all fine detail, can also occur, especially in species in which the hymenium reacts KI+. If this occurs then try again with a more dilute solution of I, or with a thinner section, or try applying pressure to the section to disrupt it and separate asci from paraphyses. The KI reaction of the apex varies during development of the ascus, and observations should be made only on asci that are mature but undischarged, and if possible on asci that have been separated from the hymenium. (Separation is desirable, though sometimes difficult to achieve without causing asci to discharge, because an underlying or overlying paraphysis may affect the refraction of light through the ascus apex in a way that mimics a KI- central region, making the ascus look more "Lecanora type" than it is.) It is advisable to examine as many asci as possible, as even with mature asci the 'typical' form may be clearly apparent in only a few. Note that an ocular chamber is sometimes visible in asci even in a water mount: this occasionally obviates the need for a KI test, as it excludes several possible ascus types. Some practical problems with the KI test are discussed in Kohn & Korf (1975). They stress that pretreatment with K is essential: application of I alone may give unreliable results in some cases. They observed cases in which K at 10% strength caused asci to discharge; this is undesirable, as important characters of the apex can generally only be observed in undischarged asci. I have not experienced this problem myself, but if it occurs, Kohn & Korf recommend use of a weaker solution of potassium hydroxide - they suggest 2%. Because of the difficulties of determining ascus type, I often find myself using KI tests on an ascus in a negative way, to exclude possibilities in a key e.g. *I am not completely sure what type this ascus is, but it is definitely not Porpidia type*.

laminal. On the flat surface of e.g. a lobe (as opposed to "marginal": at the edge of the lobe).

Lecanora type. (1) Asci with much of apex staining KI+ blue but with a fairly broad KI- central region. The KI-region cuts completely through the KI+ blue region and reaches the upper surface of the ascus. In section, the staining region thus appears separated into two parts. (2) A Lecanora type wall is a distinct ascospore wall seen in some species in Lecanoraceae. It is of uniform thickness, about 0.7 - 1 \( \mu m \) wide, without ornamentation, and easily visible.

Lecidea type. Asci with small, strongly KI+ blue region near top.

Lecidella type. Similar to Lecanora type, but the KI- region is more conical and may not reach the top of the ascus.

leprose. Entirely sorediate.

lichen. A symbiotic union of a fungus (most commonly an ascomycete) and a photosynthetic alga or cyanobacterium. Formally the Latin name of a lichen denotes the fungus alone, but when there is no risk of confusion (i.e. most of the time) it is commonly used to refer to the entire symbiotic union.

lichenicolous. Occurring on lichens. Often used to denote the large group of non-lichenised fungi that are closely associated with, and often parasitic on, lichens.

lichenised. Used of a fungus that is in the state of forming a symbiotic union with a photosynthetic alga or cyanobacterium. By definition, a lichen contain a lichenised fungus. In a few cases a fungus may be lichenised in some circumstances but not others (facultatively lichenised), or may be so weakly associated with algae or cyanobacteria that it is unclear whether it is lichenised.

lirella. (pl. lirellae). An apothecium that is much longer than broad.

lobe. A component of a lichen thallus that is free of the substrate over most of its extent. The term is usually used to denote either a large structure (with or without a lower cortex), or a small structure that possesses a lower cortex. A small lobe-like structure lacking a lower cortex is usually called a squamule.

lobule. A small lobe-shaped structure.

longitudinal. When used of a lobe (or similar structure) it means the direction parallel to the axis of symmetry of the lobe (in which most cases means parallel to the long axis of the lobe).

lower cortex. The cortex on the lower surface of a corticate lichen having distinct upper and lower surfaces.

Lugol's iodine. See T.

Macaronesia. Azores, Canary Islands, Madeira and Cape Verde Islands.
macrolichen. An informal term used to denote any lichen that is not crustose. Sometimes used more narrowly to mean not crustose and not squamulose.

Malesia. Indonesia, Malaysia (including peninsular Malaya), New Guinea, Philippines, Singapore.

mazaedium. (pl. mazaedia). (Or sometimes "mazedium" and "mazedia".) A type of ascoma in which the asci dissolve leaving a loose mass of ascospores. (Such ascospores are presumed to be dispersed by passive processes, e.g. raindrops or invertebrates, rather then by being forcibly expelled into the air by an ascus.)

medulla. A layer of hyphae, lacking photobiont cells and typically rather loosely interwoven, that forms the interior of many lichens.

moniliform. Like beads on a string. Most commonly used to describe paraphyses in which the final few cells on the same paraphysis are swollen.

muriiform. Containing both transverse and longitudinal septa.

muscicolous. Occurring on mosses. Sometimes used loosely to mean "occurring on bryophytes".

mycelium. (pl. mycelia). A network of fungal hyphae. The term is not normally usually used for networks forming part of a lichenised tissue.

mycobiont. The fungal partner in a lichen symbiosis.

N. Nitric acid. Usually supplied commercially at a concentration of 100% or 65%, but for lichenological purposes usually used at 50% concentration, so you may have to dilute what you are supplied. Caution: always dilute by adding acid to water, not the other way round, and do it slowly; the process is strongly exothermic. (If you do it the wrong way round, it may explode and throw acid into your face.) At 50% concentration, N can still give a nasty burn, so handle with care. It is a good idea to keep the N that you use routinely in a very small bottle, to minimise the quantities involved should any spillage occur; you need only handle larger quantities occasionally, when refilling the small container. In case of contact with the skin, immediately flood the affected area with large quantities of water. (Small quantities of water may do more harm than good.) Do not let N on a microscope slide come into contact with the objective of your microscope, unless you are prepared to buy a new one. Note that a few authors have used "H" to denote this reagent.


norstictic acid. A substance present in some lichens. If present in sufficient quantity it reacts K+ yellow > red in spot tests (though low concentrations may give what looks like a + orange or even just + yellow reaction). It diffuses a yellowish pigment into solution and, after a minute or two, needle-shaped red crystals form. Use as little K as possible. With too much K, although the yellowish solution may be observed, it may be too dilute for crystals to form. Attranorin and stictic acid also diffuse a yellow pigment, but no crystals are formed. Salazinic acid gives irregularly shaped red crystals.

North America. (Usually as N. America.) Alaska, Canada and the lower 48 states of the USA only. Excludes Greenland, Mexico, Bermuda, the Caribbean Islands and Hawaii.

North Africa. (Usually as N. Africa.) Algeria, Ceuta, Egypt, Libya, Melilla, Morocco, Tunisia and Western Sahara only. The phrase "northern Africa" is intended to denote Africa north of the the tropical vegetation zone; this region is not precisely delimited, but it does include the island of Socotra.

Nostoc. A genus of cyanobacteria. Cells are globose and typically occur in unbranched chains one cell wide.

NSW. New South Wales.

NZ. New Zealand.

NZN. North island of New Zealand.

NZS. South island of New Zealand.

ocular chamber. A protrusion, usually longer than wide, from the spore-bearing part of an ascus upwards into the tholus.

Opegrapha type. Asci with two small KI+ blue dots near the apex; they are obviously part of a ring in 3 dimensions. However the dots are not always visible, and this type of ascus may be recorded as reacting faintly and obscurely KI+ blue near the apex, or even as KI-. Occasionally the two dots may appear joined, as a horizontal bar.

ostiole. A narrow opening at the top of a perithecium.

P. Para-phenylenediamine, always used in solution. It tends to give the best, and least ambiguous, results when used as a solution in ethanol, but such a solution must be made up fresh daily. Most of my observations were made using Steiner's solution (see below), and I use an ethanol solution only in difficult or critical cases. The solid form should be handled with care and not allowed to come into contact with skin, as it is a powerful skin irritant; if you allow even a single crystal to fall onto your skin, you will eventually notice it. Crystals of P will stain paper permanently, so keep it away from with books. Note that P may be carcinogenic, but as it does not emit any vapours and can easily be handled without contacting the skin, it probably does not pose any real hazard to lichenologists. (Don't panic if you get a spillage on your skin; the danger is negligible. Just don't make a habit of it.) Reactions with P
may take a few minutes to develop. By far the best way to work with P (as Steiner's solution) is to hold it in
draughtsmans pens, which permit very precise and economical application of the reagent. See Skinner (1985) for
further details. It is usually easy to distinguish between a P- and a P+ reaction, but care is required when recording
the precise colour of a P+ reaction. The colour may take several minutes to develop, the colour obtained after any
particular interval of time depends on the concentration of the relevant lichen substance, on the concentration of the
P solution itself, and on the ambient temperature, and the colour usually darkens with time, so that a +red reaction
may appear +yellow or +orange for several minutes, or even permanently if too weak a P solution is used. In case of
doubt, add more P to the same spot on the lichen.

Pacific. All the islands in the Pacific Ocean that are not clearly included in some other main region.

paraphysis. (pl. paraphyses). A hypha between asci. Paraphyses grow in a generally upwards direction, though they
may anastomose.

paraphysoid. An inter-ascal hypha that is attacked to the wall of the ascoma at both its upper and lower end.
(Paraphyses are attacked only at the lower end.) Paraphysoides are usually branched and anastomosed.

paraplectenchyma. See cellular.

parasymbiont. A non-lichenised fungus occurring within, or closely associated with, a lichen, but which does not
appear to damage the lichen, i.e. which is not obviously parasitic.

periphysoids. Hyphae growing down from the top of a perithecium, but not reaching the base. Not sharply distinct
from periphyses which are hyphae growing sideways from the inner part of the ostiole of a perithecium.

perisporie. A gelatinous layer surrounding an ascospore.

perithecium. (pl. perithecia). A kind of ascoma in which the spore-bearing layer is mostly covered by fungal tissue
and not exposed to the air. Ascospores are liberated through an ostiole.

photobiont. The photosynthetic organism in a lichen. It is a green alga or a cyanobacterium. Because it can be
difficult to identify photobionts to genus, I have normally restricted myself to just three basic terms: blue-green (i.e.
cyanobacterium), green and Trentepohlia. These terms are intended to be exhaustive and mutually exclusive: that is,
yany photobiont belongs to one and only one of these categories. Note, therefore, that when used as a description of a
photobiont, 'green' means a member of the green algae other than Trentepohlia, even though Trentepohlia belongs
taxonomically to the green algae. The photobions of lichens merit more precise and more extensive descriptions
than I have given them in this Flora, but to do that properly requires culturing the photobionts independently of the
fungus, and I have neither the expertise nor the time to do that. In lichenology as a whole, the proper study of
photobionts is a neglected topic, and offers a wide-open field of research for anyone who wishes to take up the
challenge.

phrygana. A slightly learned Greek term for vegetation dominated by shrubs: it corresponds roughly to the French
terms maquis or Garrigue. See also roumani.

phyllocladia. Corticate outgrowths from some species of Stereocaulon.

placodioide. Possessing distinct, lobe-like (but completely attached), radiating structures at the margin. Only crustose
lichens may be placodiodi.

PNG. Papua New Guinea

polarilocular. A distinctive type of ascospore with a single septum perforated by a narrow channel. The lumina often
appear shaped like an hour-glass or the digit "8". The equivalent term polaribilocular was sometimes used in older
publications.

Porpidia type. Asci with an apical dome that is mostly KI- except for a central KI+ blue tube.

PR. Puerto Rico.

proper exciple. Some older publications use this term for what is here simply called an exciple.

prosoplectenchyma. See hyphal.

prothallus. A loosely organised structure of non-lichenised fungal hyphae at the margin of a lichen thallus.

pruina. A fine powder, sometimes distinctly crystalline, found on the upper surface of some lichens.

pruinose. Possessing pruina.

pseudocortex. A poorly structured or poorly defined outer layer of a lichen thallus.

pseudocyphella. (pl. pseudoclyphellae). A region of the surface of a generally corticate lichen (usually the upper
surface of a macrolichen) where the cortex is absent. Pseudocyphellae are usually white, and may form dots, lines
or a reticulate network on an otherwise coloured surface.

pseudoparaphysis. (pl. pseudoparaphyses). Inter-ascal filaments that are indistinguishable from paraphyses when
mature. However, they grow from downwards, from the top of the ascoma, whereas paraphyses grow upward from
the base.

pseudoparenchyma. Tissue with a cellular appearance.

pubescent. Possessing fine, soft hair.
punctiform. Point like; formed of a single point.
pycnidium. (pl. pycnidia). A type of conidioma that encloses conidia. Pycnidia are typically globose or flask-shaped.
pyriform. Shaped like a pear.
reticulate. Forming a net or network.
revolute. Lying flat (relative to some surface) but with downturned ends or margins.
rhizine. (pl. rhizines or rhizinae, depending on how erudite you want to appear.) A narrow protrusion from the lower surface of a lichen, forming an attachment organ. Rhizines do not contain photobiont cells.
rhizohypha. (pl. rhizohyphae). A hypha, usually on the lower surface of a thallus, that is presumed to function as an means of attachment to the substrate. Rhizohyphae may be isolated or may occur in loose groups, but are never aggregated into well-structured rhizines. They may be more apparent in thin section under the transmission microscope than in external view.
roumani. The word that ordinary Greek people use for vegetation dominated by shrubs: it corresponds roughly to the French terms *maquis* or *garrigue*. See also phrygana.
salazinic acid. A substance present in some lichens. It reacts K+ yellow > orange to red, C-, P+ orange, C-, UV-. It diffuses a yellow pigment into solution in K, and may form small (no more than 2 µm), irregular red crystals.
saxicolous. Occurring on rock.
scleroplectenchyma. See hyphal.
Scytonema. A genus of cyanobacteria. Cells are globose to slightly flattened or squareish, and typically occur in unbranched chains one cell wide with a distinct wall. The chains may have false branches, formed by splitting.
septate. When used in connection with ascospores, usually means possessing only transverse septa. Ascospores containing both transverse and longitudinal septa are usually described as muriform, not septate.
septum. (pl. septa). An internal wall. Most commonly used in connection with ascospores, but hyphae (including paraphyses) may also contain septa.
sigmoid. Shaped like a letter "S".
simple. (1) When used of ascospores it means without septa. (2) When used of paraphyses or rhizines it means not branched (and, in the case of paraphyses, not anastomosed).
soralium. (pl. soralia). A small structure formed on the surface of a lichen thallus, consisting of one to many soredia, and presumed to function for vegetative propagation. Soralia vary greatly in morphology, from concave to convex, and from well-delimited to very diffuse. They are never corticate.
sorediate. Possessing soredia or soralia.
soredium. (pl. soredia). A cluster of a few photobiont cells enclosed in fungal hyphae. The hyphae are unstructured and do not form a cortex.
South Africa. (Usually as S. Africa.) Republic of South Africa.
South America. (Usually as S. America.) Includes Falkland Is, Galapagos Is, Juan Fernandez Is.
sporodochium. (pl. sporodochia). A type of conidioma in which the conidia occur in a layered mass.
squamule. A component of a lichen thallus that is firmly attached to the substrate in places but free of the substrate at the tip or margin. It differs from a lobe in that a squamule lacks a lower cortex.
squamulose. Formed of squamules.
squarrose. Possessing small projections at right angles to the main axis. Usually used of rhizines.
Steiner's solution. An aqueous solution containing P, with sodium sulphite added as a stabiliser. I also add a small quantity of detergent, to promote wetting. It gives the same colour reactions as P dissolved in ethanol, but is stable for several weeks. If it is no longer colourless then it needs to be replaced. Sodium sulphite is not dangerous.
stellate. Star shaped.
sterile. Lacking ascomata.
stictic acid. A substance present in some lichens. It reacts K+ yellow or orange, C-, KC-, P+ orange. In K it diffuses into solution a yellow pigment that does not form crystals.
Stigonema. A genus of cyanobacteria. Cells are variously shaped and typically occur in chains which may branch and which are more than one cell wide. The side branches are formed by cell division perpendicular to the main chain.
stroma. A structure containing several ascomata.
subhymenium. The part of an apothecium between the hymenium and the hypothecium. It is formed of tissue that is not continuous with the exciple. In many species a subhymenium is absent or not well differentiated from the hypothecium.
substrate. What a lichen is growing on.
symbiont. An organism participating in a symbiosis. For a lichen the mycobiont (fungus) and the photobiont (alga or cyanobacterium) are the two symbionts.
taxon. (pl. taxa). A group of related organisms at any rank (e.g. a species, a genus, a variety).

Teloschistes type. Asci staining KI+ blue in an arched zone at the apex. The outer part of the arch stains more strongly than the inner part.

terricolous. Occurring on the ground.

thalline margin. A layer of lichenised tissue around the sides of an apothecium, i.e. it contains photobiont cells. If present, it is the outermost layer and surrounds the exciple (if present). Note that the phrase, at least as used in this Flora, does not mean "the margin of the thallus". Some older publications used the term "thalline exciple" for this tissue.

thallus. The main part of a lichen. It excludes ascomata, conidiomata, prothallus and hypothallus.

thin section. A thin layer cut from a lichen for examination at high magnification with a transmission microscope. For most purposes, cut at right angles to the surface of the lichen. Use a razor blade to cut sections: if you use it well, you won't need expensive scalpels or a microtome. The edge of a blade dulls quite quickly, so use a fresh blade for critical work. (I keep two blades in use. The fresher one is for critical work. The second one is for undemanding tasks such as removing a layer of cortex so that reagents can be applied to the medulla. When the fresh blade becomes unsatisfactory I discard the second one entirely, downgrade the first one to second, and get a new first one. Keep the two blades in different containers, so you can remember which is which.) It is best to cut thin sections under a dissecting microscope. It can be done with the aid of just a hand lens, but that is harder and results will not be as good. Hold your breath while making the actual cut. This reduces body movement, and for a section that may be only a few microns thick even a small movement can have a big effect. For observing anatomical detail you want a section that is as thin as possible, but sometimes it is difficult to cut a uniform section that is thin enough. In that case, cut a section that is slightly wedge-shaped. The fine anatomical detail will be observable at least at the narrow end of the wedge, where the thickness tapers to zero. For counting ascospores within an ascus you don't want a section that is too thin, especially in species that have large ascospores, as ascii will be disrupted and the ascospores will fall out. To avoid that problem you may need to cut a section that is thicker than usual.

tholus. That part of an ascus apex where the wall thickens inwards. Not all asci have a tholus.

tomentum. A mat, often dense, of unstructured hyphae.

tomentose. Possessing tomentum.

transverse. When used of a lobe (or similar structure) means the direction perpendicular to the axis of symmetry of the lobe (which in most cases means perpendicular to the long axis of the lobe).

trebouxioid. Resembling green algae of the genus Trebouxia in having a large, central chloroplast.

Trentepohlia. A genus of green algae. Fresh cells have internal orange pigment, unlike other algae relevant to Greek lichens. It is easily visible under the microscope. Macroscopically, it can usually be detected by scraping the thallus: the part scraped becomes pale orange in places. Unfortunately, the orange pigment fades after a few months. For a while thereafter Trentepohlia cells are a lime-green colour that differs from the more intense green of other algal photobionts.

umbilicate. Possessing an umbilicus.

umbilicus. A central attachment organ.

umbo. A region of sterile tissue in the centre of an apothecium.

umbonate. Possessing an umbo.

upper cortex. The cortex on the upper surface of a corticate lichen having distinct upper and lower surfaces.

urceolate. Strongly concave and immersed (e.g. in a thallus).

USA. The lower 48 states only. Alaska and Hawaii are not included.

UV. Ultra-violet light. It is used to test for fluorescence from lichen substances. Normally, long-wave UV is used, but occasionally I find it useful to make further observations in short-wave UV light. "Long wave" here, and in the descriptions of taxa, means peak irradiance at 365 nm, "short wave" means peak irradiance at 254 nm. Best results are obtained by using a viewing cabinet which excludes extraneous light. Some UV light sources also emit a small amount of light at visible wavelengths and, in a dark viewing cabinet, reflection of this light from a pale coloured thallus can be confused with a true fluorescence. The problem is usually less acute with short wave UV. Caution: a viewing cabinet must be used if the UV source is strong or if it emits short-wave UV light, to avoid damage to eyes or skin. It is best not to handle a specimen inside a viewing cabinet while a strong or short-wave source is switched on, but occasionally there may be no choice; I wear opaque gloves if I must handle a specimen under those conditions.

vertical. When used to indicate the orientation of hyphae or other structures, it means perpendicular to the surface of the thallus or to the surface of the disc (or to whatever other surface is clearly implied), NOT parallel to the force of gravity.

Washington. Means Washington State, not DC.
Yemen. Does not include the island of Socotra.
Appendix: Higher Level Classification of the Ascomycota

All ascomycete families mentioned in the taxonomic section are shown here under the most recent comprehensive system in which they have been organised, that in Frey (2016). Ascomycetes are now treated as a distinct phylum, as are basidiomycetes.

The numbers following each taxon are the number of lichens and the number of lichenicolous fungi within it, according to my own database. Other sources may quite slightly different numbers. Totals for fungi that are neither lichenised nor lichenicolous are not given, though some taxa include large number of them.

Entities shown in regular or bold regular font have at least one lichenised or lichenicolous Greek representative, those in italic or bold italic font do not. Only the more important or interesting non-Greek taxa are given, which is one reason why totals for an order may not equal the sum of the totals for the listed families. Another reason is that some genera can not be assigned to a family though they may be assignable to an order. Similar problems occur at higher ranks too. The difference between the totals of lichenicolous fungi for Pezizomycotina and Ascomycota is mainly because some lichenicolous hyphomycete and coelomycete genera have not yet been integrated into the taxonomic structure.

Despite substantial recent advances, ascomycete taxonomy is still unstable, and the information below is likely to date rapidly.

BASIDIOMYCOTA (40,81)

ASCOMYCOTA (21079,1320)
TAPHRINOMYCOTINA (0.0)
SACCHAROMYCOTINA (0.0)
PEZIZOMYCOTINA (21044,1145)
Arthoniomycetes (1624,40)
Arthoniales (1624,40): Arthoniaceae (754,0), Lecanographaceae (39,36), Opegraphaceae (393,0), Roccellaceae (409,0), Roccelllographaceae (6,0)

Coniocybomycetes (36,0)
Coniocybales (36,0): Coniocybaceae (36,0)

Dothideomycetes (959,522)
Abrothallales (0,26): Abrothallaceae (0,26)
Asterinales (0,29): Asterinaceae (0,29)
Capnodiales (4,123): Mycosphaerellaceae (0,111); Teratosphaeriaceae (0,1)
Eremithallales (75,0): Melaspilaceae (75,0)
Lichenoconiales (0,14): Lichenocniacese (0,14)
Lichenostigmatales (0,36): Phaeococcomycetaceae (0,36)
Monoblastiales (119,0): Monoblastiaceae (119,0)
Pleosporales (177,52): Arthopyreniaceae (131,0), Naetrocymbiaceae (16,1), Pleomassariaceae (0,5)
Strigulales (100,0): Strigulaceae (100,0)
Trypetheliales (450,0): Trypetheliaceae (450,0)

Fam. Inc. Sed. in Dothideomycetes: Dacampiaceae (0,93), Polyccocaceae (? , ?)

Eurotiomycetes (1504,83)
Chaetothyriomycetidae (1405,81)
Pyrenulales (325,0): Pyrenulaaceae (310,0)
Verrucariales (1068,63): Verrucariaceae (1066,51)
Myccaliomycetidae (99,1)

Laboulbeniomycetes (0,1)

Lecanoromycetes (16415,85)
Acarosporomycetidae (307,0)
Acarosporales (307,0): Acarosporaceae (307,0)
Candelariomycetidae (86,0)
Caldelariales (86,0): Candelariaceae (83,0), Pycnoraceae (3,0)
Lecanoromycetidae (11421,41)
Caliaciales (1487,0): Caliciaeaceae (803,0), Physciaceae (684,0)
Lecanares (6607,38): Carbonicolaceae (3,0), Catillariaceae (173,0), Cladoniaceae (494,0), Haematommataceae (40,0), Lecanoraceae (1027,0), Parmeliaceae (2820,13),
Pilocarpaceae (393,12), Psoraceae (62,0), Ramalinaceae (1106,10), *Ramboldiaceae* (27,0), Scoliciosporaceae (16,1), *Sphaerophoraceae* (39,0), Stereocaulaceae (242,0), Tephromelataceae (76,0)

Lecideales (805,2): Lecideaceae (795,2)

Leprocaulales (37,0): Leprocaulaceae (37,0)

Peltigerales (1280,0)

Collematineae (708,0): Coccocarpiaceae (37,0), Collemataceae (269,0), Pannariaceae (377,0), Placynthiaceae (25,0)

Peltigerineae (569,0): Koerberiaceae (10,0), Lobariaceae (402,0), Massalongiaceae (10,0), Nephromataceae (39,0), Peltigeraceae (100,0), Vahliellaceae (8,0)

Rhizocarpales (160,0): Rhizocarpaceae (155,0), Sporastatiaceae (5,0)

Teloschistales (1006,0)

Letrouitineae (36,0): Letrouitiaceae (20,0)

Teloschistineae (970,0): Teloschistaceae (916,0)

Ostropomycetidae (4405,38)

Arctomiales (13,0): Arctomiaceae (13,0)

Baeomycetales (29,0): Baeomycetaceae (26,0)

Hymeneliales (35,0): Hymeneliaceae (35,0)

Ostropales (3009,34): Coenogoniaceae (107,0), Gomphillaceae (376,0), Graphidaceae (1823,1), Gyelectaceae (93,1), *Odontotrema* (0,21), Phlyctidaceae (33,0), Porinaceae (443,0), Sagiolechiaceae (5,0), Stictidaceae (45,9), Thellenellaceae (51,0), Thrombiaceae (17,0)

Pertusariales (1117,0): *Icamadophila* (44,0), Megasporaceae (296,0), Ochrolechiaceae (76,0), Pertusariaceae (678,0)

Umbilicariomycetidae (191,3)

Sarrameanales (22,0): Sarrameanaceae (11,0), Schaereriaceae (11,0)

Trapeliales (179,0): Trapeliaceae (179,0)

Umbilicariales (185,3): Elixiaeae (3,0), Fuscideae (58,3), Ophioparmaceae (11,0), Umbilicariaeae (113,0)

**Leptoliales**

Helotiales (0,51): Hyaloscyphaceae (0,13)

Fam. Inc. Sed.: Cordieritidaceae (0,56)

**Lichinomycetes** (395,0)

Lichinales (395,0): Gloeoheppiaceae (9,0), Lichinaceae (337,0), Peltulaceae (49,0)

Orbiliomycetes (0,0)

Pezizomycetes (0,0)

Sordariomycetes (13,210)

Hypocreomycetidae (0,133)

Hypocreales (0,118): *Bionectriaceae* (0,78), Nectriaceae (0,20)

Sordariomycetidae (0,28)

Xylariomycetidae (0,8)

Ord. Inc. Sed. in Sordariomycetes: Phyllachorales (0,35): Phyllachoraceae (0,35)

**Xylonomycetes** (0,0)

Ord. Inc. Sed. in Pezizomycotina: Thelocarpaceae (24,0): Thelocarpaceae (24,0)

Fam. Inc. Sed. in Pezizomycotina: Dactylosporaceae (0,45), Strangosporaceae (7,0), Xantypyreniaceae (32,35)

For a proper discussion of the groups listed, consult a textbook of mycology. The following brief remarks are intended merely to help the average lichenologist get some understanding of the overall picture.

**Basidiomycota** are not of much interest to lichenologists. The group has exploited symbiosis with photosynthetic organisms in a big way, but unlike ascomycetes it has mostly done it via mycorrhizae. Most species of lichenised basidiomycete are uncommon or poorly known. Sixty percent of lichenicolous basidiomycetes are presently placed in the genus *Tremella*: those species are mostly rare and poorly known.

**Ascomycota** are now subdivided into three subphyla. Two subphyla contain a variety of organisms, some of them yeasts, some not forming ascomata; most species are saprobic, a few are parasitic. Lichens and lichenicolous fungi appear to be restricted to the third subphylum, Pezizomycotina. That subphylum contains 12 classes, 8 of which contain some lichens, though only 5 have many lichen species. Lichenicolous fungi are present in 6 classes, a report for a seventh is probably incorrect. Lichenicolous fungi are commonest in 3 classes: Dothideomycetes, Leotiomycetes and Sordariomycetes; only the first of those also has numerous lichens. The 12 classes are:
Arthoniomycetes is predominantly a tropical group. Several species are present in Greece, but none are common and the class is not a major component of the lichen biota.

Coniocybomycetes is a small class with just two Greek species. Both have been reported only once.

Dothideomycetes has a few Greek representatives, both lichenised and lichenicolous, but none are common. Worldwide the class is predominantly tropical, as least as regards lichens.

Eurotiomycetes are well represented in Greece by the family Verrucariaceae, species of which are common and widespread, though the taxonomy of many groups is not well understood. Other families are encountered only rarely.

Laboulbeniomycetes is a class of insect parasites. A single, tropical species said to be a lichenicolous fungus, Gliocephalis pukhella, has been referred to a genus in this class, but I doubt that it belongs here.

Lecanoromycetes contains most of the world's lichens, and most of those in Greece. All 17 orders are present in Greece, but Caliciales, Lecanorales and Teloschistales are the dominant ones, with Pertusariales not far behind.

Leotiomyces is a large class, but it has no lichens and few lichenicolous taxa.

Lichinomycetes is a small, specialised class of lichens, found mainly on rock and soil in dry habitats (though sometimes associated with intermittently wet depressions in those habitats). Most species are rare and the taxonomy of some groups is not well understood. It is present in Greece, but there are few records.

Orbiliomyces is predominantly a class of saprophytic fungi in warm, dry regions.

Pezizomycetes contains many of the larger and more dramatic ascomycetes, but no lichens or lichenicolous fungi.

Sordariomycetes is a large class that includes a few lichenicolous fungi.

Xylonomycetes contains just a single species that is parasitic on vascular plants.
... and so there ain't nothing more to write about, and I am rotten glad of it, because if I'd a knowed what a trouble it was to make a book I wouldn't a tackled it and ain't agoin' to no more.

Huck Finn