THE LICHENS AND LICHENICOLOUS FUNGI OF GREECE

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Note: This is an early draft. Many sections need revision and improvement. There are probably still many errors. Use with caution.

Note: I would be happy to consider collaborating with others with a view to improving this Flora. The main need is for full descriptions, from Greek material, of those species that I have not seen myself. Without such assistance this Flora will never be a complete document, as I do not have the resources to do all the necessary work myself.

Copyright: Some rights reserved. For details see the Introduction section.
Warning: This is an early draft. It is incomplete and it may contain errors.

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Scope

This work is best used together with the Greek lichen checklist, Abbott (2009), and the Atlas of Greek Lichens, www.lichensofgreece.com/atlas. It began as an attempt to put in order my own observations on the lichens of the Peloponnese, and its origins still show, as lichens of that region are treated more thoroughly than those of other parts of Greece.

This is not a critical Flora, even for the Peloponnese. The lichens of SE Europe are not well known, there are outstanding taxonomic problems in many groups, and it is not possible to write a critical Flora at present. However, this guide will assist those with an interest in Greek lichens. The absence of such a guide, in English, for any part of SE Europe has undoubtedly held back the study of Greek lichens.

Although my own fieldwork has been limited to the Peloponnese, the keys include all Greek species except for a few poorly known ones. Information on distribution and ecology is provided for all Greek species. The keys themselves amount to brief descriptions of all species, but I provide full descriptions only for species that I have seen myself. For the others, I indicate where in the literature good descriptions may be found. I hope to add more descriptions, and improve the existing ones, in future versions of the Flora.

The keys also include numerous species not reported for Greece but which might occur here.

The reader should remember that there are significant gaps in our knowledge. Large areas of Greece, especially in the north of the country, remain poorly explored. The serious worker is likely to encounter species of lichens not previously reported for Greece, and is certain to encounter species of lichenicolous fungi that are new to Greece or undescribed.

The serious worker will also soon meet some of the taxonomic problems just mentioned. Some collections are difficult to place, and I have several that may represent undescribed species. I have deliberately refrained from formally describing any new species from Greece. What we need at present are careful monographic revisions of particular groups incorporating ample material from SE Europe, and with proper regard to the many neglected taxa described long ago from the region, not premature publication of names which may have to be reduced to synonymy later. Many neglected taxa described from North Africa, especially Morocco, by French lichenologists, especially Werner but also others, are also in need of study. It is almost certain that many of them too are relevant to Greek lichenology.

No specialist in lichenicolous fungi has ever collected in Greece. I myself have not gone out of my way to look for these organisms, my collections have been made incidentally while collecting lichens, and many of them are scanty as a result. The same probably applies to collections made in Greece by other workers. This, combined with the difficulty of accessing the very scattered literature on these organisms, means that I have not been able to determine many of my collections. Other workers should expect to encounter similar difficulty. It is certain that many more lichenicolous fungi are present in Greece than are included in this Flora.

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 Greek Setting

The lichen biota of any region is strongly influenced by many geographical factors, especially geology and climate. A serious Flora ought to discuss them, especially in a country as diverse as Greece. Unfortunately I am not familiar with many regions of Greece myself, and good published information is scarce.

Crete is very well covered by Rackham & Moody (1996), for the island of Samothraki there is a good basic summary in Biel & Tan (2014), and there is a good website for the island of Thasos. I have not found much else. To supplement these meagre sources, an Appendix gives my own observations about the Peloponnese, the area I know best. Those observations are applicable without much change to many other, though not all, parts of southern Greece.

If you are aware of good summaries, in English, for other regions, I would appreciate your drawing them to my attention.

A note for beginners

This Flora assumes some previous knowledge of lichens. Beginners will find it difficult to use, though the Glossary section does provide some help with terminology and technique. 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. I
can merely offer the following general advice to anyone who wishes to learn more about lichens.

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 Άβιες) 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 used for chromatography pose substantial additional health hazards, but chromatography is outside the scope of this Flora.)

I can offer further assistance, by email, 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.

Updates

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.

I would, of course, be grateful to learn of any errors in this document. They will be corrected as soon as is practical.

Other feedback would also be gratefully received. I would welcome feedback on the keys, especially the parts for taxa that I have not seen myself.

Keys and taxonomic treatment

The keys distinguish between taxa that have been reported for Greece and those that have not but which might occur here.

The taxonomic section includes all taxa that have been reliably reported for Greece. I include a full description for most taxa that I have seen myself in Greece; the exceptions are those for which my collections were scanty, or in groups where I consider that I do not adequately understand the taxonomy. Descriptions 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. Where I do not provide a description, I refer to one or more descriptions in the literature. 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. Rather than attempt to always follow the latest ideas, which are themselves often unstable, 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 also uncomfortable with the increasing tendency to delimit genera on the basic 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. To say 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.

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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 impactical, 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, Kerry Knudsen, Mark Powell, Ayhan Şenkardeşler, Harrie Sipman, Ulrik Sochting, 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.

Finally, this project would have got nowhere without my husband, Reay Sutherland, who, for 36 years, has supported and assisted me in ways that are far too numerous to list.
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 type in parentheses, e.g. (Gloeohepia), 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 then 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.

The meaning of technical terms is explained in the Glossary. If you encounter any terms whose meaning is not obvious, but which I have not placed in the Glossary, please let me know. 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 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.

These keys, and also 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.

These keys should work reasonably well for Peloponnesian taxa, as they are based on my own direct experience of those taxa, but they may not always work so well for other taxa. For collections from outside the Peloponnesse, it may be advisable to use the keys with some caution. Feedback on any deficiencies, and suggestions for improvement, would of course be appreciated.

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, and not yet reliably reported for Greece. **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 elongate apothecia. **Generic key 8: Crustose lichens with elongate apothecia**

55 Ascomata apothecia that are ±rounded or, in a few genera, irregular but not obviously elongate.

66 Thallus and/or apothecia yellow, orange or red. **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 4.

1 Fungus not forming a lichenised thallus, but parasitic or commensalistic on other lichens. **Generic key 12: Lichenicolous fungi** See Notes 5 and 6.

(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 Collema and Leptogium are also keyed there and the remaining species in the first branch are rare.

(4) 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.

(5) 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. 

(6) 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 scanty 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) Not correctly reported for Greece, but a key to species is provided.
   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. *Leptogium*
   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 greasy tinge. Ascospores septate to muriform. On various substrates. *Leptogium*
   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 vermiciform, sometimes spirally twisted, 50 - 95 x 5 - 6 µm. Exciple hyphal. On bark or bryophytes on bark. See Note 2. *Arctomia fascicularis*
   5 Ascospores 1- to multi-septate, or muriform, usually not acicular or vermiciform, size various. Exciple hyphal or cellular. Substrate various. *Collema*

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.

33 Thallus subgelatinous, green-brown, of small (1 - 2 mm) inconspicuous squamules, each of which may contain 1 to several immersed apothecia. On non-calcareous soil. *Epiphloea*

33 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. *Epiphloea*

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)*

6 Photobiont *Scytonea* (see Note 1). On wet or dry calcareous or at least basic rock.

77 Basal part of thallus with a one- to multi-layered hyphal strand. Apothecia with a distinct thalline margin. Asci often with more than 8 ascospores. On calcareous rock that is at least periodically wet.

**Zahlbrucknerella**

7 Basal part of thallus without a hyphal strand. Apothecia without a thalline margin. Asci with 8 ascospores. On dry calcareous or basic rock. *(Thermutis)*

5 Thallus growth form various; if filamentous, then shape of entire thallus not resembling that of the photobiont.

66 Asci formed in gall-like swellings of the thallus (thallinocarps). Disc rough and usually concolourous with the thallus when wet. Hymenium IKI+ blue turning wine-red. Probably *Thallinocarpon*, but also consider *Lichinella* and *(Gonohymenia)*, as the delimitation of these genera are not clear to me.

6 Sterile, or ascomata not thallinocarps. Disc smooth (but occasionally umbonate). Hymenium IKI- or IKI+ blue (rarely turning wine-red).

77 Photobiont cells in filaments, though sometimes obscurely so.

88 Photobiont cells bead-like (actually Nostoc). Thallus usually homoioemerous; some species with hormocystangia. *Lempholemma*

8 Photobiont cells not bead-like (Rivulariaceae). Thallus various.

99 Thallus distinctly fruticose. On siliceous rock at the sea. **Lichina**

9 Thallus squamulose or crustose. On moist siliceous rock, but not marine. If present in Greece then probably northern or alpine. *(Porocyphus)*

7 Photobiont single-celled.

8888 Thallus fruticose.

99 Lobes distinctly flattened. **Lichinella**

9 Lobes arounded 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. **Synalisia symphorea**

8888 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. **Pterygiopsis**
9 Disc not umbonate and hymenium not divided by sterile, hyphal bands. Disc open or ±punctiform.
   AA Exciple thick. Thalline margin excluded early.
   BB Thallus crustose-areolate, effigurate, granulose to subfruticose. Usually on moist siliceous or calcareous rock. If present in Greece then probably northern or alpine sites. (Porocyphus)
   B Thallus granulose-crustose. On dry calcareous rock or crusts. Not restricted to northern or alpine sites. **Lemmopsis**
A Exciple thin or absent. Thalline margin distinct, persistent.
   BB Paraphyses thick, usually distinctly moniliform eventually. Sheath of photobiont cells usually reddish or purplish. **Pyrenopsis**
   B Paraphyses thin, not distinctly moniliform. Sheath of photobiont cells usually yellow-brown. **Psorotichia**

(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.

(2) This couplet is optional, as Arctonia fascicularis is included in the key to Collema. Doubtful specimens are best determined using the Collema key.

**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**
   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 microscopticum**
   4 Primary thallus not leprose, corticate. Secondary thallus taller than 5 mm in most species, unbranched to very branched, with corticate outgrowths (phylocladia), ±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.
   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. *Leptogium*, especially *L. teretiusculum*.
4 Thallus filamentous. Apothecia present or not.
55 Thallus shining brown, ±erect. Apothecia frequent. Amongst mosses on trees and rocks. *Polychidium musciola*
5 Thallus matt, blackish or greenish, ±prostrate or erect. Apothecia rare. On damp siliceous rock.

**Splenomera**
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 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 *Ramatina*
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*
66 Pseudocyphellae absent. Thallus KC+ yellow. *Evernia*
5 Thallus grey. *Lethariella*
4 Thallus without a tough axial strand, breaking easily when branches stretched.
55 Thallus uniform shade of grey or green.
66 Pseudocyphellae absent. 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 *Ramatina*
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*
66 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 Photobiont green. *Trentepohlia*. Cortex or medulla or soralia C+ red. Always at or close to the coast.
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 *Aspicilia*
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)
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 (Peloponnese only); 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 (Physconia 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. **Heterodermia 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. Soralia absent. **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. **Foliose 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. **Foliose 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. **Foliose 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-. **Degelia**
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. **Leptogium**

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

55 Hyphae more closely aggregated near 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. **Collema**

(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. **Heteroderemia**

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**

55 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 without 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**

6 Lower cortex hyphal. Lower surface white to pale brown everywhere. **Physciella**

(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.

(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 with 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**

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 ±closey 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 axils of lobes. Very common throughout Greece. **Parmelia**

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. **Melanelia**

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(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.

**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**

111 Ascospores muriform.

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

2 Hymenial gelatin not containing algae. Ascospores colourless. **Agonimia**

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 pseudo septum.
22 Thallus distinctly squamulose.

- 33 Involucrellum present. Perithecia between the squamules. (Involutcropyrenium)
  - 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**
  - 55 Medulla and lower cortex not very distinct. Cellular structure extending through a large part of the squamule. Ascii clavate. Ascospores ± biseriate. Squamules small. **Heteroplacidium**
  - 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. Most species on bark or bryophytes, predominantly in habitats that are not very dry.
22 Photobiont not confined to a distinct layer. Ascospores muriform. Many species with an upper and lower cortex of ± rectangular cells, precisely one cell layer thick. **Leptogium**
2 Photobiont confined to a ± distinct layer. 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 1.
444 Upper surface olivaceous to blackish, sometimes grey to dark brown. Hypothallus poorly developed and inconspicuous. Apothecia with a thalline margin. Isidia and soralia absent, but thallus and thalline margin sometimes granular. Hymenium I+ deep blue (Note 2). **Protopannaria**
44 Upper surface olivaceous to brownish. Hypothallus thin, blackish. Apothecia with or without a thalline margin. Isidia or soralia present in some species. Hymenium I+ blue, slowly > blue-green or red-brown (Note 2).
55 KI+ blue region of ascus apex forming a sheet at top of ascus. Ascospores without a perispore. Thalline margin irregularly developed. Isidia present or absent. Soralia absent. **Vahlilia**
5 KI+ blue region of ascus forming a ring at top of ascus, central part of ring KI- or only weakly KI+ blue. Ascospores often with a perispore. Thalline margin sometimes well developed. Isidia absent. Soralia present or absent. **Fuscopannaria**
4 Upper surface bluish or brownish, smooth. Hypothallus of rhizohyphae, sometimes visible from above. Apothecia without a thalline margin. Isidia or soralia present in some species. Hymenium I+ blue (Note 2). **Parmeliella**
1 Photobiont not Nostoc. Most species on rock or soil, predominantly in dry habitats.
22 Asci with 8 ascospores.
33 Thallus squamulose, without large internal air spaces, with an upper and/or lower cortex. Photobiont Scytonema. **Heppia**
3 Thallus squamulose or squamulose-crustose, sometimes with large internal air spaces, without a cortex. Photobiont of isolated, rounded cells. (Gloeohepia)
2 Asci with at least 24 ascospores. **Peltula**
(1) 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.
(2) 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**
1 Asci with 8, or about 8, ascospores.
22 Ascospores septate.
33 Ascospores brown. **Buellia badia**
3 Ascospores colourless.
44 Apothecia with a thalline margin, at least when young (Note 1). Asci ±Catillaria type. On rock or soil. **Solenopsora**
4 Apothecia without a thalline margin. Asci Bacidia or ±Biatora type. On various substrates.
55 Photobiont layer present below hypothecium. On rock. **Waynea**
5 Photobiont layer not present below hypothecium. On various substrates.
66 On bark or wood. Ascospores not often 1-septate, usually simple. See **Carbonicola** and **Xylopsora** below.
6 On rock or soil, or parasitic on lichens on rock or soil. Ascospores commonly septate.
77 Paraphyses not conglutinated, each with a distinct swollen apical cell covered by an external gelatinous pigment cap. **Toninia**
7 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 Apothece red. **Psora testacea**
3 Apothecia variously coloured, not K+ purple.
44 Apothecia with a thalline margin, at least when young.
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. **Rhizoplaea**
7 Medulla often very thick, dense and chalky. On ±calcareous rock or soil. **Squamarina**
6 Thallus subsquamulose, sometimes areolate in central parts.
77 Asci Lecanora type. **Lecanora**
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**
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**
77 Epithecium green, dark green or green-black (sometimes with a brown tinge). (Glyphopeltis), (Psorula)
7 Epithecium blue-green. **Toninia tristis** subsp. **thalloedaemiformis**

(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-.
   22 Squamules ±ascending, at least at margins.
      333 Squamules pale green, shiny. On bark. Waynea stoechadiana
      33 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 rotted 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. Toninia
      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. Lecanora
      3 On non-calcareous rock. Consider Stereocaulon and Lecanora

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.
   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. Jullela
7 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 foliicolous. (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.
55 Thallus dark brown, not pruinose. Parasitic when young on Aspicilia calcarea. Heteroplacidium fusculum
5 Thallus pale grey to brown-grey, densely pruinose.
66 Ascospores 20 - 30 x 6 - 11 µm. Parasitic when young on Lecanora muralis. Placocarpus schaereri
6 Ascospores 13 - 16 x 6 - 8 µm. Not associated with Lecanora muralis. Dermatocarpon subcrustosum
3 Thallus strictly crustose, superficial or endolithic. On various substrates.
4444 Ascospores subsimuliform or muriform, often becoming brownish.
55 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.
6 Cortical cells not papillate. Perithecial wall not multi-layered. Polyblastia
444 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.
666 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 generally 10 - 18 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 Pseudoparaphyses short. Any species with a radially split involucrellum (x20) belongs here. Species with persistently poorly developed ascospores probably also belong here.

99 Upper cortex fairly well differentiated. Perithecium ± immersed. Involucrellum, if present, often with radial cracks. Oil cells often present in lower part of medulla (Note 2). Ascospores often poorly developed in some species. **Bagliettoa**

9 Upper cortex not well differentiated. Perithecium superficial or semi-immersed. Involucrellum present, without radial cracks. Oil cells absent. **Parabagliettoa**

8 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) 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. Ascii 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. Ascii 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 µm 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 µm 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 µm long, without gelatinous appendages. On various substrates. **Porina**

2 Ascospores less than 5 times as long as wide.
   33 Tissue between asci almost cellular. Ascii 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. Ascii 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 Interascal hyphae unbranched. (Lithothelium)
   5 Interascal hyphae branched and often anastomosed.
   66 Involucrellum ±cellular, not containing bark cells. **Anisomeridium**
   6 Involucrellum not cellular, often containing bark cells. **Arthopyrenia**
**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.

33 Ascospores ellipsoid. *(Microcalicium)*

3 Ascospores spherical to subglobose.

44 Ascospores wall colourless. Spore mass pale.

55 Asci formed singly. Photobiont *Trentepohlia*. *(Sclerophora)*

5 Asci forming in chains. Photobiont green (*Stichococcus*), not *Trentepohlia*. *(Chaenotheca gracilenta)*

4 Ascospores wall brown to blackish. Spore mass brown to black.

55 Ascomata with long slender stalks. Spore mass medium brown. Thallus lichenised. **Chaenotheca**

5 Ascomata short-stalked or sessile. Spore mass black. Thallus parasitic or parasybiotic, not lichenised. **Sphinctrina**

2 Ascospores septate to submuriform.

33 Spore mass brown. **Chaenotheca**

3 Spore mass black or green-black.

444 Ascomata immersed.

55 Exciple strongly thickened at base. Fertile verrucae 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 asci penetrated by a thin canal. Asci usually less than 55 µm long. **Chaenothecopsis**

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

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

44 Ascosporos simple or 1-septate, ellipsoid. Asci more than 65 µm long. *(Phaeocalicium)*

4 Ascosporos (1) 3 -septate, broadly to narrowly fusiform. Asci 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)*

**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**

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)

**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.

2222 Ascospores multisepitate.
    33 On calcareous rock. **Caloplaca ochracea**
    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)

222 Ascospores polarilocular or clearly derived from a polarilocular state, usually ellipsoid or lemon-shaped. **Caloplaca**

22 Ascospores 1-septate (not polarilocular). **Fulgensia**

2 Ascospores 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. **Fulgensia**
    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 Ascospores appearing 1-septate, but in fact simple with 2 locules. **Candelariella**
    33 Ascospores (1) 3 -septate. (Chrysothrix)
    3 Ascospores with 7 or more septa. If present in Greece, then strictly montane. (Arthrorhaphis)

2 Ascospores simple.
    33 Ascospores ±tear-shaped (dacryform). Thallus leprose. (Psilolechia)
    3 Ascospores ±ellipsoid. Thallus not leprose.
44 Apothecia ± punctiform, immersed in thallus. Thallus yellow, superficial, with radiating marginal lobes. Ascii 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. Ascii 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). Ascii 8 - 32 spored, Candelaria type. On various substrates. **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. Ascii 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 lilacina**

(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.

22 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. **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. Ascii 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.

77 Mature ascospores septate (Note 1). **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. **Pertusaria**

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 2. **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 lilacina**

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 capitulate 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) Immature asci in Aspicilia often appear granular and the contents could be mistaken for small ascospores. However, Aspicilia has a greenish epithecium and moniliform paraphyses, unlike any genus in key 10H.

(3) 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**

2 Ascospores simple. Photobiont absent. **Agyrium**

I 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 Ascii 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. (Vezdacea)

2 Ascii 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**

2 Ascospores septate. Prothallus present or absent. Soralia present or absent. Thallus variously coloured, sometimes pruinose. **Placynthium**

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

I 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. Epithecium with green and/or brown pigment, green pigment (Aspicilia green) N+ distinctly green or blue-green. Disc black or almost.
66 Marginal lobes not well developed. Occasional collections of **Aspicilia**.

6 Marginal lobes often well developed. Very common. **Lobothallia**

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. **Lecanora**

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

111 Ascospores submuriform or muriform. **Leptogium**

11 Ascospores septate.

22 Thallus ±immersed. Disc pale. **Petractis clausa**

2 Thallus superficial. Disc dark brown to black.

33 Cortex without obvious structure. Ascospores 3 - 7 -septate, 25 - 35 µm long. Thallus without marginal lobes. **Collolechia**

3 Cortex distinctly cellular. Ascospores 1 - 3 -septate in most species (but 3 - 7 -septate in Placynthium garovaglioi). Thallus with or without marginal lobes. **Placynthium**

1 Ascospores simple.

22 Photobiont Nostoc, in a distinct layer. **Protopannaria pezizoides**  

33 Ascospores with a perispore. Apothecia to 2 mm diameter, with a thalline margin. **Moelleropsis nebulosa**

2 Photobiont not Nostoc, in a distinct layer or not.

33 Ascii with at least 24 ascospores. **Peltula**

3 Ascii with 8 ascospores.

44 Photobiont cells without a gelatinous covering. Thallus not, or only weakly, gelatinous when wet. Thallus subsquamulose, not strictly crustose. (Gloeoeheppia)

4 Photobiont cells with a distinct, gelatinous covering. Thallus ±gelatinous when wet. Thallus various. **Bactrospora**

55 Exciple thick. Thalline margin excluded very early.

66 Apothecia arising from below pycnidia. On moist siliceous or calcareous rock. (Porocoryphus)

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 in Schismatoma). **Schismatoma**

33 Ascospores submuriform. (Dipslocistella)

3 Ascospores septate.

44 Thallus C+ red. On bark or rock. **Dirina**

4 Thallus C-. On bark or wood; not on rock (in Greece). **Schismatoma**

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 often more than 50 µm long, multiseptate (usually many more than 12-septate), sometimes fragmenting into part spores. Asci with small but distinct KI+ blue cone at apex, ascus wall KI-.

**Bactrospora**

4 Ascospores usually less than 50 µm long. 3 - 12 -septate, not fragmenting into part spores. KI+ blue apical cone absent or poorly developed, ascus wall faintly KI+ blue.
55 Ascus without distinct apical structures. Ascospores with gelatinous perispore, which may be weakly developed. **Lecanographa**

5 Ascus with distinct KI+ blue apical ring. Ascospores without perispore.

66 Exciple carbonised, hyphae not visible. Epithelial granules K+ orange or purple. **Cresponea**

6 Exciple dark, but hyphae visible (at least in K). Epithelial granules K-. (Lecanactis) Greek reports doubtful, but a key to species is provided.

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.

Asci 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). **Hymenella**

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 Ascii 8-spored. **Gyalecta**

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

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

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

11 Ascii 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 Ascii 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. Ascii Rimularia type (like Lecanora type, but with small KI+ blue plug at top centre of ocular chamber). **Rimularia**

222 Ascospores 1-septate. Ascii 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**

4 Apothecia without a thalline margin.

55 Ascii 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. Norstictic acid absent. **Rinodina**

5 Ascii 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); ±Buella 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). Buella
22 Ascospores 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 Ascospores distoseptate (see Glossary). Calcium oxalate crystals present in thallus. Apothecia often heavily pruinose. Diplotomma See Note 4.
3 Ascospores euseptate (see Glossary). Calcium oxalate crystals generally not present. Apothecia pruinose or not, but rarely heavily pruinose. Buella
2 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
3 Asci with 4 or more ascospores. Diplorschistes

(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 Buella commonly lack conidiomata, so keys to species under Buella include Amandinea species.
(4) If parasitic on Lecanora albescens, consider also the poorly known, non-lichenised species Buella 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. Jamesiella anastomosans
2 Hyphophores squamiform. Apothecia yellow-green or grey-brown. Usually foliicolous. (Gyalectidium)
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**

11 Ascospores polarilocular. Caloplaca
1 Ascospores not polarilocular.
22 Apothecia with thalline margin (which may become excluded). Asci Bacidia or Catillaria type.
33 Hymenium with distinct purple tinge. Most ascospores simple, only occasionally 1-septate. Tephromela atra
3 Hymenium without purple tinge. Most ascospores septate.
44 Ascospores 1-septate, with perispore that swells in K. Asci Catillaria type. On rock or parasitic on lichens on rock. Very rare in Greece. Halecana
4 Ascospores (0) 1 - 3 (7) -septate, without perispore. Asci Bacidia type. On various substrates. Some species fairly common in Greece. Lecania
2 Apothecia without thalline margin. Asci various.
33 Ascus apex when stained in KI without a distinct vertical central part.
44 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.
55 Paraphyses strongly capitulate, with dark-coloured apical cap. Ascospores without layered walls. Apothecia usually black. On bark or rock, not restricted to humid sites. Common. Catillaria
5 Paraphyses only weakly capitulate. 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
4 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.

3 Ascus apex when stained in KI with vertical central part distinctly more intensely blue or distinctly less intensely blue than sides of apex.

444 Ascus apex KI- except for KI+ blue apical tube (Porpidia type). Not usually on bark.

555 On soil, detritus, or decaying bryophytes. Ascospores 0 - 3 -septate. Some species presently treated in Mycobilimbia

55 On calcareous rock. Ascospores 0 - 1 -septate. Porpidinia tumidula

44 Ascus KI+ blueish, containing a darker blue tubular ring structure (Byssoloma type). Ascospores 1 - 7 -septate. Paraphyses branched and anastomosed. Usually on bark.

55 Exciple tomentose, loosely structured in section. Ascospores 3-septate. (Byssoloma)

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

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

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

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

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

66 Hyphae of exciple moderately branched or foraminose (Note 2). Apothecia black, sometimes pruinose. Thallus often pruinose. Epithecium distinctly pigmented, usually grey, green or black.

77 Asci with 8 ascospores. Usually on rock or soil, occasionally lichenicolous, not normally on bark. Ascospores various. Toninia

7 Asci with 8 - 16 ascospores. On bark. Ascospores 10 - 18 x 4 - 5 µm, usually 3-septate. Arthrosporum

6 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.

77 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

7 Rim without such a gelatinous layer. Ascospores without warted perispore. On various substrates. 88 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.)

8 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.

99 Cell lumina in exciple wide and irregularly shaped. Pycnidia often present and conspicuous. Usually on bark or wood. (Clistostomum)

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

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

CC Ascospores narrowly ellipsoid, 1 - 3 -septate. On various substrates. Morphs of Lecania species without a thalline margin.

C Ascospores broadly ellipsoid, 1-septate with a thin septum. On calcareous rock. Some species present treated under Catillaria

B Ascospores usually elongated, not ellipsoid, 3- or more-septate.

CC 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 narrowly cylindrical, 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**

C 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 asci 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.

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

111 Apothecia compound. On rock in arid regions. (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 Apothecia with a thalline margin; algae present at least when viewed in section.
3 Apothecia usually immersed, occasionally ± sessile. On rock or lichenicolous. Ascus apex KI+ blue or KI-, not staining in distinct layers.
444 Asci **Porpidia** type. 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 Ascus apex KI+ weakly blue, close to Lecanora type. 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.
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.
444 Epithecium with many granules that react K+ scarlet or +purple and then dissolve. Apothecia orange, densely pruinose, K+ red-purple. **Piccolia**
4 Epithecium without granules, K-. Apothecia brown-red, scarlet-red, brown or black, not pruinose, K-.

22 Apothecia without a thalline margin; algae absent even in section.
33 Apothecia ± pale. Ascospores various. On bark or soil.
44 Ascosporas ± globose. On bark. (Biatoridium)
444 Ascosporas ± ellipsoid. On bark or soil. (Biatorella)
33 Apothecia orange, red or red-brown. Ascospores ± globose. On bark or wood, or overgrowing bryophytes.
44 Epithecium with many granules that react K+ scarlet or +purple and then dissolve. Apothecia orange, densely pruinose, K+ red-purple. **Polysporina**
4 Epithecium without granules, K-. Apothecia brown-red, scarlet-red, brown or black, not pruinose, K-.

3 Apothecia dark brown to black. Ascospores ellipsoid or globose. On rock or (rarely) parasitic on lichens on rock.
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 capitulate. Apothecia black. Disc umbonate, often becoming gyrosem. **Polyphora**
5 Paraphyses simple, sometimes with visible septa, sometimes ± capitulate. Apothecia red-brown to black. Disc not umbonate, not gyrosem. **Sarcogyne**
Generic key 10I: Lecanorine genera.

   222 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 of Lecanora 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. Aspicilia
   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 Epithecium N+ violet-pink. Hymenelia
   5 Epithecium N- or N+ intensifying green. Ionaspis

1 Apothecia emergent, at least eventually. Paraphyses not, or only weakly, moniliform. On various substrates.
   22 Hymenium distinctly purple or brown-purple. Tephromela atrata
   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 Asci Porpidia type. Thallus white to pale grey, pruinose. On calcareous rock. (Koerberiella pruinosa)
   4 Asci 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. Lecanora

(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. Rimularia
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 Ascii without any apical apparatus; discharging by splitting. On rock. Schaereria
   3 Asci with apical apparatus. On various substrates.
   44444 Ascus 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**

5 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. **Cephalophyisis leucospila**

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

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. Epitheciium and hypothecium sometimes with a green tinge. Pycnidia often present. **Farnoldia**

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

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**

4444 Asci Lecidea type. **Lecidea** sensu stricto.

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. Epitheciium and hypothecium sometimes with a green tinge. Pycnidia often present. **Farnoldia**

8 True exciple not friable. Apothecia sessile or immersed. Epitheciium 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 Epitheciium or exciple K+ purple, purple-red or red-purple, reaction often fleeting. On bark. **Pyrrhospora**

5 Epitheciium 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. **Miriiquidica**

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- part of asci convergent towards apex, not open above. Epitheciium usually with a green-black, blue-green or black-blue pigment. Very common. **Lecidella**

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

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

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

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

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

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 Epitheciium 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:** Porphidia often has ascospores that are noticeably larger than the other genera.
- **Disc, colour:** Pure black in Lecidella (except some shade specimens) and Porphidia; black to very dark red-brown in Clauzadea. Often pale in Biatora. Pyrrhospora quernae has distinctive dark red-brown discs.
- **Epithelial pigment:** Often a distinctive blue-green-black in Lecidella.
- **Hypothecium:** Always dark brown in Porphidia.
- **Isidia:** Only in Placynthiella.
- **Exciple:** Black in Clauzadea (most species), Lecidella and Porphidia; often shiny in Lecidella.
- **Rarity:** Clauzadea and Lecidella are common. Other genera are rarer.
- **Soredia:** Never in Clauzadea.
- **Substrate:** Clauzadea, Immersaria, Miriquidica, Porphidia 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** and **Fulgensia**. Pruinose or terricolous specimens usually belong to Fulgensia.
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 nor medulla yellow or orange.
33 Photobiont blue-green. **Placynthium**
3 Photobiont green.

444 Thallus some shade of green. **Lecanora muralis** and related species.
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.
22 Thallus with isidia or structures resembling isidia.

33 Photobiont blue-green. **Placynthium nig run**
3 Photobiont chlorococcoid.

444 Thallus C+ persistent orange. On bark.

55 Isidia globose to cylindrical, abut 0.1 mm wide, 0.1 - 0.3 mm tall. **Pertusaria flavida**
5 "Isidia" actually blastidia; globose, to 0.1 mm diameter. **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-. **Pertusaria albescens var. corallina**

2 Thallus without isidia but with soredia.

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 **Schismatomma 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. **Buellia 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 C+ red or pink, usually not persistent.

77 Young soralia excavate (never convex), surrounded by a prominent, upturned thalline margin, never very large, UV+ whitish (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+ white 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. **Loxospora elatina**

9 Thallus P-. Consider **Pertusaria albescens** or **Ochrolechia**.
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 Ascii 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 Ascii 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. See (Diederimyces) and **Lichenostigma** in key 12E.

6 Ascospores with interascal filaments. **Clypeococcum**

5 Ascospores multi-septate. (Homostegia), (Lasiosphaeriopsis salisburyi)

4 Perithecia not in a stroma.

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

**Lichenicolous ascomycetes, perithecia dark, with hairs**

5 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. (Marchandiobasidium)

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. Haustorial filaments (see Note 1) not arising from a mother cell. (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. (Cystobasidium)

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, claviform or capitate, 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. (Cornutispora), (Cladoniicola)

2 Cladonia not branched, septate or simple.

33 Pycnidia pale (except sometimes at ostiole). (Bachmanniomyces), (Epaphroconidia), (Karsteniomyces), (Lawalreea), (Libertiella)

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)

4 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 Phaeographis 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. Lichenonoconium

5 Conidia colourless.

66 Ostiole surrounded by many hairs. (Pyrenochaeta)

6 Ostiole not surrounded by hairs.

7777 Pycnidia growing on mazaedia of Calicaires species. (Asterophoma)

777 Pycnidia on thallus or podetia of Cladonia species, and there often forming galls. Pycnidia often with a
flattened base. (Epicladonia) 
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 foliose Parmeliaceae. (Vouauxiomyces) See Note 1. 
9 Conidia not flattened at base. On various hosts. 
AA Conidia more than 10 µm long. (Diedrichelia), (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. (Didymocyrtis), (Phoma) 

(1) Vouauxiomyces is the anamorph genera of Abrothallus and its species are more correctly treated under that name. 
As there are not yet any Greek reports of Vouauxiomyces, it is simpler to retain the old usage for the present.

**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. (Illosporium), (Marchandiomycetes) 
5 Conidia septate. (Fusarium), (Illosporiopsis) 
4 Sporodochia dark brown or black. 
555 Conidia not septate but with an oblong, pale zone that resembles a window. (Fenestroconidia) 
5 Conidia not septate, without internal structure. 
666 Conidia colourless. (Hainesia) 
66 Conidia with a green tinge. (Bloxamia) 
6 Conidia dark brown. 
77 "Sporodochia” actually raised stromata. (Phaeosporobolus) 
7 Sporodochia adpressed or immersed. 
88 On Lecidella species. (Felgeniomyces) 
8 On Pertusaria species. **Sclerotococcum**

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), (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. **Xanthoricola** 
55 Conidia distinctly longer than wide, but forming a well-defined shape; not massed together. (Alysidium),
(Ampullifera), (Cladosporium), Intralichen
5 Conidia very irregularly shaped, appearing warty. (Milospium)
44 Many conidia septate. (Some simple conidia may also be present.)
5555 Conidia arising singly at ends of conidiophores. (Codonmyces), (Endophragmiella), (Pseudocercospora), (Sporidesmium)
555 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. (Taeniolella), (Taeniolina), (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
      33 Ascospores 1-septate.
      44 Apothecia stalked. Calicium
      4 Apothecia sessile. Cyphemium
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). (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. Rhymbocarpus
       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), (Odontotrema), (Paralethariicola)

**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. Dactylospora
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. **Dactylospora**

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. (Lettauia, (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. Epitheciun greenish. Ascospores 3 - 4.5 µm wide. (Toninia plumbina)

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

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.

66 Asci with 12 - 16 ascospores. **Catillaria mediterranea**

6 Asci with 4 - 8 ascospores.

77 On Aspicilia calcarea. **Toninia episema**

7 Usually on Peltigera or related genera. (Scutula)

5 Apothecia elongate

66 Exciple continuous below hymenium. **Labrocarpon**

6 Exciple not continuous below hymenium. (Hemigrapha)

3 Ascospores simple.

44 Asci with 100 or more ascospores.

55 Paraphyses richly branched and anastomosed, generally without visible septa, not capitulate. 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**

4 Asci with 8 or fewer ascospores.

55 Hypothecium ±colourless.

66 Exciple carbon-black. **Carbonia**

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. (Phaeopyxis)

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.
      33 Thallus without network of dark hyphal strands. Ascospores colourless, spirally bent, one or both ends ± pointed. Hymenium I-, KI-. On Fuscidea. (Diederimyces)
      3 Thallus with or without network of dark hyphal strands. Ascospores colourless or brown, ends rounded or blunt. Hymenium I- or I+ blue or red, KI- or KI+ blue. Not restricted to Fuscidea. **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.

11 Ascomata entirely within a stroma, ostiole indistinct. (Broomella)
1 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**
      3 Ascospores mostly 1-septate. (Nectria), **Nectriopsis**, (Pronecinctria), (Xenonecinctriella). 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. (Paraneocinctria)
      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. (Pleonecinctria)

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

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

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

11 Ascii 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. (Bellemerella)

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 Ascii with 8 or fewer ascospores.

2222 Ascospores simple. (Adelococcus), (Phaeosporis), (Reconditella), (Rosellinia), (Roselliniella), (Roselliniopsis)

222 Ascospores mostly 1-septate.

33 Inter-asal 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. Clypeococcus psoromatis

4 Not as above. Polycoccus

3 Inter-asal 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. (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. Sphaerellotheicum

22 Ascospores mostly multi-septate.

33 Inter-asal hyphae indistinct.

44 Asci with fewer than 8 ascospores. (Lasiosphaeriopsis supersparsa), (Pyrenidium actinellum)

4 Ascii with 8 ascospores. Phaeospora

3 Inter-asal hyphae clearly visible. (Leptosphaeria), (Pyrenidium), (Weddellomyces), (Wernerella)

2 Ascospores mostly submuriform or muriform.

33 Inter-asal hyphae indistinct. Merismatium

3 Inter-asal hyphae clearly visible. (Dacampia), (Pleospora)

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

111 Hymenium of ±globose cells, without inter-asal filaments. See (Diederimyces) and Lichenostigma in key 12F.

11 Hymenium not of globose cells, with numerous oil droplets 3 - 8 μm diameter. Ascii with 4 or 8 ascospores. Inter-asal 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 Asci with more than 8 ascospores. (Neolamya)

3 Asci with at most 8 ascospores.

44 Inter-asal filaments becoming indistinct in mature perithecia. Sarcopyrenia

4 Inter-asal filaments persistent. (Sagediopsis)

2 Length/width 6 or less.

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

3 Ascospores septeate, submuriform or muriform.

44 Ascomata catathecia. 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-ascal filaments distinct, at least initially.
77 Ascospores more than 30 µm long. (Rhagadostoma)
7 Ascospores less than 30 µm 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, Catapyrenium or Endocarpon. Cercidospora
9 Ascomatal pigment brownish, never with a green or blue tinge. On Collema, Catapyrenium or Endocarpon. Didymellopsis
6 Inter-ascal filaments indistinct, even in young perithecia.
77 Asci with 8 ascospores. Stigmidium
7 Ascii with more than 8 ascospores. See Note 2.
88 Perithecium with a depression around ostiole. Wall of perithecium with two distinct layers.
8 Perithecium without a depression around ostiole. Wall of perithecium without two distinct layers.
8 Pseudoparaphyses elongated, with rounded basal cell and 1-3 apical elongated cells. (Bellemerea)
8 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 Aspicilia species. The only modern description is by Grube & Hafellner in Nova Hedwigia 51(3-4): 329-331. 1990
(2) Ascospores in Bellemerea 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.

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 taxon that has been reliably reported for Greece is discussed individually. Synonyms listed include the basionym, if there is one, and all the names under which the taxon has been reported for Greece. Other synonyms are not normally listed.

I include a description if I have collected and studied the taxon myself in Greece. 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). The descriptions are based on fewer specimens than would be appropriate for a taxonomic monograph, and so may not indicate the full range of variation that each species may display. Many of your collections will deviate slightly from the descriptions 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.

If I have not seen the species myself, or if for some other reason I am unable to provide a good description, I indicate where descriptions can be found. I have tried to cite mainly well-known European or North American Floras, not all published descriptions, but for taxa that are not well treated in those Floras, or for which a much better description exists elsewhere, I do 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 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. The reported distributions outside Greece usually take 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.

**Abrothallus De Not. (1846)**


Type: *A. bertianus* De Not. Family: *Abrothallaceae*. 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 On *Platismatia glauca*. (A. cetrariae)
3 On other species.

44 Hymenium K-. Epithecium K+ yellow. On Pleurosticta or *Parmelina*.
55 On Pleurosticta acetabulum. **A. acetabuli**
5 On *Parmelina*. **A. buellianus**

4 Hymenium or epithecium K+ green, blue-green or olive-green, at least in places; no part K+ yellow. On various hosts.
55 On *Usnea*. (A. usneae)
5 Not on *Usnea*.

666 Ascospores 7-11 µm wide. On *Xanthoparmelia*. (A. tulasneii)
66 Ascospores 3-5.5 µm wide. On *Flavoparmelia*. (A. microspermus)
6 Ascospores 5-8 µm wide. On other hosts.
77 Hymenium entirely K+ green. On *Parmotrema*. (A. parmotrematis)
7 Hymenium K+ green in upper part only, K- in lower part.
88 Hymenium colourless or pale green. On various hosts. **A. parmeliarum**
8 Hymenium with brown tinge. On *Hypogymnia*. (A. prodiens)

**Abrothallus acetabuli** Diederich (1990)
in: *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)
in: *Flora* 57: 102; *Lecidea parmeliarum* Sommerf. (1826) in: Suppl. Fl. Lapp. 176 as 'parmeliorum'

The earliest name, *Lichen parasiticus* Sm. (1808), is an illegitimate later homonym of *Lichen parasiticus* Hoffm. (1784). The epithet *parasitica* was legitimated as *Endocarpon parasiticum* Ach. (1814). *Lecidea parmeliarum* Sommerf. is a legitimate nomen novum for *Endocarpon parasiticum* Ach., which Sommerfelt cited in synonymy, the epithet *parasitica* being unavailable owing to *Lecidea parasitica* Flörke (1819). The epithet *parasitica* thus has priority over *parmeliarum*, and at present the correct name for this species is *Abrothallus parasiticus* (Ach.) Nyl. ex Sacc. (1881). However, it has been proposed to conserve the name *Lecidea parmeliarum*.

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,* (?) *Neofascelia 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)**

In: Ric. Auton. Lich. Crost. 27

Type: *A. schleicheri* (Ach.) A. Massal. Family: *Acarosporaceae.* Literature: The genus is difficult; there are many species and some of them are rather variable. Magnusson (1929) is a world monograph, but is dated. A more modern monograph relevant to southern Europe was published by Clauzade & Roux in *Bull. Mus. Hist. Nat. Marseille* 41 [not seen], and even that is probably better for SW than SE Europe. The only other way into the genus is to piece together information contained in Clauzade & Roux (1985), Nash et al. (2007), Roux (2007), Smith et al. (2009), and other publications.

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. Epitheciun: orange-brown or brown. Paraphyses: simple. Asci: narrowly clavate to almost cylindrical, KI-.

Ascospores: colourless, simple, ellipsoid, very small, many per ascus. Pycnidia: 100% immersed, not visible externally. Conidia: 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 200 species worldwide, though the taxonomy of the genus is not well understood and 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.*

The present account is provisional, and in need of substantial improvement. The genus is not well represented in the Peloponnese, where only *A. cervina* is at all common; I have few collections, and many of them have proved impossible to determine with confidence. *Acarospora* in SE Europe needs a careful revision, on the basis of extensive collections from the region.

**Key to Acarospora main groups**

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

1 Thallus not yellow; usually brownish, sometimes whiteish, 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-calcareous rock. (A. maroccana)

   2 Thallus not pure yellow; with green or white-green shades. On soil. (A. placodiiformis)

1 Thallus margin not lobed. Parasitic or not.

   22 Thallus well developed.

      33 Squamules strongly convex (though top may be flat). (A. charidema), (A. epithallina)
      3 Squamules flat or slightly convex.

     444 Disc pale yellow-brown, not very different in colour from thallus. *A. sulphurata*
     44 Disc brown, dark brown or red-brown, distinctly darker than thallus.

      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 brown to white. *A. gallica*
   3 Squamules pale or dark brown, lobed or not, overlapping or not. Margin of lower surface 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; medulla C-. *A. fuscata*
     5 Upper cortex weakly C+ red, KC+ red. Medulla said to be C+ red but reaction may be very weak.

       66 Apothecial sections with patches of sterile tissue. Probably montane. (A. peliscypha)
       6 Apothecia without patches of sterile tissue. Probably confined to regions with a true Mediterranean climate.

       *A. pseudofuscata*

(1) It is not usually necessary to turn a squamule over to examine the lower surface. If the black 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 black 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.

22 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 small, almost entirely occupied by apothecium and sometimes just forming a rim to it. **A. subrufula**

4 Squamules not entirely occupied by apothecium. (A. rufotestacea)

3 Hymenium (80) 100 - 200 µm tall. See **Myriospora smaragdula**

**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. macrospera**

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 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.

222 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 Ascosporos ellipsoid or subcylindrical.

66 Disc roughened (Note 1).  Thallus of contiguous squamules.  In Greece, probably restricted to the uplands.  **A. nitrophila**
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 Squamules 0.2 - 1.4 mm wide, ±scattered or in groups.
88 Hymenium 50 - 100 µm tall.  Areoles ±dark chestnut brown.  Upper cortex 10 - 25 µm thick.  Disc red-brown or black-brown.  **A. veronensis**
7 Squamules 0.2 - 0.3 mm wide, forming a squamulose-areolate thallus that is often clearly delimited; marginal squamules sometimes long and almost radiating.
88 Cortex 30 - 50 µm thick.  **A. complanata**
8 Cortex 10 - 30 µm thick.  (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 cannot express any firm opinion.

**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), Antartic (subantarctic islands).

**Acarospora cervina** A. Massal.  (1852)
Acarospora percaena (Ach.) J. Steiner; Acarospora percanoides auct. graec.

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. Exciple: 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. Hypothecium: pale brown to orange-brown, K-, pigment 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 ascus. 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 I have seen 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 incomnixa.

Widely distributed 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.


Island of Samothraki, on siliceous rock at an altitude of 130 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)
in: 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)
in: Flora 53(30-31):469; Lichen fuscatus Schrad. (1794) in: 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 ± asquarose (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. Photobiont: green, cells globose, 8 - 10 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)

Not accepted by Abbott (2009) owing to the uncertainty in the determination of the only Greek collection.

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, K+ blue. Hypothecium: 25 - 50 µm tall, colourless. Paraphyses: simple, 1 µm wide at base, 1.5 - 2 µm at apex, not capitulate 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 ±regular layer 90 - 125 µm thick.

The only Peloponnesian collection does not agree in all respects with published descriptions. Further collections are needed to clarify the matter.

Northern Peloponese, 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 glaucocarpa** (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 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), N. America (widespread), C. America (Mexico), perhaps S. America (Argentina), Australasia (NSW, S. Australia, NZS).
Acarospora hilaris (Dufour ex Nyl.) Hue (1909)

The name sometimes cited as basionym, *Parmelia hilaris* Dufour ex Fr. (1871) in *Lichenogr. Scand.* 209 is not validly published.

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

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 (1929).

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)
in: Lichenogr. Scand. 214

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, brown or orange-brown in upper part, colourless below, of small rounded cells, C+, K-, pigment scarcely changed in K. Apothecia: subimmersed 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-, KC- 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 Peloponnesse, 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)

The name *A. suzai* H. Magn. may be synonymous, and has priority.

Description: Knudsen et al. (2014).

Reported from a single unspecified locality in Attica, at an altitude abound 850 m.

Scattered in central Europe from France to Russia, rare in Italy and Greece. Absent from northern Europe. Also Asia (Siberia, Mongolia).

Acarospora irregularis H. Magn. (1929)

The name *A. suzai* H. Magn. may be synonymous, and has priority.

Description: Knudsen et al. (2014).

Reported from a single unspecified locality in Attica, at an altitude abound 850 m.

Scattered in central Europe from France to Russia, rare in Italy and Greece. Absent from northern Europe. Also Asia (Siberia).

Acarospora macrospora A. Massal. ex Bagl. (1857)
in: *Mem. Reale Acad. Sci. Torino*, Ser. II, 17: 396; Published earlier as *Myriospora macrospora* Hepp (1853), but the genus *Myriospora* was not validated until 1861.; (?) *Acarospora squamulosa* f. *rufescens* Arnold
The nomenclature of this species is complicated, and bound up with that of A. cervina. There may be earlier legitimate names at species rank. As a first step, the name Lichen squamulosus Ach. (1799) needs to be clarified.

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 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 murrorum A. Massal. (1853)
in: Mem. Lich. 130

The correct name is A. truncata (A. Massal.) A. Massal, basionym Biatorella truncata A. Massal. in Ric. Auton. Lich. Crost. 132. 1852, if the synonymy can be confirmed.

A. murrorum 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; overlaying 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. Asci: 100 - 110 x 13 - 15 µm, cylindrical, KI-.

Acarospora nitrophila H. Magn. (1924) subsp. nitrophila

in: Monogr. Scand. Acar. 74

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Chios and central Peloponnesian, 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 subsp. praeruptarum (H. Magn.) ined.

Acarospora praeruptarum H. Magn. (1924) in: Svensk Bot., Tidskr. 18: 330; (?Acarospora badiofusca var. lepidioides sensu Szatala; Acarospora nitrophila var. praeruptarum (H. Magn.) Clauzade & Cl. Roux

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. praeruptarum; Magnusson (1929) as A. praeruptarum;
Roux (2007)
Limos 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.

Known only from Greece.

**Acarospora pseudofuscata** Sipman (2002)

Descriptions: Roux (2007); or see the protologue

Known only from Greece.

**Acarospora reagens** Zahlbr. (1902)

If *Acarospora reagens* f. *radicans* (Nyl.) H. Magn. is synonymous, as some authors have suggested, then the correct name for this species is *Acarospora radicans* (Nyl.) Zahlbr. Priority of the epithet *radicans* at species rank dates from 1884.

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.

Known only from Greece.

**Acarospora schleicheri** (Ach.) A. Massal. (1852)


Naxos and Crete. On soil at altitudes 500 - 900 m.

Known only from Greece.

**Acarospora scotica** Hue (1909)

Description: Clauzade & Roux (1985); Nash et al. (2007).

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, California, New Mexico), C. America (Mexico).

**Acarospora sinopica** (Wahlenb. ex Ach.) Körb. (1855)

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)


The correct name may be Acarospora tersa (Fr.) ined., based on Parmelia chlorophana f. tersa Fr. At species rank the epithet tersa has priority from 1861.

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

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)

in: Geneac. Lich. 17

Type: A. conoidea (Fr.) Körb. Family: Monoblastiaceae. 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 involucrellum. Usually on calcareous rock, rarely on soil. (A. salweyi)
1 Wall of perithecia appearing ± colourless at base, clearly distinct from black involucrellum. 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
3 Perithecia 0.3 - 0.6 mm diameter. On bark or wood. (A. cavata)
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)

The earliest name may be Verrucaria alba Schrad. (1794), but according to Swinscow (1974: 225) it has not been possible to trace Schrader's material.

Description: Clauzade & Roux (1985); Poelt & Vězda (1977); Smith et al. (2009).

Widespread but not very common; usually not very far from the sea. On bark of a wide range of species, at altitudes 20 - 2400 m.

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)

Type: A. tristicula (Nyl.) Zahlbr. 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. boryschenika)

**Agonimia octospora** Coppins & P. James (1978)
in: **Lichenologist** 10(2): 181-183

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)
in: Lich. rar. exs. no. 330; **Physcia opuntiella** Poelt & Buschardt (1980) in: Poelt, **Flora** 169: 24-31

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 in the northern half of Greece, but also reported for Crete. 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)**
in: Syst. Mycol. 2(1): 231 (numbered 251 by a printer's error).


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. (2012)

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)**
in: Luyken, Tent. Hist. Lich. 95

Type: *A. sarmentosa* (Ach.) Ach. Family: *Parmeliaceae*. 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 ±round 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 Ramalinna thrusta: 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 Peloponnes, 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. In Greece, this species appears to have its headquarters in the Abies forest of the Menalo Mountains of the central Peloponnis, where it is locally abundant.

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.


Type: A. coniops (Wahlenb. ex Ach.) M. Choisy ex Scheidegger & H. Mayrhofer. Family: Caliciaceae. 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 corticolous 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 subquamulose. 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 subquamulose. 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.) Copps & Scheid. (1993) in: Scheidegger, in: Lichenologist 25(4): 343; Verrucaria punctata Hoffm. (1796) in: Deutschl. Fl. 2: 192; Buellia aequata (Ach.) Szatala; (?) Buellia aequata f. perminuta (Arnold) Szatala; Buellia aequata var. virens (J. Steiner) Szatala; Buellia myriacarpa var. stigmaticata sensu H. Olivier; Buellia myriacarpa var. virens J. Steiner; Buellia punctata (Hoffm.) A. Massal.; (?) Buellia punctata var. perminuta (Arnold) Zahlbr.; 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 stigmatea 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 excluded 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, capitax, apex 3 - 5 µm with an internal brown crescent-shaped or hemispherical pigment cap. Asci: 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)

in: Grundr. Krypt.-Kunde 197. It is a nomen novum for Hagenia Eschw., nom. illeg.

Type: A. ciliaris (L.) Flot. Family: Physciaceae. Literature: The only monograph is Kurokawa (1962), but it 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.

Differ from Physcia in having a distinctly hyphal (prosoplectenchymatous) 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.

1 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. roemeri), (A. ulotrichoides)
3 Lobes without hairs.
44 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)
in: Jahresb. Schles. Ges. vaterl. Kultur 28: 119; Lichen ciliaris L. (1753) in: Sp. Pl. 1144; (? Anaptychia ciliaris f. glaberrima auct. (probably lapsus for glabrisssima); Anaptychia ciliaris var. melanosticta (Ach.) Boistel; (? Anaptychia ciliaris f. nigrescens (Bory) Zahlb.; (? Anaptychia ciliaris f. pannis (H. Olivier) Harm.; (? Anaptychia ciliaris var. Schulz-korthii Szatala; Borrera ciliaris (L.) Ach.; (? Borrera ciliaris var. glaberrima auct. (probably lapsus for glabrisssima); (? Borrera ciliaris ß (= var.) nigrescens Bory; (? Borrera ciliaris y (= var.) tomentella Bory; Physcia ciliaris (L.) DC.; (? Physcia ciliaris var. angusta (A. Massal.) Hepp, Physcia ciliaris var. saxicola Nyl.; (? Physcia ciliaris f. tomentella (Bory) J. Steiner

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 channelled). Upper surface: grey to brown, not pruinose, finely tomentose everywhere. Lower surface: white, channelled, 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 brown, 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. Asci: 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 type). 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 A. 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 hageniae (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 (Schlecht. ex Schaer.) Védza ex Nowak (1993)
in: Kochman et al., Flora Polska, 128. (A 1977 combination by Védza was not validly published.); Borrera crinalis Schlecht. ex Schaer. (1840) in: Lich. Helve Spic. 488. (Published by Schleicher as a nomen nudum in 1815. For a full discussion of the publication history of this name and its basionym, see Pilić, 1999.); Anaptychia ciliaris f. crinalis (Schlecht. ex Schaer.) Raben.: Anaptychia ciliaris var. crinalis (Schlecht. ex Schaer.) Rabenh.


I have not assigned any of my own Peloponnesian collection to this species, for the reasons discussed under Anaptychia ciliaris, but some might belong here.

Scattered in the southern half of Greece: Crete, Evia, Peloponnese, 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 Merensch. ex Rääsänen (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)
in: Beitr. Gloeolich. 40 and 91. Nylander used the name in 1879, in Flora 62: 353-354, introducing the two species, A. nummularium and A. nummulariellum, but did not describe the genus so the name was not validly published then. The name is conserved against Omphalaria A. Massal. (1855).

Type: A. decipiens (A. Massal.) Forssell. Family: Lichinaceae. 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: Claustade & 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. (A. moedlingense), (A. nodulosum) Note 1.
2 Thallus of adpressed squamules.
   33 Squamules 0.2 - 1 mm diameter, densely aggregated. A. prodigulum
   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

(1) All Greek reports of A. nodulosum are tentative. For the present I do not treat it as a Greek species.

Anema decipiens (A. Massal.) Forsell (1885)
   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 nummularium (Dufour ex Durieu & Mont.) Nyl. ex Forsell (1885)
in: Beitr. Gloeolich. 94. ( Mentioned by Nylander in 1879, in Flora 62: 354, but not validly published there as the generic name Anema had not been validly published.); 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. I have no opinion on the matter, as I am unfamiliar with the entire genus, but for the moment the key distinguishes them.
   Descriptions: Jørgensen, in Ahti et al. (2007) is best. See also: Clauzade & Roux (1985); Roux (2007).
   Crete and Dodecanese. On calcareous rock at altitudes below 0 - 250 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)
   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** (Schaer.) 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)**

Type: A. virescens (Zahlbr.) Breuss. Family: Verrucariaceae. 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)


Paros and Corfu, at altitudes of 20 - 40 m. One report was from rock, the other from soil. 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)**
in: Lich. Arct. 287

Type: A. delicatula Th. Fr.. Family: Arctoniaceae. 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)
in: Lichenologist 45(3): 302; Lichen fascicularis L. (1767) in: 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 Arctoniaceae, 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), Malesia (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)**

in: *Neues J. Bot.* 1(3): 3-9. The name is conserved against *Coniocarpon DC.*

Type: *A. radiata* (Pers.) Ach. Family: *Arthoniaceae.* 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. Exciple: 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.

**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. albopulverea**

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. Asci KI-. Hyphae of thallus I+ blue. (A. spectabilis)

3 Ascospores 17 - 24 x 7 - 9.5 µm. Asci 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 Fuscopannaria 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 Ascii arranged in compact black ascomata. On Lecanora.  
      444 On Lecanora muralis. (A. protoparmeliopseos)
      44 On Lecanora rupicola. **A. varians**
      4 On Lecanora carpineae (A. subfuscicola)
   3 Asci often intermixed with those of the host. On Lecidella. (A. intexta) Greek reports incorrect.

1 Ascospores strictly 1-septate.
   22 Asci with 4 ascospores.
   33 On Diploicia canescens. (A. diplociae)
   3 On other lichens. (A. oligospora)

2 Asci 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**
         77 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.
      55 Epithecium orange, K+ purple. On Cladonia species. (A. colombiana)
      5 Epithecium brown, K+ greenish.
      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. cal cicola**
   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 the other. Hymenium KI+ 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. Hymenium KI-.

A. ligniaria

5 Apex of paraphyses without brown pigment cap. Other characters various.

66 Photobiont Trentepohlia or absent. On bark. (A. tenellula)

6 Apothecia 0.3 - 0.7 mm diameter. Hymenium dark. A. patellulata

92 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. elegans)

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. cinereopruniosa), (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 Ascospores 5 - 6 -septate, (A. reniformis)

7 Ascospores 3 -septate (when mature). A. radiata

6 Photobiont absent. Thallus not delimited by a black line.

77 Thallus distinct. Mature ascospores 3 - 5 -septate, 12 - 18 x 5 - 7 µm. Apothecia 60 - 100 µm tall, irregularly rounded to elongate. A. albopulverea
7 Thallus rather indistinct. Mature ascospores strictly 3-septate, 13 - 23 x 5 - 7 µm. Apothecia 40 - 60 µm 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 µm tall, colourless, I- or I+ faintly blue in places, KI+ blue. Hypothecium: 10 - 20 (70) µm, colourless to very pale brown. Asci: subglobose to broadly clavate, 23 - 55 x 18 - 23 µm; 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 µm, reacting I-.


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 *Vitex agnus-castus*.

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).

Santorini and Sterea Ellada at altitudes 200 - 1400 m. Reported from *Lecanora dispersa* and *Lecanora agardhiana*. 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)
in: *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)
in: *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. : Fr.) Wallr. (1831)

There are earlier names, but sanctioning gives priority to that of De Candolle.

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).
Dodecanese (Kalimnos and Kos), on calcareous rock at altitudes around 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.*
Widely distributed in Europe except for arctic regions. 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 epiphytica** Nyl. (1875)
in: 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 *Allanthus 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 medioilla** 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)
in: Annales Mycol. 12: 336

Descriptions: Clauzade & Roux (1985, 1989); Smith et al. (2009). 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)
in: Thunbergia 3: 2; *Tichothecium molendoi* Heufl. ex Arnold (1864) in: Verh. k. k. zool.-bot. Ges. Wien 14: 461-462; (?) *Conida lecanorina* var. ancta J. Steiner

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2007); Smith et al. (2009). Crete and Sterea Ellada, at 900 - 1400 m on species of *Caloplaca*. Reported from *C. aurantiia* 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)
in: Botaniska Notiser 1865: 182

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* probably 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 capitate apex, but in many cases extending horizontally for a considerable distance through the epithecium. Asci: 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) ined.
(The name was discussed, but not validly published in Clauzade, Diederich & Roux 1989.; *Conida nideri* J. Steiner (1898) in: Sitz. math.-nat. Cl. Kaiserl. Akad. Wiss., Wien 107: 171-172

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)
in: 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)
in: Botaniska Notiser 1853: 95-96

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).

Naxos, and perhaps Ikaria, on bark at around 200 m.

Mostly temperate and cool parts of Europe, as far north as southern Scandinavia; very rare south of the Alps. Although accepted as a Greek species by Abbott (2009), confirmation is desirable. Also Asia (Russia), N. America (widespread in cooler regions).

**Arthonia phaeophysciae** Grube & Matzer (1997)

Descriptions: Nash et al. (2007); Smith et al. (2009).

Known from a single site in Epiros, where it occurred on *Phaeophyscia ciliata* and *P. orbicularis* at an altitude of 620
However, his protologue states that the ascospores are 5-septate. His description is not adequate for me to include it in Zahlbr. (1911). However, until Steiner's taxon is better understood it would be premature to publish a nomen novum.

Arthothelium rechingeri

Arthonia rechingeri (J. Steiner) ined.

Australasia (SE Australia, NZN, NZS), Pacific (Hawaii, Ogasawara Shoto). Algeria, Tunisia), N. America (widespread), C. America (Mexico), S. America (Colombia, perhaps elsewhere), C. America (Mexico).

Arthonia pinastri


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


Recently transferred to Pachnolepia, as P. pruinata (Pers.) Frisch & G. Thor, 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). Corfu and the Dodecanese island of Kos, on bark at altitudes 20 - 200 m. Reported from Ceratonia siliqua and Olea europaea.

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 punctiformis


Thallus: crustose, very pale grey, very thin, not conspicuous, not well delimited; in section: 40 µm thick, poorly structured, without distinct cortex, ecolourescent. Apothecia: usually rounded and 0.3 - 0.5 mm diameter, sometimes irregular or elongate, ± flat to slightly convex, not pruinose. Disc: black. Exciple: absent. Epithecium: 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 capitate, apical cell with an internal crescent-shaped pigment cap. Ascii: 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. Reported from Abies cephalonica, Celtis, Fraxinus and Olea. The author's Peloponnesian collection was on twigs and small branches of A. cephalonica.

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


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


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 focus-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)

The earliest name is *Arthonia radiata* var. *anastomosans* Ach. (1810), but it does not have priority at the rank of species.

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 *Diploptoma hedini* 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. Asci: 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 though I would expect it to occur there. 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** (Szatala) ined.

*Allarthonia wagneriana* Szatala (1941) in: *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)**


Type: *A. parmeliarum* Hafellner. Family: of uncertain position in *Arthoniales*. 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)


Type: A. cerasi (Schrad.) A. Massal. The type is conserved. Family: Arthopyreniaceae. 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. Asci 40 - 55 µm tall. A. punctiformis
6 Perithecia 200 - 500 µm diameter. Asci 60 - 90 µm tall. A. fraxini

1 Ascospores soon becoming 3-septate. (A. cerasi), (A. rhyponta)

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)


The earliest name may be Lichen punctiformis Schrank (1789) in Baier. Fl. 513, but Persoon did not refer to that name in any way, and his description is independent of that of Schrank.

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. Reported from Ceratonia siliqua, Olea europaea, Pinus brutia and Quercus sp.

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.

Arthosporum A. Massal. (1853)

in: Mem. Lich. 127-128

Type: A. populorum A. Massal. Family: Ramalinaceae. Literature: Ekman (1996) discusses the delimitation of this monotypic genus, which is clearly close to Toninia s. lat. It 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)
in: Mem. Lich. 128; Bacidia populorum (A. Massal.) Trevis.
Description: Clauzade & Roux (1989) as Bacidia populorum.
Thallus: close to sea level, on bark of Arbutus sp. and Quercus 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)
Type: A. cinerea (L.) Körb. Family: Megasporaceae. Literature: There is no easy way into this genus. It is necessary to assemble information from the standard Floras and from many miscellaneous publications. Clauzade & Roux (1985), though not adequate, is still 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. Exicile: 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, 4, 6 or 8 per ascus, 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.

Usually easily recognised by the combination of simple ascospores, Aspicilia green pigment, and moniliform paraphyses. Lobothallia (as accepted in this Flora) differs in having a distinctly radiating margin to the thallus. Collections without ascospores are, unfortunately, common, but the Aspicilia green pigment alone is usually diagnostic. Collections without ascospores and with only brown apothecial pigment should be checked against the black-fruited species of Caloplaca.

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. Aspicilia forms an important component of the lichen flora of calcareous rock in Greece, and a good monograph is very much needed. The present contribution is completely inadequate.

Ascospore characters are important in determining species of Aspicilia, and it is unwise to attempt a determination without having seen mature ascus containing reasonably well developed ascospores. Unfortunately, many collections of Aspicilia with abundant apothecia entirely lack mature asci. Usually, if one collection lacks mature asci, then all others collected on the same date at the same site will also lack them. (This suggests that ascospore production in these species is influenced by some external factor, perhaps seasonality. The matter would benefit from systematic study over a period of a few years.) Ascospores that appear to be well developed are often very fragile and easily disrupted; they can hardly function effectively as propagules. I get the impression that Aspicilia must rely to a considerable extent on asexual means of reproduction, even in species that do not possess obvious vegetative propagules. If true, this would help explain the great variability of many of the "species".

Like many large old genera, Aspicilia s. lat. is being subdivided. Two recent segregates relevant to Greece are Circinaria and Lobothallia. Numerous species have been placed in them on the basis of molecular evidence alone, and the genera are not well characterised morphologically. That is particularly troublesome in a rather poorly understood group like Aspicilia s. lat., where the delimitation of species is often difficult and the status of many species described in the past is unclear. Until the group as a whole has been adequately monographed I am reluctant to follow the latest opinions. In this Flora, I place in Lobothallia only those species with a distinctly lobed thalline margin, and I do not recognise Circinaria at all. Those who wish to use the newer names may note that, of the species treated below, A. chadefaudiana, A. cheresina and A. farinosa have recently been placed in Lobothallia, while A. contorta, A. fruticulosa and A. hispida have recently been placed in Circinaria.
A. caesiopruinosa (H. Magn.) J. W Thomson, A. cheresina var. granuligera (J. Steiner) Szatala, A. crusti 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.

11 Not on rock and not parasitic on saxicolous lichens. (A. crespiana), (A. mansourii), (A. uxoris) Note 1.

11 On rock, or parasitic on saxicolous lichens. Thallus ±fruticose.

22 Branches short, not delicate, with conspicuous pseudocyphellae at tip. Branching dichotomous. A. fruticulosa

22 Branches short to elongate, sometimes delicate, without pseudocyphellae at tip. Branching dichotomous or irregular. A. hispida

1 On rock, or parasitic on saxicolous lichens. Thallus crustose to (occasionally) subsquamulose-areolate.

22 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 2.

22 Ascospores more than 15 µm long. Algae not present below apothecia.

33 Isidia, blastidia or soredia present.

44 Ascospores 22 - 27 x 10 - 15 µm. A. grisea

4 Ascospores 14 - 25 x 8 - 10 µm. (A. simoensis)

3 Isidia, blastidia and soredia absent.

44 Most asci with more than 4 ascospores (usually 8, sometimes 6) (Note 3). On calcareous or siliceous rock.

555 Medulla K+ yellow > blood-red (abundant norstictic acid) (Note 4), P+ yellow to orange (reaction sometimes faint). On siliceous rock

666 Ascospores 12 - 18 x 9 - 11 µm. Paraphyses moniliform, terminal few cells globose or subglobose. A. cinerea

6 Ascospores 17.5 - 24.5 x 10 - 14 µm. Paraphyses not moniliform, terminal few cells elongated. (A. prestensis)

6 Ascospores 20 - 30 x 11 - 15 µm.

77 Conidia 6 - 8 µm long. Areoles white-grey, grey or copper-brown, sometimes multi-coloured. A. cupreoglauca

7 Conidia 7 - 12 µm long. Areoles uniformly white to pale grey. A. intermutans

5 Medulla K+ yellow > slightly reddish (stictic acid; norstictic acid absent or present only in small amounts) (Note 4), P+ orange. On siliceous rock. If present in Greece, probably restricted to high altitudes. (A. laevata)

5 Medulla K- (Note 4), P-. On calcareous or siliceous rock.

66 On calcareous rock. Thallus white. Probably restricted to high altitude.

77 Apothecia pruinose; thalline margin raised, fairly well developed. A. candida

7 Apothecia not pruinose; thalline margin poorly developed. (A. verruculosa)

6 On siliceous rock. Thallus some shade of grey. Not restricted to high altitude.

77 Ascospores 8.5 - 12 µm wide (and 13 - 22 µm long). (A. calcitrapa) Note 5.

7 Most ascospores at least 14 µm wide.

88 Thallus pale (white-grey or pale grey). Ascospores 22 - 35 x 14 - 18 µm. On periodically submerged or very humid rocks. (A. aquatica)

8 Thallus not pale (blue-grey, brown-grey or dark grey). Ascospores 14 - 30 x 15 - 18 µm. Not restricted to humid rocks. A. caesiocinerea

4 Most asci with 4 ascospores. (A few asci may have 6 and, rarely, more.) Usually on calcareous rock. Note 6.

555 Thallus 1 - 3 mm thick, verrucose areolate, sand coloured, grey, green-grey or brown-grey. A. desertorum

5 Thallus well developed but usually less than 1 mm thick (to 1.4 mm in A. serenensis), areolate, cracked-areolate or continuous, usually chalk white, grey-white or grey (sometimes with a slight brownish tinge in A. serenensis).

666 Thallus continuous or ±fissured around apothecia, chalk-white to grey-white. Medulla K-. A. subfarinosa

66 Thallus of rounded (often almost circular) areoles, that are usually well separated (only occasionally becoming contiguous and then sometimes not rounded as a result of compression), mostly pale grey (sometimes white around apothecia, sometimes white pruinose). Medulla K-. A. contorta subsp. contorta

6 Thallus of ±contiguous areoles, chalk-white to fairly dark grey. Medulla K- or K+.

77 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. A. contorta subsp. hoffmanniana

7 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+. Some species common.

88 Medulla 400 - 1300 µm thick. Central part of thallus sometimes with a slight brown tinge. (A. serenensis)

8 Medulla to 300 µm thick. Thallus never with a brown tinge. Very common. A. calcarea s. lat.

99 Medulla K-. A. calcarea var. calcarea

5 Thallus immersed, except at apothecia where it forms a strongly white pruinose thalline margin that is distinctly raised above level of disc. A. coronata

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

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

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

55 Conidia 13 - 24 µm long. Thallus pale-white-grey to dark brown-grey. A. polychroma

5 Conidia 5.5 - 8 µm long. Thallus grey-white. (A. brucei)

4 Epithecium N- or weakly N+ pale green. On calcareous rock. Not strictly montane. Conidia 4 - 8 µm long. Thallus white or whitish.

55 Cortex 30 - 90 µm thick. A. chadefaudiana

5 Cortex 10 - 40 µm thick. (Lobothallia controversa)

3 Algal cells forming a well-defined layer below apothecia.

44 On calcareous rock. Thallus white or greyish. Not restricted to high altitude.

55 Thallus with small papillae. Thallus K- (but apothecia may be K+).

66 Apothecia 0.7 - 1.5 mm diameter, eventually becoming sessile; thalline margin distinct. Exciple and hypothecium K+ red (norstictic acid) according to Clauzade & Roux (1985). (A. cernohorskyana) Not confirmed for Greece, but discussed below.

6 Apothecia 0.2 - 0.8 mm diameter, remaining immersed; thalline exciple not distinct. Exciple and hypothecium K-.

5 Thallus without papillae. Thallus K+ or K-.

56 Thallus continuous or occasionally slightly cracked, chalk-white; surface slightly farinaceous. A. farinosa

6 Thallus cracked-areolate, white to grey; surface not farinaceous. A. cheresina s. lat.

77 Thallus K+ yellow > blood red (norstictic acid only) (Note 4). A. cheresina var. microspora

77 Thallus K+ yellow > red-brown (stictic acid; sometimes also a little norstictic acid) (Note 4). A. cheresina var. justii

7 Thallus K- (Note 4). A. cheresina var. cheresina

4 On siliceous rock. Thallus grey. If present in Greece, then probably restricted to high altitudes. (A. reecedens)

(1) A. caesiocinerea, A. cinerea and A. contorta, keyed out here as saxicolous, have been reported from wood very rarely; see Rico et al. (2007).

(2) Perhaps common in Greece. See Senkardesler & Calba (2011) for a full description, and a discussion of some similar species.

(3) 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.

(4) In Aspicilia, always observe K test on a thin section under the transmission microscope. Spot tests are often misleading in this genus.

(5) 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.

(6) Some species in this branch are variable. A few collections may have ambiguous characters and will not be determinable with confidence.

Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold (1886)
subdepressa (Nyl.) Nyl.

The name Aspicilia polygonia (Vill.) A. Massal. (1852) has priority if synonymy can be confirmed, but Lichen polygonius Vill. (1789) does not appear to have been typified. There are also other earlier names.

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 a colourless, ±structureless epicortex about 5 µm thick. Medulla: white. Apothecia: immersed in thallus, rounded to slightly irregular, 0.2 - 0.55 mm diameter, concave, not pruinose. Disc: black. Exciple: not visible externally; in section: 15 µm wide, colourless except at surface which is green-brown, formed of a network of anastomosed hyphae. 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 surrounding thallus. 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 epithecial pigment, Ki+ 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. Asci: 100 - 130 x 20 - 28 µm, slightly clavate, apex Ki-, wall rather fuzzily and faintly Ki+ 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-, l-; 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.

A. cinerea and A. cupreoglaucu occur on similar substrates but contain norsteric acid and have narrower ascospores.

Scattered throughout Greece. On siliceous rock, probably at all altitudes. The lichenicolous lichen Caloplaca insularis has been reported once from this lichen. According to Nimmis (1993) material from the lowland Mediterranean may not belong to A. caesiocinerea s. str. Collections seen by me have slightly broader ascospores than usually reported for A. 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).


Description: none seen.

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 calcarea (L.) Bagl. (1857) var. calcarea


U. calcareae var. concreta Schäer. (1826) is a superfluous name for U. calcarea, and names derived from it are all superfluous.

Thallus: crustose, white or white-grey, areolate, 250 - 450 µm thick, to several cm diameter, sometimes with a 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 hyphae with broad rounded lumina, often giving a cellular appearance (cells about 4 µm diameter), though this may be difficult to observe owing to 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 both K­. Medulla: white. Apothecia: usually abundant, immersed in thallus, flat, often slightly irregular or angular in shape. Disc: black, often slightly white pruinose. Exciple: poorly developed; in section: 15 - 25 µm wide but not very distinct from hymenium. Thalline margin: usually ±absent; the part of the areole adjacent to an apothecium differs little from the remainder. 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, KI+ blue. Hypothecium: 75 µm tall, colourless. Paraphyses: sparingly branched, with visible septa throughout, 1 -
Aspicilia calcarea var. reagens (Zahlbr.) Szatala (1943)
Like var. 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.

There is no real justification for recognising what are clearly two distinct chemotypes as a single taxon, var. reagens, while simultaneously treating a third chemotype as var. calcarea. Logically, the three chemotypes should be treated either as three taxa or as a single, chemically variable taxon. I am reluctant to regard the three chemotypes as distinct taxa, and would be inclined to synonymise var. reagens with var. calcarea. However, since recognising var. reagens does preserve some information that would otherwise be lost, I maintain this variety pending a proper monographic treatment of Aspicilia.

Throughout Greece, though less common than var. 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.

Circum-Mediterranean. In Europe known from the Iberian Peninsula, Italy and Greece. Also western Asia (Syria), N. Africa (Morocco).

Aspicilia candida (Anzi) Hue (1910)
Description: Clauzade & 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 cernohorskyana (Clauzade & Vězda) Cl. Roux (1979)
Mentioned in Abbott (2009) on the basis of a single collection from the Peloponnese, but was accepted there as a confirmed Greek species. That collection is difficult to interpret. In places it resembles A. farinosa, but in other places the surface is broken up into many prominent, angular blocks 0.1 - 0.2 mm wide. According to Clauzade & Roux (1985) the hypothecium of A. cernohorskyana contains norstictic acid, but none is present in the Peloponnesian collection. The overall appearance does not suggest A. chadefaudiana. Additional collections are needed to clarify the matter.

Aspicilia chadefaudiana Cl. Roux (1977)
Thallus: crustose, areolate, white to pale grey, 3 cm diameter (in the single 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 but later becoming rough and irregular on a scale of 0.05 - 0.1 mm, sometimes developing into 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. Exciple: not visible externally; in section: poorly developed, 0 - 20 µm wide. Thalline margin: not developed. Epithecium: green to orange-brown, K- (some green pigment dissolves), N+ bright blue-green. Hymenium: 80 µm tall, colourless, K+ blue. Hypothecium: 100 - 150 µm tall, colourless. Paraphyses: with visible septa throughout, 1.5 µm wide at base, 4 - 6 µm at apex, moniliform. Ascii: 60 x 15 - 17 µm, clavate, K-. Ascosporas: colourless, simple, ellipsoid, 8 per ascus, 12.5 - 13 x 7.5 - 8 µm. Chemistry: medulla K-, C-, KC-, I-; thallus K-, C-, KC-, UV-. Photobiont: green, not present below apothecia; cells globose, 6 - 12 µm diameter. Photobiont layer: 60 - 125 µm thick, irregular and discontinuous; cells often arranged in clumps or vertical bands.

The small ascospores, absence of photobiont cells below the apothecia and the calcareous substrate are diagnostic, but this species is most easily recognised by the small-scale roughness of the upper surface and the rather large, subrounded, slightly convex areoles.

NE Peloponnese only. On limestone at an altitude of 60 m. According to Clauzade & Roux (1985) A. chadefaudiana is a submediterranean to montane species. If the Greek collection is correctly determined, then the ecology of this species in the eastern Mediterranean is different from further west. Additional collections are needed to understand this species properly in Greece.

Known only from the Iberian Peninsula, France, Austria, Yugoslavia and Greece.

Aspicilia cheresina (Müll. Arg.) Hue (1910) var. cheriesina

Abbott (2009) tentatively synonymised Aspicilia platycarpa var. tincta (J. Steiner) Szatala and Lecanora platycarpa var. tincta J. Steiner with this variety, but that is unlikely to be correct. The protologue, in Steiner (1898 :143) states that the thallus reacts K+ red. If Steiner's taxon is related to A. cheresina at all then it is probably a synonym of A. cheresina var. microspora.

Abbott (2009) referred several Peloponnesian collections here, but those collections either belong elsewhere or can not be referred to A. cheresina with certainty. The only remaining Greek collections still referred here are old reports of Lecanora platycarpa.

Description: Clauzade & Roux (1985).

Scattered throughout Greece, on limestone at altitudes 100 - 1400 m.

Scattered in Southern Europe. Also Asia (Turkey, Iran, Tibet, and perhaps also - as A. platycarpa which may be synonymous - Syria and Japan), N. Africa (Morocco, Egypt).

Aspicilia cheresina var. granuligera (J. Steiner) Szatala (1957)

Description: none seen.

Mt. Olympus, on calcareous rock at altitudes 700 - 1200 m.

Var. granulifera is known from Greece and Iran.

Aspicilia cheresina var. justii (Servit) Clauzade & Cl. Roux (1974)
in: [need to investigate]; Lecanora justii Servit (1935) in: Feddes Rep. 38: 441-444

Peloponnesian material that I have referred here has a few small groups of photobiont cells below the apothecium, rather than a well-developed algal layer like that in the rest of the thallus. Until I have seen much more material, I can not be certain that this is typical of this taxon or that these Peloponnesian collections are correctly determined, so no description is provided. For a published description, see Clauzade & Roux (1985).

Scattered, with no clear pattern. On rock, usually calcareous, or overgrowing other lichens (Acarospora or Aspicilia spp.) at altitudes 0 - 1000 m.

Scattered in Southern Europe. Also western Asia (Turkey).

in: [need to investigate - don't know title of publication]; Aspicilia calcarea var. microspora Arnold (1870) in: Verh. k. k. zool.-bot. Ges. Wien 20: 450; 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), or consult the protologue.
Scattered, with no clear pattern, but never very far inland. Usually on calcareous rock, but sometimes overgrowing (’parasitic on) Aspicilia calcarea. At altitudes 100 - 2300 m.

Fairly widely distributed in southern Europe, and there are a few reports from north of the Alps. Also Asia (Israel, Iran, Afghanistan), N. Africa (Morocco, Algeria).

Aspicilia cinerea (L.) Körb. (1855)

Thallus: crustose, pale grey, warded-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. Asci: 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 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 layer: there is a continuous, regular layer 40 - 60 µm thick, but isolated clumps of algal cells are often present below it.

The single collection that I have seen 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 Antarctica (Kerguelen Is - determination not certain).

Aspicilia contorta (Hoffm.) Körb. (1855) var. contorta

in: Syst. Lich. Germ. 166; Verrucaria contorta Hoffm. (1790) in: Descr. Pl. Cl. Crypt. 1: 97-98; Aspicilia contorta f. albocincta (J. Steiner) Szatala; Aspicilia contorta var. albocincta (J. Steiner) Szatala; Aspicilia contorta var. bulbosa (A. Massal.) Szatala; Aspicilia contorta f. cinereovirens (A. Massal.) Kremp.; Aspicilia contorta var. disseminata (J. Steiner) Szatala; Aspicilia contorta λ (= var.) glaucopsis (Flörke) Kremp.; (? Aspicilia contorta var. murorum (A. Massal.) Szatala; Aspicilia contorta f. ochrocincta (J. Steiner) Gattefossé & Werner; Aspicilia viridescens (A. Massal.) Bagl.; Lecanora calcarca var. bulbosa (A. Massal.) J. Steiner; Lecanora calcarca var. contorta (Hoffm.) Hepp; Lecanora calcarca var. viridescens (A. Massal.) Zahlbr.; Lecanora concreta var. viridescens (A. Massal.) J. Steiner; Lecanora contorta (Hoffm.) J. Steiner; Lecanora contorta var. albo crucinca 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 a 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 overlain 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. Exciple: poorly developed; in section: 15 µm wide, scarcely distinguishable from hymenium. Thalline margin: distinctly raised, paler than rest of areole. 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, with visible septa throughout, 1.5 µm wide at base, 3.5 - 5 µm at apex, moniliform. Ascospores: colourless, simple, globose to ellipsoid, 4 (6) per ascus, 21 - 37 x 20 - 27 µm. Chemistry: medulla K- (one collection perhaps with stictic acid - needs confirmation), I-; thallus K-, C-, KC-, UV-. 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. Var. hoffmanniana sometimes has rounded, and sometimes slightly separated, areoles, but is much darker in colour.
Throughout Greece. On rock, usually calcarceous, at all altitudes. The lichenicolous lichen Caloplaca inconnexa 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).

Aspicilia contorta subsp. hoffmanniana S. Ekman & Froberg (1989)
in: Froberg, The calcicolous lichens on the Great Alvar of Oland, Sweden, 39; Aspicilia contorta var. hoffmannii auct. graec.; Lecanora calcarea var. hoffmannii auct. graec.

The epithet hoffmannii has often been misapplied to this lichen, but the original Lichen hoffmannii Ach. nom. illeg., and combinations based on it, are obligate synonyms of Verrucaria contorta Hoffm.

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. Ascii: 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, a few collections are difficult to place.

Scattered throughout Greece, but less common than subsp. contorta. On rock, usually calcarceous, at all altitudes.

The European distribution of subsp. hoffmanniana is similar to that of subsp. contorta, though possibly it does not extend so far north. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia, Egypt), perhaps elsewhere (?North America, ?Argentina, ?Australia).

Aspicilia coronata (A. Massal.) de Lesd. (1906)
in: Bull. Soc. Bot. Fr. 53(7): 516. (Sometimes said to have been published by Anzi in 1863, but I have not been able to trace that combination.); Pachyospora coronata A. Massal. (1853) in: Mem. Lich. 131-132; (?) Aspicilia coronata var. petkae (Servit) Szatala; Aspicilia laurenzii de Lesd.; Lecanora coronata (A. Massal.) J. Steiner; Lecanora coronuligera Zahlbr.; (?) Lecanora coronuligera var. petkae Servit

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. Exciiple: 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 calcarceous 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 crusii Klem. (1958)
in: Krause & Klement, in Acta Geobot. 8: 18

Description: [none seen]

Evia, on siliceous rock (including serpentine) at altitudes around 30m.

Only reported from Greece and Bosnia.
Aspicilia cupreoglauca de Lesd. (1910)
in: Bull. Soc. Bot. Fr. 57: 32; (? Aspicilia reticulata Kremp.; (? Aspicilia reticulata var. subpercaena (J. Steiner) Szatala; (? Aspicilia reticulata var. turigida (J. Steiner) Szatala; (? Lecanora intermutans f. reticulata (Rehm) Nyl.; (? Lecanora intermutans var. reticulata (Rehm) J. Steiner; (? Lecanora reticulata (Rehm) J. Steiner; (? Lecanora reticulata var. subpercaena J. Steiner

The name Aspicilia reticulata has priority if the synonymy is confirmed.

Thallus: crustose, 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 µm). Areoles: 0.3 - 1 mm wide, angular. Cortex: 40 - 50 µm 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 µm 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 µm tall, colourless or with some epiphytic pigment in upper part, KI+ blue. Hypothecium: 30 - 100 µm tall, colourless. Paraphyses: often simple, sometimes sparingly branched and anastomosed, with visible septa throughout, 1 µm wide at base, 3 - 5 µm at apex, moniliform. Asc: 100 - 135 x 24 - 29 µm, cylindrical to slightly clavate, apex KI-, wall weakly and rather diffusely KI+ blue. Ascospores: colourless, straight, 6 - 8 (9) x 1/4 - 1 µm. 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 µm diameter. Photobiont layer: continuous, 60 - 150 µm 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 material seen by me has a brownish tinge to the thallus (at least in the herbarium), and is 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 rugulosus (s. lat.) and Rosellinula haplospon is 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)

Unfortunately, Krempelhuber's name is not legitimate, as he included, via his (= var.) esculenta, the name Lichen esculentus Pall. The first step in clarifying the nomenclature will be to typify Krempelhuber'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 in western USA), C. America (Mexico).

Aspicilia farinosa (Flörke) Flagey (1888)

The basionym is U. contorta var. farinosa, I think, not U. calcarea var. farinosa as stated in the conservation proposal by Nordin & Roux (2009), though Flörke's text is not very clear.

Description: Clauzade & Roux (1985).

Throughout Greece, but with a preference for sites not too far from the sea. On calcareous rock at altitudes 0 - 2300 m.

Widely distributed in southern Europe. Present north of the Alps, but does not reach British Is or the Nordic Countries. Also Macaronesia (Canary Is), Asia (widespread at least as far east as Mongolia), N. Africa (Morocco, Algeria, Egypt).
Aspicilia fruticulosa (Eversm.) Flagey (1896)
Description: McCune & Geiser (2009).
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, and also reported for N. Africa (Morocco, Algeria), N. America (western USA).

Aspicilia grisea Arnold (1891)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
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 hispida Meresch. (1911)
Description: McCune & Geiser (2009); Nash et al. (2007); Nimis & Martellos (2004).
Sterea Ellada, on calcareous soil at an altitude of 1850 m.
Scattered, and rather rare, in warm, dry regions of souther Europe Also Asia (widespread as far east as Mongolia), N. America (inland regions of western USA, and SW Canada).

Aspicilia intermutans (Nyl.) Arnold (1887)
in: Verh. k. k. zool.-bot. Ges. Wien 37: 98.; Lecanora intermutans Nyl. (1872) in: Flora 55: 354; Aspicilia reticulata var. ammotropha (Hue) Szatala; Aspicilia reticulata var. contortoides (J. Steiner) Szatala; Aspicilia reticulata var. intermutans (Nyl.) Szatala; Lecanora reticulata var. contortoides J. Steiner
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 5 - 1400 m. The lichenicolous lichens and fungi Caloplaca inconnexa, Endococcus verrucosus, Immersaria athroocarpa and have been recorded from this lichen. 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)
in: Cat. Lich. Sondr. 59; Aspicilia ochracea (Anzi) W. Krause & Klem., nom. illeg.; Lecanora polychroma var. pallescens Anzi
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)

In the only Peloponnesian collection referred here, none of the many apothecia sectioned had ascospores or even semi-mature asci. The determination is therefore not entirely certain, and I prefer not to provide a description. For published descriptions see Şenkardesler & Sohrabi (2011), or 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)

Often cited from Verh. k. k. zool.-bot. Ges. Wien 19: 610. 1869, but the name there was A. polygonia (indefinite rank) trachytica.

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)

Type: B. roSELLA (Pers.) de Not. Family: RamalInACEae. 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. thyrenica, 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, pale pink, orange, brown or black, usually flat when young, often becoming convex later. Exciple: of anastomosed hyphae on an overall radiating trend, sometimes with elongated lumina in outer part, rounded lumina absent or restricted to the very outermost part. Thalline margin: absent. Epitheciun: colourless, brownish or greenish, in some species poorly developed and not well differentiated from hymenium. Hymenium: colourless, though sometimes with some epithecial pigment in upper part. Hypotheciun: colourless (in Greek species seen by me) or dark. Paraphyses: simple, never capitate, but in some species broadening gradually towards apex. Ascii: 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 very 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 a few hundred 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 flora.

Almost every character that one might use in a key to species of Bacidia suffers from the problem of species with overlapping values of that character. It seems impossible to construct a workable key in which each species occurs once only, and the keys presented here are far less "clean" than I would like. The keys also assume that apothecia are present. In regions where the lichen flora is better known than in Greece, several species of Bacidia commonly occur sterile. Some of them probably occur in Greece, 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

I can not assign B. acerinoides to any of the Groups.

11 Ascospores 10 or more times as long as wide.
   22 Upper part of hymenium green, blue-green or green-grey, usually N+ red to purple, sometimes with a precipitate of blue crystals. Group 1.
   2 Upper part of hymenium colourless, yellow, orange, brown or dirty purplish, N reaction variable.
      33 On shaded parts (crevices and overhangs) of siliceous rocks by the sea. Ascospores 25 - 45 x 1.5 - 2.5 µm, 3 - 7-septate, ends pointed. Hypothecium pale red-orange in upper part, colourless in lower part. (B. scopulicola), (B. sipmanii)
      3 Not as above.
         44 Hypothecium dark (brown-orange, orange-brown, red-brown, dark brown or red-black), at least in upper part. Group 2 (keyed here).
         55 Ascospores to 25 µm long, ends blunt. B. incompta
         5 Ascospores more than 25 µm long, ends pointed (or at least tapered). (Bacidina brandii), (B. herbarum), (B. polychroa)
   4 Hypothecium pale (colourless, yellow or pale brown).
      55 Exciple and/or upper part of hymenium with crystals (Note 1). Group 3.
      5 Exciple and upper part of hymenium without crystals (though a crystalline pruina may overlie the hymenium).
         66 Many ascospores more than 7-septate. Group 4.
      6 Most ascospores 3 - 7 -septate. Group 5.

1 Ascospores less than 10 times as long as wide.
   22 Upper part of hymenium green, blue-green or green-grey, N+ red to purple, sometimes with a precipitate of blue crystals. Group 6.
   2 Upper part of hymenium colourless, yellow, orange, brown or dirty purplish, N reaction variable. Group 7.

(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: Ascospore aspect ratio >10; hymenium green in upper part

11 Hypothecium distinctly brown, at least in upper part.
   22 Ascospores spirally twisted in ascus. B. rhodi
   2 Ascospores not spirally twisted.
      33 Terricolous or overgrowing bryophytes or plant debris on calcareous substrates. B. bagliettoana
      3 On bark. B. subincompta
   1 Hypothecium ±colourless throughout.
      22 Terricolous or overgrowing bryophytes or plant debris on calcareous substrates, rarely directly on calcareous rock. (B. viridescens)
      2 On bark, or overgrowing bryophytes on bark.
         33 Ascospores a straight, with ±blunt ends, 20 - 30 µm long. B. circumspecta
         3 Ascospores curved, with pointed (or at least tapered) ends, length various.
            44 Ascospores 17 - 26 µm long, usually 3-septate. (B. beckhausii)
            4 Ascospores more than 30 µm long.
               55 Exciple with many small granular inclusions, soluble in K. Ascospores 45 - 80 µm long, 7 - 16 -septate. B. absistens
               5 Exciple without inclusions. Ascospores 30 - 50 µm, 3 - 7 -septate, B. friesiana

Key to Bacidia group 3: Ascospore aspect ratio >10; hymenium not green in upper part; hypothecium pale; crystals in apothecia.

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 it is not uncommon to find collections with a few (and occasionally more than a few) crystals of the "wrong" kind or
in the "wrong" place. It is often necessary to weigh all the evidence before making a determination.

11 Ascospores 55 - 95 µm 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. (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 µm, 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 not granular or granular isidiate; smooth to warted. 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 µm. 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), that are soluble in N but not in K. Ascospores and habitat various.

44 Ascospores 45 - 70 µm 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 µm 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**: ascospore aspect ratio >10; hymenium not green in upper part; hypothecium pale; apothecia without crystals; ascospores >7-septate

11 Most ascospores less than 2.5 µm wide. Apothecia pale or dark.

22 Soredia present. Ascospores 0.9 - 1.2 µm wide. See (Bacidina adastra)

2 Soredia absent. Ascospores at least 1.5 µm wide. **B. arceutina**

1 Most ascospores more than 2.5 µm wide. Apothecia not pale: at least partly brown-yellow or ± orange to red-brown to black.

22 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. **B. absistens**

2 Upper part of hymenium colourless, yellow, orange or brown; K and N reactions not jointly as above. Exciple with or without minute crystals.

33 Thallus entirely consisting of isidiate granules.

44 Granules often brownish or grey on their upper surface. Apothecia pink-brown to black. Upper cortex without crystals. In section, at least upper part of exciple and part of hymenium ± red-brown, K+ purplish. (B. biatorina)

4 Granules never dark coloured on their upper surface. Apothecia never black. Upper cortex with crystals. In section, exciple ± yelllowish to pale orange throughout, K+ intensifying but not K+ purplish. **B. rubella**

3 Thallus not granular or isidiate.


55 Epithecial pigment forming ± distinct grey-brown caps over apices of paraphyses. (B. heterochroa)

5 Most epithecial pigment dissolved in the gelatinous matrix or as irregular granules between apices of paraphyses. **B. laurocerasi**

4 Exciple yellow or red-yellow, K+ mauve. Epithecium colourless to brown-orange. Disc brown-orange to purple-brown, often darkening with age. (B. polychroa)
Key to Bacidia group 5: ascospore aspect ratio >10; hymenium not green in upper part; hypothecium pale; apothecia without crystals; ascospores 3 - 7 -septate

11 Thallus ±entirely granular.
   22 Apothecia brown (not red-brown), soon becoming convex. On slightly nutrient-enriched substrates, especially bark. **B. arceutina**
   23 On bark. **B. rubella**
      3 On soil, decaying vegetation or limestone rock. (B. herbarum)

1 Thallus not entirely granular, ±continuous, though surface may be granulose.
   22 Disc of apothecia ±black, not pruinose. Few or no ascospores more than 35 \( \mu m \) long. **B. vernifera**
   2 Disc usually not black, pruinose or not. Ascospores more than 35 \( \mu m \) long in some species
      33 Ascospores (2.5) 3 - 4 \( \mu m \) wide. Disc sometimes pruinose. (B. polychroa)
      3 Most ascospores less than 2 \( \mu m \) wide. Disc not pruinose.
         44 Outer part of exciple yellow-brown. **B. arceutina**
         4 Outer part of exciple ±colourless. **B. punica**

Key to Bacidia group 6: ascospore aspect ratio <10; hymenium green in upper part.

11 Asci Porpidia type. (B. trachona)
   1 Asci Bacidia type (or similar).
      22 Hypothecium brown, at least in places.
         33 Ascospores 5 - 7 -septate, 23 - 31 \( \mu m \) long. Usually on bark. **B. subincompta**
         33 Ascospores mostly 3-septate, 11 - 20 \( \mu m \) long. On rock, usually calcareous. **B. coprodes**
      2 Hypothecium colourless to at most pale yellow.
         33 Ascospores 12 - 19 \( \mu m \) long. Apothecia 0.2 - 0.5 mm diameter. **B. igniarii**
         3 Many ascospores more than 19 \( \mu m \) long. Apothecia sometimes more than 0.5 mm diameter.
         44 Apothecia 0.5 - 1.5 mm diameter. Exciple colourless to green. Epithecium K+ violet. (B. beckhausii)
         4 Apothecia 0.2 - 0.7 mm diameter. Outer part of exciple dark purple-brown. Epithecium K-, often with blue crystals. **B. circumspecta**

Key to Bacidia group 7: ascospore aspect ratio <10; upper hymenium colourless to brown.

11 Hypothecium dark brown. Most ascospores 3-septate. **B. incompta** (If ascospores 3 - 7 -septate, see (Fellhaneropsis vezdae).)
   1 Hypothecium colourless or pale. Ascospore septation various.
      22 On bark or overgrowing bryophytes thereon.
         33 Ascospores 1 - 3 -septate **B. crozalsiana**
         3 Ascospores 5 - 6 -septate **B. auerswaldii**
      2 On rocks or soil, or overgrowing bryophytes thereon.
         33 Ascospores 12 - 18 x 4 - 4.5 \( \mu m \), 3-septate. (B. fuscoviridis)
         3 Many ascospores longer than 18 \( \mu m \), sometimes with more than 3 septa.
         44 Thallus grey-green, on a white prothallus. On hard siliceous rock. (B. carneoglauca)
         4 Thallus white to green-white. Usually overgrowing bryophytes, sometimes directly on rock. (B. microcarpa)

**Bacidia abisitsens** (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 *Capressus sempervirens* and *Platanus orientalis*.
   Widespread in the western half of Europe and in Macaronesia. 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 *Scoliciosponum*, but the ascospores are rather long for species of that genus (reported as 40 - 64 x 4 - 4.5 \( \mu m \)). If a *Bacidia*, it seems close to *B.*
The earliest name is *Bacidia* circumspecta (Nyl. ex Vain.) Malme (1895) in: *Botaniska Notiser* 1895: 187. (Also the same year in Fries's exsiccata Lichenenes Scandinaviae rariores et critici exsiccati, Fasc. 3. no. 66. It is unclear which is earlier,); *Lecidea luteola* y L. (= var.) arcetina Ach. (1803) in: 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 (Turkey, Russia, Taiwan, Japan), N. America (southern Canada, cooler parts of USA), perhaps S. America (Argentina, Brazil), perhaps Australasia (Queensland).

*Bacidia arceutina* (Ach.) Th. Fr. (1865)

in: *Botaniska Notiser* 1865: 187. (Also the same year in Fries's exsiccata Lichenenes Scandinaviae rariores et critici exsiccati, Fasc. 3. no. 66. It is unclear which is earlier,); *Bacidia auerswaldii* Hepp ex Stizenb. (1882) in: *Jahresber. St. Gall. naturwiss. Ges.* 22: 41

The earliest name is *Bilimbia effusa* Auersw. ex Raben. (1885), but the epithet *effusa* is not available for this species in *Bacidia* owing to the earlier *Bacidia effusa* (Sm.) Trevis. (1856), a synonym of *Bacidia arceutina*.

Thallus: crustose, of green-grey granules, not pruinose, forming small patches to about 2 cm diameter. Granules: 0.04 - 0.1 mm diameter, usually ±spherical, rarely elongated. Medulla: white. Apothecia: sessile, flat, 0.2 - 0.5 mm diameter, not pruinose. Disc: orange-brown to black. Exciple: dark orange-brown to black, persistent; in section: 50 µm wide, colourless in inner part, red-brown or brown-red in outer part, of anastomosed trend, lumina rarely present; pigment K+ intensifying red-purple. Thalline margin: absent.


The rather short ascospores with blunt ends separate *B. auerswaldii* from other corticolous Greek species of the genus.

Naxos and western Peloponnesse, on bark at altitudes 0 - 600 m. The only phorophyte explicitly reported is *Juniperus phoenicea*.

Widely distributed in Europe as to far north as southern Sweden, but nowhere common. Also Macaronesia, N. America (BC, Montana), and perhaps elsewhere.

*Bacidia bagliettoana* (A. Massal. & De Not.) Jatta (1900)


Thallus: crustose, green, warted. Apothecia: to 0.9 mm diameter. Disc: black. Exciple: present; in section: 50 µm wide, dark brown, with a blue-green pigment visible when brown pigment bleached by C; K-, N+ violet producing a few granules. Thalline exciple: absent. Epithecium: green-black to blue-green, C-, K-, N+ violet. Hymenium: 60 - 75 µm tall, colourless to dull blue-green, C-, K-, N+ violet producing a few ±blue granules. Hypothecium: 70 µm tall, dark brown. Paraphyses: not coherent, strongly capitate. Ascospores: colourless, 3 - 4 -septate. straight or slightly curved, ends rounded, 23 - 42 x 2 µm.

Certainly present in Crete and Peloponnesse at altitudes 200 - 900 m, where it is ±terricolous. Abbott (2009) also cited here a report of *B. muscorum* from Mt. Olympus, on bryophytes at 1800 m; that report might refer to this species or to *Trapeliopsis granulosa*.

Throughout Europe. Also Asia (widespread), N. Africa (Morocco), N. America (widespread, but absent from SE USA), Australasia (NZS), Antarctica (subantarctic Signy Is).

*Bacidia circumspecta* (Nyl. ex Vain.) Malme (1895)


The earliest name is *Rhaphiosporum muscorum* f. *quercicola* (Nyl.) Arnold (1870), but I do not yet know whether it has priority at the rank of species.
Bacidia coprodes (Körb. ex Arnold) Lettau (1912)

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 reported for N. America (Ontario, eastern half of USA), Antarctic (subantarctic islands).

Bacidia crozalsiana (H. Olivier) Zählbr. (1926)
in: Cat. Lich. Univ. 4: 108; Lecanora (or ?Lecania) crozalsiana H. Olivier (1905) in: [need to investigate­ don't know title of paper]

Description: Clauzade & Roux (1985).
Naxos, on bark at an altitude of 200 m.
Only France and Greece.

Bacidia fraxinea Lönnr. (1858)
in: Flora 41: 612–613; Bacidia fallax (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, Russia).

Bacidia friesiana (Hepp) Körb. (1860)
in: Parerga Lichenol. 133 (Also by Anzi in Cat. Lich. Sondr. 70. It is not known which was published first); Biatora friesiana Hepp (1857) in: Flecht. Eur. no. 288

Descriptions: Ekman (1996); Llop (2007a); Smith et al. (2009).
Corfu and Peloponnese, 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), N. America (Oregon).

Bacidia igniarii (Nyl.) Oxner (1968)
in: Flora lischainikiv Ukraini. 2(1): 166; Lecidea igniarii Nyl. (1867) in: Flora 50: 328

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. America (widespread in Canada, also present in Minnesota).

Bacidia incompta (Borrer) Anzi (1860)

Descriptions: Llop (2007a); Smith et al. (2009).
Sterea 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 Sweden, but nowhere common. Also Macaronesia, Asia (Russia, Tajikistan), perhaps N. Africa, perhaps S. America (Colombia as B. aff. incompta), perhaps Australasia (Queensland), perhaps Pacific (Hawaii). Its status in N. America is disputed.

Bacidia laurocerasi (Delise ex Duby) Zählbr. (1926)
in: Cat. Lich. Univ. 4: 213; Patellaria laurocerasi (as "lauro-cerasi") Delise ex Duby (1830) in: Bot. Gall. 2: 653; Bacidia endoleuca (Nyl.) Kickx

Descriptions: Ekman (1996); Llop (2007a); Smith et al. (2009).
Corfu and Rhodes, on bark at altitudes 0 - 250 m. Reported from *Olea europaea* and *Quercus macrolepis*.

Throughout Europe, to as far north as southern Scandinavia. Commonest in regions with a maritime climate, but can occur elsewhere, even in Russia. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, perhaps S. Africa; also St Helena), N. America (eastern half of USA and southern Canada; perhaps also California), perhaps Caribbean (Bahamas), perhaps C. America (Mexico - old report), S. America (Colombia; perhaps also Brazil and JF), Australasia (Victoria, perhaps elsewhere in Australia; both islands of NZ). Many reports, especially older ones, may refer to other species.

**Bacidia paratalassica** Llop & Gómez-Bolea (1999)
in: *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, medulla 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 medulla, absent from cortex, large (to 10 µm diameter), colourless to pale yellow, soluble in N but not in K. Thalline margin: absent. Epithecium: 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 medulla 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 - 350 m. Reported from a wide range of phorophytes, with no clear preference.

Southern Europe, from Portugal to Greece. Also N. Africa (Morocco).

**Bacidia punica** Llop (2010)
in: *Bryologist* 113(2): 366-370

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 *Laaurus nobilis* at an altitude of about 300 m.

Widely distributed in southern Europe. Not reported from other continents.

**Bacidia rhodi** Szatala (1943)

Description: See the protologue. According to Şenkardeşler et al. (2014), who had seen the type, this species belongs in *Scoliciosporum*

Rhodes, on bark of *Celtis* sp. at about 1100 m altitude. Known only from the type collection.

**Bacidia rosella** (Pers.) De Not. (1846)

The earliest name may be *Lichen alboincarnatus* Wulf. (1791).

The Peloponnesian collections that Abbott (2009) cited under this name all belong to *B. paratalassica* 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. paratalassica* and *B. thyrrenica*.

Thallus: crustose, green-grey or grey-green, not pruinose, continuous or cracked, smooth or warted, 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
hyphae with broad lumina perpendicular to surface, 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, number 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 cortex, soluble in K but not in N. Thalline exciple: absent. 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: colourless or with a faint yellow tinge. Paraphyses: simple, 1 μm wide at base. Asc: 80 - 100 x 11 - 13 μm, ±cylindrical, Bacidia type. Ascospores: colourless, 9 - 17 -septate, acicular, 52 - 85 x 3 - 4 (4.5) μm. 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. Apparently throughout Greece, though never very far from the coast. The two Peloponnesian collections shown on the map are reliably determined, but many of those for other parts of Greece may not be. The Peloponnesian collections were on bark of *Quercus* spp. at altitudes 700 - 850 m. The reported altitude range for the other Greek records, all of which are from bark, strongly suggests that some of them refer to *B. parathalassica* or *B. thyrrenica*, though others are probably correct.

There are reports of *B. rosella* 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. thyrrenica*. Also Macaronesia, Asia (Turkey, Russia, Japan), perhaps N. Africa (Morocco). Reports for N. America are incorrect and refer to *B. rosellizans*, so reports for C. America (CR, Mexico) may also be incorrect.

**Bacidia rubella** (Hoffm.) A. Massal. (1852)


The *luteola* names at species rank are superfluous names for *Lichen luteus* J. F. Gmel., but there is a legitimate basionym for this group, namely *Biatora vernalis* f. *luteola* Fr. (1831).

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 very 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. Thalline margin: absent. Epithecium: very pale orange-brown, K-, pigment only 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. Asc: 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. rosella* 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. rosella*, but *B. rubella* is present in the Peloponnesian.) 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, S. Africa), N. America (widespread), perhaps C. America (CR; an old report for Mexico), S. America (Colombia, Galapagos Is; there are also old reports for Brazil), perhaps Pacific (Hawaii).
Bacidia subincompta sensu (Nyl.) Arnold (1871)
in: Flora 53: 472; Lecidea subincompta sensu Nyl. (1865) in: Flora 48: 147; Bacidia affinis (Stiizn.) Vain.; (?) Bacidia affinis var. incrassata Vain.; Bacidia affinis var. separabilis (Nyl.) Vain.
Lecidea subincompta Nyl. is a nomen novum for Biatora atrosanguinea (Schaer.) Hepp, the epithet atrosanguinea not being available in Lecidea. Unfortunately, Hepp's name is a synonym of Bacidia incompta. To preserve current usage of the well-established name Bacidia subincompta it will be necessary to conserve the name Lecidea subincompta Nyl. with a conserved type.

Descriptions: Llop (2007a); Smith et al. (2009).

Very 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 (Madeira), Asia (widespread), N. Africa (Morocco), N. America (widespread, but absent from warmer parts of USA).

Bacidia thyrronica 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, 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 enclosed; 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. Thalline margin: absent. 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. Hypothecium: mostly colourless, upper part sometimes pale grey or pale yellow-brown. Paraphyses: simple, 1 µm wide at base, 1 - 2 µm at apex, not capitata. Asci: 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.

For separation from B. parathalassica see under that species. There is so much overlap in the characters of B. parathalassica and B. thyrronica 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. rosellae seems possible. Recorded from a wide range of photrophyes, with no clear preference.

Mediterranean Europe, from the Balearic Is to Greece. Also Macaronesia (Tenerife), western Asia (Turkey).

Bacidia vermifera (Nyl.) Th. Fr. (1874)
My only collection is rather scanty, so I can not prepare a complete description. For published descriptions, see: Llop (2007a) or Smith et al. (2009).

Thallus: crustose, inconspicuous. Apothecia: subsessile, flat at first, becoming slightly convex later, 0.2 - 0.5 mm diameter, not pruinose. Disc: black. Exciple: black, becoming almost enclosed; in section: 35 - 45 µm wide, red-brown in inner part, black in outer part, K reaction as for epithecium. Thalline margin: absent. 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 capitata. 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 ascospores, red-black apothecial pigment, and two types of conidia, is very distinctive. This species can not be confused with any other.

Northern Peloponese, 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 (Scotland, Estonia, Finland). South of the Alps it is very rare, though it is reliably reported for Salamanca in Spain. Also Asia (widespread in Siberia, also present in Mongolia), N. America (southern Canada, cooler parts of USA).
Bacidina Vězda (1991)


Type: *B. phacodes* (Körb.) Vězda. Family: *Ramalinaceae*. Literature: The best introduction to the genus 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). For more information on the recently described *B. canariensis* see Lumbsch & Vězda (1992) and for *B. neosquamulosa*, see Aptroot & van Herk (1999b).

*Bacidina* is a segregate from *Bacidia* s. lat. The characters separating it from *Bacidia* s. str. are subtle and, perhaps as a result, *Bacidina* is not accepted by all lichenologists. The delimitation of *Bacidina* seems sound to me, but it is not yet known whether the genus is monophyletic, so a final judgment can not yet be made. *Bacidina* has about 39 species, of which about 20 have been reported for Europe. There are only a few Greek records.

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), (B. brandii)
2 Hypothecium colourless, yellow or pale brown.
33 Many ascospores more than 45 μm long.
44 Ascospores 2.5 - 4 μm wide. Thallus ±isidiate, of granular microsquamules. On basic bark. (B. neosquamulosa)
4 Ascospores less than 2.2 μm wide. Thallus and substrate various.
55 Thallus ±entirely sorediate. Usually on basic bark, sometimes on other substrates. (B. adastra)
5 Thallus not entirely sorediate; goniocysts present or absent but thallus continuous at least in places. On bark or leaves.
66 Epithecium N+ red. On leaves. (B. canariensis)
6 Epithecium N-. On bark. **B. assulata**
3 Few or no ascospores more than 45 μm long.
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)

Körber's epithet was first used at species rank in 1967, as *Bacidia assulata*. It is preceded at this rank by *Bacidia intermedia* (Hepp ex Stizenb.) Arnold (1871), but that name is not legitimate, being a later homonym of *Bacidia intermedia* Hampe (1861).

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, on bark of *Pistacia* sp. at an altitude of about 500 m, and northern Epiros on bark (phorophyte not specified) at an altitude of 735 m. The report for Crete dates from 1943, and Crete is on the margin of the distribution range for this species, so confirmation of its presence on that island is desirable.

Basically a species of the central part 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 (Oklahoma).

**Bacidina delicata** (Larbal. ex Leight.) V. Wirth & Vězda (1994)
Descriptions: Llop (2007a); Smith et al. (2009) as Bacidia delicata.

Crete, at about 600 m. The substrate was not recorded. Although Crete is on the margin of the distribution range for this species, the record was made in recent times and by experienced lichenologists, so is probably correct.

Most records are from middle latitudes of Europe, though it does reach southern Scandinavia and there are a few records from southern Europe. Also Macaronesia (Azores), Asia (southern Siberia, Hong Kong, 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 water could leach calcium ions from an initially calcareous substrate. Abbott (2009) accepted this 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 (Gomera), Asia (fairly widespread in cool and temperate regions), N. America (SE Canada, fairly widespread in USA). A report for S. America (Brazil) seems doubtful to me.

Bacidina phacodes (Körb.) Vězda (1991)

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.

Widely distributed in temperate and warm parts of Europe. Also Macaronesia (Gomera), Asia (widely spread), N. Africa (Morocco), 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)


About 30 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. (B. dryina)

1 Ascospores 3 - 4 µm wide, sometimes slightly constricted at centre, not usually fragmenting in ascus, but sometimes fragmenting outside asci into multicellular segments.

22 Ascospores 60 - 95 µm long, up to 17-septate. B. patellarioides s. lat.

33 Apothecia flat or at most slightly convex, 0.3 - 1.2 mm diameter. Exciple prominent, persistent. Subhymenium colourless. Exciple 50 - 80 µm wide at top, 60 - 160 (250) µm at base. Conidia 8 - 13 µm long. B. patellarioides var. patellarioides

3 Apothecia convex, 0.3 - 0.6 mm diameter. Exciple inconspicuous, becoming excluded. Subhymenium pale brown to dark brown. Exciple 20 - 50 µm wide at top, up to 80 µm at base. Conidia 13 - 17 µm long. B. patellarioides var. convexa

2 Ascospores 35 - 60 µm long, 3 - 9 -septate. (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 the substrate. Apothecia: sessile, usually ± flat, sometimes slightly concave or slightly convex, 0.3 - 0.9 mm diameter, not pruinose. Disc: black. 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. Thalline margin: absent. Epithecium: orange-brown to dark brown, K- or developing a slight green tinge, N-, pigment not soluble in K or N. Hymenium: 95 - 130 µm, 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 KI- central region; wall of ascus KI- 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: 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 the 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: 28% of records are from J. oxycedrus subsp. macrocarpa or J. phoenicea.

Widely distributed in southern Europe, but not present north of the Alps. Also Macaronesia, Asia (Israel, Japan), N. Africa (Morocco, Algeria, Tunisia, Libya), western N. America (BC, California).

Bactrospora patellarioides var. convexa (de Lesd.) Egea & Torrente (1993)
in: Lichenologist 25(3): 249; Lecanactis patellarioides var. convexa de Lesd. (1922) in: [need to investigate]

Descriptions: Egea & Torrente (1993a); Nash et al. (2005).

Corfu, on bark and wood of Olea europaea at an altitude of 20 m.

Var. convexa is known only from Italy, Greece, Morocco and California.

Baeomyces Pers. : Fr. (1794)

Type: B. rufus (Huds.) Rebent. Family: Baeomyctaceae. 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).

About 8 species. At least 3, and perhaps 4, 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 two sites in northern Greece, close to the border with Bulgaria, at altitudes 1200 - 1380 m. The only substrate explicitly mentioned was bark of Picea. (Probably decaying bark close to the base of the tree, though that is not stated.)

Common in cold and temperate parts of 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 (Colombia, Venezuela).

Bagliettoa A. Massal. (1853)
in: Mem. Lichenogr. 146-147

Type: B. limborioides A. Massal. Family: Verrucariaceae. Literature: The best starting points are Halda (2003) and
**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 at least 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.

11 Thallus with a purple, pink or red tint (red crystals in the cortex).
   22 Involucrellum present, with fine radial cracks. **B. cazzae**
   22 Involucrellum absent. **B. marmorea**

11 Thallus dark green, blue-green or blue-grey. Green pigment present in upper cortex (visible in compound microscope if thallus sectioned). **B. parmigerea**

1 Thallus grey, white or ochre. Green pigment present or not in upper cortex.
   22 Involucrellum absent. **B. calceda**
   22 Involucrellum present, with fine radial cracks.
   33 Involucrellum narrower than exciple.
      44 Upper cortex with green pigment. **B. barmigerella**
      4 Upper cortex without green pigment. **B. baldensis**
   3 Involucrellum as large as or larger than exciple.
      44 Involucrellum protruding, large, 0.3 - 0.4 mm diameter. Thallus sometimes with an ochre tinge. **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). **B. steineri**
      5 Exciple brown to black, at least in some parts.
      6 Ascospores 12 - 15 x 5 - 6 µ. Exciple 0.1 - 0.2 mm wide. (B. quarnerica)
      6 Ascospores 13 - 15 x 7 - 12 µ. Exciple 0.2 - 0.3 mm wide. **B. parmigera** s. lat.

**Bagliettoa baldensis** (A. Massal.) Vězda (1981)


Some of the infra-specific names cited here may be synonyms of *B. parmigera* 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).

The correct name appears to be *Bagliettoa sphinctrina* (Dufour) Körb., as Dufour's epithet dates from 1831.

Thallus: crustose, to several cm diameter, immersed or thinly superficial, inconspicuous, white, 130 - 260 µ thick. Cortex: 25 - 50 µ thick, colourless, without distinct structure even in K, K-. Medulla: white, not delimitated from photobiont-bearing layer. Perithecium: 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 perithecium. 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 visible septa, lower ones (where tips are less crowded) sometimes slightly capitate. Ascii: 70 - 75 x 30 - 35 (50) µ when mature, broadly cylindrical to distinctly clavate, fragile and easily disintegrating, wall very thin at sides, thickening to 2 - 4 µ at apex. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 17 - 26 x 11 - 13 µ, usually fragile, easily disrupted and appearing granular. Photobiont: green, not trebouxioid; cells 5 - 7 µm diameter, often a few grouped together (presumably following division). Photobiont layer: not well defined, cells scattered in all of thallus below cortex in loose clumps 15 - 30 µm diameter. [The description may include material of *B. parmigera* and *B. steineri*, which were regarded as synonyms until very recently.]

Usually easily recognised by the 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 pink crystals in the cortex are distinctive. However scanty collections may lack pink areas, and could then be

Throughout Greece, but commonest in sites not very far from the sea. On calcareous rock at altitudes 0 - 1800 m, but two thirds of reports are from below 400 m.

Throughout Europe as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (scattered in USA), perhaps C. America, Australasia (widespread).


Krzewicka (2012); Smith et al. (2009) Verrucaria calciseda.

Bagliettoa cazzae (Zahlbr.) Věžda & Poelt (1981)

Islands of Corfú, Evia and Lefkada. On calcareous rock at altitudes 100 - 1100 m.

Southern Europe, from the Iberian Peninsula to Greece. Also western Asia (Turkey).

Bagliettoa limborioides A. Massal. (1853)
in: Mem. Lichenogr. 147; Bagliettoa parmigera var. calcivora (A. Massal.) ined.; Verrucaria calciseda f. calcivora A. Massal. ex Arnold; Verrucaria calciseda var. calcivora A. Massal. ex Flagey; Verrucaria sphinctrina Ach.

The earliest name may be Verrucaria sphinctrina Ach., but the synonymy is disputed.


Southern and central Europe. Absent from British Is, Baltic States and the Nordic Countries. Also Africa (Morocco, Algeria, perhaps elsewhere), perhaps N. America, perhaps S. America (Argentina, Chile).

Bagliettoa marmorea (Scop.) Gueidan & Cl. Roux (2007)
in: Gueidan, Roux & Lutzoni, Mycol. Res. 111: 1157; Lichen marmoreus Scop. (1772) in: Fl. Carniol., Ed. 2, 2: 367; Amphoridium marmoreum (Scop.) Baroni; Lecidea wulfenii (Clemente) Ach. nom. superfl.; Lecidea wulfenii var. purpurascens Ach. nom. superfl.; Verrucaria hoffmannii Hepp; Verrucaria marmorea (Scop.) Arnold; Verrucaria marmorea f. hoffmannii (Hepp) Arnold; Verrucaria marmorea f. purpurascens Arnold; Verrucaria marmorea var. purpurascens Arnold; Verrucaria marmorea f. rosea (A. Massal.) Servit; Verrucaria marmorea var. rosea (A. Massal.) Zahlbr.; Verrucaria purpurascens Hoffm. nom. superfl.; Verrucaria purpurascens var. hoffmannii Körb.

Verrucaria purpurascens Hoffm. (1790) is a superfluous name for Lichen marmoreus Scop. The epithet was used at varietal rank as Ureolaria wulfenii var. purpurascens Ach. (1803), but the change in rank does not make that name legitimate, as the type of U. wulfenii var. purpurascens is the type of U. wulfenii (see below). Priority of the epithet at varietal rank dates from 1833.

Lichen wulfenii Ach. (1799) is also a superfluous name for Lichen marmoreus Scop. The epithet wulfenii was used at varietal rank in 1807, as Lecidea immera var. wulfenii Clemente. That name is legitimate, and at varietal rank the epithet wulfenii has priority over marmorea, which was first used at varietal rank in 1810.

Thallus: crustose, immersed in substrate, mostly grey but with some pale pink to purple patches, especially near perithecia, to several cm diameter, sometimes bordered by a black prothallus 0.05 - 0.15 mm wide. Cortex: 25 µm thick, about half filled with large clusters of pinkish crystals. Perithecia: black, 0.2 - 0.5 mm diameter, 90 - 100 % immersed in pits in substrate; in section: aglobose, 300 - 450 µm tall x 310 - 500 µm wide. Exciple: colourless to pale brown. Involutellum: present, black (but sometimes with a red tinge), 350 - 420 µm diameter, 100 µm thick, sometimes with a few irregular radial cracks, extending about one-third of the way down perithecium, not separating. Periphyses: present. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 17 - 30 x 10 - 15 µm. Photobiont: green. [The description probably includes material of B. cazzae, which was treated as synonymous until very recently.]

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 (SE USA).

Bagliettoa parmigera (J. Steiner) Vězda & Poelt (1981)
description: See the protologue. There is a translation in Halda (2003).
Scattered throughout Greece, but always close to the sea. On calcareous rock at altitudes 50 - 1200 m.
Mainly southern Europe, but present in central Europe and probably reaching as far north as southern Scandinavia. Also western Asia (Turkey, Syria, Israel), North Africa (Morocco).

Bagliettoa parmigerella (Zahlbr.) Vězda & Poelt (1981)
in: Bestimmungschl. Eur. Flecht. 2: 363; Verrucaria parmigerella Zahlbr. (1919) in: Öst. Bot. Z. 68: 64-65; Verrucaria bagliettoaformis var. erumpens Serví; Verrucaria baldensis var. rechingeri Serví; 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) Serví; Verrucaria sphinctrinella f. circumarata (Serví) Serví; Verrucaria sphinctrinella var. expallida Serví; Verrucaria sphinctrinella f. spermogonifera (Arnold) Serví
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)
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).

type: B. alpina (Sommerf.) Clauzade & Cl. Roux. Family: Lecideaceae. literature: There is no good 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 7 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 "thallus ... KHO adh. lutescit, CaCl₂₂ non mutatur" (= thallus ... K+ yellow, C-), but one expects the thallus to react K-, C- in this species. 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 in the west of the continent, but also reported from New York State). A report for Hong Kong seems doubtful to me.

**Biatora Fr. (1817) : Fr.**


Type: *B. vernalis* (L.) Fr. Family: Ramalinaceae. Literature: There is a key to all European species in Printzen & Otte (2005); the key below is based on it.

About 56 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 nearly all of them.

Because the genus is not very well known, I include a fairly comprehensive key just in case any of these species turn up in Greece. The key does not include *B. athoa* Räsänen.

11 Soredia present. (B. chrysantha), (B. efflorescens), (B. fallax), (B. pontica), (B. vacciniicola)

1 Soredia absent.

22 Apothecia grey, grey-black, green-black or khaki. (B. globulosa), (B. mendax), (B. ocelliformis), (B. sphaeroidiza)

2 Apothecia without grey or blue tinge; pale beige, orange-brown, red-brown or dark brown.

33 Ascospores mostly 3-septate.

44 Apothecia orange-brown. Excipular hyphae with narrow, elongate lumina. (B. agraefaciens), (B. rufidula)

4 Apothecia white to pale brown. Excipular hyphae with broad lumina (1 - 2.5 μm, reaching 1.5 - 3.5 μm in apical cell). **B. epirotica**

3 Ascospores mostly simple or 1-septate.

44 Ascospores 3.5 - 7 times as long as broad. On bark or wood. (B. longispora)

4 Ascospores 2 - 4.5 times as long as broad. On various substrates.

55 Apothecia in section C+. On bark or wood. (B. helvola), (B. sphaeroidiza)

5 Apothecia in section C-. On various substrates.

66 Thallus of minute, densely crowded squamules, C+ pink. On bark or wood. (B. fallax)

6 Thallus crustose, C-. On bryophytes, decaying vegetation, soil or bark.

77 Thallus granular, often with a green tinge. Exciple colourless or ±uniformly pale brown.

88 Thallus white to green-white, granular-verrucose or with coherent granules 80 - 150 μm diameter. Exciple ±uniformly pale brown. Ascospores (0) 1 -septate. (B. vernalis) Greek report doubtful.

8 Thallus grey-green, finely granular; granules 27 - 70 μm diameter. Exciple colourless. Ascospores (0) 1 (3) -septate. See **Mycobilimbia pilularis**

7 Thallus not granular, white-grey. Exciple colourless in outer part, pale brown in inner part. (B. subduplex)

**Biatora athoa Räsänen (1944)**

in: *Hedwigia* 81: 232-233. The name was cited in Szatala ("1943b"), but with attribution to Räsänen and without a description.

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)**

in: *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.

**Biatora ungeri Hepp (1862)**

in: Unger, in: *Wissenschaftliche Ergebnisse* 102

Known only from the type collection from Corfu. Hepp’s description is too brief to make it clear what species is involved, but it is not a species of *Biatora* as understood today. In Abbott (2009) it was listed as an independent species,
but Arnold (1887:150), who had probably seen Hepp's material, synonymised it with *Ricasolia olivacea* (= *Solenopsora olivacea*).

**Biatora vernalis** (L.) Fr. (1831)
The single Greek report was not accepted by Abbott (2009). The epithet *veralis* has sometimes been misapplied to *Bilimbia sabuletorum*, a species which does occur in Greece, and the report might refer to that.

**Biatoropsis Räsänen** (1934)
Type: *B. usnearum* Räsänen. Family: of uncertain position in *Basidiomycota*. Literature: Diederich (1996). This genus of lichenicolous basidiomycetes has only one species.

**Biatoropsis usnearum** Räsänen (1934)
Descriptions: Diederich (1996); Nash et al. (2005). 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).

**Bilimbia De Not.** (1846)
in: *Giorn. Bot. Ital. ann. 2*, 1(1): 190-191. De Notaris's name was long misunderstood and considered to be not legitimate. However, Veldkamp (2004) demonstrated that it *is* legitimate. Because of this misunderstanding, publications before 2005 generally treat the species of *Bilimbia* under other generic names, especially *Bacidia*, *Mycobilimbia* and *Myxobilimbia*.

Type: *B. hexamera* De Not. (= *B. sabuletorum*). Family: *Ramalinacea*. Literature: The most convenient source for the southern European species is Nimis & Martellos (2004), which treats them under the genus *Myxobilimbia*.

About 10 species, some poorly known, of which 6 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 - 12 -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)
in: Veldkamp, in *Lichenologist* 36(3-4): 195; *Lecidea lobulata* Sommerf. (1827) in: *Kongel. Norske Vidensk. Skr. 2*(2): 54; *Myxobilimbia lobulata* (Sommerf.) Hafellner; *Thalloidima syncomistum* (Flörke) Vain. *(Greek reports as 'Thalloedema'); Toninia lobulata* (Sommerf.) Lynge
The earliest name is *Lecidea sabuletorum* var. *syncomista* Flörke (1808), but Flörke's epither has not have priority at the rank of species.

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 warted. 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. Exciple: excluded early; in section: brown, of radiating hyphae. Thalline margin: absent. 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 capitate, sometime branched, very coherent. Asci: 65 x 15 µm, KI+ 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 the 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 1000 - 2300 m. Almost throughout Europe, though south of the Alps it is restricted to the mountains. Also Macaronesia (CVI), Asia (widespread, at least as far east as Mongolia), N. Africa (Morocco), N. America, Australasia (SE Australia, NZS), Antarctica (subantarctic islands, Antarctic Peninsula).

Bilimbia sabuletorum (Schreb.) Arnold (1869)


Scattered on the mainland and Crete. Overgrowing bryophytes on calcareous rock, apparently sometimes directly on calcareous rock, at altitudes 0 - 1700 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 (Australia, NZS), Antarctica (Antarctic Peninsula).

Blastodesmia A. Massal. (1852)


The only species in the genus is not lichenised, but it 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 Germany and Switzerland are probably incorrect. I have not seen any reports for other continents.

in: Lichenologist 29(4): 340

Type: B. lesdainii (Hue) Canals et al. Family: of uncertain position in Verrucariales. 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.


The earliest name may be Alysphaeria flavovirens Turpin (1827), but original material probably no longer exists and the synonymy is not certain.

Descriptions: Canals et al. (1997); Nash et al. (2007); Smith et al. (2009).

Scattered in the southern half of Greece, but not reported for Peloponnese or for any of the smaller islands. Modern reports are from calcareous rock at altitudes between 40 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 prove to be less common in southern Europe than elsewhere. Also Macaronesia, Asia (Russia,
India, Japan, Taiwan), N. America (Alaska, USA, so probably also present in Canada), perhaps S. America.

**Brianaria S. Ekman & M. Svensson (2014)**

in: *Lichenologist* 46(3): 291-292


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*.

Crete, on rock at an altitude of 200 m.

Widely distributed in temperate latitudes of Europe as far north as southern Scandinavia, but rare south of the Alps. Also Macaronesia (Azores, Tenerife), N. America (Nova Scotia, Michigan, Virginia). A report for Hong Kong seems doubtful to me.

**Brodoa Goward (1986)**

in: *Bryologist* 89: 220


Three species, all present in Europe and two of which are reported for Greece. All have a distinctly arctic-alpine distribution. Greece is at the extreme margin 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.

**B. intestiniformis** has a rather northern distribution in 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, where it occurred on granite rock at altitudes 1750 - 1800 m.

Widespread in Scandinavia and Russia. The Greek report appears to be the only European one from outside those areas. Also Asia (widespread in Russia, Mongolia), and N. America (Alaska, Canada and mountains of western USA).

**Bryobilimbia Fryday, Printzen & S. Ekman (2014)**

in: *Lichenologist* 46(1): 29


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 their blue granules in the hymenium. The genus is rare in Greece.
11 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 rocks or calcareous soils. **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**

**Bryobimbia hypnorum** (Lib.) Fryday, Printzen & S. Ekman (2014)


The date of the basionym is sometimes given as 1853, when it was validly published as *L. hypnorum* Lib. ex Massal. in Mem. lich. 124. However, Sayre (1969) clearly implies that names in Libert's exsiccata are validly published. If the name was not, in fact, validly published until 1853, then the name *Lecidea templetonii* Taylor (1836) would have priority.

Thallus: crustose, grey, superficial but thin, to 3 cm diameter. Cortex: apparently absent; outermost part of thallus is a colourless to very pale brown, structureless layer, 15 - 25 µm thick. Apothecia: 0.4 - 0.8 mm diameter, sessile, flat, not pruinose. Disc: black. Exciple: black, becoming almost excluded; in section: 75 µm wide, mostly very dark brown and opaque (structure not visible), sometimes colourless to blue-green in outermost 10 µm. Thalline margin: absent.


Very scattered, with no clear pattern, at altitudes 300 - 1700 m. 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), N. Africa (Morocco), N. America (fairly widely distributed from Alaska to cooler parts of USA), Australasia (scattered in Australia), Antarctica (subantarctic Signy Is).

**Bryobimbia 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.

Kefallonia and Macedonia, at altitudes 700 - 1100 m. The only substrate explicitly reported was bark of *Abies cephalonica*.

There are reports for several localities in central and southern Europe. Also Macaronesia, Asia (Japan), N. America (Colorado, perhaps elsewhere in USA).

**Bryoria Brodo & D. Hawksw.** (1977)

in: *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 is difficult, and although Clauzade & Roux (1985), and Smith et al. (2009) between them appear to cover all the species that are likely to occur in Greece, they need to be supplemented by other sources. For *B. capillaris* and *B. implexa* see especially Holien (1989). Brodo et al. (2001) cover all the species below except for *B. smithii* (but they treat *B. implexa* under *B. pseudofuscescens*). For *B. smithii*, there is some additional information in Hawksworth (1972a), under *Alectoria smithii*. Brodo & Hawksworth (1977) is still the best introduction to the genus as a hole, but its focus is the North American species. Myllys et al. (2011) discuss the phylogeny of the group.

Thallus: fruticose, pendent (in Greek species), prostrate or erect, often very long, usually some shade of brown. Branches: rounded at least in most places, with or (in Greek species) without lateral spinules. Pseudocyphellae: present in some species, at least slightly elongate, longitudinally oriented. Soralia: present in some species. Cortex: of periclinal hyphae, these sometimes spiral slightly around the branches. Apothecia: very rare. Pycnidia: very rare.

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 45 species, of which about 18 occur in Europe. Most are rather northern, and in Mediterraneans regions are restricted to the mountains.

Although two species are here reported for the Peloponnese, I am not certain that this is correct. All my Peloponnesian collections are chemically identical, so far as I can determine from spot tests, and it may be that they represent a single, morphologically variable, taxon. Additional collections are needed to clarify the position. See also the notes under each species.

*Bryoria* has a limited range of morphologies, but individual species are often morphologically variable. Identification therefore relies heavily on chemistry, though even this is variable within some species. Spot tests are difficult, as the dark colour of the thallus tends to mask any positive reactions. Some authors recommend extracting lichen products onto filter paper, either by extraction with acetone followed by application of the reagent to the filter paper, or by applying the reagent directly to the lichen and simultaneously soaking up the reaction products with the filter paper, but I have not had much success with these methods. I place a fragment of a branch on a glass microscope slide and observe under the binocular microscope while adding the reagent; if necessary, this can also be done under the compound microscope. 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; they are also thinner, which helps if you need to add a cover slip.

11 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 K+ yellow, C+ pink, KC+ red, P+ red. B. nadvornikiana

1 Thallus pendent or prostrate. Lateral spinules absent or few. Medulla or soralia (not always both) P+.

22 Pseudocyphellae present (Note 1). Soralia present or absent. Medulla K- or K+, KC- or KC+.

33 Pseudocyphellae narrowly fusiform to linear, usually abundant and conspicuous. Soralia, if present, tuberculate and/or in fissures. Chemistry varied. B. impexa s. lat. Several chemotypes are recognised: nomenclature follows Holien (1989).

44 Medulla K+ yellow-red (norstictic acid). (chemotype 2 = B. pseudofuscescens)

4 Medulla K- or K+ but without norstictic acid.

55 Thallus P+.

66 Thallus and soralia P+ strongly bright yellow (psoromic acid). (chemotype 1)

6 Thallus and soralia P+ red-orange, orange-red or red (fumarprotocetraric and protocetraric acids).

(chemotype 4)

5 Thallus P-, but soralia P+ red-orange, orange-red or red (fumarprotocetraric and protocetraric acids).

66 Thallus C+ red, KC+ red (gyrophoric acid). (chemotype 3 = B. friabilis = B. vrangiana)

6 Thallus C-, KC-. chemotype 5

3 Pseudocyphellae shortly fusiform, often sparse and inconspicuous. Soralia often present, tuberculate. Medulla K+ yellow (not norstictic acid), KC+ red, P+ yellow. B. capillaris

2 Pseudocyphellae absent (Note 1). Soralia usually present, tuberculate and/or in fissures, P+ red. Medulla K-, KC-

33 Thallus white-grey to grey or pale brown, base not paler than apices. Soralia tuberculate. Cortex and medulla strongly P+ red. B. subcana

3 Thallus brown to dark brown, base usually pale than apices. Soralia tuberculate and/or in fissures. Cortex and medulla P- or P+ red.

44 Main stems more than 0.5 mm diameter. B. chalybeiformis

4 Main stems less than 0.5 mm diameter. B. fuscescens s. lat. Two varieties are sometimes recognised.

55 Thallus pendent. Soralia abundant. Thallus sometimes paler at base. B. fuscescens var. fuscescens

5 Thallus prostrate. Soralia scarce or absent. Thallus not paler at base. (B. fuscescens var. positiva)

(1) The surface of B. fuscescens may have depressions which are fusiform to elongate, i.e the same shape as pseudocyphellae in some other species. However, these depressions are corticate, and are not pseudocyphellae. Fissures with a broken cortex may also occur in this species, but they can usually be distinguished from pseudocyphellae by the presence of soredia.
Bryoria capillaris (Ach.) Brodo & D. Hawksw. (1977)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Mt. Olympus and island of Ikaria, on bark at altitudes up to 1800 m. The only substrate explicitly specified was Pinus nigra.

Widely distributed in Europe, though in the south confined to the mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread in cool to cold, suboceanic areas, but almost absent from the centre of the continent).

Bryoria chalybeiformis (L.) Brodo & D. Hawksw. (1977)


Description: Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Reliably reported from northern Macedonia, on granite rock at altitudes 1200 - 1800 m. An old report for Thessaly, on bark at an altitude of 150 m, is doubtful.

Widely distributed in northern and central Europe, but in the south very rare and restricted to high mountains. Also Asia (Mongolia, widespread in Russia), North America (Alaska, Canada, cold parts of USA), South America (Falkland Is), and Antarctica (subantarctic islands).

Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw. (1977)


Lichen jubatus L. (1753) and all combinations based on it are nomina utique rejicienda; the epithet jubatus has been misapplied to so many species that it is a source of confusion. The next available name at species rank appears to be Alectoria prolixa (Ach.) Ny1. Hawksworth (1972a) claimed that this is a rejected name, but this claim seems incorrect to me. Nylander's combination is based on Alectoria jubata var. prolixa Ach. (1810), which is not a "combination based on" Lichen jubatus L., and so is not a rejected name. As fas as I can see, the correct name for this species is Bryoria prolixa (Ach.) ined. [However, need to check whether Hawksworth made that combination based on an epithet other than the Acharian one - there is some evidence that he did.]

Greek records with jubata epithets probably refer to Bryoria fuscescens or to Bryoria impexa. Abbott (2009) cited them all under Bryoria fuscescens.

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 tubeulate and others developing in longitudinal fissures in the thallus. Cortex: of periclinal hyphae; sometimes they spiral slightly around the branch. Chemistry: medulla K-, KC-, P+; cortex possibly K- (a faintly yellowish pigment is mobilised, but it is not clear to me whether this is simply the original cortical pigment going into solution or a +yellow reaction due to atranorin), KC-, P+; soralia K-, KC-, P+ red. Photobiont: green.

My only Peloponnesian collection that I have referred to B. fuscescens lacked pseudocyphellae, though it did have some broadly fusiform fissures in which soralia were developing. Numerous soralia were present, and they included both tubeulate and fissural types. However, this collection had identical chemistry to that of all the collections that I have referred to B. impexa.

It is not clear to me whether Bryoria fuscescens var. positiva is a good taxon or merely an ecological modification. All Peloponnesian material seen by me corresponds to var. fuscescens.

Throughout Greece, though uncommon on the islands. Reported from altitudes of 300 - 1700 m, but commonest in montane forests above about 800 m. Usually on bark of conifers (Abies, Pinus and Picea spp.) or Fagus. Once on wood of Castanea sativa, and once on moss on granite.

Widespread; absent only from regions with an arctic or true Mediterranean climate. Also Macaronesia, Asia (widespread), Africa (widespread in uplands with a ±temperate climate), N. America (widespread).

Bryoria impexa (Hoffm.) Brodo & D. Hawksw. (1977)


The circumscription of this species is controversial. European authors regard Bryoria friabilis Brodo & D. Hawksw. (syn. B. vrangiana (Gyeln.) Brodo & D. Hawksw.) and Bryoria pseudofuscescens (Gyeln.) Brodo & D. Hawksw. as merely chemotypes of B. impexa, but North American authors have tended to treat them as distinct species.

Thallus: fruticose, to 18 cm long. Branches: pendent, without lateral spinules, usually rounded in section but sometimes slightly flattened where branches diverge, green-brown to dark brown, matt, smooth, 0.2 - 0.6 mm diameter;
branching dichotomous. Pseudocyphellae: few to abundant but always present, white, linear or narrowly fusiform, 0.25 - 0.8 x 0.02 - 0.08 mm. Soralia: frequent to very rare but present in all specimens seen, forming on broad fissures in cortex (much broader than the pseudocyphellae), ± flat when young, sometimes becoming tuberculate later, ± rounded, 0.25 - 0.7 mm diameter. Cortex: 40 - 100 µm thick, brown in outermost 10 µm, colourless in inner part, of periclinal hyphae; pigment K-, N-, dissolving quickly and almost completely in K, more slowly and less completely in N. Medulla: of very sparse hyphae (so branches appearing almost hollow in thin section), 2.5 - 4 µm wide, often with visible septa, without encrusting crystals. Chemistry: medulla K-, KC-, P+, I-; thallus K-, C-, KC-, P-, UV-; soralia K-, KC-, P+ orange or red, UV-. Photobiont: green, cells globose, 11 - 15 µm diameter, wall usually 1+ reddish; cells tending to form clumps so photobiont layer irregular and sometimes discontinuous, where present 40 - 70 µm thick.

I have referred to B. imp lex all Peloponnesian specimens with distinct pseudocyphellae. All had pseudocyphellae that were linear or narrowly fusiform. All were sorediate, though the abundance of soralia varied widely: one specimen had only a single soralium. All these collections had identical chemistry, and it corresponds to chemotype 5 of Holien (1989). Note, however, that this chemistry is also identical to that of the single collection that I have referred to B. fusescens (see note under that species).

Quite widely distributed in Greece, but absent from most of the smaller islands. On bark of conifers (usually Abies or Pinus; a single record from Picea) in montane forests at altitudes of 1000 - 2400 m (though a single record is from only 400 m). There is a single record from rock and one from bryophytes on granite.

Fairly widely distributed in northern and central Europe, but less common in the south and probably restricted to the mountains. Also Asia (Russia, northern India, Nepal, Mongolia), N. America (widespread in cooler regions). Its status in Macaronesia (Canary Is) has been disputed.

Bryoria nadvornikiana (Gyeln.) Brodo & D. Hawksw. (1977)
Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).
Macedonia, on bark of Picea abies at an altitude of about 1400 m.

Northern and central Europe, rare in the mountains of the south. Also Asia (widespread), E. Africa (Kenya, Tanzania, Uganda), North America (widespread), and perhaps Pacific (Hawaii).

Bryoria subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw. (1977)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Mt. Olympus, on bark of Pinus heldreichii at altitudes of 1000 m and above.

Widely distributed in northern and central Europe, but very rare south of the Alps. Also Asia (Russia, Kazakhstan, Mongolia), N. America (scattered, in cooler regions).

Bryoria sp. (undescribed)

According to Prof. D. L. Hawksworth (pers. comm.) an undescribed species of *Bryoria* occurs on Mt. Olympus. It has an "even colour, pseudocyphellae and no soralia".

**Buellia** De Not. (1846)

Type: *B. disciformis* (Fr.) Mudd (conserved type). Family: *Caliciaceae*. Literature: The best starting point for the saxicolous species is Scheidegger (1993). Information on other species is scattered, but useful sources are Ahti et al. (2002), Clauzade & Roux (1985), 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, I- or I+ blue, sometimes poorly developed in thin thalli. Apothecia: rounded, small to medium sized (exceeding 1 mm diameter in only a few species), subimmersed to sessile, flat or convex, without a thalline exciple. Disc black. Exciple: black; in section: usually some shade of brown, dark and almost opaque in some species. Epithecium: brown, K and N reactions various. Paraphyses: about 1 µm wide at base, simple, often capitulate, apical cell often with internal brown pigment. Ascii: ± Bacidia type. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, small to medium sized (mostly in the range 10 - 25 µm long), without wall thickenings (Buellia type) in most species. Chemistry: various. Photobiont: green, trebouxioid.

*Buellia* s. lat. contains several hundred species. They occur on most substrates except leaves. Several segregates
have been recognised in recent years, but European lichenologists have been slow (or reluctant) to adopt them. In this Flora I take a conservative view of Buellia, and only segregate Amandinea. The genus is not as well represented in Greece as is Rinodina, the other large crustose genus in the Physciaceae, perhaps because saxicolous species of Buellia generally prefer siliceous rather than calcareous substrates.

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 Buellia and distinctly anastomosed in Rhizocarpon.

Some keys refer to ascospore types. Buellia 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 midpoint 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 Buellia main groups**

11 Ascospores 3-septate or submuriform. Group 1.
1 Ascospores 1-septate, or apothecia absent.
  2222 On other lichens. Group 2.
  22 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 Buellia group 1**: ascospores 3-septate or submuriform

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 Lichenicolous on Lecanora albescens. (B. lecanorae)
  22 Terricolous, or overgrowing mosses or lichens on the ground. B. geophila
  2 On bark or wood; occasionally lichenicolous 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. zoharyi
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).
22 Ascospores 17 - 26 x 7 - 10 μm. **B. disciformis**
2 Ascospores 25 - 32 x 12 - 15 μm. (B. arnoldii)
1 Hymenium without oil droplets. Exciple persistent or not. Thallus K- or K+
222 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 present. Ascospores 11 - 18 x 6 - 9 μm. **B. erubescens**
4 Exciple not exceeding 80 μm wide.
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)
33 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
55 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**
66 Thallus areolate, dark brown, often glossy. (B. tyrolensis)
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 (sistic acid; atranorin may also be present). **B. spuria**
5 Medulla weakly K+ 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**

2 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 to 6 µm wide.
55 Ascospores 9 - 11 x 5 - 6 µm. **B. tesserata**
5 Ascospores 11 - 13.5 x 4.5 - 5.5 µm. **B. abstracta**

**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. leptoclinoïdes**
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-.
33 Soredia present. (B. sorediosa)
3 Soredia absent.
44 Exciple of intricate, narrow, randomly oriented hyphae.
55 Medulla I+ blue. (B. leptoclinoïdes), (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-.
66 Hymenium with numerous oil droplets. **B. excelsa**
6 Hymenium without oil droplets.
77 Thallus K+ red (norstictic acid). (B. longispora)
7 Thallus K- or K+ yellow (atranorin; concentration sometimes too low to demonstrate in spot tests). **B. dispersa**

**Buellia abstracta** (Nyl.) H. Olivier (1903)
in: [need to investigate]; Lecidea abstracta Nyl. (1883) in: Flora 66: 102; Buellia sequax auct.

The name Buellia sequax has commonly been misapplied to this species, but when used correctly that name denotes the species called Buellia excelsa in the key. (The names Lecidea excelsa Nyl. and Lecidea sequax Nyl. were both published in 1875, and it is not clear which has priority.)

Descriptions: Nash et al. (2007); Scheidegger (1993); Smith et al. (2009), all as Buellia sequax.

Islands of the Aegean, including Crete. On siliceous, or less commonly calcareous, rock at altitudes 5 - 300 m.

Basically a species of warm temperate Europe. Present in British Is, but absent from Baltic States, the Nordic Countries and most of the eastern half of Europe. Also Macaronesia, Asia (Hong Kong), Africa (Morocco, S. Africa), N. America (Arizona, California. New Mexico), C. America (Mexico), S. America (Paraguay, Uruguay), Pacific (Hawaii).

**Buellia aethalea** (Ach.) Th. Fr. (1874)

I have only a single collection, and this is said to be a very variable species, so for the present I prefer not to provide a description. For published descriptions, see:: 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.
Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa; Ascension Is, St Helena),
N. America (widespread but very scattered, from Alaska to southern USA), S. America (Argentina, Bolivia, Brazil, Colombia), Australasia (widespread in Australia, NZS), Pacific (Marquesas), Antarctica.

**Buella atrocinerea (Nyl.) Scheid.** (1993)
in: *Lichenologist* 25(4): 345; *Lecanora atrocinerea* Nyl. (1872) in *Flora* 55: 428; *Rinodina atrocinerea* (Nyl.) Boiĭstel
Description: Scheidegger (1993).
Northern Peloponnesse, at an altitude of 700 m. The substrate was not reported.
Southern Europe, from Portugal to Greece, and N. Africa (Morocco).

**Buella badia** (Fr.) A. Massal. (1853)
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 epicortical layer about 5 µm thick. Medulla: white. Apothecia: 0.2 - 0.7 µm diameter, flat to convex, sessile, not pruinose. 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 hyphae that develop broad lumina. Thalline margin: absent. Epithecium: brown to dark brown, K- (and all other apothecial pigment), 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. Ascii: 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 (crystals of norstictic acid in section) 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 *Acarospora scotica, Lecanora muralis* subsp. *bolcana, Neofuscelia sp.*, and *Squamarina cartilaginea.*
Throughout Europe. According to Nimis (1993), in southern Europe it mainly occurs in the uplands, but this is not very apparent from Greek records to date. Also Macaronesia, Asia (widespread outside warm, moist areas), Africa (Morocco, Kenya, Zimbabwe), N. America (scattered in cool and temperate parts of Canada and USA), C. America (Mexico), S. America (Argentina), Australasia (widespread but scattered in Australia; NZS).

**Buella chloroleuca** Körb. (1860)
in: *Parerga Lichenol.* 191.
Thallus: crustose, thin, pale grey, to 2 cm diameter, without vegetative propagules. Apothecia: immersed to sub sessile, flat to convex, 0.2 - 0.55 mm diam, not pruinose. Disc: black. Exciple: black; in section 55 - 70 µm wide, K-.
Thalline exciple: absent. Epithecium: K-.
Apothecia: brown, 1-septate, ellipsoid, (12) 16 - 20 x (6) 7.5 - 10 µm, Buella type. Chemistry: thallus K-, KC+ persistent orange, UV+ orange (or sometimes with a green tinge). Fairly easily separable from similar species by the KC+ orange reaction of the thallus and the absence of norstictic acid.
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.* Possibly some upland reports of that species belong here.
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-.)
Crete and Peloponnesse, on wood of *Cupressus sempervirens* and *Pinus nigra* at altitudes 1340 - 1500 m.
Scattered in northern and central Europe. The two Greek reports are the only ones I have seen from south of the Alps and Pyrenees. Probably rare in southern Europe, but easily confused with other species of *Buellia* s. lat. Also widespread in cooler parts of N. America.

**Buella disciformis** (Fr.) Mudd (1861)
Fries introduced the basionym in a very untidy way, and it is not at all clear to me whether it is an obligate synonym
of *Lecidea tersa* Ach. (1810). If it is, conservation will be required to maintain the epithet *disciformis*.

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 hyphae perpendicular to surface, with broad, rounded lumina), K-. Medulla: white. Apothecia: submersed to subsessile, flat, 0.3 - 1.2 mm diameter, not pruinose. Disc: black. Exciple: black, thin but persistent; in section: 30 - 50 µm wide, brown to very dark brown, often opaque, of radiating hyphae. Thalline margin: absent. Epithecium: pale brown to brown, K-, pigment not soluble in K (all other apothecial pigment react the same way). 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. Paraphyses: 1 µm wide at base, simple, sometimes capitate, apex 2.5 - 3.5 microns, apical cell with internal brown pigment cap. Asc: 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-, I-; thallus K-, UV- (or almost). Photobiont: green, cells ±globose, 9 - 13 µm diameter, forming a continuous, regular layer 45 - 75 µm thick.

The only Peloponnesian collection seen by me agrees well with published descriptions of *B. disciformis*, except that the thallus is K- (tested in several different places), 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 the genus.

Scattered rather thinly, perhaps throughout Greece, at altitudes 400 - 1500 m. On bark, and reported from *Abies* sp., *Acer pseudoplatanus*, *Fagus* sp. and *Quercus* sp.

Throughout Europe, though in the south it avoids the zone of truly Mediterranean vegetation. 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 are 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.

Basically a species of southern Europe, from Portugal to European Turkey, but also present in Austria and Switzerland, and there is a disjunct report for Finland. Also Macaronesia (Canary Is), Asia (Israel, Iran), Africa (Morocco, Egypt, S. Africa, Ascension Is), N. America (southern Canada, scattered in western half of USA), C. America (Mexico), S. America (Chile).

**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. (1872)


Crete, at an altitude of 900 m.

Widely distributed in Europe (though absent from British Is), but not common. In southern Europe restricted to the uplands. Also Asia (widespread in cold and temperate areas as far east as Tajikistan), N. Africa (Morocco), N. America (scattered in cool parts of USA), S. America (Argentina), Australasia (Australia). The reports for the Southern Hemisphere may be in need of confirmation.

**Buellia erubescens** Arnold (1875)

in: *Verh. k. k. zoöl.-bot. Ges. Wien* 25: 493; *Buellia disciformis* var. *saprophila* (Ach.) Jatta; *Buellia zahlbruckneri* J. Steiner

The earliest name may be *Lecidea parasema* var. *saprophila* Ach. (1810), but it does not have priority at the rank of species.
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, though south of the Alps and Pyrenees confined to the uplands. Also Macaronesia (only Azores), Asia (widespread in cold to temperate regions), N. Africa (Morocco), N. America (widespread), C. America (Mexico), S. America (Argentina; perhaps Brazil).

**Buellia excelsa** (Leight.) A. L. Sm. (1911)

The names *Lecidea excelsa* Leight. and *Lecidea sequax* Nyl. were both published for this lichen in 1875, and it is unclear which epithet has priority.
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. Perhaps also North America (New Mexico), South America (Brazil, Paraguay, Uruguay), Pacific (Hawaii).

**Buellia geophila** (Flörke ex Sommerf.) Lynege (1937)
in: Meddel. Grønl. 118(8): 181; Lecidea geophila Flörke ex Sommerf. (1826) in: Suppl. Fl. Lapp. 157-158. (It is a nomen novum for *Lecidea sabuletorum* var. depauperata Flörke); *Buellia triphragmia* (Nyl.) Arnold; Dipiotomma 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.
Widely distributed in Europe from the Alps northwards, but very rare in southern Europe. Also Asia (Russia, Nepal, Mongolia), N. Africa (Morocco), N. America (northern USA northwards). Nineteenth century reports for S. America (Brazil, as *Lecidea triphragmia*) seem doubtful to me.

**Buellia griseovirens** (Turner & Borrer ex Sm.) Alm. (1952)
in: Botaniska Notiser 1952: 246; Variolaria griseovirens Turner & Borrer ex Sm. (1812) in: English Botany 34, tab. 2400; Dipiotomma betulinum (Zwackh) Arnold: Dipiotomma betulinum f. superreagens (Serv.) Szatala

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. 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. Thalline margin: absent. Epithecium: colourless to dark brown, K- (as is all other pigment in apothecium). Hymenium: 130 µm tall, colourless, without oil droplets. Hypothecium: 100 µm tall, brown in uppermost 20 - 40 µm, dark brown in lower part. Paraphyses: 1.5 µm wide, simple, not moniliform, usually slightly capitulate, apex 2 - 3 µm, usually with an internal crescent of brown pigment, sometimes with visible septa in upper part. Asci: 75 x 20 µm, clavate. Ascospores: brown, 3-septate to subunimorphic, 8 per ascus, 23 - 26 x 12 - 17 µm. Chemistry: soralia C+ rather 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 perpendicular to surface), 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 southern Europe it is restricted to the uplands. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Tunisia), N. America (scattered in southern Canada and cooler parts of USA), S. America (Chile), Australasia (both islands of NZ).
**Buellia ibérica** Giralt (2000)
Description: See the protologue.  
Endemic to southern Europe (Andorra, Portugal, Spain, Greece).

**Buellia insignis** Körb. (1855)
Often cited with authorship (Hepp) Körb., supposedly based on *Lecidea insignis* Hepp (1853) in: Flecht. Eur. no. 39. but that is a nomen nudum.  
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 Europe, and the mountains of the Pyrenees, Alps and Caucasus. Reliably reported from south of the Alps from a very few montane localities in Italy and Greece. Also Asia (Turkey, Russia, Kazakhstan, Mongolia), N. America (a few montane localities in western USA). I am sceptical of a report for Caribbean (Guadeloupe).

**Buellia leptoclinoides** (Nyl.) J. Steiner (1907)
*Hafellia leptoclinoides* (Nyl.) Scheid. & H. Mayrhofer  
Descriptions: Clauzade & Roux (1985); Scheidegger (193) as *Hafellia leptoclinoides*; Smith et al. (2009).  
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. Entirely absent from northern Europe and parts of eastern Europe with a continental climate. Also Macaronesia (Canary Is.), Africa (Morocco, Algeria; mid Atlantic islands of Ascension and St Helena).

**Buellia maritima** (A. Massal.) Bagl. (1856)
in: Massalongo, Sched. Crit. 150; *Catolechia maritima* A. Massal. (1855) in: Framm. Lichenogr. 22  
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: (if present) 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. Disc: black. Exciple: black, thin (0.02 - 0.04 mm) but persistent; in section: 30 µm wide, dark brown, opaque. Thalline margin: absent. Epithecium: 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 epithecial pigment. Hypothecium: 80 - 130 µm, colourless in upper part, becoming brown below. Paraphyses: 1 µm wide at base, simple, usually capitate, apical cell 2.5 - 5 µm wide with internal brown pigment. Asci: 50 x 14 µm, narrowly clavate, apex K+ blue. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, 11 - 13 x 7 µm. Chemistry: medulla K+ yellow > red (abundant crystals of norstictic acid; also in photobiont layer), 1-; 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) is probably incorrect. On siliceous rock at altitudes 0 - 300 m.  
Only Italy and Greece in Europe. Also Macaronesia (Tenerife), N. America (California, C. America (Mexico).

**Buellia ocellata** (Flt.) Körb. (1855)
in: Syst. Lich. Germ. 224; *Lecidea petraea* var. *ocellata* Flörke ex Flt. was merely cited as a synonym, and is not validly published; *Buellia verruculosa* auct. mult., non (Sm.) Mudd  
Descriptions: Ahti et al. (2002); Clauzade & Roux (1985) as *Buellia verruculosa*; Smith et al. (2009).  
Thallus: crustose, areolate, to 5 cm diameter, pale green-grey, not pruinose. Areoles: rather small, 0.2 - 0.3 mm wide. Prothallus: sometimes present, black. Hypothallus: sometimes visible in central parts of thallus, black.  
Apothecia: 0.3 - 0.45 mm diameter, immersed, flat, not pruinose. Disc: black. Thalline margin: absent. Exciple: not very distinct in external view; in section: 15 - 30 µm wide, brown. Hymenium: 100 µm tall, colourless to pale brown.  
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 only from a single recent collection and a single one from the 19th century.

Widely distributed except for parts of eastern Europe with a distinctly continental climate. In southern Europe it is restricted to the mountains. Also Macaronesia, Asia (Russia, Thailand), N. America (Maine). The report for Thailand is modern, but seems doubtful to me.

**Buellia olympica** Müll. Arg. (1879)
in: *Flora* 62: 167

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, so it is just possible that he may mean the Bithynian (Turkish) Mt. Olympus. Zahlbruckner (Catalogus 7: 429-430) considered it to be a synonym of *Buellia vilis*, but without giving any reasons, and given the uncertain status of *B. vilis* itself in Greece that view is not entirely convincing. It will be necessary to study type material to determine the application of this name.

High mountains of mainland Greece, on siliceous rock.

**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.

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. Disc: black. Exciptle: 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. Thalline margin: absent. 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 usually small ascospores (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*.

Widely distributed as far north as the tree limit. Also Macaronesia, Asia (Russia, Mongolia, China), N. Africa (Morocco, Socotra; a 19th century report for Sao Tome may be unreliable), N. America (scattered in USA), C. America (Mexico), S. America (Argentina, Brazil, Colombia).

**Buellia spuria** (Schaer.) Anzi (1860)
in: Cat. Lich. Sondr. 87 (Also by Körber in Parerga Lichenol. 183. It is not known which was published first.); *Lecidea spuria* Schaer. (1828) in: *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.

Most reports are from 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 (Morocco, S. Africa, Zimbabwe), N. America (widespread in USA, perhaps present in Canada and Alaska), 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).


Islands of the Aegean, including Crete, never very far from the sea. On rock, usually siliceous, at altitudes 0 - 300 m. Some reports may refer to B. maritima.

Subcosmopolitan in cool to warm temperate regions, but absent from the 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, CR), S. America (widespread), Australasia (both islands of NZ, perhaps Australia), Pacific (widespread), perhaps Antarctica (St Paul Is - old report).

Buellia subdisciformis (Leight.) Jatta (1900)
in: Syll. Lich. Ital. 392. (The combination is often ascribed to Vainio in 1890, but Vainio's name was B. disciformis * (= subsp.) subdisciformis; Lecidea subdisciformis Leight. (1871) in: Lich. Fl. Gr. Brit. 308; Buellia scutariensis J. Steiner; Buellia subdisciformis var. scutariensis (J. Steiner) J. Steiner

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.

Warm temperate Europe, as far north as the British Is. Absent from the Nordic Countries, Baltic States and those parts of eastern Europe with a continental climate. Also Macaronesia, Asia (Turkey, China, Taiwan, Thailand), Africa (Morocco, S. Africa), N. America, C. America (Mexico), S. America (Brazil), Australasia (19th century 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.

Basically a species of southern Europe (Portugal, Spain, Italy, Greece), though its range does extend a little further north (France, Tirol province of Austria). There are no reports for other continents.

Buellia tesserata Körb. (1860)
in: Parerga Lichenol. 189; Buellia fimbriata (Tuck.) Sheard

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2007).

Islands of the southern Aegean. On siliceous rock at altitudes 10 - 450 m, but 80% of records are from below 200 m.

Mediterranean and Atlantic Europe (though absent from British Is); almost entirely absent from the interior of Europe. Also Macaronesia (warmer parts), Asia (Turkey, Bahrain), Africa (Morocco, Algeria; Ascension Is, St Helena), N. America (Arizona, California, perhaps also Oklahoma), C. America (Mexico).

Buellia triseptata A. Nordin (1999)
in: 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. 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. Thalline margin: absent. Epithecium: brown to dark brown, K-, pigment not (or incompletely) soluble in K. Hymenium: 50 - 65 µm tall, colourless, K+ blue. Hypothecium: 120 µm tall, pale brown to dark brown. Paraphyses: 1 µm wide, simple, capitiate, apex to 4 µm with internal brown pigment. Asci: 50 - 75 x 15 µm, clavate, apex K+ blue, ±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 Diploptomma.
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 it is difficult to be certain that the parasitic specimen belongs here, not in Diplotomma).

Southern Europe (Portugal, Spain, Greece). Also western USA (Arizona, California, Oregon), 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.

Widely distributed in central and northern Europe, but very rare south of the Alps. Also Asia (Russia), N. America (widespread in cold parts of the western half), continental Antarctica.

**Buellia zoharyi** Galun ex Poelt & Sulzer (1974)
in: *Nova Hedwigia* 25(1-2): 188. The 1970 publication in *The lichens of Israel* 74 was invalid (no type designated).


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 (Egypt, Morocco).

**Calicium** Pers. (1794)


Type: *C. viride* Pers. Family: *Caliciaceae*. 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 36 species, about 20 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 probably restricted to the few remaining patches of ±undisturbed montane forest, where it is uncommon.

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. Ascii clavate. On rock. (C. corynellum)
3 Thallus grey to green, well developed, irregularly granular to verrucose. Ascii 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.
55 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. Ascii 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.

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). Squash preparations are not adequate for observing fine details. The descriptions below are provisional and need substantial improvement.

**Calicium abietinum** Pers. (1797)
in: 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. Widely distributed 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 in cooler regions), perhaps C. America, S. America (Chile, Colombia, Venezuela), Australasia (widespread).

**Calicium glaucellum** Ach. (1803)
in: 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. Ascii: 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 salicinum* has a brown pruina and smaller ascospores.

Very scattered, usually in fairly undisturbed forests at altitudes 300 - 1200 m, on bark, usually of conifers, or on wood. This appears to be the least rare species of the genus in Greece.

Almost throughout Europe, absent only from treeless arctic regions, but not common south of the Alps. Also Asia (widespread), Malesia (PNG), N. America (widespread, but generally avoiding the continental interior), Caribbean (PR), C. America (CR, Mexico), S. America (Argentina, Chile, Colombia), Australasia (widespread).

**Calicium quercinum** Pers. (1797)
in: Tent. disp. meth. fung. 59.

Descriptions: Ahti et al. (1999); Clauzade & Roux (1995); Muniz & Hladun (2011); Smith et al. (2009).

Epiros, on bark at an altitude of 750 m.

Throughout Europe, except for arctic regions, and perhaps avoiding regions with a true Mediterranean climate. Also Asia (widespread in cold and temperate regions), North America (Minnesota, New York).

**Calicium salicinum** Pers. (1794)

The nomenclatural situation requires clarification. Persoon included in synonymy three earlier names, *Mucor lichenoides* L., *Trichia lenticularis* Hoffm. and "Embolus" (error for *Evela*) *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 (and I have not been able to do that) 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. Ascii: 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 500 - 1500 m on bark or, less commonly, wood. Reported from *Abies cephalonica*, *Juniperus drupacea*, *Quercus pubescens* and *Prunus pseudoarmeniaca*. 
Throughout Europe, except for treeless arctic regions, but not common south of the Alps. Also Macaronesia, Asia (widespread), Africa (Algeria; widespread in E. Africa, also known from Malawi), N. America (widespread), Caribbean (PR), C. America (CR, Mexico, Nicaragua), S. America (Colombia, Venezuela; perhaps also Brazil, Chile), Australasia (widespread).

**Calicium viride** Pers. (1794)

Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Muñiz & Hladun (2011); Nash et al. (2004); Smith et al. (2009).

Ikaria, at an unspecified altitude, and northern Epiros at 730 m; both on bark of unspecified phorophyte. Ikaria is a surprising locality for this species, but *C. viride* is distinctive, and it was reported by an experienced lichenologist, so the report is probably reliable.

Throughout Europe, except for treeless arctic regions, but not common south of the Alps. Also Asia (widespread), N. America (widespread in cooler regions), S. America (Argentina, Chile; also a 19th century report for Brazil). A report for Caribbean (Bahamas) seems very doubtful to me.

**Caloplaca Th. Fr. (1860)**
in: *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).

Type: *C. cerina* (Hedw.) Th. Fr. Family: *Teloschistaceae*. Literature: It is very difficult to get a good overview of this genus 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 & Åkélius (2009) for taxa related to *C. herbidella*; Gaya (2009) for the saxicola group; Giralt, Nimis & Poelt (1992) for the flavorubescens group; Muggia, Grube & Tretiach (2008) for the endolithic, black-fruited species; Navarro-Rosinés & Hladun (1996) for the lactea group; Sochting (1999) for species with bluish and greenish soredia; Soun et al. (2011) for the cerina group; van den Boom & Rico (2006), who provide a key to the idiosiate and granular isidiate species occurring in western Europe; Vondrák, Říha et al. (2009) for the citrina group in the Black Sea region; Vondrák, Soun 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 Peloponnesian collections that I can not determine, and the present treatment of the genus must be regarded as a provisional one. However, *Caloplaca* does at least compensate for these problems by including some of the most attractive of all lichens.

Because of the difficulties, it is even more important in this genus 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.

As presently circumscribed, *Caloplaca* includes the crustose members of the *Teloschistaceae* with asciospores that are polariloculare, or fairly clearly derived from a polarilocular type. The genus is far 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, perhaps, leaves. It may be imprudent to generalise about such a large and heterogeneous group, most species of which I do not know, but the genus does seem to show some preference for warm, dry, conditions, and some tendency to avoid strongly acidic or nutrient-poor substrates. Perhaps for this reason, it is very well represented in Mediterranean regions of Europe, and is the largest genus in Greece.

*Caloplaca* in the above sense is a very large assemblage of about 1000 species, and contains the majority of the species in *Teloschistaceae*. Fruticose and foliose species in this family have traditionally been placed in *Teloschistes* and *Xanthoria* respectively, while crustose species with ascospores that are not polarilocular have been placed in *Fulgensia*.

For convenience, I follow that practice here. However, these genera, except perhaps *Teloschistes*, are artificial, and the taxonomy of the *Teloschistaceae* will undergo major changes in the future. Various segregates of *Caloplaca* were
recognised by older authors, and some of them are now being resurrected; also some new small groups have been segregated more recently. It is clear, on traditional grounds alone, that *Fulgensia* is polyphyletic, see Westberg & Kärnefelt (1998), and the few molecular studies to date, including Arup & Grube (1999) and Sochting & Lutzoni (2003), indicate that *Caloplaca* and *Xanthoria* are also polyphyletic. Arup et al. (2013) made a major step in subdividing *Teloschistaceae* into smaller, more natural groups, but they treated only a small fraction of the species and the taxonomy of the family is likely to remain unclear for many years. In the interests of nomenclatural stability, I have chosen to retain the four traditional genera for the present.

About 100 species are present in Greece, but the genus can not be said to be well understood here. *C. biatorina* var. *pusilloides* J. Steiner, *C. festivella*, *C. hymetti* J. Steiner, *C. sororicida* M. Steiner & Poelt, and *C. transescaspa* (Nyl.) Zahlbr. are reported for Greece but are not included in the keys as I have insufficient information.

### Key to Caloplaca main groups

<table>
<thead>
<tr>
<th></th>
<th>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.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>On rock. Group 1.</td>
<td></td>
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<tr>
<td>2</td>
<td>On bark or wood. Group 2.</td>
<td></td>
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<tr>
<td>1</td>
<td>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.</td>
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#### 1

<table>
<thead>
<tr>
<th></th>
<th>Vegetative propagules present.</th>
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</thead>
<tbody>
<tr>
<td>33</td>
<td>Soredia absent. Vegetative propagules corticate (isidia, blastidia, schizidia, lobules, granules or similar; Note 1). Group 3.</td>
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<tr>
<td>3</td>
<td>Soredia present. Other kinds of vegetative propagules present or absent.</td>
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<tr>
<td>44</td>
<td>Soredia some shade of yellow, orange or red, K+ purple. Group 4.</td>
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<tr>
<td>4</td>
<td>Soredia differently coloured, K- in most species, rarely K+ violet or purple. Group 5.</td>
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#### 2

<table>
<thead>
<tr>
<th></th>
<th>Vegetative propagules absent.</th>
<th></th>
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<tbody>
<tr>
<td>33</td>
<td>Apothecia sessile, with prominent, broad, persistent, grey thalline margin. Group 6.</td>
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<tr>
<td>3</td>
<td>Thalline margin absent in most species. If present then not prominent, broad and persistent, or not grey, or apothecia immersed.</td>
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<tr>
<td>44</td>
<td>Mature ascospores with 4 locules (Note 2). Thallus thin, usually orange with white patches, or white with orange patches; sometimes with a thin, black prothallus. Apothecia orange, concave to flat, to about 0.5 mm diameter, initially immersed, later becoming sessile. On limestone. Group 7. Only <em>C. ochracea</em></td>
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<tr>
<td>4</td>
<td>Mature ascospores with 2 locules.</td>
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<tr>
<td>55</td>
<td>Thallus, and thalline margin if present, orange, yellow or green-yellow, at least in places; orange part K+ purple.</td>
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<tr>
<td>66</td>
<td>Thallus with a lobed margin.</td>
<td></td>
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<tr>
<td>77</td>
<td>Ascospores rhomboid or lemon shaped, at least when mature. Group 8.</td>
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<tr>
<td>6</td>
<td>Thallus without a lobed margin.</td>
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<tr>
<td>77</td>
<td>Ascospore septum thin, remaining less than 3 μm wide. (Note 3) On rock (nearly always calcareous), or on calcareous soil at high altitudes, or on soil containing gypsum. Group 10.</td>
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<tr>
<td>7</td>
<td>Ascospore septum at least 3 μm wide in mature ascospores. (Note 3) On various substrates.</td>
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<tr>
<td>88</td>
<td>Thallus with a green tinge (green-orange or green-yellow) (Note 4). Pycnidia usually present in marginal parts of thallus. On bark or calcareous rock. Group 11.</td>
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<tr>
<td>8</td>
<td>Thallus without a green tinge. Pycnidia present or (more usually) absent. On various substrates.</td>
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<tr>
<td>99</td>
<td>Disc yellow or orange, without a red tinge (Note 5). On various substrates. Group 12A.</td>
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<tr>
<td>9</td>
<td>Disc with a red tinge: red, rust red, red-brown or red-orange (Note 5). On calcareous or siliceous rock, or parasitic on Rinodina alba on siliceous rock. Group 12B.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Thallus, and thalline margin if present, white, grey, green-grey, (rarely brown or yellow-green), or inapparent; K- (or rarely K+ yellow). Note 6.</td>
<td></td>
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<tr>
<td>66</td>
<td>Ascospore septum thin, remaining less than 3 μm wide. (Note 3) Group 13.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ascospore septum at least 3 μm wide in mature ascospores. (Note 3)</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Disc with a red tinge (red, orange-red, brown-red or rust red), later becoming blackish in some species. Group 14.</td>
<td></td>
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<tr>
<td>7</td>
<td>Disc yellow, orange or brown-orange; without a red tinge, not becoming blackish. Group 15.</td>
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</table>

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 vegetative propagules does not key out in one branch, try the other branch.

(2) Immature ascospores may appear to have 2 locules, but they often have a very broad septum through which passes a conspicuous and unusually wide channel. Later this channel becomes swollen in its middle part.

(3) Unfortunately, this dichotomy is not sharp. If a species with septum width near the cutoff value does not key out in one branch, try the other branch.

(4) The green tinge is not visible in some forms of artificial light, so use natural light, or a daylight bulb, here. The green tinge will be apparent if the thallus is large, but is not very pronounced and can be overlooked if the thallus is small.

(5) This couplet may be ambiguous if the disk is very dark orange, but I have not found a better way to subdivide Group 12. In case of difficulty, consult both branches.

(6) If the thallus is inapparent and the apothecia have an orange exciple, it advisable to confirm in section that no part of the exciple contains algae, i.e. that there is no orange thalline margin.

Key to Caloplaca group 1: without orange pigments; saxicolous

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 poliarilocular. On calcareous or non-calcareous rock.

22 Vegetative propagules (blastidia, isidia, schizidia or soredia) present.

33 Vegetative propagules blastidia or schizidia. Surface of thallus with ± spherical, white pruinose outgrowths about 0.2 mm diameter (Note 1). (C. albopustulata)

3 Vegetative propagules soredia.

44 Thallus endolithic, often forming bowl-shaped depressions in the substrate. (C. erodens)

4 Thallus epilithic, well developed. Soredia arising on margins of areoles, erupting from lower surface, sometimes eventually spreading over entire upper surface. (C. concreticola)

2 Vegetative propagules absent.

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 thin, small, forming roundish to spots to 1 cm diameter. Apothecia usually less than 0.5 mm diameter.

55 Hymenium with oil drops. Not restricted to maritime sites. (C. 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, very tightly arranged. Hypothecium with vertical rows of small, round cells. Not restricted to arid sites, and probably not present in very arid ones. C. 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 clearly 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. 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 ±immerse in substrate (Note 4). Sedifolia grey pigment present or absent in apothecial sections. Apothecia immersed in pits 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 protocorallia). Epitheicum grey-brown, K+ red-brown. (C. 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. Epitheicum 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. Ascospora 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. alcicola

(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. chalybea.

(2) Sedifolia grey may be present only in low concentration, and may occur together with a brown pigment that is K-.

(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 2: 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. Epitheicum K-.

1 Thallus white to grey, usually thin. Blastidia absent. Soralia present or absent. Epitheicum 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. Epitheicum K-. Ascosporae 10 - 13 µm long. C. obscurella

2 Disc dark brown to black. Soralia absent. Epitheicum 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. servitiana

3 Thallus white. Thalline margin absent. C. oleicolor

### Key to Caloplaca group 3: Some part K+ purple; isidia or similar present.

11 Thallus yellow or orange.

22 Isidia branched to coralloid. On bark. C. coralliza

2 Isidia ±granular, in some species easily eroding and becoming somewhat sorediate. Usually on rock.


3 Thallus not placodioid; tentirely subsquameulose or crustose.

44 Thallus distinctly orange. Apothecia small, not exceeding 0.4 mm diameter. Asc with 8 ascospores. On calcareous rock

55 Thallus areolate. C. coronata

5 Thallus not areolate, consisting mainly of scattered granules. C. lithophila

4 Thallus not pure orange; yellow, brown-orange or olive-orange. Apothecia and ascospores various. On various substrates.
55 Thallus distinctly yellow. Asci with 8 ascospores. Ascospores 9 - 16 x 4.5 - 7.5 µm.

66 Thallus with ±distinct white or pale prothallus. Blastidia eventually covering most of thallus. (C. thamnoblastia)

6 Prothallus absent.

77 Blastidia confined to central part of thallus, not giving rise to soralia. (C. arcis)

7 Blastidia sometimes extending over entire thallus surface, sometimes giving rise to soralia. C. limoniana

5 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. xanthostigmoidea) 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) Greek report slightly doubtful, but discussed below.

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 Isidia branched to coralloid. Apothecia present of absent. On bark or wood.

44 Isidia usually brown to orange, rarely grey, 55 - 90 µm wide. Apothecia usually absent. On bark. C. corallina

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. (The few reports to date are from non-calcareous rock.) (C. squamulosisidiata)

5 Isidia, blastidia or granules globose or irregular; if ±elongate then not on rock. On various substrates.

66 On bark.

77 Disc brown. Thallus brown, with globose to flattened blastidia. C. fuscoblastidiata

7 Disc yellow or orange.

88 Thallus endophloedeal. If present in Greece, probably restricted to the uplands. Parvoplaca nigroblastidiata (treated for the present as Caloplaca nigroblastidiata)

8 Thallus grey, thin to thick but not endophloedeal, almost entirely granular. At all altitudes. C. monacensis

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. emiliii

8 Blastidia covering most of the areoles. C. 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- or K+ purple. On wood. C. furfuracea

5 Disc yellow to brown. On non-calcareous rock. C. xerica

(1) C. granulosa var. sardonia is similar but lacks isidia. C. bilewskii de Lesd. also keys out here, but is a poorly known taxon whose status needs clarification. Neither is reported for Greece.

(2) In C. gelleverjae the thalline margin is restricted to the lower surface of young apothecia.

Key to Caloplaca group 4: Yellow, orange or red soralia present. Many species in this group are discussed in Arup (2006a).

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.

22 Thallus entirely leprose, bright yellow. C. xantholyta

2 Thallus not entirely leprose.

33 Thallus of ±umbilicate squamules, C. arcisproxima

3 Thallus not squamulose.
44 Soralia mainly lip-shaped, on short lobes or along margins of areoles. Usually on exposed, calcareous rock.

**C. decipiens**

4 Soralia crater-like, punctiform or irregular. Usually in shaded sites.

55 Thallus ± rosette-forming.

66 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. cirrochroa**

6 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. proteus)

5 Thallus normally a thin crust, areolate or not, sometimes with marginal lobes. (C. obliterans)

1 Thallus without marginal lobes, not distinctly radiating, not (or only obscurely) squamulose. On various substrates.

22 On bark or wood, or on bryophytes thereon.

33 Thallus inconspicuous, immersed in bark. Soralia punctiform, not becoming confluent, yellow-grey, yellow, dark yellow, brown-orange or green-orange. Always sterile. (C. lucifuga)

3 Thallus conspicuous, superficial. Soralia variously shaped, becoming confluent or not, colour various. Apothecia sometimes present.

44 Thallus completely, or almost completely, dissolved into soredia, at least eventually. Note 1.

55 Apothecia absent. Thallus entirely leprose. Soralia yellow to brown yellow, without a grey tinge. In shaded sites. Usually saxicolous but sometimes on other substrates. **C. chrysodeta**

5 Thallus not completely dissolved into soredia.

55 Thallus forming a very thin crust, pale yellow to grey. Soralia breaking through cortex, almost crater-like. **C. chrysophthalma**

5 Thallus areolate, squamulose or almost lobate, yellow to orange-yellow. Soralia mainly marginal. **C. flavocitrina**

2 On rock or soil, or on bryophytes thereon, or parasitic on lichens thereon.

33 Thallus entirely leprose. Apothecia absent. On calcareous rock, or overgrowing bryophytes thereon.

44 Thallus grey-yellow, brown-yellow or orange-brown. **C. chrysodeta**

4 Thallus bright yellow. **C. xantholyta**

3 Thallus usually not entirely leprose; if entirely leprose then not as above.

444 Soralia discrete, very small, punctiform, one on top of each areole. Soredia fine, intense yellow to yellow-orange. Strictly maritime. (C. sorediella)

4 'Soralia' actually corticate granules. Thallus usually red-orange. Apothecia often present. On calcareous rock, especially when nutrient-enriched, or parasitic on lichens on calcareous rock. **C. coronata**

4 Soralia not as above.

55 Thallus and soralia yellow-orange to red-orange. Prothallus often present. Soralia often crater-like. Thallus of closely adpressed areoles. Apothecia usually absent. Usually on shaded vertical rocks. (C. obliterans)

5 Thallus and soralia yellow to orange. Prothallus usually absent. Soralia and thallus various. Thallus various. Apothecia present or absent. On various substrates.

66 Soralia ± delimited (though old thalli may be entirely sorediate), developing mainly from margins of areoles.

77 Thallus dull to bright yellow, 150 - 400 µm thick, sometimes with very small marginal lobes. Soredia coarse, 40 - 140 µm diameter. Ascospores without thick walls. **C. limoniana**

7 Thallus yellow to orange, 80 - 160 µm thick, without marginal lobes. Soredia fine 30 - 50 µm diameter. Ascospores sometimes with thick walls. (C. dichroa)

6 Soralia not delimited, thallus often entirely sorediate.

77 Areoles large, 0.5 - 1.1 mm wide, 130 - 260 µm thick. Old thalli usually entirely sorediate. Usually on concrete. **C. austrocitrina**

7 Areoles generally smaller, to 180 µm thick. Thallus usually not entirely sorediate. On various substrates.

88 On siliceous coastal cliffs, to about 20 m above sea level.

99 Blastidia developing over much of upper surface of areoles (not just at the margins). At least some soralia developing from cracked blastidia or after blastidia have eroded. (C. confusa)

9 Blastidia, if present, mainly at the margins of areoles. Soralia marginal and ±labriform, not developing from cracked blastidia. **C. nigromarina**
8 On other substrates.
99 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. flavocitrina
9 Soralia covering (5) 25 - 100 % of thallus, usually concolourous with 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; probably never on bark. C. 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 5: Apothecia K+ purple (or absent), and with soralia that are not yellow, orange or red. Most species in this group are rather poorly known, and there are few Greek records.

11 On bark or, rarely, on wood or decaying plant remains.
222 Soralia K+ violet (test in a decaying preparation), delimited, pustulate, with a distinct thalline rim. (C. ahtii)
22 Soralia K+ pale pink or purple (test in squash), not delimited and often covering large areas of the thallus. C. phlogina
2 Soralia K-.
33 'Soralia' corticate. (C. virescens)
3 True soralia present, not corticate. Until these species are better known, I think it inadvisable to present a key that uses only vegetative characters, and the key assumes that apothecia are present. To determine sterile material, consult the primary literature.
44 Disc yellow, orange or red, K+ purple.
55 Thalline margin persistent.
66 Thallus very thin, ± smooth. Soralia yellow-green, developing from distinct blisters on the thallus surface. (C. alstrupii)
6 Thallus areolate. Soralia green-grey to white or with blue tinge, not developing from blisters. (C. turkuensis) Greek report needs confirmation. (An uncommon chemotype of C. phlogina could also key out here)
5 Thalline margin soon excluded. C. ulcersa (The poorly known (C. viperae) would probably also key out here.)
4 Disc brown, K- C. obscurella
1 On rock.
22 Soralia dark grey, usually well-delimited, K-. Thallus grey, well-developed, thick, areolate. On siliceous rock (C. soralifera)
2 Soralia pale grey, not well delimited, K+ violet or K-. Thallus white or pale grey, well developed or not. On calcareous or at least base rich rock.
33 Thallus ± well developed, with marginal lobes (which may be obscure). C. teicholyta
3 Thallus poorly developed, grey, thin, without marginal lobes. C. albolutescens

Key to Caloplaca group 6: With K+ purple apothecia, without vegetative propagules, with prominent grey thalline exciple.

11 Disc some shade of orange or yellow, without a red tinge.
22 Paraphyses not broadening at tips. On siliceous rock. C. viridirufa
2 Paraphyses distinctly broadening towards tips. Not usually on siliceous rock.
33 Thallus areolate, not smooth, covered in minute (0.01 mm diameter) spherical isidioid outgrowths that are easily overlooked. C. chlorina
3 Thallus without such outgrowths.
444 Parasitic on Aspicilia. C. furax
44 On bark or wood, or overgrowing mosses or plant debris on the ground.
55 Thallus entirely or mostly of small granules, about 0.1 mm diameter. Apothecia sometimes pruinose, especially when young. C. monacensis
5 Thallus not granular. Disc usually not pruinose; thalline margin may be pruinose.
66 On bark or wood. Disc waxy yellow, sometimes with a grey tinge. C. cerina var. cerina
6 On bryophytes or decaying vegetation. Disc green-yellow or orange.
77 Thalline margin brownish. Thallus thick, well developed, areolate to subsquamulose.  (C. congrediens)
7 Thalline margin ± grey. Thallus usually thin, not very well developed, often inconspicuous.
88 Disc pale green-yellow to dark green-yellow.  C. cerina var. chloroleuca
8 Disc orange.  C. cerina var. muscorum

4 On calcareous rock.  C. areolata

1 Disc with a red tinge.
22 Ascospore septum thin, remaining less than 3 μm wide. Parasitic on Candelariella. Thallus immersed in host.  C. grimmiae
2 Ascospore septum at least 3 μm wide in mature ascospores. Parasitic or not. Thallus usually superficial; if immersed then on rock and not parasitic.
33 Thallus squamulose-lobate, black-grey. On siliceous rock or parasitic on lichens on siliceous rock.  C. pellodella
3 Thallus crustose, white, grey, brownish or blackish. On bark or rock; not parasitic.
44 Disc remaining dark red. Thalline margin grey. On bark.  C. haematites
4 Disc eventually becoming blackish. Thalline margin sometimes blackish. On rock.  C. conversa

Key to Caloplaca group 8: With K+ purple apothecia, without vegetative propagules, without a prominent grey thalline exciple, with conventionally polarilocular ascospores that are lemon-shaped or rhomboid (at least when mature), and with an orange thallus with a lobed margin

11 Marginal lobes flat, closely adpressed. Thallus often appearing zoned in colour. On limestone.  C. aurantia
1 Marginal lobes either convex or loosely adpressed (or both). Thallus zoned in colour or not. On calcareous or siliceous rock.
22 Marginal lobes loosely adpressed, slightly convex. Thallus yellow-orange to brown-orange, not pruinose. On siliceous rock not far from (to a couple of kilometres) the sea.  C. aegae
2 Marginal lobes closely adpressed, at least some distinctly convex. Thallus orange, pruinose or not. On calcareous or siliceous rock.
3 Lobe ends palmately rounded, matt, orange, sometimes with white pruinose patches. Most paraphyses not branched. On calcareous rock, maritime or not.  C. flavescens

Key to Caloplaca group 9: With K+ purple apothecia, without vegetative propagules, without prominent grey thalline exciple, with conventionally polarilocular ascospores that are ellipsoid, and with orange thallus with a lobed margin

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 infra-specific taxa within C. biatorina. See the treatment of individual taxa below.
7 On ultrapotassic, volcanic rock. (C. cancarixiticola) See Note 1.
6 Ascospores broadly ellipsoid; length/width typically less than 2.5
77 Thallus red-orange or orange-red.
88 Ascospores broadly ellipsoid, 5 - 8 µm wide, aspect ratio 1.4 - 2. At alpine levels. C. biatorina
8 Ascospores narrowly ellipsoid, 3 - 7 µm wide, aspect ratio 2 or more. Alpine or not.
99 Ascospores 5 - 6.5 µm wide, aspect ratio 1.6 - 2.3. Thallus usually of well-delimited rosettes, usually whitish and decaying in central parts. Alpine. (C. arnoldiconfusa)
9 Ascospores 4 - 5.4. µm wide, aspect ratio usually more than 2. Thallus rosettes often confluent, not decaying in centre. Alpine or not.
A Thallus without pruina. Marginal lobes rarely forked. Central areoles flat. Usually on siliceous (or superficially decalcified) rock. C. arnoldii subsp. obliterata

7 Thallus orange, brown-orange or yellow-orange, without a red tinge.
88 Apothecia brown, not pruinose. On siliceous rock (reported from flint). (C. 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. aegaea
9 Marginal lobes strongly adpressed. Apothecia pruinose or not. On various substrates.
AA Ascospores 7 - 9 µm wide, septum 3 - 6 µm broad. (C. granulosa v. sardonia)
A Ascospores 4 - 7 µm wide, septum 2.5 - 4.5 µm broad. C. saxicola s. lat.
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. saxicola s. str.
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 non-calcareous rock. C. arnoldii subsp. obliterata
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 runoff. (C. arnoldii subsp. nana)

1 Marginal lobes not well developed.
22 On bark or wood. Thallus generally only clearly visible in young plants, later obscured by apothecia.
33 Ascii 16-spored. Ascospore septum 2 - 3.5 µm broad. (C. persica)
3 Asci 8-spored. Ascospore septum 5 - 9 µm broad. C. lobulata
2 On rock, or parasitic on lichens on rock. Thallus generally visible throughout.
33 On marine rock, directly affected by seawater or salt spray. Not parasitic.
44 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. marina) Greek reports doubtful.
4 Apothecia ±same colour as thallus. Disc and exciple same colour. Apex of paraphyses not swollen, 1 - 2 µm wide. Ascospores 10 - 12 x 4 - 6 µm. C. ora
3 Not on marine rock, or if on marine rock then not as above. Parasitic or not. See Group 12A key, especially C. inconnexa, C. lithophila, C. necator, C. polycarpa and C. saxicola s. str.

(1) Apart from the unusual substrate, the original description of C. cancarixiticola does not include any characters that seem to me to distinguish it clearly from C. tenuata.

Key to Caloplaca group 10: With K+ purple apothecia, without vegetative propagules, without a prominent grey thalline exciple, with conventionally poliarolicular ascospores with a narrow septum, and with an orange thallus without marginal lobes.
11 Ascospores 9 - 12 µm long.
22 Thallus pale orange. Apothecia 0.2 - 0.5 mm diameter, immersed. Disc orange. Ascospores 6.5 - 8.5 µm wide, septum 2.5 - 3 µm broad. Only known from type collection, on metamorphic rocks. (C. sarda)
2 Thallus yellow. Apothecia 0.3 - 1 mm diameter, initially immersed but eventually becoming sessile. Disc red-brown. Ascospores 4 - 6 µm wide, septum 2.5 - 3 µm broad. On calcareous rock. C. adriatica
1 Ascospores 12 - 23 µm long.
22 Disc orange to brown-orange. Septum 2.5 - 3.5 µm long. Apothecia 0.5 - 1 (1.5) mm diameter. On soil in fissures and cracks of calcareous rocks, at high altitude. C. flavovirescens
2 Disc yellow-orange to brown-orange. Septum 1.5 - 3.5 µm long. Apothecia various. On various substrates. C. crenulatella

Key to Caloplaca group 11: With K+ purple apothecia, without vegetative propagules, without a prominent grey thalline exciple, with conventionally polarilocular ascospores with a ±broad septum, and with a green-orange or green-yellow thallus without marginal lobes.

11 On bark. Apothecia to 3 mm diameter, but usually much less.
22 Ascospores (12) 15 - 18 x 6 - 10 (11) µm (Note 1), septum 5 - 9 µm. Paraphyses not of two types. Apex of paraphyses 3 - 4 µm wide. Thallus yellow-green to white, continuous. C. flavorubescens s. lat. (Note 2).
33 Apothecia 0.5 - 1.5 mm diameter (Note 1). Exciple visible, thalline margin not visible (or not clearly), margin moderately thick. C. flavorubescens v. flavorubescens
5 Thallus yellow-orange to brown-orange. Septum 1 - 2.5 µm long. Apothecia 0.3 - 0.5 mm diameter. On calcareous rock. C. interfulgens
3 Thallus crustose or crustose-areolate, sometimes poorly developed. Hymenium 80 - 120 µm tall. Apothecia 0.5 - 1.5 (2) mm diameter. On soil in fissures and cracks of calcareous rocks, at high altitude. C. aurea
2 Thallus pale orange. Apothecia 0.2 - 0.5 mm diameter, immersed. Disc orange. Ascospores 6.5 - 8.5 µm wide, septum 2.5 - 3 µm broad. Only known from type collection, on metamorphic rocks. (C. sarda)
2 Thallus pale orange. Apothecia 0.2 - 0.5 mm diameter, immersed. Disc orange. Ascospores 6.5 - 8.5 µm wide, septum 2.5 - 3 µm broad. Only known from type collection, on metamorphic rocks. (C. sarda)

Key to Caloplaca group 12A: With K+ purple apothecia, without vegetative propagules, without a prominent grey thalline exciple, with conventionally polarilocular ascospores with a ±broad septum, and with an orange (no green tinge) thallus without marginal lobes. Disc yellow or orange.

Many species in this group are difficult to separate, partly because the published descriptions that I have been able to consult are too brief to allow me to construct a good key, and partly, I suspect, because in Mediterranean regions there is more variation (and perhaps more taxa) than published sources acknowledge. To avoid compounding the difficulties, it is advisable to work only with well-developed material possessing many mature ascospores. Collections that do not meet these criteria tend to lead to confusion.

(1) Dimensions are from Roux (2007). In all my collections 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 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.
I have numerous collections in this group that I cannot determine.


1111 On bark or wood. See group 15. (A few rather variable species. To avoid duplication, they are keyed only under Group 15.)

11 Parasitic, at least when young, on saxicolous lichens.

222 On Verrucaria species on calcareous, or at least base rich, rock (and perhaps on other species of endolithic calcareous lichens).

33 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. oasis**

3 Thallus usually ±well developed, superficial, orange. Apothecia 0.2 - 0.3 mm diameter. **C. polycarpa**

22 On Clauzadella immersa. Thallus ± immersed. Apothecia 0.2 - 1 mm diameter. Alpine localities. **C. nubigena**

2 On other species.

333 Thallus inconspicuous, not granular. On lichens on siliceous rock. (C. subpallida)

33 Thallus of granules that are not lobed. On Aspicilia polychroma at alpine levels. (C. insularis) Greek reports doubtful.

3 Thallus of granules that are usually at least weakly lobed. Usually on Aspicilia or Acanospore. Not restricted to alpine levels. **C. inconnexa** s. lat.

44 On lichens on calcareous rocks, usually species of Aspicilia or Acanospore. **C. inconnexa var. inconnexa**

4 On Aspicilia species on siliceous rock. **C. inconnexa var. nesodes**

1 On rock, not parasitic. (If material does not key out here, try previous branch, since some parasitic species are not obviously so.)

222 Ascospores swollen at septum. Wall of mature ascospores thickened at apices. Lumina of mature ascospores resembling Physcia (or even Mischoblastia) type of Physciaceae (Note 1). On calcareous rock.

33 Thallus fairly well developed, distinctly areolate. Prothallus absent. Apothecia 0.4 - 1 (1.5) mm diameter, often densely crowded and irregular. **C. 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 never crowded. **C. latzelli**

22 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. On calcareous rock. **C. calcitrata**

2 Ascospores not as above; normal polarilocular type, not swollen at septum. On calcareous or siliceous rock.

33 Thallus with a yellow tinge (yellow or orange-yellow). See Note 2.

444 Thallus with parietin crystals on surface, and thus appearing rugose (but not obviously pruinose). On calcareous or siliceous rock. **C. saxicola** s. str.

44 Thallus pruinose, at least in places, well developed, areolate. Apothecia 0.8 - 1.3 mm diameter. On calcareous, or at least base-rich, rock. (C. ruderum) Greek report very doubtful.

4 Thallus not pruinose or rugose, or if pruinose then with smaller apothecia. On calcareous or siliceous rock.

55 On calcareous rock.

66 Thallus very poorly developed, almost immersed. Apothecia 0.3 - 0.7 mm diameter. **C. holocarpa**

6 Thallus usually distinct, though sometimes thin. Apothecia various.

77 Apothecia mostly 0.2 - 0.4 mm diameter. Ascospore septum 2.5 - 4.5 µm wide. Not restricted to maritime sites. **C. oassis**

7 Apothecia mostly 0.3 - 0.6 mm diameter. Ascospore septum 3 - 6 µm wide. Strictly maritime. **C. calcitrata**

5 On siliceous rock.

66 Thallus covered with coarse granules. Strictly maritime. **C. communis**

66 Thallus not covered with coarse granules. Not restricted to maritime sites. **C. vitellinula**

3 Thallus without a yellow tinge (pale orange, orange or brown-orange). See Note 2.

44 Apothecia 0.15 - 0.3 mm diameter. Thallus of scattered, orange, corticate granules. At least some paraphyses moniliform, apex to 5 µm wide. On calcareous rock. **C. lithophila**

4 Many mature apothecia exceeding 0.3 mm diameter. Other characters various.

55 Black hypothallus visible in places between areoles or at margins of areoles. Areoles of thallus generally well-developed. Thallus often wide-spread. On calcareous rock. **C. dalmatica**

5 Black hypothallus usually absent; if present (some morphs of C. inconnexa) areoles of thallus poorly developed. On calcareous or siliceous rock.
666 On dry, schistose rock in sub-Mediterranean zone. Apothecia remaining immersed. Thallus pale orange. Only known from the type collection, in Sardinia. (C. sarda)

66 On marine rock (calcareous or siliceous) directly affected by seawater or salt spray. Apothecia sessile. Thallus orange.

77 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. marina) Greek reports doubtful.

7 Apothecia same colour as thallus. Disc and exciple the same colour. Apex of paraphyses not swollen, 1-2 µm wide. Ascospores 10-12 x 4-6 µm. C. ora

6 On calcareous rock, not restricted to marine localities. Apothecia sessile. Thallus sometimes with a brown tinge. Areoles of thallus often poorly developed and few or rather inconspicuous. Thallus usually forming small patches, to 1 cm diameter. Parasitic when young, and some trace of parasitism can often be detected when mature; any close association with an Aspicilia species suggests this lichen. C. inconnexa var. inconnexa

(1) The swelling around the septum develops early. Unfortunately, apical wall thickenings and the unusually shaped lumina may only be observable in mature ascospores.

(2) 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 12B:** With K+ purple apothecia, without vegetative propagules, without a prominent grey thalline exciple, with conventionally polarilocular ascospores with a ±broad septum, and with an orange (no green tinge) thallus without marginal lobes. Disc with a red tinge.

111 Parasitic on Rinodina alba on siliceous rock. Apothecia to 1 mm diameter. (C. rinodinae-albae)

11 On calcareous rock, not parasitic. (If parasitic, see group 12A.) Apothecia various.

22 Thallus pink or orange-pink. Usually montane. C. coccinea

2 Thallus without a pink tinge. Not confined to upland regions.

222 Ascospores 25-32 x 3-5 µm. (C. nivalis)

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-riek, substrates. C. sinapisperma

222 Ascospores 25-32 x 3-5 µm. (C. nivalis)

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-riek, substrates. C. sinapisperma

2 Ascospores 10-13 x 6-7.5 µm. C. schoeferi

11 On rock. C. 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 an alpine species. (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. 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 Ascospores 8 - 11 µm long. (C. brachyspora)

3 Most ascospores more than 11 µm long.

44 Apothecia 0.6 - 2.0 mm diameter. Disc orange to brown-orange. Ascospores 16 - 23 µm long, septum 1 - 2 µm wide. **C. ferrarii**

4 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.

55 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. 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.

66 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**

6 Apothecia 0.2 - 0.5 (0.8) mm diameter. Most ascospores more than 15 µm long. Disc various.

77 Disc orange, orange-red or grey-red. Exciple uniformly hyphal (prosoplectenchyma). 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. marmorata**

7 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) 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 14**: With K+ purple apothecia and a disc with a red tinge, without vegetative propagules, without a prominent thalline exciple, with conventionally polarilocular ascospores with a ±broad septum, and with a grey or white thallus.

The distinction between groups 14 and 15 is not sharp. Species with distinctly red or rust red apothecia belong here. However, in some species the colour of the apothecia is ambiguous, or varies over a wide range. In case of difficulty, it may be necessary to consult both keys.

11 Thallus with marginal lobes.

22 Thallus grey. Marginal lobes poorly developed. **C. fuscoatroides**

2 Thallus yellow-green. Marginal lobes well developed.

33 Apothecia brown-red or dull red. **C. carphinea**

3 Apothecia bright red. (C. scorpiophila)

1 Thallus without marginal lobes.

2222 Parasitic on other lichens.

33 Thallus not visible, contained within host thallus. On Aspicilia. (C. interna) Greek reports tentative.

3 Thallus clearly visible, areolate to squamulose-areolate

44 Disc orange; red tinge not well developed. Ascospores 11 - 14 µm long, septum 3 - 4 µm wide. **C. pellodella**

4 Disc red-orange to rust red. Ascospores 13 - 18 µm long, septum 5 µm wide in material seen (but probably 3 - 8 µm). **C. fuscoatroides**

222 On bryophytes or decaying vegetation at alpine levels. **C. ammiospila**

22 On bark or wood.

33 Apothecia red-brown or yellow-brown to almost black, often pruinose, 0.4 - 1 mm diameter, margin not convoluted but sometimes deformed by compression. Ascospores thick-walled (for Caloplaca). Note 1. **C. pollinii**

3 Apothecia rust red or orange-red, not pruinose, diameter various, margin convoluted or not. Ascospores not thick walled.

44 Exciple bright orange, distinctly paler than disc, not becoming excluded; or exciple yellow-orange or orange-yellow. **C. aegatica** and **C. pyracea**. See Group 15 key.

4 Not as above. (If exciple orange then not bright orange.)

55 Apothecia 0.5 - 2 mm diameter, usually remaining flat. Thallus usually fairly well developed, though never
very thick. Disc and exciple usually distinctly rust red, 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 2. *C. ferruginea*

5 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 2. *C. hungarica*

2 On rock or soil.

33 Thallus chalky, white, well developed and well delimited.

44 On limestone. *C. erythrocarpa*

4 On soil or on base-rich siliceous rock. *C. aetnensis*

3 Thallus not chalky, white to 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.

55 On strongly calcareous rock. Thallus immersed or thin. Hymenium 70 - 120 µm tall. Exciple 5 - 15 (25) µm thick, K+ purple. *C. cretensis*

5 On siliceous or (usually weakly) calcareous rock. 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. Apothecia becoming blackish or not.

55 Thallus granular, at least in places; granules grey. (Non-granular part of thallus, if present, white, fairly thick). *C. teicholyta*

5 Thallus not granular.

66 On weakly calcareous rock at high altitude (alpine level). Thallus white to grey, or ± immersed. Apothecia rust red. Exciple paler than disc. Ascospores 15 - 17 x 8 - 10 µm, septum 4 - 6 µm. (C. percrocata) Greek reports doubtful The poorly known (C. lojkae), with ascospores 10 - 12 µm long, may also key out here.

66 On calcareous rock, usually limestone. Not restricted to high altitude. Thallus, exciple and ascospores various.

77 Apothecia red-orange, with distinct red-orange pruina, not becoming blackish. Exciple becoming thin but generally persisting. Apothecia 0.2 - 0.8 mm diameter. Ascospores 10 - 13 x 5 - 7 µm. Near the sea. *C. tavaresiana*

7 Apothecia not pruinose. Near the sea or not.

88 Thallus immersed. Apothecia red-orange to red or rust red. Exciple usually persistent. Apothecia 0.2 - 0.8 mm diameter. *C. marmorata*

8 Thallus superficial, usually areolate. Apothecia red-brown. Exciple becoming excluded. Apothecia 0.2 - 1.3 mm diameter. *C. subochracea*

6 On siliceous rock.

77 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. scotoplaca) Greek reports doubtful.

7 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. Note 3.

88 Thallus dark (dark grey, brown or black). Dark prothallus or hypothallus commonly present.

99 Apothecia C-. Dark hypothallus often present. *C. atroflava*

9 Apothecia C+ purple Hypothallus absent but dark prothallus may be present. *C. neotaurica*

8 Thallus pale grey. Prothallus present or absent.

99 Thallus bordered by distinct black prothallus. Thallus cracked to areolate. On hard rock affected by salt-spray from the sea. *C. limitosa*

9 Prothallus, if present, weakly developed. Thallus morphology various. Not confined to marine rocks.

AA Thallus squamulose or squamulose-areolate. *C. fuscoatroides*

A Thallus smooth, continuous to ± cracked. *C. crenulata*

(1) Published information on the ecology of *C. pollinii* 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.

(2) 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.

(3) Caloplaca festivella probably belongs in this group. It has a (fairly dark) grey, areolate thallus. The central parts of the apothecia tend to become blackish.

Key to Caloplaca group 15: With K+ purple apothecia and a yellow or orange disc, without vegetative propagules, without a prominent thalline exciple, with conventionally polarilocular ascospores with a ±broad septum, and with a grey or white thallus.

1111 Parasitic on other lichens.
   22 On Aspicilia.
      33 Thallus developing within thallus of host, not visible externally. Apothecia orange. (C. interna) Greek
          reports tentative.
   3 Thallus superficial. Apothecia with a brown tinge.
      44 Thallus squamate to areolate, with irregular short marginal lobes. Vegetative propagules absent. C. furax
   4 Thallus continuous to weakly areolate, without marginal lobes. Vegetative propagules often present, as
      dark grey pustules or lobules on thallus surface. C. xerica

2 On Verrucaria. C. oasis

111 On soil, or decaying vegetation on the ground, or bryophytes on soil or rock. Probably not in Mediterranean or sub- 
Mediterranean climatic zones.
   22 Apothecia with thick, brownish thalline margin. Thallus well developed, areolate to subsquamulose. On 
bryophytes. (C. congrediens)
   2 Thalline margin absent, or grey, thin and becoming excluded. Thallus well developed or not.
   33 Thallus moderately well developed. Ascospores 10 - 13 µm long. Usually on decaying plant material,
      occasionally on bryophytes. Climatic preferences not well known. (C. raesaeni)
   3 Thallus thin, often inconspicuous. Ascospores various. On bryophytes or decaying plant material. Restricted 
to high altitude (above tree line).
   444 Most ascospores more than 17 µm long. Disc orange-yellow to brown-orange. Strongly alpine. (C.
      jungermanniae)
   444 Ascospores 14 - 17 x 7 - 9 µm. Disc yellow or yellow-orange (said to become green-yellow, dark green or 
even blackish later). C. tiroliensis
   444 Most ascospores less than 13 µm long.
      55 Disc bright orange. Ascospores 10 - 12 x 6 - 7 µm. (C. saxifragarum)
   5 Disk dull yellow orange to pale brown-orange. Ascospores 10 - 13 x 6 - 7.5 µm. (C. schoeferi)

11 On bark or wood.
   22 Ascospores 12 - 14 x 4.5 - 5 µm; septum 3.5 - 4 µm. Apothecia 0.2 - 0.4 (0.6) mm diameter, usually crowded.
      Thallus well-developed, wide spreading. C. suadae s. lat.
   2 Most ascospores more than 5 µm wide. Apothecia and thallus various.
   33 Ascii with 12 - 16 ascospores (Note 1). C. cerinella
   3 Ascii with (4) 8 ascospores (Note 1).
      44 Apothecia very small, (0.1) 0.2 - 0.4 mm diameter, usually crowded. Ascospores 8 - 12.5 (15) x 6 - 7 µm;
      septum 3 - 5 µm. Hypothecium 10 - 45 (50) µm tall. Thallus usually forming small patches, just a few mm 
diameter. C. cerinelloides
   4 Apothecia 0.3 - 2 mm diameter, crowded or not. Ascospores 10 - 18 µm long. Hypothecium (plus 
      subhymenium, if present) more than 50 µm tall. Thallus from a few mm to many cm diameter.
      55 Ascospores (12) 15 - 18 x 6 - 10 µm. Shade forms of C. flororubescens
   5 Ascospores 10 - 15 µm long.
      66 Some paraphyses with some cells swollen and containing oil (Note 2). Thallus clearly visible,
      ±continuous, grey without any yellow or orange. Pycnidia often present in marginal parts of thallus.
      Apothecia 0.3 - 2 mm diameter. Thalline margin grey, fairly distinct (except sometimes in very mature 
apothecia). Exciple persistent. Probably restricted to humid localities not far from the coast. C. aegatica
   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 coastal localities.
   77 Thalline margin distinct, 50 - 80 µm wide, yellow-grey to pale grey; lower part with distinct cortex to 20 
      µm thick. Disc orange to dark orange. C. pyrcaca
   7 Thalline margin usually not apparent, 0 - 50 µm wide; cortex absent or poorly developed, 0 - 10 µm thick.
      Disc yellow to orange.
88 Ascospores narrowly ellipsoid, 4 - 6 µm wide; aspect ratio often more than 2. C. skii
8 Ascospores ellipsoid, 6 - 8 µm wide; aspect ratio usually less than 2. Only rarely corticolous (usually saxicolous). C. holocarpa

1 On rock.
22 Thallus, or at least hypothallus, clearly visible.
33 On siliceous rock. Thallus (or hypothallus) pale brownish to black.
44 Thallus, if present, of dark grey to black convex areoles, often on a black hypothallus. C. atroflava s. lat.
55 Apothecia yellow-orange to brown-orange. Aquatic, or at least close to water. C. atroflava var. submersa
5 Apothecia orange. Not aquatic. C. atroflava var. atroflava
4 Thallus continuous or weakly areolate.
55 Surface of thallus, at least in older parts, distinctly warty and irregular on a scale of about 0.1 mm, generally darker where warty. Disc and exciple both with a brown tinge. C. xerica
5 Surface not warty. Disc and exciple orange or red, without a brown tinge. C. neotaurica
3 On calcareous rock. Thallus pale, at least in central parts.
444 Thallus chalk white, cracked to areolate. On maritime calcareous rock.
55 Thallus clearly delimited. Apothecia orange or brown-orange. Epitheicum brown-orange. Exciple 40 - 75 µm thick (measured perpendicular to hyphae). Ascospores 11 - 14 x 6 - 7 µm. (C. egeana)
5 Thallus not clearly delimited. Apothecia very orange. Epitheicum orange. Exciple 100 - 160 µm thick (measured perpendicular to hyphae). Ascospores 9 - 12 x 5 - 6 µm. C. veneris
44 Thallus sand coloured in centre, grey to dark grey at margin. Apothecia with thalline margin. (C. erythrina var. pulvinata)
4 Thallus whiteish or yellow-green. Apothecia without thalline margin. C. flavovirescens
2 Thallus and hypothallus absent, indistinct or poorly developed.
33 Ascospore septum ± narrow, to 3.5 µm wide. Exciple usually persistent.
44 On calcareous rock. C. marmorata
4 On siliceous rock. C. arenaria
3 Ascospores septum 3 - 6 µm wide. Exciple persistent or not.
44 Ascospores 13 - 23 µm long. Exciple persistent. On maritime calcareous rock. C. aquensis
4 Ascospores 9 - 15 µm long. Exciple persistent or not. On various substrates.
55 Ascospore septum 3 - 4 µm wide. C. oasis
5 Ascospore septum 4 - 6 µm wide.
66 Exciple paler than disc, thin to well developed, formed of anastomosing hyphae, not cellular. On calcareous or slightly nutrient-enriched rock, not restricted to maritime environments. C. holocarpa
6 Exciple ± same colour as disc, thin, with at least some cellular structure in outermost 10 - 15 µm. On maritime calcareous rock. C. navasiana

(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.

Caloplaca sp.
Material represented by collections 13-Jan-2000/L12H, 28-Feb-2007/L53H and 24-Mar-2007/L40G represents a fairly well-defined taxon in group 12A that I can not determine. It is not included in the key to that group. It is characterised by a thin, smooth to slightly cracked, yellow-orange thallus, and very small apothecia that remain immersed for a long time, though eventually becoming subsessile.

Caloplaca Adriatica (Zahlbr.) Serví (1931)
Description: Clauzade & Roux (1985).
Crete and Evia, on calcareous rock at around 1100 m.
Mediterranean parts of Europe, and Bulgaria. Also N. Africa (Morocco).

**Caloplaca aegaea** Sipman (2002)
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 the upper part diffuses a red-purple pigment into solution and then becomes pale red. Lower cortex: present in the outermost 0.3 mm or so of the marginal lobes; it has the same structure as, the 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 exciple: present, prominent in young apothecia, in older apothecia almost confined to lower surface; in section: 130 µm wide, of which cortex 20 µ. Exciple: orange, paler than disc, persistent; in section: 25 - 100 µm wide, orange at surface, colourless in inner part; inner part of ±radiating hyphae, outer part of more randomly oriented hyphae 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 (never strongly so), sometimes branched in upper part.Ascii: 60 x 17 µm, cylindrical or narrowly clavate. Ascospores: colourless, polarilocular, ellipsoid at first, becoming rhomboid later, 8 per ascus, 11 - 14 x 6 - 8 µm, septum 3 - 5 µ. Pycnidia: dark orange, darker than thallus, 0.1 mm diameter; in section: 100% immersed, single chambered, ellipsoid, 300 x 200 µm, colourless. Conidia: colourless, bacilliform, 3 x 0.5 µ. Chemistry: thallus K+ purple. Photobiont: green, cells globose, 10 - 12 µm diameter, forming distinct clumps so that the photobiont layer is irregular (though ±continuous), layer 30 - 100 µm thick.

*C. aegaea* could be confused with *C. flavescens*, but the latter 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 to about 200 m. It is maritime, rather than strictly marine, and may occur some distance inland.

At present, known only from southern Spain, Italy, Greece and the Canary Is.

**Caloplaca aegatica** Giralt, Nimis & Poelt (1992)
Thallus: crustose, grey, moderately thick, cracked, forming a patch 2 x 0.7 cm. (The only collection occurred on rather rough bark. The thallus might be continuous on smoother bark.) 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 on average (but not individually) parallel to surface. Medulla: poorly developed. Apothecia: subimmersed when young, later sessile, flat, not pruinose, 0.3 - 0.6 mm diameter. Disc: orange. 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 crystal crystals. Thalline exciple: grey, thin, becoming excluded. Epithecium: orange-brown, K+ red, pigment diffusing into solution and forming minute crystals. Hymenium: 95 µm tall, colourless. Hypothecium: 75 µm tall (including subhymenium, which is not clearly differentiated), colourless. Paraphyses: sometimes branched in upper part; a few paraphyses containing oil cells in the upper third of the hymenium. Oil cells: ±globose to elongated, sometimes with pointed ends, 7 - 12 x 5 µm, with a slight greenish tinge that contrasts with the 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, 8 per ascus, 10.5 - 12.5 x 5.5 - 6 µm, septum 5.5 - 7 µ. 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 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 µ. 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. alinetorum*, but that is an upland species, whereas *C. aegatica* occurs at low altitude. If the oil cells are not noticed, it could be confused with *C. pyracea*.

Southern half of Greece, never very far from the sea. At the only Peloponnesian locality where I have observed it, the site had the sea on one side and a lagoon on the other, so was probably unusually humid. On bark at altitudes 0 - 900 m. Reported from *Ficus carica, Pinus brutia*, and *Pistacia lentiscus*.

A circum-Mediterranean/Macaronesian species. Spain, Italy, Croatia, Greece and Cyprus. Also Macaronesia (Madeira, Canary Is), western Asia (Syria), N. Africa (Morocco).
Caloplaca aetnensis de Lesd. (1935)  

*C. aetnensis* is reported here with some hesitation, as both collections appear to intergrade into material that looks like typical *C. crenulata*. However, some of the material has a definitely white, rather chalky, usually fairly well developed (but not as well developed as 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. Exciiple: orange to red, usually paler than disc, matt, smooth, persistent; in section: dark brown in outer part, colourless in inner part. Thalline margin: present in young apothecia, but becoming excluded. Epithecium: orange-brown. Hymenium: 80 - 110 µm tall, colourless. Hypothecium: 90 µm tall, colourless. Paraphyses: moniliform. Ascospores: colourless, polarilocular, 8 per ascus, sometimes swollen at septum, 16 - 17 x 8 - 10 µm, septum 4 - 5 µm wide. Chemistry: apothecia K+ purple. Photobiont: green.

Closely related to *C. erythrocarpa*, but that occurs on calcareous rock. *Caloplaca ichololyta* differs in being sorediate, usually only sparingly fertile, and occurring on calcareous substrates. *C. crenulata* has a much darker thallus (grey or brown-grey).  
Southern Peloponnesian, on siliceous rock close to sea level.

Known only from Spain, Italy, the Canary Islands and Morocco.

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Caloplaca albolutescens (Nyl.) H. Olivier (1909)  

Description: Clauzade & Roux (1985); Smith et al. (2009).

Cretan, on calcareous rock at an altitude of 100 m.

This species is either uncommon or overlooked, and there are not many records. Most of them are from central Europe, though its range extends into southern Scandinavia. For southern Europe, reported for Portugal and Greece. Also Macaronesia (Canary Is), western Asia (Turkey, Syria).

Caloplaca albopruinosa (Arnold) H. Olivier (1909)  
in: Mém. Soc. Natn. Sci. Nat. Math. Cherbourg 37: 147; Biatorina albopruinosa Arnold (1859) in: Flora 42: 152; Blastenia agardhiana auct.; Blastenia agardhiana var. albopruinosa (Arnold) Servit; Blastenia agardhiana var. granuligera (J. Steiner) Szatala; (?) Blastenia agardhiana var. isabellina (J. Steiner) Szatala; (?) Blastenia agardhiana var. minuta (J. Steiner) Szatala; Blastenia albopruinosa (Arnold) Th. Fr.; Blastenia granuligera (J. Steiner) Szatala; Caloplaca agardhiana auct.; Caloplaca agardhiana f. albopruinosa (Arnold) J. Steiner; Caloplaca agardhiana var. albopruinosa (Arnold) Zahlbr.; Caloplaca agardhiana var. granuligera J. Steiner; (?) Caloplaca agardhiana f. isabellina (J. Steiner) J. Steiner; (?) Caloplaca agardhiana f. minuta (J. Steiner) J. Steiner; (?) Caloplaca agardhiana var. minuta (J. Steiner) Zahlbr.; Caloplaca intercedens (Trevis.) Stüzenb.; (?) Caloplaca intercedens var. isabellina J. Steiner; (?) Caloplaca intercedens f. minuta J. Steiner; Pyrenodesmia agardhiana auct.

Thallus: immersed or, less commonly, very thinly superficial, white to pale grey. Prothallus: not seen in Peloponnesian material. Vegetative propagules: absent. Apothecia: often immersed in pits in substrate, sometimes sessile, usually ±flat, (0.1) 0.3 - 0.55 mm diameter Disc: black or very dark brown, often white or blue-white pruinose. Exciiple: present, usually fairly prominent, persistent, black or very dark brown but 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, but hyphal tips expand near the surface giving a thin cellular layer, without crystals. Thalline margin: generally absent (but forms with a very poorly developed thalline exciple on the lower part of the apothecium are occasionally encountered, and these are hard to separate from *C. variabilis*).

Epithecium: grey to brown, K+ violet; crystals absent or very few (except for the 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 wide at apex, often with distinct septa, usually moniliform in upper part though never strongly so, sometimes branched in upper part. Asci: clavate to broadly clavate, 40 - 62 x 12 - 20 µm, Teloschistes type (with a bow-shaped, KI+ blue, cap). Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 10 - 15 x (5) 7 - 8 µm, septum (2) 2.5 - 5 µm. 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 paraplectenchymatous easily separate this species from most of the others in this group. However, separation from *C. alociza* and endolithic forms of *C. variabilis* is sometimes problematic, and will remain so until species concepts have been better worked out.
Almost throughout Greece, but rare in the north. On calcareous rock at all altitudes. There is a single report of it on *Clauzadea immersa*, but it was probably merely overgrowing, rather than parasitic on, that species.

Widely distributed in southern Europe, but not ranging far north of the Alps. Also Asia (Turkey, Armenia, Kazakhstan, China) N. Africa (Morocco, Algeria, Egypt). Some reports may be unreliable owing to confusion with other species.

**Caloplaca alnetorum** Giralt, Nimis & Poelt (1992)  

Description: It is best to consult the protologue, but there are also descriptions in: Roux (2005); Wasser & Nevo (2005).

Scattered, with no clear pattern, though most reports are from sites not very far from the sea. On bark of deciduous trees at altitudes 60 - 1750 m.

Southern Europe and the Alps, western Asia (Turkey, Israel, high altitude in India), Africa (Tunisia, Namibia).

**Caloplaca alociza** (A. Massal.) Lettau (1912)  

Thallus: crustose, immersed, to 2 cm diameter. Prothallus: 0.5 - 2 mm wide, zoned (in material seen to date), 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. Exciple: black, thin, becoming almost excluded (said to become completely excluded sometimes); in section: 45 - 50 µm wide, brown in outer part, colourless to pale brown in inner part, of radiating hyphae with distinct lumina, and appearing rather cellular overall; outer part K+ dull violet. Thalline margin: absent. Epithecium: ±colourless to brown, K+ dull violet. 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 capitulate, 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 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. Apparently commoner in the southern half of the country, though this may just reflect the greater intensity of study there. On limestone rock at all altitudes.

Widely distributed in central and southern Europe. Absent from Scotland, and almost absent from the Nordic countries, apart from a couple of records for southern Sweden. Also Asia (widespread in warm, dry regions as far east as Pakistan and Tajikistan), N. Africa (Morocco, Tunis, Egypt).

**Caloplaca amniospila** (Wahlenb. ex Ach.) H. Olivier (1909)  


Known from a single site in Epiros, at an altitude of about 1100 m. The substrate was not stated.

Widely distributed from the High Arctic to the Alps, but very rare south of the Alps. Also Asia (widespread in cold regions), N. America (arctic and alpine regions), C. America (Mexico), Australasia (both islands of NZ), Antarctica (Antarctic Peninsula and nearby subantarctic islands).

**Caloplaca aquensis** Houmeau & Cl. Roux (1984)  


Crete, on rock at sea level.

Not reported for Peloponnesse, but there are a couple of records for Crete.

Only Spain, France (mainland and Corsica), Greece and Ukraine.

**Caloplaca arisproxima** Vondrák, Říha, Arup & Sochting (2009)  
in: *Lichenologist* 41(6): 588

Description: See the protologue.
Chios and Crete, on siliceous rock at altitudes 5 - 230 m.
Known only from Greece and Ukraine.

**Caloplaca arenaria** (Pers.) Müll. Arg. (1862)

Thallus: crustose, 1 cm diameter, thin and inconspicuous, pale grey. Apothecia: 0.35 - 0.55 mm diameter, submersed at first, later sessile, flat to slightly convex (when mature), not pruinose. Disc: orange to brown-orange. Exciple: orange, paler than disc, persistent. Ascospores: 15 x 5 - 6 µm, septum 2.5 - 3 µm.
The description is brief, since my only Peloponnesian collection to date was scanty. For a more detailed description see Clauzade & Roux (1985), or Smith et al. (2009).
Throughout Greece, on siliceous rock at altitudes 0 - 2150 m. Reports from calcareous rock are probably incorrect.
Throughout Europe. Also Macaronesia (Madeira), Asia (widespread), Africa (Morocco, Algeria, Egypt, S. Africa), N. America (southern Canada, widespread in USA), C. America (Mexico).

**Caloplaca areolata** (Zahlbr.) Clauzade (1968)
The correct name is *Caloplaca spalatensis* Zahlbr., if the synonymy is confirmed.
Description: Clauzade & Roux (1985) as *Caloplaca spalatensis*.

Island of 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).

**Caloplaca arnoldii** (Wedd.) Zahlbr. ex Ginzb. (1915) s. lat.
in: [need to investigate - don't know title of paper in Denk Wien 92:]; *Lecanora arnoldii* Wedd. (1876) in: *Bull. Soc. Bot. Fr.* 23: 96; *Caloplaca saxicola subsp. arnoldii* (Wedd.) Clauzade & Cl. Roux; *Caloplaca saxicola subsp. biatorinoides* Clauzade & Cl. Roux; *Gasparrinia arnoldii* (Wedd.) Szatala

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 arnoldiiconfusa*.

Mt. Olympus and island of Samothraki, on calcareous rock at altitudes 200 to above 2000 m.
Most European reports are from middle latitudes. Absent from the Nordic countries and British Is. Present in Provence and the Italian Alps, but very rare in southern Europe. Also Macaronesia (only Azores), and Asia (Bhutan, Nepal). A report for N. Africa (Egypt) is certainly incorrect, and may refer to *C. biatorina*.

**Caloplaca arnoldii subsp. obliteratora** (Pers.) Gaya (2009)

Persson's epithet is correct Latin; it is derived, ultimately, from the verb oblittero. In genera of feminine gender it must become obliteratora. There is no justification for using 'obliteratora'.

Descriptions: Gaya (2009); Wilk (2012).

Chios, on siliceous rock at an altitude of 500 m.
Throughout Europe. Also Macaronesia (Madeira), Asia (Tajikistan), Africa (Ascension Is), N America (a few western states in USA), S America (Brazil, Colombia), 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. It will be necessary to collect more material before this species is properly understood in Greece, and its relation to other taxa clarified.
Eastern Peloponnes 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.

Most European records are from north of the Alps. South of the Alps it is reported for Spain (locality unknown, so might be Pyrenees), Greece and Cyprus. Also western Asia (Turkey, Israel, Armenia), N. America (BC, scattered in 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. Kalimnos, on schist at an altitude of 30 m.

Scattered, from southern Scandinavia to as far south as Calabria in southern Italy, and from western Ireland to Greece. I have not seen any reports from outside Europe.

Caloplaca aurantia (Pers.) Hellb. (1890)
in: Bih. K. Sv. Vet.-Akad. Handl. 16(3): 60; Lichen aurantius Pers. (1794) in: Ann. Bot. (Usteri) 11: 14; Caloplaca aurantia var. callopisma (Ach.) J. Steiner; Caloplaca aurantia var. enissalse (Servit & Cretz.) Szatala; Caloplaca aurantia f. orientalis (J. Steiner) ined.; Caloplaca callopisma (Ach.) Th. Fr.; Caloplaca callopisma f. orientalis J. Steiner; Caloplaca sympagae (Ach.) Zahlbr. Gasparrinia aurantia (Pers.) Syd.; Gasparrinia aurantia var. intermedia (Zahlbr.) Szatala; Gasparrinia callopisma (Ach.) Syd.; Gasparrinia callopisma var. enissalse (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 ‘aurantiaca’; Placodium callopismum (Ach.) Mérat

Thallus: crustose, forming neat rosettes to about 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 is sometimes present between the central and marginal parts. Marginal lobes: flat, usually not overlapping, 0.25 - 0.8 mm wide, to about 3 mm long, 250 - 320 µm thick. Cortex: present, 25 - 40 µm thick, colourless except in outer 10 - 15 µm which is orange, cellular, cells 6 - 11 x 4 - 6 µm, generally with the long axis oriented perpendicular to surface; K+ red-purple, usually also diffusing a red-purple pigment into solution, with the pigment in distinct granules. Apothecia: abundant in central parts of thallus but not present on marginal lobes (absent in at least outermost 3 mm), subimmersed when young, sessile when mature, flat, not pruinose, 0.3 - 0.75 (1.0) mm diameter. Disc: dark orange to dark orange-brown. Excieple: 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 uppermost part; reaction with K as for cortex. Thalline margin: usually present and persistent but in mature apothecia confined to lower surface; in section: 60 - 90 µm wide, cortex 20 - 40 µm wide with orange pigment in the outer half, colourless within. Epithecium: orange-brown to dark brown-orange, K reaction as for cortex. Hymenium: 80 µm tall, colourless to very pale brown-orange, generally underlain by a ±colourless subhymenium to 100 µm tall. Hypothecium: 50 µm tall (excluding subhymenium), colourless. Paraphyses: 1 µm wide at base, 3 - 4 µm at apex, often moniliform, not branched. Asci: 60 - 62 x 20 µm, Teloschistes type. Ascospores: colourless, polarilocular, 8 per ascus, 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). Pycnidia: often present on marginal lobes, dark orange, darker than thallus, 0.05 mm diameter; in section: 100% immersed, cup-shaped with a flat top, 150 x 120 µm, colourless (except where overlain by cortex), sometimes 2-chambered. Conidia: colourless, bacilliform, 3 - 4 x 0.75 µm.

Chemistry: orange parts K+ purple. 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 ensure that C. aurantia is usually easy to recognise. However, scanty material can sometimes be confused with C. flavescens, 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 the central parts of the thallus) but pure orange in C. flavescens (not differing much in colour from the central part). In C. flavescens, the 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 all altitudes, but scarce above 1000 m. A report from bark of Quercus, in Riga-Karandinos (2000), is unexpected but perhaps not impossible. The lichenicolous fungus Arthonia mokendoi has been reported from this species.

Present in most of Europe, except for the Nordic countries, but commonest in the southern part of the continent. Also Macaronesia (Azores), Asia (widespread), N. Africa (Morocco, Algeria, Egypt, Somalia), S. America (Argentina). Its status in N. America appears to be uncertain.
Caloplaca aurea (Schaer.) Th. Fr. (1871)  
  Mt. Olympus, on soil at altitudes of 1800 m and above.  
  Most European reports are from middle latitudes. Absent from the Nordic countries and British Is. In Italy is is confined to the north, though not quite restricted to the Alps. Also western Asia (Syria), N. Africa (Morocco).

Caloplaca austrocitrina Vondrak, Říha, Arup & Sochting (2009)  
in: Lichenologist 41(6): 588-589  
  Description: See the protologue.  
  Very scattered in the southern half of Greece. On calcareous rock close to sea level. Known from central Europe and Greece.

Caloplaca biatorina (A. Massal.) J. Steiner var. biatorina (1910)  
  The name Parmelia parietina var. biatorina Fr. (1831) may be synonymous, but Massalongo did not cite it.  
  Descriptions: Gaya (2009) is best. See also Clauzade & Roux (1985).  
  Scattered, on Crete and the mainland, but not reported for any of the smaller islands. On calcareous rock. The few reports to date cover almost the entire range of altitudes available in Greece. However, according to Gaya (2009) this is a holarctic species, so reports for low altitude, especially in southern Greece, are almost certainly unreliable. C. biatorina (at least sensu lato) is widely distributed in southern and central Europe, to as far north as southern Scandinavia, though it is absent from British Is. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread in western USA), Australasia (NZS).

Caloplaca biatorina var. pusilloides J. Steiner (1910)  
in: (probably) Ann. Mycol. 8(2): 239; Gasparrinia biatorina var. pusilloides (J. Steiner) Szatala  
  I have not seen a description of this variety, and I have no further information about it. It may prove to be a synonym of var. biatorina.  
  Mt. Olympus, on calcareous rock above 1800 m.  
  Only known from Greece and Iran.

in: Bull. Soc. Linn. Provence 51: 147  
  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: subsessile to sessile, flat to slightly convex, 0.3 - 0.9 mm diameter, not pruinose. Disc: orange. 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 obscuringly cellular (best seen in K) with cells 5 x 3 µm, lower part distinctly hyphal, but hyphae not parallel; pigmented part K+ red-purple, diffusing red-purple pigment into solution. Thalline margin: absent externally, sometimes obscurely present in section. Epithecium: almost colourless to pale orange-brown, K+ red-purple, diffusing red-purple pigment into solution. Hymenium: colourless, 80-100 µm. Hypothecium: colourless, 150 µm tall, sometimes with oil droplets 0.5 - 2 µm diameter. Paraphyses: often moniliform, apex 2 - 5 µm wide. Ascospores: colourless, ±polarilocular, 8 per ascus, ellipsoid, rarely very slightly swollen at septum, 12 - 16 x 5 - 7 µm, septum (when reasonably well defined) 3 - 7 µm wide, wall often distinctly thicker than is usual in Caloplaca, but some Greek collections have only thin-walled ascospores, lumina always with rounded ends but otherwise very varied: ellipsoid (in which case the ascospore appears simple), or hourglass shape, or forming 2 distinct lumina with the two internal ends usually pointed. Photobiont: green, of globose cells 12 - 19 µm diameter.  
  Provided that a sufficient number of ascospores are examined, this species can not be confused with any other, as the combination of thick-walled ascospores and hourglass-shaped lumina is very distinctive. However, care is required, as the distinctive ascospores are rare in some Greek collections.  
  Chios and Peloponnesse, never very far from the coast, on limestone at altitudes 5 - 850 m. Probably present, but overlooked, in other coastal parts of Greece. A circum-Mediterranean and Black Sea species. Spain, France, Italy, Greece, Bulgaria and Ukraine. Also western Asia (Turkey), N. Africa (Morocco, Algeria).
**Caloplaca 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), and surprisingly South America (Chile).

**Caloplaca cerina (Hedw.) Th. Fr. (1860) var. cerina**

in: Lich. arct. 118; Lichen cerinus Hedw. (1789) in: Descr. Micr.-Anal. Musc. Frond. 2: 62. (Authorship is not "Ehrh. ex Hedw."). Hedwig states that Ehrhart collected the lichen and sent it to him, but Hedwig does not ascribe the name itself to Ehrhart; Calloprosma cerinum (Hedw.) De Not.; Caloplaca cerina var. effusa (A. Massal.) Jatta; Caloplaca cerina f. ehrhartii J. Steiner nom. superfl.; Caloplaca cerina var. ehrhartii Trevis. nom. superfl.; Lecanora cerina (Hedw.) Ach.; Placodium cerinum f. dispersum (H. Olivier) Szatala; Placodium cerinum f. ehrhartii Szatala nom. superfl.; Placodium cerinum f. fuscum (A. Massal.) Szatala

Lecidea cerina var. ehrhartii Schaer. (1850) is a superfluous name for Lecidea cerina. All ehrhartii names derived from it are also superfluous.

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 warts. Prothallus or hypothallus: absent. Cortex: present but often rather irregularly developed, 8 - 25 µm thick, mostly colourless but 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 but 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. Exciple: usually not visible externally; in section: (0) 8 - 25 (40) µm wide, colourless in inner part, brown-orange or brown-orange-brown at surface. Thalline margin: always present, smooth and persistent, but in other respects very variable in external appearance; sometimes abundantly white pruinose at the apex, the coarse pruina then forming a very distinct white 'ring' when viewed from above; in section: (40) 80 - 180 µm thick, with a thick cortex that is well delimited from the algal layer; cortex usually colourless (sometimes pale brown in outermost 5 µm), 20 - 120 µm thick in water, sometimes swelling markedly in K, of anastomosed hyphae embedded in a K-soluble gel (in water it appears merely to consist of rounded cell-like 'blobs'), structure of outermost 10 - 20 µm sometimes appears slightly different. Epithecium: brown-orange or orange-brown, diffusing a purple-red solution in K and afterwards colourless or with clusters of purple-red crystals. Hymenium: colourless, 50 - 100 µm tall, KI+ blue. Hypothecium: colourless, 40 - 110 µm tall. Paraphyses: 1 - 1.5 µm wide at base, apex 3 - 5 µm, sometimes slightly moniliform, often branched in upper part. Asci: Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid or narrowly ellipsoid, 8 per ascus, 10 - 17 x 5 - 8 µm, septum 4 - 8 µm. Pycnidia: almost invisible externally; in section: 100% immersed, 90 x 60 µm, very pale grey at top part but elsewhere colourless. Conidia: colourless, bacilliform, 3 x 0.5 µm. Chemistry: disc K+ purple. Photobiont: green, cells globose, 7 - 15 µm diameter, forming a ±continuous 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 merely a response to that irregularity. Until I have seen well-developed material of C. monacensis on parietal bark, for comparison, I prefer not to refer any collections to that species. C. cerina can be confused with some morphs of C. holocarpa that possess a thalline exciple. However, in C. holocarpa the thalline exciple is never very well developed, is generally confined to the sides of the apothecia, and is usually excluded eventually. C. holocarpa also possesses a well-developed exciple, whereas the exciple in C. cerina is very narrow and usually not visible externally. C. haematites, which also occurs on bark, is easily separated from C. cerina by its smaller apothecia and the distinct red tinge to its disc.

Peloponnesian material referred here is heterogeneous, especially in characters concerning the external appearance of the apothecium. Morphology of the thallus is also variable. Peloponnesian material may represent a complex of closely-related taxa. The morph most commonly encountered has a thalline exciple that eventually becomes very thin, though it is never completely excluded. Another morph has a very thick thalline exciple throughout. What may be a third morph resembles the first one but has unusually small (0.25 - 0.5 mm diameter) apothecia. It has been noted in the literature that C. cerina is heterogeneous in Italy (Nimis, 1993) and in Crete (Vondrak et al., 2008, who remark that none of the Cretan material corresponds to C. cerina sensu stricto). There is a need for a revision of all Mediterranean material of this 'species'.

Throughout Greece. Almost always on bark, but recorded once on rock and once on wood of Abies cephalonica. Recorded from the bark of over 35 species of tree or woody shrub, with no obvious preference for particular hosts. Recorded at all altitudes where there are suitable substrates. Surprisingly, in view of the large number of records, no lichenicolous fungi have been recorded from this lichen. I have seen several collections with parasitised apothecia, but
have not been able to determine any of the parasites to species.

Subcosmopolitan in cool to warm temperate regions. Throughout Europe. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (widespread), C. America (Mexico, Guatemala), S. America (widespread), Australasia (widespread in temperate parts), Pacific (New Caledonia), Antarctica (James Ross Is). Some reports probably refer to *C. cerina* s. lat., not var. *cerina*.

**Caloplaca cerina var. stillicidiorum** (Vahl) Th. Fr. (1860)

as *C. cerina* β *stillicidiorum*, in: Lich. arct. 118; *Lichen stillicidiorum* Vahl (1792) in: [need to investigate]; *Caloplaca cerina var. chloroleuca* (Sm.)Th. Fr.; *Caloplaca cerina f. stillicidiorum* (Vahl) Th. Fr.; *Caloplaca stillicidiorum* (Vahl) Müll. Arg.

Descriptions: Clauzade & Roux (1985) as *Caloplaca stillicidiorum*; 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. South of the Alps it is much less common and confined to the mountains. Also Macaronesia, Asia (widespread in upland areas), N. Africa (Morocco), N. America (widespread in cooler regions), perhaps South America (Bolivia).

**Caloplaca cerina var. muscorum** (A. Massal.) Jatta (1900)


Considered by some authors to be a synonym of var. *stillicidiorum*, but as the matter does not seem to have been settled definitively I prefer to retain the name for the present.

Thallus: crustose, grey, rather granular. Prothallus: absent. Apothecia: abundant, crowded, almost obscuring the thallus, sessile, usually at least slightly concave, 0.55 - 1.5 mm diameter. Disc: red-orange to brown-orange, not pruinose. Proper exciple: in section: 25 - 30 µm wide, mostly colourless but orange-brown at surface. Thalline margin: persistent, white pruinose when young; in section: 80 - 110 µm, cortex 25 - 40 µm thick, with same structure as in var. *cerina*. Epithecium: orange-brown, diffusing a red-purple solution in K, and afterwards colourless or with clusters of red-purple crystals. Hymenium: colourless, 80 µm. Hypothecium: colourless, 50 µm. Paraphyses: 1 µm wide at base, 3 - 6 µm at apex, moniliform (more so than in var. *cerina*), often branched in upper part. Ascii: 50 x 18 µm. Ascospores: colourless, polarilocular, 8 per ascus, 14 - 20 x 7.5 - 9 µm, septum 5 - 7 µm. Chemistry: disc K+ purple.

A few authors have not recognised this variety. Although I have only a single collection from the Peloponnesian, it appears clearly distinct from all the material that I have cited as var. *cerina*. 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, and a granular thallus, as well as occurring on a different substrate. If these differences are consistently present, then I feel that this taxon ought to be treated at the rank of species.

Very scattered, in the mountains. On bryophytes on soil at altitudes 900 - 1750 m. Reported from many places in central and southern Europe, but absent (or at least unreported) from British Is and the Nordic countries. Also Macaronesia, Asia (widespread as far east as NW China), N. Africa (Morocco).

**Caloplaca cerinella** (Nyl.) Flagey (1896)


The earlier homonym *Lecanora cerinella* Flörke (1826) in Steud. & Hochst., Enum. Pl. Germ. 204 is a nomen nudum.

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. 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. Thalline exciple: sometimes weakly present; if present, to 45 µm wide in section, cortex poorly developed. Epithecium: 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, sometimes ±moniliform, apex to 3.5 µm wide. Asci: clavate to almost cylindrical, 40 - 52 x 10 - 20 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 12 - 16 per ascus, 8 - 12 x 5 - 5.5 (7) µm, septum 3 - 5 µm. Photobiont: green, cells globose, 10 - 16.5 µm diameter.

The very small apothecia ensure that this species can not be confused with any other 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. In
the Peloponnese, I have encountered the lichenicolous fungus *Lichenodiplis lecanorae* several times on this lichen.

Widely distributed in Europe to as far north as southern Scandinavia, but rather uncommon south of the Alps. Also Macaronesia (only Palma), Asia (fairly widespread outside the humid tropics), N. Africa (Morocco), perhaps S. America (Argentina), Australasia (Tasmania, NZS).

**Caloplaca cerinelloides** (Erichsen) Poelt (1993)


Thallus: crustose, immersed to 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: sessile to sessile, usually flat, not pruinose, 0.15 - 0.35 (0.4) mm diameter. Disc: orange to orange-yellow. 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. Thalline margin: sometimes visible, thin, grey, tending to become excluded; in section generally visible at least on lower surface of apothecia, 30 - 75 µm wide, cotex to 20 µm. Epithecium: orange to orange-brown, K+ mobilising a purple-red pigment into solution leaving the epithecium colourless. Hymenium: 50 - 60 µm tall, colourless. Hypothecium: 10 - 50 µm tall, colourless, without distinct structure. Paraphyses: 1 µm wide at base, 1.5 - 3 µm at apex, simple, capitiate or moniliform, with visible septa. Ascii: 47 - 50 x 12 - 14 µm, clavate, Teloschistes type. Ascospores: colourless, ellipsoid, 5 per ascus, 8.5 - 13 x 5 - 7.5 µm, septum 3 - 5 (6) µm. Photobiont: green (best seen below apothecia), cells globose, 10 - 15 µm diameter.

This species could only be confused with *C. cerinella*, but that has 12 - 16 ascospores per ascus.

Widely distributed 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 trees and shrubs, at altitudes 0 - 900 m. Most reports are from altitudes below 200 m. It appears to be a pioneer species on bark, and distinctly more thermophilic than *C. cerinella*. I have never seen any lichenicolous fungi on this species. If further observations show that *C. cerinella* is commonly parasitised by *Lichenodiplis lecanorae*, whereas *C. cerinelloides* is never host to that fungus, that might be a useful character for routine determination.

Widely distributed in Europe, just reaching southern Scandinavia, but not common south of the Alps. Also Asia (widespread), Australasia (NZS).

**Caloplaca chalybaea** (Fr.) Müll. Arg. (1862)


Thallus: crustose, superficial but sometimes very thin, to several cm diameter, thickness to 0.15 mm in a few specimens but generally less; specimens with a thin thallus are generally smooth or cracked, those with a thicker thallus are areolate. Areoles: white, pale brown or pale grey, sometimes with a 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 subimmersed 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. Exciple: present but sometimes rather indistinct and poorly developed, especially in specimens with a well-developed thalline exciple, 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. Thalline margin: sometimes present, but becoming excluded, to 100 µm wide in section. 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: colourless, 50 - 150 µm tall, sometimes with abundant crystals in lower part (?rock debris), usually without distinct structure but occasionally with a weak cellular texture in lowest part. Paraphyses: 1.5 µm wide at base, 2.5 - 5 µm at apex, usually at least slightly moniliform, sometimes branched in upper part. Asci: broadly clavate, 48 - 52 x 25 - 27 µm, Teloschistes type. Ascospores: colourless, polariilocular, usually ellipsoid but occasionally slightly lemon-shaped, 12 - 17.5 x 7 - 10 µm, septum 2.5 - 5 µm, 8 per ascus. Pycnidia: sometimes present near margin of thallus, appearing like black dots 0.04 - 0.07 mm diameter; in section: almost oblong, 180 x 220 µm (height x width), 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, probably not Trebouxia; 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.

In one collection, almost all the photobiont cells had a conspicuous black inclusion, like a developing tadpole in a frog’s egg.

For separation from *C. variabilis* see under that species. "Typical" maerial of this species is usually fairly 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 seen once what appeared to be this species on siliceous rock.) Host to the lichenicolous species *Muellerella erratic* and *Placopyrenium fuscum*.

Widely distributed 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)

Thallus: crustose, grey, areolate. Areoles: 0.3 - 1.5 mm diameter, 120 µm thick at margins, 200 µm at centre (plus another 100 µm where the distinction between thallus and rock is obscure). Prothallus: sometimes present, brown-orange, to 0.5 mm wide. Isidia: abundant over most of the surface of the areoles, very small, 0.01 mm diameter, almost black (much darker than thallus). Soralia: absent. Cortex: broad 15 - 50 µm thick, mostly colourless but sometimes pale brown in outer 5 - 10 µm, cellular; cells subrounded, 4 - 6 µm diameter; outer part faintly K+ violet (probably Sedifolia grey). Apothecia: frequent (in the only collection seen to date), subimmersed to subsessile, slightly concave to flat, 0.4 - 0.5 mm diameter, not pruinose. Disc: brown-orange. Proper exciple: present, orange, paler than disc; in section: 20 µm wide, colourless except at surface, which has same pigments as epithecium, cellular; cells +-isodiametric near surface, but in inner part lumina distinctly elongated. Thalline margin: present, persistent, 50 - 90 µm wide in section; cortex: present, colourless, 18 - 25 µm wide. Epithecium: orange-brown, diffusing a reddish pigment in K, and afterwards colourless to pale red. Hymenium: colourless, 60 µm tall, KI+ blue. Hyposphecium: colourless, 130 µm tall, without distinct structure (except sometimes in a thin layer at base which is continuous with exciple). Paraphyses: 1 µm wide at base, broadening to 3 - 4 µm at apex, sometimes slightly capitate, rarely moniliform. Asci: 45 - 52 x 15 - 17 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid (occasionally slightly swollen at septum when mature), 8 per ascus, 12.5 - 15 x 7.5 - 9 µm, septum 5 - 6 µm. Pyecidia: fairly common near margin of thallus, appearing as black dots 0.1 mm diameter; in section: 100% immersed, slightly pyriform, 150 x 120 µm, 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 isidia on a grey, areolate thallus ensure that this species cannot be confused with any other Peloponnnesian *Caloplaca*. However, its relation with *C. chlorina* sensu stricto is not clear to me. That species is often described as having a granular thallus, but the thallus is the only Peloponnnesian collection was not at all granular. *C. chlorina* is sometimes also described as having soredia, but the Peloponnnesian collection did not have soredia. I think it likely that *C. chlorina* as presently circumscribed in heterogeneous. For an alternative description, see Smith et al. (2009).

Scattered in the southern half of Greece, rare in the north, never very far from the sea. On rock, usually calcareous, at altitudes of 50 - 2000 m. The author's only Peloponnnesian collection was from a site where the level of nutrient enrichment was unusually high, as there was a large pen for sheep and goats nearby.

Reported from most of Europe. Also Macaronesia, Asia (Turkey, Russia, Pakistan), N. America (widespread but scattered), perhaps C. America. However, as presently delimited the species may be heterogeneous. It is not at all clear to me, for example, that the material occurring on calcareous rock around the Mediterranean is conspecific with that occurring on bark in Scandinavia.

**Caloplaca 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). 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. Also Macaronesia, Asia (widespread), N. America (scattered in USA), perhaps S. America, Australasia (Norfolk Is, NZS).

**Caloplaca chrysophthalma** Degel. (1944)

I suspect that Degelius misunderstood the status of some earlier names, and introduced a superfluous name here, but I have not yet seen his protologue.

Thallus: crustose, forming patches to a few cm diameter, white to orange, the orange parts being 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 not becoming entirely sorediate. Cortex: in orange parts of thallus 25 - 30 µm thick, colourless to pale brown, rather obscurely hyphal in upper part, hyphae oriented ±parallel to surface, sometimes obscurely cellular in lower part, K+ red-purple. Chemistry: thallus (orange parts) and soralia K+ purple. Photobiont: green, cells globose, 10 - 12 µm 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 of 500 - 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 (Russia, Tajikistan, Mongolia, Taiwan), N. America (southern Canada, widespread in USA), Australasia (Tasmania, NZS).

Caloplaca circumalbata (Delile) Wunder (1974) var. circumalbata

What follows, including the description, refers to 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, usually with an irregular surface. 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-. Epithectial pigment in upper part, without crystals. Hypothecium: 100 µm tall, colourless or with some epithelial pigment in upper part, without crystals. Hypothecium: 100 µm tall, colourless to pale brown. Paraphyses: usually simple, 3 µm wide at apex, clavate, not capitulate, sometimes slightly moniliform, with visible septa. Ascospores: 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 the southern and eastern parts of Greece. On limestone at altitudes to 1200 m. A circum-Mediterranean taxon. Most reports do not indicate which variety is involved, but the species has a whole range of variation.

Caloplaca circumalbata var. candida (Stizenb.) Wunder (1974)
in: Bibl. Lich. 3: 71; Basionym: Caloplaca [or ? Pyrenodesmia] variabilis var. candida Stizenb. [date not known] in: [need to investigate]

Description: 1 have not seen an adequate description of this taxon.

Scattered in the southern half of Greece; there is also a record for the Athos Peninsula. On calcareous rock, from sea level to 2500 m but rare above 1200 m. Var. candida is reported only for the Iberian Peninsula, Croatia and Greece.

Caloplaca 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.

Widely distributed in Europe. Also Asia (widespread), N. Africa (Egypt), N. America (widespread in cooler regions), S. America (Argentina, Brazil, Galapagos Is), Australasia (eastern Australia).

Caloplaca citrina (Hoffm.) Th. Fr. (1860)
in: Lich. arct. 118; Verrucaria citrina Hoffm. (1796) in: Deutschl. Fl. 2: 198

The earliest name may be Lichen linkii J. F. Gmel. (1792).

The Peloponnesian collection of Abbott (2009) probably belongs to C. flavocitrina. Most Greek reports probably also refer to other species, especially C. flavocitrina.

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.

According to Vondrák, Říha et al. (2009), C. citrina sensu stricto is probably almost restricted to northern and central Europe. C. citrina sensu lato is distributed throughout Europe. Also Macaronesia (widespread), Asia (widespread), Africa (widespread in N. Africa; also present in Socotra, Namibia), N. America (widespread), Caribbean
(Guadeloupe), C. America (CR, Mexico), S. America (Argentina, Brazil, Chile, Colombia), Australasia (widespread in temperate parts), Pacific (Hawaii), Antarctica (widespread).

**Caloplaca coccinea** (Müll. Arg.) Poelt (1975)

Description: Clauzade & Roux (1985).

Crete and Mt. Olympus, on calcareous rock at high altitude (1800 m and above).

Basically a species of central Europe; there are only a few records from south of the Alps. Absent from northern Europe I have not seen any reports for other continents. In Italy it has been under-collected according to Nimis (1993), and the same may apply to Greece.

**Caloplaca communis** Vondrák, Říha, Arup & Sochting (2009)
in: *Lichenologist* 41(6): 591-593

Description: see the protologue.

Crete, at altitudes 0 - 300 m.

SE Europe (Bulgaria, Ukraine, Russia, European Turkey, Crete, Sicily), and western Asia (Asiatic Turkey).

**Caloplaca conversa** (Kremp.) Jatta (1900)

Description: Nash et al. (2007) is a good recent description. Clauzade & Roux (1985) is best used in conjunction with Roux (2005).

Chios and western Crete, on siliceous rock at altitudes 5 - 500 m.

Widely distributed in southern and central Europe, but absent from British Is and the Nordic countries. Also Macaronesia, Asia (widespread as far east as Tajikistan; also a disjunct report for Hong Kong), N. Africa (Morocco, Algeria), N. America (scattered in USA), C. America (Mexico).

**Caloplaca coralliza** Arup & Åkelius (2009)
in: *Lichenologist* 41(5): 471-474

The correct name in *Caloplaca* appears to be *C. vipersae* (Zahlbr.) H. Olivier; in *Blastenia* it would be *B. vipersae* 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 & Åkelius (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 at altitudes 550 m and above.

Known from a large part of Europe, and also western Asia (Syria), N. Africa (Tunisia).

**Caloplaca coronata** (Kremp. ex Körb.) J. Steiner (1919)

I have referred three Peloponnesian collections to this species, but two are very scanty and their determinations are tentative. The third collection certainly belongs here, but is not extensive, and so the description below is brief. For a published description see Clauzade & Roux (1985).


Southern half of Greece, on rock (most commonly limestone) at altitudes 50 - 1050 m.

Widely distributed in Europe, though absent from British Is. Also Asia (Turkey, Syria, Siberia, China), N. Africa (Morocco).
Caloplaca crenularia (With.) J. R. Laundon (1984)

in: *Lichenologist* 16(3): 231; *Lichen crenularius* With. (1796) in: *Arr. Br. Pl. Ed. 3, 4: 22* (as *crenulatus*, clearly an error as Withering had already described a *Lichen crenulatus*. The spelling was corrected in the index); *Caloplaca caesiorufa* (Ach.) Flagey; *Caloplaca furuginea f. saxicola* [author unknown]; *Caloplaca festiva* auct., non Zwackh; *Lecanora caesiorufa* (Ach.) Nyl.; *Placodium festivum* auct., non Hepp

When Acharius introduced the name *Lecidea caesiorufa*, in 1803, he cited in synonymy his 1799 discussion of *Lichen caesiorufus* Schrad., a name that predates Withering's *Lichen crenularius* by two years. However, Acharius explicitly excluded the type of that name, so *Lecidea caesiorufa* must be treated as a new name dating from 1803 and attributed solely to Acharius. *Lichen caesiorufus* Schrad. therefore has no nomenclatural connection with *Caloplaca caesiorufa* (Ach.) Flagey. In fact, the identity of Schrader's lichen is uncertain according to Laundon (1992a).

The epithet *festiva* has often been misapplied to *C. crenularia*, but *Lecidea caesiorufa var. festiva* Ach. (1814) is an obligate synonym of *Caloplaca arenaria*, because Acharius cited in synonymy his own *Lecanora craspedia var. arenaria* (Pers.) Ach., a name that is based on *Lichen arenarius* Pers.

The *crenularia* group on siliceous rock is in need of revision in Greece. This seems to be yet another case where there is more genetic diversity in SE Europe than botanists working in other parts of Europe have recognised, and existing species concepts do not work very well. The relation between *C. limitosa*, *C. fuscoatroides* and Greek "*C. crenularia*", is the first problem that needs to be sorted out. The relation of this group to *C. aetnensis* and *C. atroflava* then needs to be addressed.

It should be noted that, as pointed out by Vondrák & Slavíková-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". Material from the Peloponnese that I have referred to this species tolerates 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 Peloponnesian 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 subquamulose or that have distinctly upturned margins has been referred to *C. fuscoatroides*. All other material in this group without any trace of chalky thallus (or chalky thalline exciple) and with apothecia that are unambiguously rust red (including those in which the apothecia becomes blackish later) has been assigned to *C. crenularia*. In other words, I am using the name in a 'dustbin' sense, and material placed under that name may be heterogeneous.

Some collections that are close to *C. crenularia* but with apothecial discs that are orange, red-orange or orange-red, but not clearly rust red, may belong to *C. atroflava*, but I cannot 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 exciple, 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 serious problem when trying to understand this group in the Peloponnese is that siliceous rock is not a common substrate 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 that follows is based on a single, but well-developed and ample, collection that fits the 'traditional' concept of *C. crenularia* reasonably well. In other words, it describes a single, real taxon, whatever name that taxon ought to be given; it is not a 'hybrid' description. The ecological information cited later, however, includes all the material that I have referred to *C. crenularia*.

Thallus: crustose, cracked to areolate, pale grey. Areoles: flat (without upturned margin). A black prothallus is weakly present in a few places, but discontinuous and inconspicuous. Apothecia: 0.4 - 1 mm diameter, sessile, flat, not pruinose. Disc: rust red, sometimes blackening a little in older apothecia. Exciple: rust red, never 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. 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. Epithecium: dark brown-orange, K+ red, diffusing a red pigment into solution. Hymenium: 70 µm tall, colourless. Hypothecium: to 120 µm tall, colourless; the upper 80 µm forming a subhymenium that is not contiguous with the exciple. Paraphyses: occasionally branched in upper part, often slightly moniliform, not capitulate. 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 the 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 the top to 260 µm wide, orange-brown in a surface layer 40 µm thick, colourless elsewhere, without a distinct wall. Conidia: colourless,
Caloplaca crenulatella (Nyl.) H. Olivier (1909)

I have collected material that keys out as this species from three sites in the Peloponnese. However, the collections are heterogeneous, and they can not all correspond to C. crenulatella sensu stricto. Peloponnesian material will have to be revised when Caloplaca groups 9, 10 and 12A are better understood in the Peloponnese.

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, 24-Mar-2007/38), cellular, cells 5 - 6 µm diameter. Apothecia: sessile, flat, not pruinose (very slightly pruinose in 24-Mar-2007/38), 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. Exciple: orange or pale orange, paler than disc, persistent; in section 15 - 30 µm wide, orange-brown at surface, colourless in lower part, hyphae in upper part developing distinct elongated lumina; pigmented part K+ red-purple (pigment diffusing into solution). Thalline exciple: variable, but never very prominent; sometimes absent; in 24-Mar-2007/38 the uneven pattern of exclusion gave a slightly crenulate appearance to the apothecia. Epithecium: brown-orange to orange-brown, K+ red-purple (pigment diffusing into solution). Hymenium: colourless, 70 µm tall (collections on lava) or 75 - 100 µm (collections on limestone). Hypothecium: colourless, 70 - 100 µm tall. Paraphyses: usually moniliform, apex 2 - 4 µm wide (collections on lava) or 3.5 - 6 µm (collections on limestone). Ascospores: colourless, polarilocular, narrowly ellipsoid, 8 per ascus, 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. Photobiont: green, of globose cells.

For published descriptions of C. crenulatella, see: Clauzade & Roux (1985); Smith et al. (2009).

Very scattered, perhaps throughout Greece. On rock, usually but not always calcareous, at all altitudes.

The statement in Nims (1993) that the type of this species was on siliceous rock is incorrect. In the protologue, Nylander cited this species supra saxa calcarea circa Staveley (Martindale). 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.

Quite widely distributed in southern and central Europe, and there are a few records from as far north as southern Scandinavia. Also Asia (Turkey, Russia), N. America (scattered in USA), C. America (Mexico), Australasia (NZS).

Caloplaca cretensis (Zahlbr.) Wunder (1971)

Descriptions: Roux (2005), or see Zahlbruckner's fairly detailed protologue.

Scattered, mostly in localities close to the Aegean Sea, but also reported for Corfu. On calcareous rock at altitudes 0 - 1200 m.

Known only from Sicily, Croatia and Greece.

Caloplaca dalmatica (A. Massal.) H. Olivier (1909)
in: Méms. Soc. Natn. Sci. Nat. Math. Cherbourg 37: 30 & 112; Callopisma dalmaticum A. Massal. (1855) in: Symm. Lich. Nov. 30-31. (Published in 1854 as a nomen nudum.); Blastenia schaereri (Arnold) Servit; (?) 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. placidia (A. Massal.) Dalla Torre & Sarnth.;
Caloplaca aurantiaca var. velana (A. Massal.) Flagey; Caloplaca dolomitica (Hue) Zahlbr.; Caloplaca placidia (A. Massal.) J. Steiner; Caloplaca placidia var. diffracta (A. Massal.) J. Steiner; Caloplaca placidia var. velana (A. Massal.) J. Steiner; Caloplaca schaereri (Arnold) Zahlbr.; Caloplaca velana (A. Massal.) Du Rietz; Caloplaca velana var. schaereri (Arnold) Clauzade & Cl. Roux; (? Lecanora aurantiaca auct. graec. (saxicolous records only); Placodium placidium var. diffrafuctum (A. Massal.) Szatala; Placodium placidium var. velanum (A. Massal.) Szatala

Several names for this taxon were published before 1855, but Callopiasma dalmaticum has priority at the rank of species.

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.

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 the edge of many of the areoles, sometimes also present at the margin of the thallus. Apothecia: immersed at first but soon becoming subsessile or sessile, often remaining flat but becoming convex in some collections, 0.2 - 0.7 mm diameter, not pruinose (but some collections have a very rough brown disc which gives the impression of a brown pruina). Disc: orange to brown, usually smooth but very rough in a few collections. 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. Thalline margin: sometimes obscurely present in section, on lower surface of apothecia, but not visible externally. Epithecium: orange-brown, K+ red-purple, often with abundant crystals. Hymenium: 50 - 75 µm tall, often (not always) with epiphytic pigment in the top third or top half, colourless elsewhere. Hypothecium: 60 - 100 µm tall (of which half to two-thirds is a subhymenium), colourless. Paraphyses: moniliform, apex 2.5 - 6 µm; the apical cell is not always the widest. Asci: ±clavate, 45 x 13 - 16 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 9 - 13 x 5 - 10 µm, septum 3 - 5 µm wide; however, many collections lack mature ascospores. Photobiont: green, of subglobose or globose cells, 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.

Peloponnesian material referred to C. dalmatica is variable and may be heterogeneous. Some collections have a distinct brown tinge to the thallus, and usually also to the apothecial disc, whereas in others the thallus and disc are unambiguously orange. Some collections have a well-delimited margin, often marked by a prothallus, whereas in others the margin is poorly defined. It will be necessary to collect and study much more material before this taxon is properly understood in the Peloponnes.

Peloponnesian collections correspond fairly well to the Clauzade & Roux (1985: 251) concept of C. dolomitica (Hue) Zahlbr (as C. velana var. dolomitica). None of them match any of the other infra-specific taxa treated by Clauzade & Roux.

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 (Morocco, Algeria, Tunisia, S. Africa; also Ascension Is, St Helena), perhaps N. America (Alabama), perhaps Caribbean (Bahamas), perhaps C. America (CR), perhaps S. America (Argentina).

Caloplaca decipiens (Arnold) Blomb. & Forssell (1880)
in: [need to investigate]; Physcia decipiens Arnold (1867) in: Flora 50: 562; (?) Caloplaca decipiens var. leprosa Arnold

Description: Gaya (2009) is best. Also in: 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 rare in Mediterranean countries. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (widespread in western half of USA), perhaps C. America, Australasia (NZS).

Caloplaca diffusa Vondrák & Llimona (2011)

Description: See the protologue.

Eastern Peloponnesse, on serpentine rock at low altitude.
Scattered in Europe 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. Not recorded since 1959 (based on collections made in 1934).

Northern and central Europe; very rare south of the Alps. Also western Asia (fairly widespread as far east as the Himalayas), western USA (Colorado, Montana), Antarctica (though this may prove to 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.

Caloplaca emilii Vondrák, Khodosovtsev, Cl. Roux & V. Wirth (2013)
Description: See the protologue.
Island of Poros, on limestone at an altitude of 200 m.

Reported from central Europe, from France to Bulgaria, and Greece, but probably widely distributed around the Mediterranean.

Caloplaca epithallina Lynge (1940)
in: Skr. Svalb. Ishav. 81: 113-114
Description: Clauzade & Roux (1985); Nash et al. (2007).

Very scattered in the northern half of Greece. One of the two published records, that for Evia, was considered doubtful by Abbott (2009). The other was from an altitude of 200 m; no substrate (or host) was cited.

Northern and central Europe; very rare south of the Alps. Also Macaronesia, Asia (widespread in cooler regions), N. America (widespread in the western half of the continent), 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 inconstant and intermitent, 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: always abundant, confined to central part of thallus, basically rounded but sometimes becoming angular by compression, (0.25) 0.4 - 0.7 (0.8) mm diameter, immersed to submersed, only rarely becoming subsessile, usually ±flat, not pruinose. Disc: dark red or rust red, sometimes blackening. 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 a weak cellular structure; pigmented part K+ red, diffusing a red pigment into solution. Thalline margin: very variable; prominent in some specimens, absent or confined to the lower surface of the apothecia in others. 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: narrowly clavate, 65 x 15 - 16 µm, ±Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12 - 16 (18) x 6 - 8 (10) µm, septum (3) 5 - 8 µm. 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 x 140 - 160 µm, pale brown to grey in a surface layer 15 - 25 µm thick, colourless elsewhere, without a prominent wall. Conidia: colourless, narrowly ellipsoid to almost bacilliform, 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* or came from something else.

It is common to encounter material with abundant apothecia but few or no mature asci. This seems to be a result of over-mature, not immature, apothecia, as staining with KI reveals remains of the apical apparatus of many discharged asci.
This distinctive and beautiful species can not be confused with any other.

Very common in the southern half of Greece, rare in the north are there perhaps restricted to sites with a maritime climate (i.e. not very far inland). Usually on limestone, but sometimes on other kinds of rock that are not strongly acidic. The few reports from bark certainly refer to other species. At altitudes 0 - 1300 m.

Widespread and common in southern Europe. Present north of the Alps, but does not reach British Is or the Nordic countries. Also Macaronesia, Asia (mostly in the west, but present as far east as NW China), N. Africa (Morocco, Algeria, Tunisia, Egypt). A report for S. America (Tierra del Fuego) seems very doubtful to me.

Caloplaca ferrarii (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, though there are a few reports for north of the Alps (Czech Republic, Ukraine). Also western Asia (Syria, Iraq, Israel), N. Africa (Morocco).

Caloplaca ferruginea (Huds.) Th. Fr. (1860)
in: Lich. arct. 123; Lichen ferrugineus Huds. (1762) in: Fl. Angl. 444; Blastenia ferruginea (Huds.) A. Massal.: Blastenia ferruginea a (= var.) genuina Körb., nom. inval.; (?) Blastenia ferruginea f. lignicola (Harm.) Szatala; (?) Blastenia ferruginea f. microcarpon (Anzi) Szatala (as microcarpa); Caloplaca ferruginea a (= var.) genuina Th. Fr., nom. inval.; (?) Caloplaca ferruginea f. microcarpon (Anzi) Mereschk. (Greek reports as microcarpa); (?) Caloplaca ferruginea var. microcarpon (Anzi) Szatala (as microcarpa); Caloplaca festiva f. cinereofusca (F. H. Wigg.) J. Steiner; Caloplaca festiva var. cinereofusca (F. H. Wigg.) Szatala; Caloplaca festiva f. oblitterata (Körb.) Szatala; Placodium ferrugineum var. genuinum Räs., nom. inval.

For a discussion of the epithet aurantiaca, see under Caloplaca flavorubescens. Some Greek records of Caloplaca aurantiaca might refer to C. ferruginea.

Thallus: crustose, pale grey, forming patches to 4 cm diameter, superficial and fairly well developed but thin (90 - 150 µm thick), slightly cracked (only 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) 0.5 - 1.4 mm diameter, not pruinose. Disc: rust red or dull red. Exciple: ± same colour as disc, or only 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 anastomosing hyphae, never developing a true cellular texture even in outermost part, all parts reacting I-, pigmented part K+ red (pigment diffusing into solution). N-. Thalline margin: absent. 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, rather variable and not always sharply delimited from hypothecium, without oil droplets, I+ blue. Hypothecium: 50 - 90 µm tall, colourless, I-. Paraphyses: simple, sometimes slightly moniliform, not so capitate, 1.5 - 2 µm wide in lower part, 2.5 - 3 µm in upper part. Asci: 45 x 14 µm, narrowly clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12 - 17 x 6 - 9 µm, septum 4 - 8 µm. Chemistry: apothecia K+ purple; thallus K-, C-, KC-, UV-. Photobiont: green, cells globose, 8 - 10 µm diameter, often in clusters, forming a discontinuous but usually ± regular layer 25 - 75 µm thick.

The I reactions of apothecial section were observed using Lugol's iodine alone (no pre-treatment with C). Roux (2005) gives a range of 6 - 7 µm for the width of the ascospores septum, but in Peloponnesian material the range is definitely greater than that. Possibly Roux's figure is appropriate for truly mature ascospores, but in practice it is not always possible to judge the degree of maturity of an ascospore.

A collection from wood of Abies cephalonica (29-Aug-2004/74) has more branching in the paraphyses than I would expect for C. ferruginea, but otherwise agrees well with that species. (This collection definitely does not belong to C. pollinii or C. hungarica.) For the present, I have retained it within C. ferruginea.

The large, flat, rust-red discs with a ±concolourous, persistent and sometimes strongly convoluted margin ensure that this species, when well developed, can not be confused with any other. C. hungarica is a much smaller species, and the apothecia are sometimes convex, and the exciple sometimes becomes excluded. Collections in which the apothecia seem unusually orange should be checked against C. aegatica and even C. flavorubescens. Those species always have some paraphyses that are branched in their 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 (82 percent of records), and recorded from a wide range of trees and shrubs; less commonly on wood (8 percent), the only species definitely recorded being Abies cephalonica. Reports from rock probably refer to other species.

Throughout Europe. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, Rwanda, S. Africa, Reunion Is), N. America (widespread), perhaps Caribbean (Bahamas), C. America (Mexico), southern S.
Caloplaca festivella (Nyl.) Kieff. (1895)
in: [need to investigate - bibliographical info incomplete]; Lecanora ferruginea var. festivella Nyl. (1873) in: Flora 56: 197

Description: See Nylander's protologue. This species belongs in group 14, but is not included in the key as I have insufficient information.

Known from a single site in western Macedonia, from serpentine at an altitude of 2170 m. Rare and scattered in the mountains of Europe, from Sweden to Calabria. Also India (Madhya Pradesh).

Caloplaca flavescens (Huds.) J. R. Laundon (1984)
in: Lichenologist 16(1): 53; Lichen flavescens Huds. (1762) in: 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 var. heppiana (Müll. Arg.) Poelt, nom. inval.; Caloplaca callopisma f. centroleuca (A. Massal.) J. Steiner; Caloplaca heppiana (Müll. Arg.) Zahlbr.; Caloplaca murorum f. centrifuga (A. Massal.) J. Steiner; Gasparrinia aurantia f. centrifuga (A. Massal.) Szatala; Gasparrinia aurantia f. centroleuca (A. Massal.) Szatala; (?) Gasparrinia aurantia var. dalmatica (Zahlbr.) Szatala; Lecanora heppiana (Müll. Arg.) Hue; Placodium murorum var. centroleucum (A. Massal.) Hepp

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 have followed Nimis (1993) and placed them here.

Thallus: crustose, orange, sometimes brown-orange in the central parts, usually not pruinose, rarely with a slight white pruina, areolate in the centre, lobed at the margin, usually forming small rosettes to about 3 cm diameter. 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, and diffusing a red pigment into solution; the pigment (at least in K) is present in abundant granules. Medulla: white. Lower cortex: absent. Apothecia: usually abundant in central part of thallus but not present within about 2 mm of the margin, sessile, flat, not pruinose, 0.55 - 0.75 mm diameter. Disc: orange to dark orange. 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 the outermost 10 - 15 µm which is brown-orange, mostly formed of anastomosing hyphae, but in the outermost 25 µm the hyphae broadened giving a weakly cellular appearance; K reaction of pigmented part as for epithecium. Thalline margin: present but generally confined to lower surface of apothecia, persistent; in section: 100 - 200 µm wide, cortex 20 - 30 µm. Epithecium: dark orange-brown, K+ red, diffusing a red pigment into solution and into the hymenium; rather few pigment granules visible in K. Hymenium: 70 µm tall, colourless, underlain by a colourless subhymenium to 100 µm tall. Hypothecium: 60 µm tall, colourless. Paraphyses: 1.5 µm wide at base, 3 µm at apex, sometimes slightly moniliform, simple. Asci: 62 x 17 µm, ±cylindrical to narrowly clavate, Teloschistes type. Ascospores: colourless, polarilocular, 8 per ascus, usually lemon-shaped or rhomboid, but sometimes almost globose, 11 - 14 (17) x 6 - 10 µm, septum 3 - 5 µm. Pycnidia: often present on the marginal lobes, where they form small bumps, dark orange (darker than thallus), 0.05 - 0.11 mm diameter; in section: 70% immersed, ±globose though with a rather flat top, 220 x 200 µm, colourless except where overlain 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 the clumps; in some places prominent bundles of hyphae extend upwards from the medulla through these gaps.

For separation from C. aurantia, see under that species.

Throughout Greece. On rock, usually limestone, but occasionally found on weakly calcareous or even apparently non-calcareous rock. The Peloponnesian collections that I have seen on substrates other than limestone do not belong to C. aegaea; they agree morphologically with C. flavescens and are not always found in coastal regions. At all altitudes, but commonest below 1000 m.

Present in most of Europe, as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Israel, Russia as far east as southern Siberia), N. Africa (Morocco, Algeria, Tunisia, Egypt).
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. (They are true soralia, and lack a cortex.) Apothecia: present but not abundant, sessile, slightly concave to flat, 0.45 - 0.55 mm diam, not pruinose. Disc: brown-orange. Exciple: present, thin, orange; in section: 25 µm wide, colourless in inner part, brown-orange at surface, hyphal. Thalline margin: present, pale yellow, sometimes abraded but not sorediate; in section: 50 µm wide, brown-orange in outer 20 µm. Epithecium: brown-orange, K+ red-purple. Hymenium: colourless, 50 µm tall. Hypothecium: colourless, 125 µm tall, 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, septum 2.5 - 4 µm. Chemistry: thallus, soralia and apothecia all K+ purple. Hymenium: colourless, 50 µm tall. Hypothecium: colourless, 125 µm tall, 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, septum 2.5 - 4 µm. Chemistry: thallus, soralia and apothecia all K+ purple. Photobiont: green, cells globose, 8 - 17 µm diameter.

Scattered in the southern half of Greece, on bark, wood and calcareous rock, usually at altitudes 0 - 400 m, though there is a single report from over 1000 m. All reports to date are from sites within a few km of the sea.

Widely distributed in Europe, as far north as southern Scandinavia. It may be commoner than the rather few records to date suggest, since it has often been confused with other species. Also Macaronesia, Asia (Turkey, Georgia, India), "Africa" (St Helena, Ascension Is), N. America (Virginia), Pacific (Hawaii).

**Caloplaca flavorubescens** (Huds.) J. R. Laundon var. flavorubescens (1976)
in: *Lichenologist* 8(2): 147; *Lichen flavorubescens* Huds. (1762) in: 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: (♀) *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* Lightf., on page 810 of Lightfoot (1777), he 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 suggested that it may be the same as *Lichen flavorubescens* Huds., but that species is never saxicolous. (Since he expressed some doubt about the synonymy, he did not establish an obligate synonym.) Saxicolous Greek records under this name probably refer to *Caloplaca dalmatica* and Abbott (2009) cited them under that name, but some might refer to *C. flavovirescens*. Corticolous Greek records probably refer to *C. flavorubescens*, and Abbott (2009) cited them under that name, but some might refer to *C. ferruginea*. The name *Lichen aurantiacus* Lightf. was lectotypified by Laundon (1976), page 148, on a Dillenian specimen that belongs to the species now known as *Caloplaca ferruginea*.

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, but 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 (especially in the "small apothecia" taxon - see below), (0.2) 0.3 - 1.5 mm diameter, not pruinose. Disc: orange. 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 (not cellular) but details of anatomy are hard to discern; pigmented part K+ red. Thalline margin: sometimes absent altogether, sometimes visible in section on the lower surface of the apothecia, occasionally just visible externally from above as a greyish or pale yellow ring, in section: 60 - 100 µm wide, with algal cells in a very neat and regular band 15 - 25 µm wide; cortex brown-orange near the surface, colourless elsewhere. (For more details of the anatomy, which is basically the same in both varieties, see under var. *quercina*.) Epithecium: orange-brown to brown-orange, K+ red. Hymenium: colourless, 60 - 100 µm tall. Hypothecium: colourless, 45 - 100 µm tall (including subhymenium), not transparent, oil droplets occasionally clearly visible but in many collections I could not observe any. Paraphyses: often slightly moniliform or at least slightly capitulate, apex 1.5 - 3 microns. Ascii: Teloschistes type. Ascospores: colourless, polarilocular, generally ellipsoid but occasionally swollen markedly at septum, 8 per ascus, (11) 12 - 17 x 7 - 11 µm, septum 3 - 8 µm wide. Pycnidia: nearly always present in marginal part of thallus (though sometimes inconspicuous), as orange dots, generally slightly darker than thallus, 0.1 mm diameter; in section: 100% immersed, agglomerate, 130 x 120 µm, wall orange in upper half, colourless below. Conidia: colourless, bacilliform to slightly pyriform, 2 x 0.7 µm, about 3 times as long as broad. Photobiont: green; cells globose, 12 - 15 µm diameter, forming in well-developed thalli a continuous and regular layer 125 µm thick.

When the thallus has a well-developed green tinge, *C. flavorubescens* can not be confused with other species. However, it is sometimes poorly developed, and collections with small apothecia and small ascospores can resemble some morphs of *C. pyracea* with a pigmented and well-developed thallus. However, in *C. flavorubescens* the thallus is always continuous; this is rarely the case in *C. pyracea*. In doubtful cases, try to find a pycnidium; the presence of even one pycnidium is sufficient, for most 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, and Sipman & Raus (2002) report it once for calcareous rock (though confusion with *C. flavovirescens* seems a possibility 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), N. America (southern Canada, widespread in USA), S. America (Argentina, Paraguay), Australasia (widespread), Pacific (Hawaii, New Caledonia, Tahiti), Antarctica (subantarctic Macquarie Is).

**Caloplaca flavovirescens** var. *quercina* (Flagey) Giralt, Nimis & Poelt (1992)

According to the material that I have seen to date, var. *quercina* differs from var. *flavorubescens* merely in having a more prominent and persistent thalline exciple. In var. *flavorubescens* the thalline exciple is poorly developed or even entirely absent. However, there seems to be a continuum from specimens entirely lacking a thalline exciple through to those with a well developed and persistent thalline exciple, and it is not clear to me whether var. *quercina* merits formal taxonomic recognition. It is said to differ also from var. *flavorubescens* in the upper limit of the diameter attained by apothecia, but that is not apparent in Peloponnesian material seen by me.

The cortex of the thalline exciple 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, 70% immersed; in section: multi-chambered, without an obvious pycnidial wall, mostly colourless but orange-brown at the very top, 260 (tall) x 250 (wide) µm. Conidia: colourless, bacilliform, 2 - 2.5 x 0.5 µm.

No comprehensive, modern description of this variety appears to have been published, though there is a brief one in Roux (2005). The description in the protologue reads merely *Thallus K.* *Sporae ellipsoidae, polariloculares, 16 x 9*, which is, to say the least, unhelpful. Authentic material was distributed as number 71 in an exsiccata of Algerian lichens - see Sayre (1969) for full details - so it should be possible to determine the application of the name.

Southern half of Greece, but less common than var. *flavorubescens* (or perhaps merely not often regarded s distinct from that variety). On bark of a fairly wide range of trees and shrubs, but avoiding strongly acidic bark, at altitudes 0 - 1500 m.

Circum-Mediterranean: southern Europe, western Asia (Syria), N. Africa (Algeria).

**Caloplaca flavovirescens** (Wulf.) Dalla Torre & Sarntch. (1902)


Scattered, usually but not always close to the sea. On rock, usually calcareous, at altitudes 300 - 2170 m.

Throughout Europe except for arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Egypt, S. Africa; also Ascension Is, St Helena), N. America (widespread), Caribbean (PR, perhaps Bahamas), C. America (Mexico), S. America (Argentina, Colombia), Australasia (Victoria, NZS).

**Caloplaca furax** Egea & Llimona (1983)
in: *Collectanea bot.* 14: 266

Description: There is a brief description in Wetmore (1996).

Chios, on sandstone at an altitude of 480 m.

Spain, Italy, Bulgaia and Greece. Also western Asia (Turkey).

**Caloplaca furfuracea** H. Magn. (1944)

Thallus: crustose, white to grey. Isidia: scarce to abundant, rather soft, usually granular, sometimes proliferating sightly but never 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 ±crinulate later (0.3) 0.5 - 1.6 mm diameter, not pruinose. Disc: usually rust red, sometimes dark orange. Exciple: rust red, often slightly paler than disc, sometimes becoming distorted 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. Thalline margin: absent. Epithecium: dark orange-brown. Hymenium: 100 µm tall, colourless. Hypothecium: 125 µm tall, colourless, upper half sometimes forming a subhyphenum that is not continuous with exciple. Ascospores: colourless, polariloculare, ellipsoid, 8 per ascus, 11 - 14 x 7.5 - 8 µm, septum 4 - 5 µm. Chemistry: isidia K- (even in section). Photobiont: green, cells globose, 7 - 15 µm diameter.

Crete and Peloponnesse. On bark (*Abies cephalonica, Cupressus sempervirens, Quercus coccifera*) or wood at
altitudes 700 - 1400 m.

Widely distributed in Europe, but scattered. Also western Asia (Turkey, Kazakhstan), N. America (Yukon), widespread in western USA.

**Caloplaca fuscoatroides J. Steiner (1919)**

Very similar to *C. crenularia*, but differing in having a thallus of subsquamulose areoles. The thallus is distinctly areolate, unlike typical collections of *C. crenularia* (which have a smooth to cracked, or sometimes weakly areolate, thallus), and the margins of the areoles are irregular and upturned.

It is not clear to me whether *C. fuscoatroides* is a good species or merely represents one of the extremes of variation within *C. crenularia*. Sipman & Raus (1995) suggest that *C. fuscoatroides* may be merely a morph of *C. crenularia* in which the form of the thallus is a response to the substrate. Since typical *C. crenularia* is common on lava on Methana, I find it difficult to accept this suggestion, though it is worth noting that at the two sites where *C. fuscoatroides* was collected, I did not collect any typical material of *C. crenularia*. More collections are needed to clarify the matter.

Fairly widely distributed in and around the Aegean Sea (including Crete), on siliceous rock at altitudes 5 - 1450 m. Restricted to regions near the Mediterranean. It Europe, it has been reported for Spain, Italy, Greece and, recently, Bulgaria. Also Asia (Turkey).

**Caloplaca fuscoblastidiata van den Boom & Etayo (1995)**
in: *Mycotaxon* 56: 126-131

Thallus: crustose, green-grey to brown-green when fresh, fading to brown in the 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. Exicle: brown, becoming almost excluded; in section: of radiating hyphae with broad lumina, but often appearing cellular. Thalline margin: absent, even in section. Epithecium: brown to green-brown, K-.

The species is very distinctive and can not be confused with any other.

Western Peloponnese, on bark of *Pinus pinea* in a coastal site at an altitude of 10 m. That site was completely destroyed by fire in 2007.

Reported from southern Portugal and southern Spain in the protologue. The Greek collection is the only other one that I know of.

**Caloplaca geleverjae Khodosovtsev & S. Y. Kondr. (2009)**
in: *Vondrák et al., in Lichenologist* 41(6): 596-597

Description: See the protologue.

Known from a single coastal site in southern Sterea Ellada, where is occurred on limestone close to sea level. Only Greece and Ukraine.

**Caloplaca 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. Exiple: orange, slightly paler than disc, persistent but becoming very thin. Thalline margin: absent. Epitheciun: orange, K+ purple. Hymenium: 80 µm tall, colourless. Hypothecium: 100 µm tall, colourless. Ascospores: colourless, ellipsoid to slightly rhomboid, often swollen at septum, 8 per ascus, 15 - 17 x 7 - 7.5 µm, septum 3.5 µm wide. Photobiont: green.

According to the protologue, mature ascospores may develop very distinctive "Physcia type" lumina. Such lumina were not observed in my single, rather scanty collection. However many ascospores were clearly swollen around the septum.

Specimens with well-developed ascospores are not likely to be confused with any other species, except perhaps *Caloplaca latzei*, but that has a smoother, non-areolate thallus. In the absence of mature ascospores, could be confused with some morphs of *C. dalmatica*, though *C. dalmatica* usually has a conspicuous black hypothallus.

Peloponese 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. Reported for Sweden, Spain, southern Italy, and Greece. Also Asia (northern Ural
Mts), N. Africa (Morocco). This pattern is hard to interpret.

Caloplaca granulosa (Müll. Arg.) J. Steiner (1894)

Descriptions: Clauzade & Roux (1985); Smith at al. (2009).

Widely distributed in southern and central Europe, but absent from Scotland and the Nordic countries. Also Asia (Russia, Tajikistan, Japan), Africa (Algeria, S. Africa), perhaps N. America, perhaps S. America (Argentina), Australasia (Victoria), perhaps Pacific (Henderson Is).

The var. sardonia Nimis & Poelt has not been explicitly reported for Greece; all reports are presumed to refer to var. granulosa.

Caloplaca grimmiaea (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 in old apothecia, usually below 800 m (80% of reports). (Reports said to be from rock may be incorrectly determined, or may have overlooked the parasitic habit.)

Widely distributed in Europe to as far north as southern Scandinavia, though absent from British Is. Also Macaronesia, Asia (widespread), N. America (scattered in USA).

Caloplaca haematites (Chaub.) Zwackh (1862)
in: Flora 45:487; Lecanora haematites Chaub. (1821) in: Saint-Amans, Fl. Agen. 492; Callophisma haematites (Chaub.) A. Massal.; Caloplaca cerina var. haematites (Chaub.) Flagey; Lecanora cerina var. haematites (Chaub.) Nyl.; Placodium haematites (Chaub.) Anzi

Thallus: crustose, usually forming small patches a few mm wide, but sometimes extending to larger areas a few cm across, grey to dark grey, thin, about 100 µm in section, occasionally thick enough to display some cracks or areolation. Cortex: to 25 µm thick when well developed, colourless, K+ violet. Apothecia: subsessile 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 a slight white pruinina on the thalline exciple. Disc: orange-red to red. 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, but hyphae broaden irregularly in upper part giving a weak cellular structure with elongated lumina; aspect ratio of lumina 1.5 - 2; surface layer K+ violet (not purple, and quite distinct from the reaction of the epithecium, but the purple reaction is masked if any epithelial pigment is present). Thalline margin: grey, persistent but sometimes becoming thin in old apothecia, usually smooth and continuous, rarely becoming 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, with a cortex 25 - 40 µm wide that is well delimited from the algal layer; the cortex appears vaguely cellular in water but its structure in K is not clear - it does not appear to be typical 'cerina' type. Epithecium: orange-brown to brown-orange, in K diffusing a red or red-purple pigment into solution (and often also into the hymenium), and afterwards appearing pale red or pale red-purple. Hymenium: 60 - 70 µm tall, colourless, occasionally with some epithelial pigment in uppermost part, K+ blue. Hypothecium: 75 - 80 µm tall, colourless. Paraphyses: 1 µm wide at base, 2 - 3.5 µm at apex, sometimes moniliform, often branched in upper part. Asci: 43 - 45 x 15 - 17 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12.5 - 16 x 7 - 7.5 µm, septum 4 - 8 µm.

Conidia: not visible externally; in section: 100% immersed, subglobose, 100 x 80 µm, 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 are also very different from *C. cerina*.

Throughout Greece. Nearly always on bark, rare on wood. Recorded from a very wide range of trees and shrubs, tending to avoid only strongly acidic bacteried conifers. At all altitudes where there are suitable substrates, though commoner below 1000 m altitude than above it. The lichenicolous fungi *Lichenidiplis lecanorae* and *Zwackhiomyces coepulonus* have been recorded from it.

Basically a southern European species, though its range does extend north to southern England, where it is rare. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). A report for S. America (Chile) seems doubtful to me.

*Caloplaca herbidella* (Nyl. ex Hue) H. Magn. (1932)


Of the two Peloponnesian collections referred to this species by Abbott (2009), one definitely belongs to *C. furfuracea*. The other is puzzling, as it has a brown thallus and narrow isidia, 0.05 - 0.08 (0.1) mm wide, but is abundantly fertile and occurred on the bark of a conifer, *Abies cephalonica*. According to Arup & Åkelius (2009) the first two characters match *C. coralliza*, whereas the second two do not, and are more characteristic of *C. herbidella*. That collection has tentatively been assigned to *C. coralliza*, but additional collections are needed to clarify its position. For additional published descriptions see Clauzade & Roux (1985); Smith et al. (2009).

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 *Quercus pubescens*, at altitudes 20 m and above. The lichen *Candelariella xanthostigma* has been reported "on" this species, but was probably merely overgrowing it, rather than parasitic.

Throughout Europe except for arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia). Reports for N. and S. America are said to be incorrect.

*Caloplaca holocarpa* (Hoffm.) A. E. Wade (1965)


The nomenclatural situation requires clarification. Wade based his combination on Hoffmann's name cited above, and cited Acharius's 1799 *Lichen holocarpus* in synonymy. However, Arup (2009) states, without explanation, that the basionym is *Lichen holocarpus* Ach. (1799). When Acharius published that name he cited in synonymy "Lichen holocarpos Ehrh. Cr. exs" and also "Verrucaria holocarpa Hoffm. Deut. Fl.". I have not yet seen a copy of Deutschlands Flora, so can not clarify the matter further at present. However, the author citation "(Hoffm. ex Ach.) A. E. Wade" used in Nash et al. (2007) is certainly not correct.

I do not understand this species. I am not certain that the collections I have placed here really do belong to *C. holocarpa*, and I have numerous undetermined collections that might belong here. The description is, therefore, brief and largely restricted to external characteristics.

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. Exciple: orange to yellow-orange, paler than disc; in section: of anastomosing hyphae. Thalline margin: absent.

Some of my 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 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 morphological criteria suggested by Arup (2009) to separate *C. holocarpa* from *C. pyracea* do not work when applied to collections from the Peloponnese. The lichenicolous fungus *Intralichen bacisporus* has been reported once from this lichen.

According to published records, *C. holocarpa* is present throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (widespread outside the tropics), N. America (widespread), C. America (Mexico), temperate S. America (widespread), Australasia (temperate parts), Antarctica (fairly widespread). However, some reports may be unreliable, owing to confusion with other species.
Caloplaca hungarica  H. Magn.  (1944) 


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. 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 anastomosing hyphae: I-, pigmented part K+ red, pigment diffusing into solution. Thalline margin: absent. 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: 1.5 µm wide in lower part, 2 - 2.5 µm near apex, slightly moniliform, sometimes branched in uppermost part. Ascii: 40 - 15 x 17 µm, usually broadest in middle part when mature and then distinctly taering towards apex, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12.5 - 17 x 6 - 8 µm, septum 4 - 6 µm. Chemistry: thallus K-, UV-. Photobiont: green; cells globose, 7 - 12 µm diameter, with large central chloroplast. Photohibit 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. Collections in which the apothecia have an orange tinge might be confused with some of the species in group 15.

Scattered, with no clear pattern. Perhaps overlooked or confused with C. ferruginea. 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.

Scattered, but widely distributed, from southern Sweden to Cyprus. Also Macaronesia (Canary Is), Asia (Syria, Russia).

Caloplaca hymetti  J. Steiner  (1893) 


Description: See the protologue.

Only known from the type collection, which was from Mt. Hymettus in Attica, at an altitude of about 1100 m.

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 re-examined.

Caloplaca inconnexa  (Nyl.) Zahlbr.  (1931) var. inconnexa 

in: Cat. Lich. Univ. 7: 145; Lecanora inconnexa Nyl. (1883) in: Flora 66: 100

Thallus: crustose, usually orange, sometimes orange-yellow, not pruinose, generally in small patches to 1 cm diameter, though sometimes several such patches may coalesce, clearly areolate when well developed, but sometimes poorly developed and discontinuous and the small areoles sometimes appearing as 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 and sometimes much more conspicuous than thallus, immersed when very young, but soon becoming subsessile to sessile, usually flat, sometimes convex, 0.25 - 0.7 (0.9) mm diameter, not pruinose. Disc: orange. 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 hypgae, outer part sometimes distinctly cellular; pigmented part K+ purple-red. Thalline margin: sometimes present but never prominent, usually soon excluded; in section: 80 - 100 µm wide, cortex 10 - 20 µm wide. Epithecium: orange-brown, K+ purple-red; crystals: abundant, granular, colourless, 1 - 1.5 µm diameter, soluble in K. Hymenium: 75 - 100 µm tall, usually entirely 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 hypgae. 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, 8 per ascus, 10 - 13 x 6 - 8 µm, septum (2) 3 - 5 (8) µm wide. Chemistry: disc K+ purple. Photobiont: green, of globose cells 10 - 18 µm diameter, forming a layer 25 - 60 µm thick. Photobiont layer: continuous and regular within a single granule, but a thallus section may include several granules and the layer may then appear irregular and discontinuous.

Material referred here is rather variable. Most collections agree well with C. inconnexa var. inconnexa, but it it 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, even when not actually parasitic on, 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.

Widely distributed in the southern half of Greece, from sea level to 1750 m. In the northern half only reported for Samothraki and Thasos. Lichenicolous on saxicolous lichens in about two-thirds of collections, otherwise free-living on rock (usually, but not invariably, calcareous rock). I have seen it on *Acarospora cervina*, *Aspicilia contorta*, undetermined species of *Aspicilia*, and an undetermined species of *Verrucaria* with a black, epilithic thallus. It has also been reported from *Aspicilia calcariae*, *Aspicilia interna*, *Aspicilia subfarinosa*, *Caloplaca aurantia*, *Lecanora rupicola* subsp. *rupicola*, *Lobothallia radiosa*, and *Verrucaria nigrescens*.

Southern Europe and parts of central Europe. Absent from British Is and the Nordic countries. Also Macaronesia (only Azores), western Asia (Turkey, Syria), N. Africa (Morocco, Algeria). I am sceptical of a report for Thailand.

*Caloplaca inconnexa var. nesodes* Poelt & Nimis (1987)
in: *Studia Geobot.* 7(1): 66; (?) *Caloplaca necator* Poelt & Clauzade

Description: see the protologue.

Scattered, with no clear pattern, at altitudes of about 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. necator* is synonymous.).

*Caloplaca 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.

A rare species of southern Europe. Also Macaronesia (Canary Is), 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 this was not accepted as a confirmed Greek species in Abbott (2009). Reports were from the islands of the southern Aegean, on siliceous rock at altitudes of 25 - 200 m.

*C. interna* is a rare species, known only from a few sites in Spain, Italy, Austria, perhaps Greece, and CVL. This suggests that its taxonomic status might merit review; *C. interna* might prove to fall within the range of variation of one of the other *Caloplaca* species that is often parasitic on *Aspicilia*.

*Caloplaca irrubescens* (Arnold) Zahlbr. (1898)

The basionym is not "*Lecanora irrubescens* Nyl. (1874) in Flora 57: 318", as is often stated. The name does not appear there. There is only *Lecanora aurantiaca* *irrubescens*, and it is not validly published.

The earliest name is *Lecanora murorum* subsp. *subsoluta* Nyl. (1873), and it probably has priority at the rank of species.

Thallus: crustose, cracked, orange-brown. Apothecia: sessile to sessile, flat, 0.2 - 0.35 mm diameter, not pruinose. Disc: red-orange. Exciple: paler than disc, persistent. Thalline margin: absent. Paraphyses: 1.5 µm wide at base, 5 µm at apex, moniliform, occasionally branched. Ascospores: ellipsoid, 11 - 13 x 6 - 8 µm, septom 4 - 5- µm wide.

The description is brief, since the only Peloponnesian collection is scanty. A better description must await the collection and study of additional material. For published descriptions, see: Clauzade & Roux (1985); Smith et al (2009).

Rare and scattered, with no clear pattern. On siliceous rock at altitudes 0 - 130 m.

Widely distributed in Europe. Probably commonest in the south, but present as far north as Scotland though absent from the Nordic countries. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (southern Canada, widespread in USA), C. America (Mexico), Australasia (Western Australia, NZS).

*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, submersed to sessile, flat. Disc: dull orange or brown-orange, often roughened and appearing obscurely pruinose as a result, but true pruina absent. Exciple: orange to dull orange, at least slightly paler than disc, sometimes much paler, persistent; in section: 30 - 50 µm wide, orange-brown in outer part, colourless in inner part, formed of broad radiating hyphae that broaden outwards, lumina large and prominent giving a cellular appearance; outer part K+ red-purple, N-, with granules like those of epithecium. Thalline margin: absent, even in section. Epithecium: orange-brown, K+ red-purple, N-, with many orange crystalline polarising granules, about 1 µm diameter, soluble in K but not in N. Hymenium: 50 µm tall, colourless. Hypothecium: 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 capitulate, usually not moniliform but sometimes weakly so. Ascii: 55 x 15 µm, ± clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12 - 15 x 6 - 8 (10) µm, septum 1 - 2.5 (4) µm wide. 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 rock (usually calcareous, never strongly acidic), at altitudes 0 - 2000 m. Some of the 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 Tajikistan and southern Siberia), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (scattered in western USA), Australasia (Western Australia, both islands of NZ).

Caloplaca lacteoides Nav.-Ros. & Hladun (1996)
in: Bull. Soc. Linn. Provence 47: 156-159

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. Exciple: 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 a definite though sometimes rather weak cellular structure, inner part distinctly hyphal; pigmented part K+ red, pigment diffusing into solution. Thalline margin: normally absent, occasionally weakly present in section. Epithecium: brown, K+ red, pigment diffusing into solution. Hymenium: 75 - 100 µm tall, colourless. Hypothecium: 50 - 75 µm tall, colourless. Paraphyses: 1 - 1.5 µm wide at base, often capitulate when mature, simple. Asci: 70 x 15 - 17 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12 - 15 x 6 - 8 (10) µm, septum 1 - 2.5 (4) µm wide. Photobiont: green, generally endolithic, of globose cells 13 - 20 µm diameter.

There may be two taxa involved. In some collections hyphae in the inner part of the exciple are clearly radiating, in others they are irregularly oriented and perhaps anastomosed. *C. lacteoides* can be readily identified by the combination of small (but not very small) apothecia, medium to large ascospores, and the fairly distinct cellular structure of the outer part of the exciple. The often rather yellowish colour of the apothecia is also helpful.

Samothraki and northern Peloponnese, on limestone at altitudes 0 - 2000 m.

Distribution not yet well known, but perhaps ±circum-Mediterranean. Spain, France and Greece. Also western Asia (Turkey, Israel, Syria and Iran).

Caloplaca latzeli (Servit) Clauzade & Cl. Roux (1985)
in: Lichende de Okcidenta Eŭropo 824; Blastenia latzeli Servít (1934) in Hedwigia 74: 151


Attica, on calcareous rock. Probably also present in the Peloponnese, but material I have seen lacked mature ascospores so could not be determined with certainty.

Eastern Mediterranean (Croatia, Montenegro, Serbia, Greece, Israel) and Russian Caucasus.

Caloplaca ligustica de Lesd. (1936)
in: [need to investigate]

The correct name is *Caloplaca pyrithromoides* (Nyl.) ined., based on *Lecanora pyracea* subsp. *pyrithromoides* Nyl. (1873). At the rank of species, Nyander's epithet has priority from 1932. However, I prefer not to displace Bouly's fairly well established name.
Description: Clauzade & Roux (1985).
The single report was from Macedonia at an altitude of about 100 m. The substrate was not reported.
C. ligustica is known only from southern Europe (Spain, France, Italy, Greece) and N. Africa (Morocco).

Caloplaca limitosa (Nyl) H. Olivier (1909)
Caloplaca festiva var. decussata (Bagl.) H. Olivier

Very similar to C. crenularia, but differing in having a prominent, continuous, marginal, black hypothallus.
Some of my 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 (but not yet Crete) and adjacent coasts on the mainland. On siliceous rock at altitudes 5 - 700
m.

Only southern Europe; Portugal, Italy and Greece.

Caloplaca limonia Nimis & Poelt (1994)

Caloplaca britannica R. Sant. is not synonymous, as some authors have claimed.
Description: Nimis & Martellos (2004); Vondrák, Říha et al. (2009).
Kos in the Dodecanese, on calcareous soil at an altitude of 230 m.
Eastern central and SE Europe, occurring no further west than the Czech Republic and Italy. Also Macaronesia
(only 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: sub sessile to sessile, flat, 0.15 - 0.25 mm diameter, not pruinose. Disc:
Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 11 - 12 x 5 - 6 µm, septum 4 - 5 µm wide.

I am using this name for a taxon that is distinctive and appears to be well defined, but I may not be using it in the
same sense as western European authors. It 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), since the type is in poor condition.

I have also seen a similar species which differs in having a non-granular thallus which, when not endolithic, consists
of scattered, flat orange patches. (See collection 27-Feb-2007/13.) It is definitely not conspecific with material that I
am calling C. lithophila, but I am unable to place it.

The combination of very small apothecia with a reddish disc, and the discontinuous thallus formed of orange
granules is very distinctive.
Scattered and rather uncommon in the southern half of Greece. 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 lobulata (Flörke) Hellb. (1897)
Description: Clauzade & Roux (1985).

Scattered, in the southern half of Greece at altitudes 0 - 800 m (with one report from about 1500 m). There are old
reports for the Peloponnese 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 Peloponnese reports
may be incorrect.
Southern and central Europe, just reaching the southernmost parts of the Nordic countries, but absent from British
Is. Also Asia (widespread), northern Africa (Morocco, Algeria, Chad), N. America (scattered in USA), perhaps S.
America (Argentina), Australasia (Tasmania).

Caloplaca luteoalba (Ach.) Th. Fr. (1860)
in: Lich. arct. 120; Lecidea cinereo-fusca (as cinereo-fusca) β (= var.) luteoalba Ach. (1803) in Methodus (Suppl.) 12-13

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 Turner had not at the time seen a copy of Acharius's Methodus, his name is clearly intended to
denote the same taxon discussed by Acharius. Acharius indicates 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 and easy to identify.

In Europe *C. luteoalba*, which is a rather uncommon species of nutrient-enriched bark, is probably most frequent in Mediterranean regions, though it also occurs as far north as southern Scandinavia. Also Macaronesia, western Asia (widespread as far east as Iran), N. Africa (Morocco), N. America, Australasia (South and Western Australia).

**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 marmorata** (Bagl.) Jatta (1900)

Descriptions: Navarro-Rosinés & Hladun (1996) is probably best. See also: Clauzade & Roux (1989); Nash et al. (2007).

Scattered, in parts of Greece close to the Aegean Sea, on calcareous rock at altitudes 40 to more than 2000 m. Commonest in southern Europe, but present as far north as Belgium. Also western Asia (widespread as far east as southern Siberia), N. Africa (Morocco, Algeria, Tunisia), N. America (at least California), C. America (Mexico).

**Caloplaca monacensis** (Leder.) Lettau (1912)
in: *Hedwigia* 52(3-4): 240; *Pyrenodesmia monacensis* Leder. (1896) in: [need to investigate - title of paper not known]; *Caloplaca cerina* var. *cyanolepra* (DC.) Zwackh; *Placodium cerinum* f. *cyanoleprum* (DC.) Anzi

The earliest name is *Patellaria cerina* var. *cyanolepra* DC. (1805), but the epithet does not have priority at the rank of species.

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 widely distributed in Europe, to as far north as southern Sweden, though not often reported. Also Asia (Turkey, Iran, India).

**Caloplaca navasiana** Nav.-Ros. & Cl. Roux (1995)
in: *Crypt., Bryol.-Lich.* 16(2): 90-95

Description: See the protologue.

Southern Greece, never far from the sea. On calcareous rock at altitudes 0 - 55 m. Circum-Mediterranean. Reported for several southern European countries, and also N. Africa (Morocco).

**Caloplaca neotaurica** Vondrák, Khodosovtsev, Arup & Sõchting (2012)
in: Vondrák, Šoun et al. in: *Lichenologist* 44(3): 414-416

Description: See the protologue.

Peloponnesse and Samothraki. Perhaps overlooked elsewhere. On siliceous rock at altitudes 5 - 770 m.

Scattered, from Wales to Cyprus, but absent from cold regions. I have not seen any reports for other continents.

**Caloplaca nigroblastidiata** (Arup, Halici & Vondrák)

For the present this taxon is discussed under *Caloplaca*, until I get around to revising the whole of *Teloschistaceae* in the Flora.

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 nigromarina** Vondrák, Říha, Arup & Sõchting (2009)
in: *Lichenologist* 41(6): 598-599

Description: See the protologue.

Island of Samothraki, on rock at an altitude of 34 m.

Bulgaria, European Turkey and Greece. Also Asia (Asiatic Turkey, Georgia).
Caloplaca nubigena (Kremp.) Dalla Torre & Sarntth. (1902)

Description: Clauzade & Roux (1985).

Athos 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 immersa, but there was no mention of a host in the single Greek report. However, the thallus in C. immersa is sometimes very inconspicuous, so the Greek report can not be discounted on those grounds alone. The Greek record was accepted by Abbott (2009), but confirmation is desirable.

Mountains of central Europe, and alpine regions of the Iberian Peninsula and Italy. The Greek report, if reliable, must be at the very edge of its range; there are no records for Mediterranean regions proper. Absent from British Is and the Nordic countries. I have not seen any reports for other continents.

Caloplaca oasis (A. Massal.) Szatala (1932)

Descriptions: Arup (2009); Clauzade & Roux (1985). My collections are rather scanty, so I can not yet prepare a good description.

Peloponnese, Chios and Mt. Olympus, on calcareous or base rich rock at altitudes 15 - 2700 m. According to Nimis (1993) it has often been overlooked, so it may be more widespread in Greece than the few records suggests.

Widespread in central Europe and at least parts of southern Europe (Iberian Peninsula, widespread in Italy). Also western Asia (Turkey, Syria, Ural Mts).

Caloplaca obscurella (J. Lahm ex Körb.) Th. Fr. (1871)

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 parallel to surface. Apothecia: 0.3 - 0.5 mm diameter, sub sessile to sessile, flat to slightly convex, not pruinose. Disc: pale brown to brown. 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. Thalline exciple: usually absent, sometimes weakly present on lower surface of apothecia in a thin section. 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 (never strongly) moniliform or capitulate, apical cell generally not pigmented though a thin pigment layer may be present in a few paraphyses. Asci: 32 - 40 x 10 - 14 µm, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 10 - 11 x 4 - 6 µm, septum 4 - 5 µm in mature ascospores. Chemistry: thallus and soralia K-, KC-, Photobiont: green; cells globose or subglobose 7 - 15 µm diameter, forming a continuous, though sometime slightly irregular, layer 40 - 50 µm thick.

Peloponnesian material does not entirely match descriptions in the literature. In particular, the apical cell of the paraphyses generally lacks pigment, or has only a very thin layer of pigment.

Scattered, usually not very far from the sea. On bark at altitudes 0 - 700 m. Reported from Cupressus sempervirens, Juniperus phoenicea, Pyrus spinosa and Quercus macrolepis.


Caloplaca ochracea (Schaer.) Th. Fr. (1861)

Thallus: crustose, forming irregular patches to several cm diameter, immersed or thinly superficial, usually white or pale grey with pale orange patches, rarely entirely pale orange. Prothallus: occasionally present, black, 0.1 mm wide. Apothecia: frequent, 0.25 - 0.5 mm diameter, generally sessile but sometimes subimmersed when young, usually ± flat, occasionally becoming slightly convex. Disc: orange to dark orange. 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 the outer half of the exciple; outer, pigmented part diffuses a red-purple solution in K and becomes pale red to red afterwards, outer part KI+ deep red-brown. Thalline margin: absent. Epithecium: orange to orange-brown, diffusing a red-purple solution in K and becoming pale red to red afterwards; with abundant granular crystals. Hymenium: 60 - 80 µm tall, usually colourless, sometimes with epithecial pigment in the upper part, KI+ blue. Subhymenium: 40 - 60 µm tall, not always very distinct from hypothecium; generally KI-, but a few patches react faintly KI+ blue. Hypothecium: 70 - 80 µm tall, colourless, KI-. Paraphyses: 1 - 2 µm wide at base, 3 - 5 µm at apex, slightly to strongly moniliform, sometimes branched in upper part. Asci: 33 - 55 x 15 - 17 µm, Teloschistes type. Ascospores: colourless, ellipsoid, 8 per ascus, 14 - 19 x 5 - 7 µm, appearing 3-septate when mature (see note below). Chemistry: apothecia and orange parts of thallus K+ purple. Photobiont: green.

The 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. The ascospores eventually developed 4 distinct lumina. The lumina may be rather irregular, but in some ascospores 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 of the country. On calcareous rock at altitudes 0 - 1100 m. Once reported as parasitic on Bagliettoa marmorea.

Present in most of Europe except for the Nordic countries. Also Asia (Turkey, Israel, Syria, Russia), N. Africa (Morocco, Algeria, Tunisia). It has also been reported for the Southern Hemisphere (Argentina, NZS) on good authority, Galloway (2007a), but these reports seem so disjunct that I wonder whether it is introduced, or whether a different taxon may be involved.

Caloplaca oleicola (J. Steiner) van den Boom & Breuss (1995)

Thallus: crustose, white, very thin, continuous, without vegetative propagules. Apothecia: abundant, sessile, ±flatt, 0.2 - 0.3 mm diameter, not pruinose. Disc: black. Exciple: in section: 40 µm wide, brown in outer part, colourless in inner part, of radiating hyphae with broad lumina, often appearing ±cellular. Thalline margin: absent, even in section. Epithecium: mostly brown to dark brown sometimes grey, K- (in my collection). Hymenium: 50 - 70 µm tall, colourless, KI+ intensely blue. Hypothecium: 25 µm tall, colourless. Paraphyses: sometimes branched in upper part, 1.5 µm wide at base, to 3 µm at apex, slightly capitate or moniliform. Asci: 52 x 15 µm, ±Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 15 x 7 µm, septum 5 - 10 µm, lumina of immature ascospores sometimes hourglass shaped. 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, the Peloponnesian 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 Peloponnesian collection was from hard wood, the latter may be a closely related, but undescribed species.

Western Peloponnes 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 apparently known only from Liguria in Italy (type collection) and Greece. Also North America (British Columbia).

Caloplaca ora Poelt & Nimis (1987)
in: Studia Geobot. 7(1): 70

Description: See the protologue.
Crete and Chios, on siliceous rock at a altitudes 5 - 35 m.

Only known from the European coast of the Mediterranean, from Spain to Crete. However, according to Vondrák, Říha et al. (2009) material that has been referred to this name is heterogeneous.

Caloplaca pellodella (Nyl.) Hasse (1913)

The epithet conglomerata has priority if the synonymy can be established with certainty.

Scattered, with no obvious pattern, from Crete to northern Greece. On siliceous rock and parasitic on an undetermined species of Aspicilia at altitudes 80 - 2070 m.

Almost confined to the southern part of Europe, though it has been reported for Bulgaria. Also Macaronesia (Canary Is), Asia (widespread), N. Africa (Morocco), N. America (SW USA), C. America (Mexico).

**Caloplaca phlogina** (Ach.) Flagey (1886)

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 mentioned in the literature is *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.

There are not many records of this species, as it has generally been subsumed under *C. citrina* s. lat., so its distribution is unclear. Probably present throughout mid latitudes of Europe as far north as southern Scandinavia. The only reports from south of the Alps are those for Greece. Also Macaronesia (Azores), Asia (northern India), N. America (Nova Scotia), S. America (Chile).

**Caloplaca 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 lignonicolous, 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*.

Widely distributed but scattered, from southern Italy to at least Norway. Also Macaronesia (CVI), Asia (Turkey, Iran, Russia as *C. phaeocarpella*, India), N. Africa (Morocco), N. America (scattered from Alaska to cooler parts of USA), Caribbean (PR), C. America (Mexico), S. America (Colombia). If *C. phaeocarpella* is a synonym, as some have suggested, then its range extends well into arctic regions of Europe and Asia, and into antarctic regions.

**Caloplaca polycarpa** (A. Massal.) Zahlbr. (1919)


Fairly easily recognised by its 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 calcareous *Verrucaria* species, or directly on calcareous rock.

Throughout Europe as far north as British Isles and southern Scandinavia. Also western Asia (Lebanon, Israel, Syria, Turkey), N. Africa (Morocco).

**Caloplaca pyracea** (Ach.) Zwackh (1862)

Thallus: crustose, but otherwise very variable; poorly developed and ± immersed to moderately well developed; if the latter, then continuous, lightly cracked, or discontinuous, rarely developing a slight areolation; usually pale grey but 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, only rarely with a yellow or red tinge. 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. Thalline margin: sometimes present in young apothecia, grey, thin and inconspicuous, becoming excluded; in section: present or absent,
to 70 µm wide if present, cortex 15 - 25 µm wide, of rather fine pseudoparenchyma, with crystals that are soluble in K. 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, K+ blue. Hypothecium (+ subhymenium if present): 50 - 150 µm tall, colourless, sometimes divided into a ±distinct subhymenium in the 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, apex 1 - 2 µm, not capitate, sometimes slightly moniliform. Asci: clavate, 50 - 60 x 14 - 16 µm, Teloschistes type. Ascospores: colourless, polarilocular, usually ellipsoid, 8 per ascus, 11 - 15 x 6 - 8.5 (10) µm, septum (3.5) 4 - 7.5 µm. Photobiont: green, trebouxioid, 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.

There has been much discussion about whether C. pyracea and C. holocarpa are synonyms. Arup (2009) found slight but clear differences in Scandinavian material, but the criteria that he used to separate them do not work in the Peloponnesse. 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; if they 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 best discounted. At all altitudes where there are suitable substrates. The lichenicolous fungi Lichenodiplis lecanorae and Lichenonoconium lecanorae have each been reported once from this lichen, but the latter may be an error for Lichenodiplis lecanorae.

Distribution unclear, owing to confusion with other species, especially C. holocarpa, but reported for most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Egypt), N. America (SE Canada, scattered in USA), S. America (Colombia; perhaps also Brazil and Paraguay), Antarctica (subantarctic Heard Is). Reports for Australasia (NZ) are incorrect.

Caloplaca rubelliana (Ach.) Rabenh. (1863)

Descriptions: Clauzade & Roux (1985); Nash et al. (2007).
Scattered, in small islands of the Aegean, on siliceous rock at altitudes around 450 m.

Widely distributed in southern and central Europe, but absent from British Is and the Nordic countries. Also Asia (Turkey, Syria, southern Siberia, Bhutan), Africa (Morocco, Algeria, S. Africa, Namibia), N. America (scattered in western USA), C. America (Mexico), Australasia (widespread in Australia if C. scarlatica is synonymous, NZ).

Caloplaca saccapodioides auct.
The collections cited under this name by Abbott (2009) belong to C. fascoblastidiata and C. oleicola.

Caloplaca saxicola (Hoffm.) Nordin (1972)
The earliest name is Lichen murrorum Hoffm. (1784), but it is illegitimate, being a later homonym of Lichen murrorum Neckr. (1771). Psora saxicola Hoffm. is a legitimate nomen novum for Lichen murrorum Hoffm. Parmelia murrorum Ach. (1803) is a superfluous name for Psora saxicola Hoffm., and subsequent murrorum names are also superfluous.

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 cold to cool temperate regions. There are scattered reports under this name from much of Greece, but I have never encountered it in the Peloponnesse, and it seems likely that many of the Greek reports are unreliable. However, some recent reports for Macedonia are reliable. 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 siliceous rock.

There are reports from all of Europe except for arctic regions. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa; also Socotra, S. Africa), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Peru, Venezuela), Australasia (southern parts of Australia, NZS), Antarctica (widespread). However, according to Gaya (2009) this is a species "of predominantly temperate distribution, with a preference for cold environments", so some of these reports may be incorrect.
Caloplaca schoeferi Poelt (1955)
in: Feddes Rep. 58: 176


Rare in the mountains of northern Greece, overgrowing bryophytes at altitudes 1450 - 2150 m.

Mountains of central and southern Europe, but not present in the more westerly parts of the continent. Also Asia (Tajikistan, Mongolia), N. America (Arizona).

Caloplaca servitiana Szatala (1943)

Description: There is a recent description in 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 2. The apothecial pigments, both in the epithecium and the 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 probably is Sedifolia grey, but the lichen does not belong to the Pyrenodesmia group of black fruited taxa.

Scattered, with no clear pattern. On bark, especially Quercus, at altitudes 200 - 140 m.

Known only from Greece and Albania.

Caloplaca sinapisperma (DC.) Maheu & A. Gillet (1914)


Mt. Olympus, on soil at altitudes 700 - 1200 m.

Widespread in central Europe, extending northward into southern Scandinavia. Rare south of the Alps, and restricted to the mountains. Also Asia (widespread in Russia; Mongolia), N. America (widespread in Canada, scattered in colder parts of USA).

Caloplaca skii Khodosovtsev, Vondrák & Šoun (2011)

Description: See the protologue.

Crete, on bark at low altitude.

Southern Europe and Turkey.

Caloplaca sororicida M. Steiner & Poelt (1993)

Description: [none seen]

Western Crete, parasitic on Caloplaca transcaspica at an altitude of 1030 m.

I have not seen any other reports of this species.


Description: Smith et al. (2009), or see the protologue.

Crete, on bark at low altitude.

C. suaeae s. str. may be restricted to England, but a closely related species is present in Greece, Turkey and Morocco.

Caloplaca 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 reported for Greece.

A rather rarely reported species with a basically circum-Mediterranean distribution (though also reported for Poland and Ukraine). It is present in southern Europe, western Asia (Turkey, Syria), N. Africa (Morocco).
Caloplaca tavaresiana Nav.-Ros. & Cl. Roux (1993)
in: Nova Hedwigia 57(1-2): 170-177
Description: See the protologue.
Scattered in the southern Aegean and adjacent coat of the mainland. On calcareous rock at altitudes 5 - 200 m Southern Europe, from Portugal to Cyprus. Also N. Africa (Morocco).

Caloplaca teicholyta (Ach.) J. Steiner (1895)
The name Lecidea talllavei 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 material seen to date. 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. Exciple: prominent, rust red, paler than disc, persistent; in section: 50 - 70 µm wide, colourless in inner part, brown-orange at surface, hyphal (though this is less apparent near the surface owing to expanded tips of hyphae); brown-orange part diffusing a red-purple pigment in K and then becoming colourless. Thalline margin: rather weakly present on the lower surface of most apothecia. Epithecium: brown-orange, diffusing a red-purple pigment in K and then becoming colourless. Hymenium: 70 µm tall, colourless. Hypothecium: 50 µm tall, colourless. Paraphyses: 1.5 µm wide at base, 2.5 - 3 µm at apex; upper part: sometimes branched, with visible septa, rarely slightly moniliform. Asci: 52 x 17 - 20 µm, Teloschistes type. Ascospores: colourless, polarilocular, usually ellipsoid but sometimes swollen at septum, 8 per ascus, 13 - 16 x 7 - 9 µm, septum 2.5 - 5 µm. 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.
Could be confused with C. erythrocarpa, but that species lacks soralia and has a thicker, whiter thallus.
Scattered, in the southern half of Greece, on limestone or basic rock, at altitudes 100 - 700 m.
Widely distributed in Europe, to as far north as southern Scandinavia, but probably commonest in the south of the continent. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia Egypt), S. America (Argentina). Reports for N. America are said to be incorrect.

Caloplaca tenuata (Nyl.) Zahlbr. (1931)
Description: Clauzade & Roux (1985).
Crete. There is also a poorly localised report for the southern Peloponnesse. On calcareous rock at altitudes 350 - 550 m. Also reported parasitic on Verrucaria calciseda.
Restricted to Europe south of the Alps (Iberian Peninsula, Italy, Croatia, Greece). Not present in other continents.

Caloplaca thracopontica Vondrák & Šoun (2008)
Description: See the protologue.
Tentatively reported for Greece (unlocalised) in the protologue. Subsequently definitely reported for Chios, on siliceous rock at altitudes 200 - 670 m
Bulgaria, Greece and Turkey.

Caloplaca tiroliensis Zahlbr. (1903)
in: Ann. Mycol. 1: 360
Thallus: crustose, inconspicuous but visible sometimes, grey. Apothecia: 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. 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. Thalline margin: weakly present in some apothecia. Grey, thin, generally becoming excluded or confined to lower surface of apothecia. Epithecium: orange-brown, with orange crystals that are 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, distinctly moniliform in the last 2 - 3 cells, apex 4 µm wide. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12 - 16 x 7 - 10 µm, septum 3 - 6 µm broad. Chemistry: disc K+ purple. Photobiont: green.
As this report is very disjunct I sought the opinion of a specialist. Dr. Ulrik Søchting kindly examined the material and confirmed the determination.
**Caloplaca transcapsica** (Nyl.) Zahlbr. (1931)  
**Description:** The only description I have found is Nylander's protologue for *Lecanora transcapsica*. It indicates that this species belongs in group 1 of the keys, but is otherwise inadequate,  
Crate, at altitudes of 900 - 1100 m on limestone. Sometimes host to the lichinicolous lichen *Caloplaca sororicida*.  
This is an Asiatic species and Greece appears to be at the western limit of its range; I have not seen any other reports for Europe. Widespread in warm, dry parts of Asia from Turkey to China.

**Caloplaca ulcerosa** Coppins & P. James (1979)  
in: *Lichenologist* 11(2): 139-141  
**Description:** Clauzade & Roux (1985); Smith et al. (2009).  
Crate, on bark of *Olea europaea* at an altitude of 55 m.  
Most reports are from central Europe and the southern parts of northern Europe. In southern Europe, it appears to be widely distributed (Spain, Italy, Greece) but rare. Also western Asia (Israel), N. Africa (Morocco), N. America (at least South Dakota).

**Caloplaca variabilis** (Pers.) Th. Fr. (1861)  
The application of the name *Caloplaca variabilis* f. *acrustacea* Müll. Arg. is not entirely clear to me. It may be a synonym of *Caloplaca alozica* 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 of no taxonomic significance.

Thallus: crustose, usually superficial and areolate, about 0.2 mm thick but sometimes less, usually brown or brown-grey but sometimes paler, occasionally white pruinose in outer part. Prothallus: absent or poorly developed in Peloponnesian material seen to date. 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 at least subsessile, usually flat but sometimes becoming convex, usually 1 (3) per areole, usually with at least some white pruinosity on disc or exciple. or both. Disc: dark brown to black when dry, brownish when wet. Exciple: always present, often prominent but sometimes not very distinct externally if thalline exciple is well developed, rather thin, 0.05 mm wide; in section: 25 - 70 µm wide, brown to grey near surface but colourless in inner part, K+ violet in outer part, inner part with distinct ±radiating hyphae which broaden near the surface to give a weak cellular texture. Thalline margin: usually present and about 0.1 mm wide, but sometimes restricted to lower surface of apothecia, occasionally absent; in section: 130 µm wide, with abundant crystals in outer part. 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
the lower part, without crystals, rarely with oil droplets. Paraphyses: 2 μm wide at base, 2 - 3 μm at apex, sometimes slightly moniliform, sometimes branched in upper part. Ascii: clavate, 65 - 75 x 18 - 25 μm, Teloschistes type. Ascospores: colourless, polarilocular, 8 per ascus, usually ellipsoid but occasionally slightly swollen at septum, 12 - 17 x 6 - 10 μm, septum 3 - 5 μm. 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 a conspicuous black inclusion, like a developing tadpole in a frog's egg, just as noted above for C. chalybaea.

Material with a well-developed thallus is usually easy to determine, though confusion with C. circumalbata might be possible. The larger and asessile apothecia can distinguish C. variabilis from C. chalybaea, but unfortunately forms with ambiguous characters are unfortunately 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. chalybaea and C. variabilis do not work particularly well. Also, both species displays a great deal of variability. I suspect that what I am treating here as the chalybaea + variabilis group may include more than one species, but it will require a thorough revision, probably incorporating molecular evidence, to clarify the position.

Throughout Greece, though some reports may refer to other species. On calcareous rock at all altitudes. The following taxa have been reported on it, though some may have merely been overgrowing it, rather than parasitic on it, it: Arthonia muscigena, Dermatocarpon subcrustosum, Lecania rabenhorstii, Placopyrenium fuscum, Verrucaria minor, and Zwackhiomyces coepulonus.

Widely distributed in Europe, but uncommon in the north and entirely absent from arctic regions. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (Alaska, fairly widespread in USA - so probably also present in Canada). A report for Argentina may refer to some other species.

**Caloplaca veneris** Cl. Roux & Nav.-Ros. (1992)
in: Bull. Soc. Linn. Provence 43: 100-103
Description: See the protologue.
Attica and Santorini. The two reports to date suggest that this may be a species of the southern Aegean region. On calcareous rock at altitudes close to sea level.

Mediterranean Europe: Corsica (but not mainland France), Italy, Greece and Cyprus; extending into the Black Sea region (Ukraine). There are no reports for other continents.

**Caloplaca viridirufa** (Ach.) Zahlbr. (1931)
in: Cat. Lich. Univ. 7: 198; Lecidea viridirufa Ach. (1810) in: Lichenogr. Universalis 204; Caloplaca aractina (Fr.) Häyrén; Caloplaca fuscoatra auct. graec.; Lecanora fuscoatra (Bayrh.) Nyl., nom. illeg.
Vondrák & Vitikainen (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. The name Parmelia aractina Fr. was published in 1825 in Systema Orbis Vegetabilis (which is not a publication relevant to sanctioning).

Descriptions: Clauzade & Roux (1985); Smith et al. (2009), both as Caloplaca aractina.
Scattered, mainly in the southern half of the country, but not yet recorded 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 from the island of Lefkada may refer to some other species.
Commonest in central and southern parts of Europe, but there are also some scattered records for the northern part of the continent. Also Macaronesia, Asia (widespread), N. Africa (Morocco).

**Caloplaca 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.
Description: Arup (2009) is best.
Scattered, with no clear pattern, on calcareous and siliceous rock, at altitudes 0 - 1150 m. However, some of these 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 in the Peloponnese, though some undetermined collections seem quite close to it.
Widely distributed in Europe outside arctic regions, though absent from the British Is. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (southwestern Canada, scattered in cooler parts of USA), Australasia (Victoria, NZS), Antarctica (Kerguelen Is).

Caloplaca 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. However, even if it the synonymy could be proved, the epithet aurea is not available in Caloplaca, owing to the earlier C. aurea (Schaer.) Zahlbr. (1890).

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; the 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 of fairly broad hyphae 2 - 3 µm wide that are often sparingly coated with minute crystals. Chemistry: medulla K- (but often appearing + purple in spot tests because of stray soredia), C-, P-, I-; thallus K+ purple. C-, P-, UV+ orange. Photobiont: green, cells globose, 10 - 15 µm diameter.

This species can not be confused with any other. In C. chrysodeta, which is also entirely leprose, the thallus is not so well delimitated and is not a pure yellow colour.

Scattered throughout Greece at altitudes 60 - 1800 m. Usually on calcareous rock, but known from other substrates. Commonly on underhangs that are protected from direct rain. The lichenicolous fungus Diplotomma scheideggerianum has been recorded from this species.

Widely distributed in temperate and warm parts of Europe, but absent from the Nordic countries. Also Macaronesia, Asia (widespread), Australasia (NZS). Reports for N. America are incorrect.

Caloplaca 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. Areoles: flat overall, but surface rather irregular on a scale of 0.1 mm. Hypothallus: absent. Isidium-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, but layer above photobiont 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, subessise, 0.5 - 0.7 mm diameter, flat when young, often slightly convex later, not pruinose. Disc: orange-brown, C-. 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. Thalline margin: sometimes weakly present in young apothecia, but excluded early; in section: present on lower surface of apothecium, 50 - 70 µm wide. Epitheicum: orange-brown, K+ red-purple. Hymenium: 80 µm tall, 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 in upper part, not capitulate or moniliform. Ascii: 37 x 16 - 18 µm, broadly clavate or bulging in middle. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 13 - 15 x 7 - 8 µm, septum 5 - 5.5 µm. 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 x 140 µm wide, colourless except at surface which is orange-brown, without a distinct wall. Conidia: colourless, narrowly ellipsoid to bacilliform, 3 x ¾ 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 they 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 occurrence on siliceous rock 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)

in: Flora 35: 567-568

Type: C. vulgaris A. Massal. (= C. concolor). Family: Candelariaceae. Literature: There is no monograph, but the only widespread European species is discussed in all the standard Floras.

About 10 species, but only 2 in Europe. Species of Candelaria usually occur on nutrient enriched substrates, as do those of the closely related genus Candelariella. Candelaria is at present separated from Candelariella by its distinctly foliose rather than crustose to placioid growth form. As with other groups that have been distinguished solely on thallus growth form, this distinction may prove difficult to maintain. From a recent molecular study, Westberg et al. (2009), it is clear 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 or conglomerate rock at altitudes 25 - 900 m.

Cosmopolitan in cool temperate to warm regions; absent only from regions with an arctic, desert, or humid tropical climate. Throughout Europe as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread south of Arctic regions), perhaps Caribbean (Guadeloupe), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

Candelariella Müll. Arg. (1894)

in: Bull. Herb. Boissier 2 (App. 1) : 11

Type: C. vitellina (Hoffm.) Müll. Arg.. Family: Candelariaceae. 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 focuses on North 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: absent in most species. Apothecia: sessile, rounded, flat to slightly convex, small to medium sized (typically 0.2 - 0.7 mm diameter). Disc: yellow to yellow-brown. 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. Thalline margin: usually present, sometimes almost confined to lower surface of apothecia, externally often difficult to distinguish from exciple. Epithecium: orange-brown to brown, K-. Hymenium: colourless. Hypotheicum: colourless. Paraphyses: simple, 1 - 1.5 µm wide at base, broadening only slightly at apices, not or scarcely capitate. 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.

Asci in Candelariella differ from those of Lecanora in having a weakly staining in KI, rather than non-staining, central part at the apex. This can sometimes be observed in favourable circumstances, but the distinction is usually difficult to make and for routine determination asci can be considered to be ±Lecanora type.

Candelariella contains a few very well known species, and a surprisingly large number of poorly known ones that do appear to be good species. It needs a modern monographic treatment, or at least a good modern summary, that includes SE Europe and the eastern Mediterranean. Overall it may have as many as 60 species, of which about 30 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. Many collections are problematic and difficult to place. 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)

1 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)

44 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 variable. 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. 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. C. oleaginascens

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. oleaginascens

2 Ascospores 12 - 32 per ascus. Thallus, if present, 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 Lichenicolous on Lecanora populicola. (C. superdistans)

4 On bark or wood.

55 Apothecia a 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

44 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

66 Thallus granules rounded, flattened or subsquamulose, 0.1 - 0.5 mm diam, often clustered. On bark or rock. C. vitellina

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.

3 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**

(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** Räsänen (1939) in: **Anales Soc. Cl. Argent.** 128: 137

Descriptions: Nash et al. (2004); Westberg (2005).

Crete, on bark of *Quercus coccifera* at an altitude of 1500 m. The material was parasitised by the lichenicolous fungus *Intralichen christianseni*.

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, N. America (western half of USA), S. America (Argentina), Australasia (S. Australia).

**Candelariella aurella** (Hoffm.) Zahlbr. (1928) in: Cat. Lich. Univ. 5: 790; *Verrucaria aurella* Hoffm. (1796) in: 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; *Gyalolechia aurella* (Hoffm.) Körb.; *Gyalolechia 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. Exciple: not usually distinguishable externally; in section: 25 µm wide, colourless except at surface which is orange-brown, of radiating hyphae that develop visible lumina in outer part. 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. Epithecium: orange-brown to brown. Hymenium: 60 µm tall, colourless, K+ 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, ±E. Ascospores: colourless, simple, ellipsoid to slightly reniform, 8 per ascus, 10 - 15 x 4 - 7 µm. Chemistry: apothecia K-. Photobiont: green, cells globose, 9 - 15 µm diameter.

Usually easily distinguishable from other limestone species by the bright yellow, K- apothecia and the poorly developed thallus. The 8-spored asci with small ascospores confirm the determination.

Throughout Greece, at all altitudes. Nearly always on calcareous or at least base-rich rock, rarely on other substrates. Once reported as overgrowing *Aspicilia calacea*.

Subcosmopolitan outside the tropics. Common throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Egypt), N. America (widespread), C. America (Mexico), S. America (Argentina, perhaps elsewhere), Australasia (NSW, NZS), 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. Proper exciple: not visible externally; in section: sometimes almost absent; when present to 15 µm wide, of radiating hyphae that with elongated lumina in outer part. Thalline margin: present, persistent, yellow, paler than disc; in section: 50 µm wide, cortex poorly developed. Epithecium: with dull brown pigment and orange-brown polarising granules, K-, brown pigment but not granules soluble in K. Hymenium: 70 µm tall, colourless, sometimes with dull brown pigment in upper part, K+ blue. Hypothecium: 50 - 60 µm tall, colourless. Paraphyses: simple, 1.5 µm wide in lower part, 2 µm at apex, not capititate or moniliform. Asci: 25 - 45 x 14 - 15 µm, broadly cylindrical to weakly clavate, ±E. Ascospores: colourless, simple, globose, 16 per ascus, 5 µm
diameter. Chemistry: disc K-; thallus and thalline exciple K-, UV-. 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.

Known from three site in 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 rock at an altitude of 750 m. Throughout northern and central Europe, but very rare south of the Alps and Pyrenees. Also Asia (widespread in cool and temperate regions), North America (Ontario, Colorado, Wisconsin), perhaps South America (Chile), Australasia (cool parts of New Zealand).

**Candelariella faginea** Nimis, Poelt & Puntillo (1989)
in: *Nova Hedwigia* 49: 276

Description: none seen.

Western Crete, on bark at altitudes 1100 - 1340 m. The only phorophyte explicitly mentioned is *Acer sempervirens*. Southern Europe: Spain, Italy, Albania, Greece, Ukraine. I have not seen any reports for other continents.

**Candelariella aff. lutella**

It is not yet clear whether Greek collections referred here belong to *C. lutella* (Vain.) Räs. or to an undescribed taxon close to it. From the limited evidence available, *C. lutella* s. str. seems to be a rather northern species, and Greece would appear to be outside its expected range.

My only collection was very scanty and I can not yet prepare an adequate description. For a published description of *C. lutella* s. str. see Westberg in Nash et al. (2004).

Thallus: crustose, inconspicuous, pale green to yellow, 3 x 1 mm (in the only collection seen by me), without vegetative propagules. Areoles: scattered, discontinuous, flat, 0.2 mm wide. Apothecia: subsessile to sessile, ±flat, 0.2 mm diam, not pruinose, K-.


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.) what is probably the same species is common in parts of the central Peloponnes.

All confirmed European reports of *C. lutella* s. str. are from the Alps northwards to Svalbard. It is also present in cooler parts of Asiatic Russia and N. America.

**Candelariella medians** (Nyl.) A. L. Sm. (1918)

The earliest name is *Parmelia parietina* var. *granulata* Schae. (1850), but it does not have priority at the rank of species.

My only collection is too scanty to permit an adequate description. For published descriptions see, e.g. Clauzade & Roux (1985); Smith et al. (2009).

Easily recognised by the yellow, placodioid thallus with distinct radiating marginal lobes, and reacting K-.

Scattered, with no clear pattern, though at present there are no reports from the westernmost parts of the country. On calcareous rock at altitudes 0 - 1050 m.

Widely distributed 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 said to be incorrect, so a report for S. America (Argentina) may also be unreliable.

**Candelariella oleaginascens** Rondon (1966)

Thallus: crustose, areolate, pale grey or pale brown to 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 hyphae ±parallel to surface. Medulla: of broad hyphae, 3 µm wide, without crystals. Apothecia: sessile, flat to slightly convex, 0.35 - 0.55 (0.8) mm diameter, not pruinose. Disc: dull yellow to brown-yellow. Exciple: bright yellow, persistent; in
Candelariella plumbea Poelt & Vězda (1976)
Most reports are from Crete, but also known from a single site in northern Epiros. On calcareous or siliceous rock, at altitudes 35 - 2100 m.
SE Europe and the southern parts of central Europe. Not reported for the Iberian Peninsula or Italy, nor any part of northern Europe. Reports from outside Europe are disjunct and difficult to interpret: Asia (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.
Present in most of Europe. Also Asia (widespread), Malesia (PNG), N. Africa (Algeria), Australasia (Tasmania, both islands of NZ). Reports for N. America appear to refer to a different taxon. The status of reports for S. America (Chile, Colombia) is not clear to me.

Candelariella unilocularis (Elenkin) Nimis (1994)
in: [need to investigate - don't know title of publication]; Candelariella cerinella var. unilocularis Elenkin (1907) in: Lichenes Florae Rossiae Mediae, 2: 273; Candelariella aurella var. unilocularis (Elenkin) Zahlbr.
Crete and Mt. Olympus, at altitudes 1250 - 1500 m. Once on calcareous rock, once overgrowing bryophytes. The Cretan collection was parasitised by the lichenicolous fungus Intraplichem lichenum.
SE Europe, from Italy and Austria to the Caucasus. Also Asia (Turkey, Iran, Tajikistan).

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 - 450 m. On bark of Olea europaea, or on wood of Pistacia.
Southern Europe, from Spain to Greece, and the southern part of central Europe. Also Asia (Turkey, Iran, Mongolia).

Candelariella vitellina (Hoffm.) Müll. Arg. (1894)
in: Bull. Herb. Boissier 2 (App. 1): 47; Patellaria vitellina Hoffm. (1791) in: Descri. Pl. Cl. Crypt. 2(1): 5-6; Candelaria vitellina (Hoffm.) A. Massal.; Candelariella vitellina f. corusca (Aeh.) Lettau (as 'coruscanus'); Candelariella vitellina f. granulosa Hakul.; (?) Candelariella vitellina var. rechingeri Šerviti; Gyalolechia vitellina (Hoffm.) Anzi; Lecanora...
vitellina (Hoffm.) Ach.

The earliest name is Lichen vitellinus Ehrh. (1785), but it is a nomen nudum

Thallus: crustose, to 7 cm diameter, yellow to orange-yellow, of discrete to contiguous corticate granules, without soralia. Granules: rounded to flattened, sometimes subsquamous 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. Exciple: (difficult to distinguish externally between thalline exciple and excipule) bright yellow, persistent, sometimes becoming crenulate or irregular in old apothecia. Excipule: in section: 10 - 25 µm wide, mostly colourless, sometimes orange-brown in outer part, of radiating hyphae, sometimes with visible lumina in outer part. Thalline margin: in section: 25 - 125 µm wide, sometimes almost restricted to lower surface of apothecia; cortex 5 - 12 µm wide, not well differentiated. 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. Asc: 65 x 10 µm, clavate, ±Lecanora type, though central tube often poorly developed.

Ascospores: colourless, simple but sometimes appearing spurious 1-septate, ellipsoid to slightly reniform, 16 - 32 per ascus, 10 - 12 x 4.5 - 6 µm. Pycnidia: abundant if present, forming small bumbs 0.1 mm diameter, with a slightly raised rim that is same colour as thallus and a slightly darker centre (and resembling tiny apothecia with a thalline exciple); in section: 100% immersed in bumph, almost hemispherical but top domed rather than flat, 110 µm tall x 150 µm wide; wall colourless except at surface where it has the usual thalline pigment. Conidia: colourless, ellipsoid to slightly dacryform, 2.5 x 1.5 µm, borne singly at the tip of a conidiophore. Conidiophores: not branched, ±straight, often with visible septa. Chemistry: apothecia K-; thallus K- or sometimes 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 Peloponnesian 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. This is probably an environmental effect, and not of any taxonomic value.

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 grimmae 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, 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)

Peloponnesian collections referred here are heterogeneous and need further study. No description is provided until those collections are better understood. For published descriptions see 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.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Tunisia, Rwanda), N. America (widespread), C. America (Mexico), S. America (Chile, perhaps 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).

About 24 species of which about 12 have been reported for Europe. There are few Greek records.
11 Parasitic on saxicolous lichens.

22 Exciple carbon black. Not lichenised

3 On Candelariella vitellina. Ends of ascospores rounded. **C. vitellinaria**

3 On Lecanora polytropa. Ends of ascospores ±pointed. **C. supersparsa**

22 Exciple dark brown in inner part, becoming more intense to carbonized towards the outside. Lichenised, but thallus not discernible outside host. On Rhizocarpon geographicum and related species. (C. intrudens)

2 Exciple green-black in outer part, colourless within. (C. assimilis), (C. distans)

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. **(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), and N. America (Michigan). Possibly in Macaronesia (Canary Is).

**Carbonea vitellinaria** (Nyl.) Hertel (1983)


Thallus: inapparent. Apothecia: concave, 0.12 - 0.18 mm diam Disc: black. Exciple: black, shiny; in section: 25 µm wide, black, opaque. Thalline margin: absent. 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* as host are a distinctive combination.

Scattered, at altitudes 1100 to about 2350 m. Always parasitic on *Candelariella vitellina*.

Widely distributed, but not especially common. Most of Europe, though south of the Alps probably restricted to the uplands. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (scattered in western half, from Alaska to California), C. America (Mexico), S. America (Chile), Australasia (NZS), perhaps Antarctica.

**Carbonea vorticosa** (Flörke) Hertel (1983)


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 rocks in arctic-alpine habitats. Quite widely distributed in northern and central Europe, rare in the Mediterranean mountains. Also Asia (widespread in central and eastern Asia, apparently not yet reported west of Kazakhstan), Africa (S. Africa), N. America (widespread), S. America (Ecuador, Peru, Venezuela), Australasia (NSW, Tasmania, NZS), Antarctica (widespread).

**Carbonicola** Bendiksby & Timdal (2013)


Type: *H. scalaris* (Ach.) M. Choisy. Family: *Carbonicolaceae*. Literature: The two European species are treated in the standard floras, under *Hypocenomyce*.

Description: Bendiksby & Timdal (2013).

A group of 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. castaneocinerea)
Carbonicola anthracophila (Nyl.) Bendiksby & Timdal (2013)
in: Taxon 62(5): 950; Lecidea anthracophila Nyl. (1865) in: Flora 48: 603; Lecidea cladonioides Th. Fr., nom. superfl. 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.
Most European records are from latitudes between the Alps and southern Scandinavia, though it is present in southern Europe. Also Macaronesia (only Azores), Asia (Russia), Africa (Namibia), N. America (scattered in temperate and warm regions), C. America (Mexico), Australasia (NSW).

Catapyrenium Flot. (1850)
in: Bot. Zeitung 8: 361
Type: C. cinereum (Pers.) Körb. Family: Verrucariaceae. 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 the Verrucariaceae with simple ascospores. That was a convenient practical circumscription, but since 1990 it has been subdivided into several more naturally circumscribed genera, leaving about 24 species, some of them poorly known, in Catapyrenium sensu stricto. Three species have been reported for 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 a 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 a lower cortex.
33 Ascii 55 - 65 x 13 - 15 µm. Ascospores 13 - 17 x 5.5 - 7 µm. Squamules pale brown, grey or with a greenish tinge. On bark or bryophytes on bark. C. psoromoides
3 Ascii 75 - 85 x 17 - 20 µm. Ascospores 17 - 22 x 6 - 8 µm. Squamules medium brown to dark brown. On soil or overgrowing bryophytes or decaying vegetation on the ground. C. daedaleum
1 Rhizohyphae pale. On rock. See (Heteroplacidium divisum)

Catapyrenium cinereum (Pers.) Körb. (1855)
Very scattered, with no clear pattern. On soil at altitudes 700 m and above.
Widely distributed in Europe. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa; also Uganda, S. Africa), N. America (widespread, mainly in the west), southern S. America (Chile), Australasia (NSW, NZS), Antarctica (S. Shetland Is). Some reports are old and may refer to other species.

Catapyrenium daedaleum (Kremp.) Stein (1879)
Descriptions: Nimis & Martellos (2004); Smith et al. (2009).
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.
Throughout most of Europe, though in Mediterranean regions restricted to the highest mountains. Also Asia (widespread), N. Africa (Morocco), N. America (BC, scattered in western USA), perhaps S. America, 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 of Juniperus phoenicea, Quercus macrolepis and Quercus pubescens at altitudes 20 - about 600 m.
Scattered widely, but thinly, throughout 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 (both islands of NZ).
Catillaria A. Massal. (1852)


Type: C. chalybeia (Borrer) A. Massal. Family: Catillariaceae. 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. Asci: Catillaria type (apical part 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 exciple, 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 flora but a few species, especially C. nigroclavata, are very common.

C. heterocarpoides Zahlbr. and C. nideri J. Steiner are not included in the key, as I have too little information.

1 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). Some species parasitic.
2 Exciple brown or blackish throughout.
   33 Exciple brown. Lichenicolous on Lobaria. (C. lobaricola)
   3 Exciple blackish. Usually on rock.
   44 Hypothecium dark brown. C. chalybeia s. lat. Note 1.
       55 Hymenium pale blue-green, at least in lower part. C. chalybeia v. chalybeia
       5 Hymenium entirely colourless. C. chalybeia v. chloropoliza
4 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.
44 Asci with 8 (16) ascospores. On various substrates.
   55 Ascospores simple. Parasitic on Usnea. (C. usneicola)
   5 Ascospores 1-septate. Parasitic or not.
   66 Asci with 8, 12 or 16 ascospores, even in same apothecium. Parasitic on macrolichens. C. mediterranea
6 Asci always with 8 ascospores. On bark or rock, rarely parasitic,
   77 Ascospores 10 - 16 x 4.5 - 6 µm. (C. subviridis)
   7 Ascospores 8 - 10 (12) x 2.5 - 3.5 µm.
   88 Hypothecium usually pale brown, at least in upper part, but sometimes almost colourless. Usually on bark, rarely on siliceous rock or lichenicolous. C. nigroclavata
8 Hypothecium ±colourless, sometimes very pale brown. On rock. C. lenticularis
4 Asci with (16) 24 - 32 (48) ascospores. On bark; usually in coastal Mediterranean vegetation, never above 850 m. C. servitii
1 Paraphyses usually not as above. Asci Bacidia type. 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 On bark or wood. Thallus with stalked, white pruinose pycnidia. (C. alba)
3 On calcareous rock. Thallus without stalked pycnidia.
   44 Epithecium and exciple colourless, pale yellow or pale brown, K-. In shaded microhabitats in regions with a cool climate. C. minuta
4 Epithecium and exciple brown, sometimes with a slight violet tinge, K+ slightly reddish, N+ reddish. Not confined to shaded habitats or to regions with a cool climate. *C. detractula*

(1) If the thallus is immersed, consider *Toninia athallina*.

**Catillaria atomarioides** (Müll. Arg.) H. Kilias (1981)

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; very rare south of the Alps and Pyrenees. Also Macaronesia (widespread but not common), Asia (Russia), and southern Africa (Zimbabwe, S. Africa). According to Smith et al. (2009) it has been much overlooked in the British Is, and that may be the case elsewhere.

**Catillaria chalybeia** (Borrer) A. Massal. (1852) var. chalybeia

All my collections to date are of small thalli, no more than about 1 cm across, with a poorly developed thallus. However, according to published descriptions, the thallus can be as varied as that in var. *chloropoliza* (see below).

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. 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 the margins, generally opaque, K-, N+ purple-red (best seen along inner edge). Thalline margin: absent. Epithecium: dark brown to dark green-black, K-, usually N- (sometimes a few small patches N+ red-purple), some of the pigment between the 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, K+ blue, blue-green pigment dissolving in N but not in K. Hypothecium: 50 - 110 µm, 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, capitate, apex 3 - 5 µm wide, apical cell with dark brown pigment that is usually confined to the upper hemisphere, this pigment K-, N-, not soluble in K or N. Ascii: 35 - 55 x 10 - 12 µm, cylindrical to clavate, Catillaria type. Ascospores: colourless, (0) 1 (3) -septate, ±narrowly ellipsoid though ends slightly pointed, 8 per ascus, 8 - 11 x 3 - 3.5 µm. Photobiont: green.

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, but sometimes on calcareous rock.

Throughout Europe, except for truly arctic areas. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa; St Helena), N. America (fairly widespread), C. America (Mexico), perhaps S. America (Brazil, Uruguay), 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 in width), thin (0 - 200 µm thick), 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. Exciple: black, sometimes eventually becoming 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-. Thalline margin: absent. 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 is present in the lower part), K1+ blue. Subhymenium: clearly present (not contiguous with exciple), but not well delimitated from hypothecium, pale brown, 15 - 60 µm. Hypothecium: 30 - 70 µm, dark brown, sometimes paler brown in upper part, K-, N-.

Paraphyses: simple, 1 - 1.5 µm wide at base, capitate, apex 3 - 5 µm wide, upper hemisphere of apical cell with dark brown pigment that is K-, N- and not soluble in K or N. Ascii: 25 x 8 µm, clavate, Catillaria type. Ascospores: colourless 1-septate, ±narrowly ellipsoid (but one end sometimes broader than the other), 8 per ascus, 8 - 13 x 2.5 - 4 µm. Pycnidia: in section: 60% immersed, 160 µm tall, 100 µm wide, colourless except for a dark brown surface layer.
Conidia: colourless, simple, ellipsoid, 3 x 1 µm. Chemistry: thallus not well suited to spot tests; thallus and medulla K- in section; thallus UV-. Photobiont: green, cells globose, 11 - 15 µm diameter; photobiont layer: 15 - 60 µm thick, sometimes irregular and discontinuous.

Easily separated from var. chalybeia by the complete absence of blue-green pigment in the hymenium. (There may be some blue-green pigment clearly visible along the inner edge of the exciple, but there is none in the hymenium.)

Scattered in the southern half of Greece, never very far from the sea. Usually on siliceous rock, often schist, occasionally on limestone. 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)
in: Expos. Syst. 2: 129; *Lecanora detractula* Nyl. (1875) in: 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. Exciple: black, excluded early; in section: 25 µm wide, colourless in inner part, brown to red-purple in outer part, basically of radiating hyphae, though a few elongated lumina are present in outermost part; pigment N+ reddish. Thalline margin: absent. Epithecium: pale brown, sometimes with a slight violet tinge, K-, N- (in material seen to date, which did not have much pigment in the epithecium), pigment dissolving in K and N. Hymenium: 65 µm, colourless. Hypothecium: 100 µm, colourless. Paraphyses: 1.5 µm wide at base, expanding gradually to apex which is 3 - 5 µm wide, not or scarcely capitate, often with visible septa, occasionally anastomosed. Asci: Bacidia type. Ascospores: colourless, 1-septate with a thin septum, ellipsoid, 8 per ascus, 12 - 15 x 12 - 13 µm.

The non-capitate paraphyses and the asci which are not *Catillaria* type indicate that this species does not belong in *Catillaria*.

Very scattered, mainly in the southern half of Greece, 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 (France, Germany, Austria, Ukraine). Also Asia (Iran, southern Siberia).

**Catillaria heterocarpoides** Zahlbr. (1932)
in: [need to investigate]

Description: [none seen]

Lefkada, on limestone at an altitude of 50 m.

Known only from Croatia and Greece.

**Catillaria lenticularis** (Ach.) Th. Fr. (1874)

Thallus: crustose, inconspicuous, white, grey-white or white-grey, very thin to almost immersed, to 2 cm diameter. Apothecia: scattered rather sparsely over the thallus, sessile, flat to convex, 0.15 - 0.3 mm diameter, not pruinose. Disc: dark brown to black. Exciple: pale brown to black, often excluded; in section: 40 µm wide, mostly colourless or pale brown, outside parts dark brown in places, cellular at least when mature, K-. Thalline margin: absent. 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 epipetalic pigment, KI+ blue. Hypothecium: 50 - 80 µm tall, colourless to very pale brown. Paraphyses: often branched in upper part, capitate, 1.5 - 2 µm wide at base, 2.5 - 4 µm at apex, apical cell with internal cap of brown pigment; this pigment K-, N-, not soluble in K or N. Ascii: 27 - 35 x 10 - 13 µm, narrow clavate to almost cylindrical, Catillaria type. Ascospores: colourless, 1-septate, narrowly ellipsoid, 8 per ascus, 7.5 - 11 x 2.5 - 3 µm. 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 capitate. 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 ascus.

Throughout Greece, though generally preferring localities not very far from the sea. On calcareous rock at altitudes 5 - 1200 m.

Widely distributed in Europe, except for truly arctic regions. Also Asia (Turkey, Israel, southern Siberia), Africa (Morocco, Algeria, S. Africa), N. America (Nova Scotia, scattered in USA), S. America (Argentina), Australasia (Western Australia; reports for NZ incorrect).
Catillaria mediterranea Hafellner (1983)
in: *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, Diederich & Roux (1989).

Scattered in southern Greece, never very far from the sea, at altitudes 500 - 1100 m. Lichenicolous. Hosts explicitly recorded include: *Anaptychia ciliaris*, and *Parmelina tiliacea*.

Probably circum-Mediterranean/Macaronesian, though not yet reported for N. Africa. Spain, France, Italy, Greece and Cyprus. Also Macaronesia (widespread in Canary Is), and western Asia (Turkey).

Catillaria minuta (A. Massal.) Lettau (1912)
in: *Hedwigia* 52(3-4): 135. (Note that *C. minuta* (Schaer.) Lettau refers to a different taxon; it is a synonym of *Bacidia arceuina*); *Biotorina minuta* A. Massal. (1852) in: *Ric. Auton. Lich. Crost*. 137

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in Macedonia, on calcareous rock at altitudes 200 - 1700 m.

Uncommon, but quite widely distributed to as far north as southern Sweden. South of the Alps it is largely restricted to the uplands. Also Asia (Turkey, southern Siberia) and, apparently, 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 also 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. Exicle: 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-. Thalline margin: absent. Epithecium: dark brown, sometimes appearing almost black, K-, N-, pigment between paraphyses soluble in K and N. Hymenium: 20 - 35 (45) µm tall, colourless. Hypothecium: 20 - 35 (50) µm, usually pale brown, but sometimes with very little pigment, K-, N-. Paraphyses: usually simple, 1 - 2.5 µm wide at base, markedly capitate, apex 3.5 - 6 µm, 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, ±ellipsoid (though ends often not rounded), 8 per ascus, 7 - 12 x 2.5 - 3 (4) µm. Chemistry: thallus too thin for spot tests. Photobiont: green, cells ±globose, 8 - 15 µm diameter, tending to form clumps so photobiont layer irregular and sometimes discontinuous, 15 - 55 µm thick.

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 leioploca*.

Most of Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Tunisia, S. Africa), N. America (southern Canada, scattered in USA), C. America (Guatemala). Nash et al. (20070 state that it is present in Australasia (NZ), but it is not treated in Galloway (2007a).

Catillaria servitii Szatala (1943)

Thallus: crustose, inconspicuous, almost immersed, 1.5 cm diameter. Apothecia: sessile, flat, 0.15 - 0.2 mm diameter, not pruinose Disc: black. Exicle: black, usually persistent; in section: 25 µm wide, colourless to very pale brown in inner part, brown to dark brown in outer part, hyphal. Thalline margin: absent. Epithecium: brown, K-, N-. Hymenium: 35 - 45 µm tall, colourless. Hypothecium: colourless to very pale brown, upper half rather obscurely differentiated into a subhymenium, 50 µm tall (including subhymenium). Paraphyses: 1.5 µm wide at base, 3 - 4 µm at apex, distinctly capitate, upper part of apical cell with internal dark brown pigment; pigment K-, N-, not soluble in K or
N. Ascospores: colourless, 1-septate, ellipsoid, 16 or more per ascus (exact number difficult to count), 7 x 3 µm. 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 (Syria). Probably circum-Mediterranean, though not yet reported for N. Africa.

Catinaria Vain. (1922)

Type: C. atropurpurea (Schaer.) Vězda & Poelt. Family: Ramalinaceae. Literature: There is no monograph. Smith et al (2009) discuss the two species included in the key below.
I know of 5 names of described species in this genus that I can not yet refer to other genera, but some of them may belong elsewhere. The genus may only contain 3 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 Asci 8-spored.

33 Ascospore wall not warted. C. atropurpurea
3 Ascospore wall warted. (C. sp. undescribed). Note 1.
2 Ascii 12 - 16 -spored. (C. neuschildii) Greek report doubtful.
1 Ascospores 3-septate, with a warded wall. (C. papillosa Coppins ined.). Note 1.

(1) Dr. B. J. Coppins (pers. comm.) kindly provided information on the undescribed species. Neither is reported for Greece.

Catinaria atropurpurea (Schaer.) Vězda & Poelt (1981)
in: Poelt & Vězda, Bestimmungsslüssel europäischer Flechten 2; 363; Lecidea sphaeroides β (= var.) atropurpurea Schauer. (1833) in: 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 Platanus orientalis.
Widespread in western parts of Europe, but rare in Mediterranean regions. Also Macaronesia, Asia (Armenia, Russia, northern India, Mongolia), N. Africa (Morocco), N. America (southern Canada, widespread in USA), perhaps C. America, perhaps S. America (Brazil), Australasia (Australia; reports for NZ appear to be incorrect).

Catinaria neuschildii (Körb.) P. James (1965)
The single Greek report, for Naxos, on bark at altitudes 5 - 800 m, was not accepted by Abbott (2009). The report may be based on misinterpretation of collections of Catinaria atropurpurea; in a poorly prepared section it is easy to misinterpret overlapping asci as a single ascus. Nearly all reports of C. neuschildii are from northern and central parts of Europe. There are very few from south of the Alps, though it is known for central Italy (Lazio).

Cephalophysis (Hertel) H. Kilias (1985)
Cephalophysis contains only one species.

Cephalophysis leucospila (Anzi) H. Kilias & Scheid. (1985)

Descriptions: Clauzade & Roux (1985); Hertel (1967), both as Lecidea ultima.
Mt. Olympus at an altitude of about 2700 m. The substrate was not stated, 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 central Asia (Tajikistan, arctic Siberia), N. America (Nunavut, Oregon).

**Cercidospora Körb. (1865)**

in: Parerga Lichenol. 465-466.

Type: *C. ulothii* Körb. (= *C. macrospora*). Family: of uncertain position in Dothideomycetes. Literature: Species of southern Europe were monographed by Navarro-Rosinés et al. in *Bibl. Lich.* vol. 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 the name *Didymella*. Navarro-Rosinés et al. (2009) give a good description of the genus itself, and also discuss a few species.

About 29 described species of lichenicolous fungi, but the genus is not well known and several more species are said to be undescribed. 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 Upper part of exciple dark red-brown, lower part pale reddish. (*C. crozalsiana*), (*C. verrucosaria*)

22 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, with 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*)

2 Exciple entirely dark brown (sometimes with a purple tinge). *C. epipolytropa*

1 Ascospores 3 - 6 -septate. Several northern species that are unlikely to occur in Greece.

**Cercidospora epicarphinea** (Nyl.) Grube & Hafellner (1990)


I am unsure whether *C. xanthoria* is synonymous with *C. epicarphinea*, but for the moment I treat it as such. Descriptions: Grube & Hafellner (1990); Triebel et al. (1991).

Epiros, parasitic on *Xanthoria parietina* at an altitude of 770 m, as *C. xanthoriae*.

Scattered throughout Europe. Also Macaronesia (Canary Is), Asia (Turkey, Russia, India), Africa (Algeria, Tunisia), N. America (Arizona, California), C. America (Guatemala, Mexico), S. America (Chile).

**Cercidospora epipolytropa** (Mudd) Arnold (1874)


Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004).

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.

Widely distributed in central and northern Europe, less common in the south. Also Macaronesia (Canary Is), Asia (Turkey, Iran, widespread in Russia, Nepal), N. Africa (Morocco), N. America (western USA).

**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 Catalonia and Crete. Also Asia (arctic Siberia), N. America (California).
Cetraria Ach. (1803)

in: Methodus 292. The name is conserved against Platyphyllum Vent. (1799).

Type: C. islandica (L.) Ach. 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. after recent segregations 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 substrate. About two-thirds of lichens with a cetrarioid growth form appear to form a monophyletic group within the Parmeliaceae. It could perhaps be recognised as a subfamily. For recent ideas on 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.

The circumscription of Cetraria has varied considerably over the years. Originally a rather large and heterogeneous genus, many species formerly referred to it have been transferred in recent years to Arctocetraria, Cetrariella, Flavocetraria, Melanelia, Tuckermannopsis, Vulpicida and other genera. On the other hand, Coelocaulon (type species Coelocaulon aculeatum) is now regarded as synonymous with Cetraria. Cornicularia (type species Cornicularia normoerica) is regarded as distinct from Cetraria, though some species of Cetraria s. str. have been placed in Coelocaulon in the past. As now understood, Cetraria is a rather small genus of about 15 usually terricolous species, of which about 10 occur in Europe.

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.
   22 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 channelled and inrolled, and appearing tubular. C. ericetorum

Cetraria aculeata (Schreb.) Fr. (1826)
in: Nov. Sched. Crit. 32; Lichen aculeatus Schreb. (1771) in: Spic. Fl. Lips. 125-126; Coelocaulon aculeatum (Schreb.) Link; Cornicularia aculeata (Schreb.) Ach.

The earliest name is Lichen islandicus var. tenuissimus L. (1753), but Schreber's epithet has priority at species rank. 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: present (some authors, such as Purvis et al. (1992), call them 'lateral spines'), globose to slightly cylindrical (distinctly shorter than the 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). Widely distributed in Europe. Also Macaronesia, Asia (widespread), Africa (widespread in temperate regions), N. America (widespread), S. America (widespread), Australasia (SE Australia, NZS), Antarctica (subantarctic islands and Antarctic Peninsula).

Cetraria ericetorum Opiz (1852)
in: Seznam 173

Description: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Known from a single mountain in northern Macedonia, where it occurred on the ground overlying siliceous rocks at altitudes 1250 - 1400 m.

Throughout northern and central Europe, but very 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)
in: Methodus 293; Lichen islandicus L. (1753) in: Sp. Pl. 1145; \( \text{Cetraria islandica var. minor} \) Harm.; \( \text{Cetraria islandica var. nuda} \) Vain.; \( \text{Cetraria islandica b C. (= var. platyna} \) Ach.; \( \text{Cetraria islandica var. rigida} \) (Retz.) Savicz

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Scattered in the northern half of Greece. However, some of these reports are from substrates on which \( \text{C. islandica} \) would not be expected (bark and calcareous rock) any may be unreliable. On soil at high altitude. 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 in cooler regions), Pacific (Hawaii). Reports for S. America, Australasia, Antarctica probably refer to subsp. \( \text{antarctica} \).

Chaenotheca (Th. Fr.) Th. Fr. (1860)
Type: \( \text{C. trichialis} \) (Ach.) Th. Fr. Family: Coniocybaceae. Literature: The northern hemisphere species were monographed by Tibell in Symb. Bot. Upsal 23(1):1-65. 1980 [not seen]. More recent treatments, perfectly adequate for Greece, are Ahti et al. (1999), and Smith et al. (2009).

About 30 species, most of which require humid, shaded habitats, so there are few Greek records. I have collections that may belong here, but they were too poorly developed to determine with certainty.

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. \( \text{C. chrysocephala} \)
  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).
  33 Pruina on ascomata white or grey. (C. cinerea), (C. xyloxa)
  3 Pruina on ascomata yellow.
  44 Thallus squamulose. \( \text{C. trichialis} \)
  4 Thallus crustose, leprose. (C. gracilenta)
2 Photobiont cells large or medium sized, globose (trebouxioid or Dictyochloropsis).
33 Ascospores 6 - 7 \( \mu \)m diameter. Thallus superficial, white to grey, often with yellow or red patches reacting K+ deep red. \( \text{C. ferruginea} \)
  3 Ascospores 3.5 - 4.5 \( \mu \)m diameter. Thallus immersed or superficial, without yellow or red patches.
  44 Thallus minutely granular. Stalk often faintly grey pruinose. (C. hygrophi)
  4 Thallus immersed. Stalk shining black. \( \text{C. brunneola} \)

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.

Widely distributed in Europe, though its ecological requirements probably restrict it to the uplands in the south. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), Africa, N. America (southern Canada, northern USA), C. America (CR), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

Chaenothece chrysocephala (Ach.) Th. Fr. (1860)
in: Lich. Arct. 250; Calicium chrysocephalum Ach. (1803) in Methodus (Suppl.) 15; (?) Chaenothece 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.

Widely distributed in Europe, but generally rare south of the Alps. Also Asia (widespread), Malesia (PNG), central Africa (Kenya, Rwanda, Zaire), N. America (northern and montane regions), 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, though probably rare in regions with truly Mediterranean climate. Also Asia (Turkey, Russia, Sichuan), East Africa (Ethiopia, Uganda), N. America (widespread in cold to temperate regions), C. America (CR), S. America (Argentina, perhaps elsewhere), 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 in cold to warm regions, but absent from the tropics), Africa (Congo, Kenya, Rwanda), N. America (widespread), C. America (CR), S. America (Argentina, Colombia, Venezuela; perhaps elsewhere), Australasia (widespread, but absent from western half of Australia).

**Chaenothecopsis** Vain. (1927)

Type: *C. rubescens* Vain. Family: *Sphinctrinaceae*. Literature: There is a key to the non-resinicolous European species in Groner (2006). All but one of the species included in the key below are described more fully in Ahti et al. (1999). Additional information on many of the European species may be found in Clauzade & Roux (1985), Clauzade, Diederich & Roux (1989) and Smith et al. (2009).

Over 50 species, including both 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.
   22 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)
   2 Not as above.
   33 On saxicolous leprose lichens (especially Haematoma 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)
   3 Not as above.
   44 Stalk reddish in squash, N+ violet-red. (C. debilis)
   4 Stalk not N+ violet-red.
      555 Stalk and head with yellow-red, yellow-brown or green pigment, K+ red to purple (pigment fast dissolving);
         N+ green > red-brown. (C. pusiola)
      55 Stalk and head with reddish pigment, K+ green, blue-green or olive-green. (C. viridireagens)
   5 Stalk and head K- or K+ brownish.
      66 Apothecia sessile, or stalk 0.1 - 0.25 mm long; N-. (C. brevipes)
      6 Apothecia with stalk more than 0.3 mm long; N- or N+.
         77 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*
         7 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)

_in: Publications from the Herbarium, University of Uppsala, Sweden, No. 4, Fasc. 2, no. 35._

Description: 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 as _C. nana_ has been reported for Sardinia its presence in Epiros does not seem impossible.

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, both islands of NZ).

**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 stated.

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.

Widely distributed in northern parts of Europe, and there are a few reports from central and even southern parts. Also Asia (Russia), S. America.

**Chrysothrix** Mont. (1852)

**Chrysothrix chrysophthalma** (P. James) P. James & J. R. Laundon (1981)

Incorrectly reported for the Peloponnese by Abbott (2009); the two collections on which that report was based are not determinable but do not belong to this species. According to Purvis et al. (1992) it is also present on Rhodes, but they do not state the source of this information and I have not been able to trace it. Smith et al. (2009) do not repeat that Greek report (but nor do they state that it was incorrect). _C. chrysophthalma_ should probably be deleted from the Greek list.

The core range of _C. chrysophthalma_ is the Nordic countries, the British Is and Macaronesia, though it is also reported for Slovakia. It is said also to be present in North America. Rhodes, and all other parts of Greece, would appear to be outside its expected range.

**Cladonia** P. Browne (1756)

_in: Civ. Nat. Hist. Jamaica 81._ The name was first used by Hill, in his Historia Plantarum, but that was published in 1751, before the nomenclature start date. Linnaeus did not use the name in Systema Plantarum. The first really clear use of the name after 1753 is in Primitiae Florae Holsaticae (Wiggers, 1780). Browne himself, when discussing _Cladonia_ does not provide a description, nor does he refer explicitly to any previous description, but on page lxx of the preface he states: "... I have followed the order and distribution of Linnaeus as much as possible: I have however differed from him ... followed Hill sometimes ...". In a conservation proposal Laundon (1984c) argued that this amounts to an indirect reference to Hill's effectively published diagnosis. I would not accept this argument, but Laundon's view has been adopted by the Code. Browne does not mention Hill on page 81, so I prefer not to cite the author as Hill ex P. Browne. Browne lists eight species of _Cladonia_, but all the names are in multinomial form, and so are not validly published. The first validly published names at species rank or below in _Cladonia_ date from 1780.

Type: _C. subulata_ (L.) F. H. Wigg. Family: Cladoniaceae. Literature: There is no recent monograph of the European species. The only world monograph, Vainio (1887, 1894, 1897), contains a great deal of interesting information, but it has no keys and in many respects is dated. Ahti (2000) has an excellent discussion of 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), or Smith et al. (2009). Most non-European Floras treat at least some species that also occur in Europe. Orange (1992) gives a key to the chlorophaea group in Europe, using microcrystal tests, while Huovinen et al. (1990) has much information on the chemistry of many species.

The thallus of _Cladonia_ species is usually squamulose; in a few species, those in subgenus _Cladina_, it is crustose but disappears early. The podetia are, in origin, apothecial stipes, and it seems best to 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, never the podetia. The word 'squamule', if unqualified, refers to the squamules of the true thallus, i.e. to what some authors have termed the 'basal squamules'. Squamule-like outgrowths from podetia are always referred to as 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 or brown-green or brown, not normally pruinose. Lower surface of squamules: white in most species.

Squamules: very varied, conspicuous to very inconspicuous; always with an upper cortex, never with a 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 bear cilia at the margins of the 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 the apex of the podetia or on the rim of the cups, usually globose. Disc: brown in all Peloponnesian and 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 wherever cortex present.

Because many species of Cladonia are widespread, conspicuous and rather variable, the genus has suffered more than most from a proliferation of infra-specific names; Vainio (1887, 1894) lists vast numbers of them. Very few of these names represent good taxa, and nearly all of them are best ignored.

Cladonia is a large genus of over 400 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, so the genus is rather poorly represented in Greece. Although quite a lot of species have been recorded for Greece, most are uncommon. However, a few species of calcareous soil in open habitats, especially C. convoluta, C. furcata, C. pocillum and C. rangiformis, are very common.

Because the diversity of Cladonia species increases rapidly on going towards cooler regions, especially if acidic substrata are present, it is possible that montane regions of the northernmost parts of Greece could have a fairly rich Cladonia flora. To include all the species that might conceivably occur there would increase the complexity of these keys substantially. I have therefore restricted the keys to those species that have been recorded for Greece and those others whose presence in Greece seems fairly likely, not merely 'conceivable'.

Determination of Cladonia specimens often involves use of the P reagent. It is usually easy to distinguish between a P- and a P+ reaction, but if determination depends on noting the precise colour of a P+ reaction then care is required. For a start, the colour may take several minutes to develop. Second, 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. The colour usually darkens with time, so that a +red reaction may appear +yellow or +orange for several minutes; if too weak a P solution is used one may never obtain a convincingly red colouration. In case of doubt, add more P to the same spot on the lichen.

Key to Cladonia main groups

11 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.
33 Podetia prominent.
44 Podetia with well developed cups, wider than stalk. Group 3
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.

11 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
   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
         2 Podetia KC-, smooth or not.
            5 Podetia densely squamulose. C. diversa (here treated as synonymous with C. coccifera but recognised by some authors.)
            2 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. (C. ciliata var. ciliata), (C. ciliata var. tenuis)
      3 Branching and apices mainly trichotomous, sometimes tetrachotomous 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.
      33 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
         4 Cups narrow in relation to length of podetial stalk. C. ochrochloara
   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.

444 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 Podetia not 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 for only a few mm at base)

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.

55 Podetia 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.

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(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 for only a few mm at base)

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.

55 Podetia 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. 666 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.
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)
33 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.
5 Medulla of squamules P+ orange.
55 Podetia with farinose soredia in upper part, corticate at the base. Squamules rarely sparingly sorediate below. *C. macilenta*
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, just reaching the high mountains of the south. Also Asia (widespread), N. America (widespread in colder parts), S. America (Chile, Colombia, Falkland Is), Antarctica (subantarctic islands, Antarctic Peninsula).

**Cladonia caespiticia** (Pers.) Flörke (1828)
The name *Cladonia fusca* Schrad. (May or June 1794) in Spic. Fl. Germ. 106 may be synonymous, and it is not clear which epithet has priority.
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 930m. There is also a poorly localised published report.
Widely distributed in moister regions; there are only a few records for south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, Tanzania, Uganda, S. Africa), N. America (SE Canada, widespread in eastern USA, perhaps present elsewhere), 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 carious 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 carious 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 the two discussions to 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).

Rare. Known only from two sites, in western Crete and western Macedonia, at altitudes 700 and 1700 m.

Terricolous.

Throughout Europe, though rare in the south and confined to the mountains. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread except in southern USA), Pacific (Marquesas, New Caledonia). Its status in S. America is not clear to me; reports for Falkland Is, at least, are incorrect.

*Cladonia cervicornis* (Ach.) Flot. (1850) subsp. *cervicornis*


Thallus: squamulose, 4 cm diameter. Upper surface of squamules: green. Lower surface of squamules: white. Squamules: to 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 the cups, cortex ±continuous, or becoming discontinuous in upper part, rarely with true squamules. Cups: always present on the podetia, 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 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. convoluta* by having much smaller squamules and no yellow tinge on the lower surface.

Scattered throughout Greece, usually fairly close to the sea. On soil at altitudes 100 - 1400 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (Irian Jaya), N. Africa (Morocco), N. America (widespread from Alaska to northern USA), C. America (Mexico), Australasia (widespread in NZ). Reports for S. America (Colombia) are incorrect, which calls into question those for Argentina.

*Cladonia cervicornis* subsp. *verticillata* (Hoffm.) Ahti (1980)


Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Very scattered, with no clear pattern. On soil at altitudes 0 - 900 m.

Present in most of Europe. According to Nimis (1993), less frequent in southern Europe than subsp. *cervicornis*, but there are too few Greek reports to test this hypothesis. Also Macaronesia (only Azores), Asia (widespread), Malesia (Malaysia), Africa (Morocco, Socotra, S. Africa), N. America (widespread), perhaps Caribbean (Bahamas), perhaps S. America (Argentina, Brazil, Venezuela; reports for Falkland Is are incorrect), Australasia (widespread in moister, temperate parts), Pacific (New Caledonia).

*Cladonia chlorophaea* (Fr.) Flörke ex Sommerf. Spreng. (1827) aggregate


This entity is chemically variable, and the chemotypes have sometimes been 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) actually 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 proved to be distinct. For the present, I prefer to take a broad view of *C. chlorophaea*, and to 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. Anyone wishing to do so may like to note that 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 of squamules: green to brown, not pruinose, rarely white maculate. Lower surface of squamules: white. Squamules: 1 - 2 x 0.5 - 1.5 mm, ±isodiametric or slightly elongated, usually ascending at least at the margins and often entirely, 150 - 200 µm thick; margin crenulate to incised, only rarely smooth, very rarely disintegrating and developing a few soreidia. Podetia: always present, (4) 5 - 14 mm tall, (0.35) 0.5 - 1.2 mm wide at the base, most commonly widening upwards rather uniformly into cups, but sometimes opening out into cups more abruptly, corticate for at least 1 mm at base, the corticate area sometimes with a few (never many) podetial squamules, upper part with coarse soreidia 0.03 - 0.08 mm diameter, not proliferating (in Peloponnesian material seen to date). Cups: always present, regular, wider than podetia, 0.8 - 3 (3.8) mm diameter, inner surface with rather coarse soreidia. Upper cortex of squamules: consisting of two layers; upper layer: 5 - 15 µm thick, colourless, structureless; lower layer: 15 µm thick, brown, pigment K- but dissolving in K, of densely interwoven hyphae of all orientations but avertical ones predominating. Medulla of squamules: white, of loosely interwoven hyphae that are 2 - 4.5 µm wide, often branched, without visible septa, and encrusted in small crystals 0.5 - 1 µm wide. Lower cortex of squamules: absent. Pycnidia: often present on rim of cups, sessile, brown, 0.1 - 0.3 mm diameter; however all those sectioned were immature. Chemistry: podetia and medulla of squamules K- or + faintly brownish, C-, KC-, P- or P+ orange, 1-, UV- in material tested by me (not all collections tested). Photobiont: green, Trebouxioid, of globose cells 10 - 11 µm diameter, forming (in the squamules) a continuous, irregular layer 50 - 70 µm thick.

Note: Since I have not seen pycnidia containing conidia, I cannot entirely exclude the possibility that what I have described as pycnidia might be incipient apothecia, though in section they do not resemble apothecia.

Cladonia chlorophaea can usually be separated easily from C. fimbriata. Its podetia are corticate, at least near the base, whereas those of C. fimbriata entirely lack a cortex. The cups of C. fimbriata expand abruptly at the top of the podetia, whereas in C. chlorophaea the podetia widen gradually upwards, and the cups are much less sharply delimited; the rate of expansion of the podetia may increase at the cups, but not by a large amount. Also, the soreidia of C. chlorophaea are coarser than those of C. fimbriata. Typical specimens of each species are easy to determine, but intermediate forms with ambiguous characters do occur.

Throughout Greece. On acidic substrates that are rich in organic material. Usually on non-calcareous soil or on slightly decaying bark, but 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 Diplophisthes muscorum has been recorded once from this species.

The C. chlorophaea aggregate is cosmopolitan outside hot deserts and the humid tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (E. Africa, S. Africa, Madagascar; Ascension Is, St Helena), N. America (widespread), Caribbean (widespread), C. America (widespread), S. America (widespread), Australasia (widespread), Pacific (Hawaii), Antarctica (widespread). Most of the chemical races appear to be widely distributed too, though they may not all be cosmopolitan.

Cladonia ciliata Stir. (1888) var. ciliata
in: [need to investigate - title of publication in Scottish Naturalist not known].

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Smith et al. (2009).

Rare, in northern Greece. The single report was from an upland site (probably around 1000 m). No substrate was stated.

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) Ahti (1993)
in: [need to investigate - probably Regnum Veg. vol. 128]. (The combination was also validly published in the same year by Nimis, in The Lichens of Italy. The name was first published in 1977, by Ahti, in Poelt & Vězda, Bibl. Lich. 9: 46, but was not validly published there.): Cladonia rangiferina γ (= var.) tenuis Flörke (1828) in: De Cladon. 164-165

If treated at the rank of form, as in some recent publications, the correct name is C. ciliata f. flavicans.

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 (scattered in eastern USA), Pacific (Hawaii).

Cladonia coccifera (L.) Willd. (1787) aggregate

Descriptions: Ahti et al. (2013); Burgaz & Ahti (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.

\textit{C. coccifera} s. lat. is subcosmopolitan in cold to temperate regions.

\textbf{Cladonia coniocraea} (Flörke) Spreng. (1827)

With the conserved type that has now been formally adopted, this taxon is distinct from, though close to, \textit{Cladonia ochrochlorea} Flörke.

Thallus: squamulose, to 3 cm diameter. Upper surface of squamules: pale green, not pruinose. Lower surface of squamules: white, often sorediate. Squamules: discrete and 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 tip, 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 Peloponnesian collection is very 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 \textit{C. furcata} and \textit{C. rangiformis}, the other common species of this group in the Peloponnesus. For separation from \textit{C. ochrochlorea} see under that species.

Scattered in mainland Greece, but commonest in the north. Not yet reported for any of the islands. On ±acidic and often slightly decaying bark, or on wood, at altitudes 700 - 1900 m.

Throughout Europe, though some reports may be unreliable owing to confusion with \textit{C. ochrochlorea}. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), perhaps Caribbean (St Lucia), C. America (Mexico), perhaps S. America (Argentina, Brazil, Uruguay), Pacific (Hawaii, Marquesas, Tahiti).

\textbf{Cladonia crispata} var. cetrariiformis (Delise) Vain. (1886)
in: Olivier, in: [need to investigate]; \textit{Cenomyce gracilis} o (=var.) cetrariiformis Delise (1830) in Duby, Bot. gall. 2: 625 (as \textit{cetrariaeformis}, which is correct Latin but which a stupid rule in the Code insists be changed).

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. Also Macaronesia, Asia, N. America, and perhaps elsewhere.

\textbf{Cladonia cyathomorpha} W. Watson (1935)
in: 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 (limestone or serpentinite).

A rather uncommon species of Mediterranean Europe and the Atlantic margin. Also Macaronesia, southernmost S. America (Argentina Tierra del Fuego).

\textbf{Cladonia fimbriata} (L.) Fr. (1831)

Thallus: squamulose, to 12 cm diameter. Upper surface of squamules: green to brown, not pruinose. Lower surface of squamules: white, often sorediate. Squamules: discrete and rather scattered, to 2 x 1.5 mm, sometimes dissolving almost entirely into soredia, margins slightly incised. 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 0.03 - 0.04 mm diameter. Cups: 1.6 - 7 mm diameter, regular, not proliferating, inside covered in fine soredia. Upper cortex of squamules: present. Lower cortex of squamules: white. Lower cortex of squamules: absent. Pycnidia: often present on rim of cups, sessile, brown, 0.1 - 0.3 mm diameter; however all those sectioned were immature. Chemistry: medulla of squamules K- or + faintly brownish, P+ orange or red; podetia K- or + faintly brownish, P+ orange.

For separation from \textit{C. chlorophaeae}, see under that species.

Probably throughout Greece, though, surprisingly, not yet recorded for Crete. At all altitudes. On ±acidic substrates that are rich in organic material, most commonly bark and soil, but also recorded on wood, overgrowing bryophytes on acidic and

\textit{C. ochrochlorea} Flörke; ?
bark and soil, occasionally directly on rock, and once overgrowing an undetermined species of bracket fungus.

Cosmopolitan outside deserts and the humid tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, S. Africa), N. America (widespread except in hot, dry regions), Caribbean (Bahamas, Bermuda, Guadeloupe), C. America (Mexico, Nicaragua), S. America (widespread), Australasia (widespread in temperate parts), Antarctica (widespread). The few reports for the moist tropics may refer to other species. The status of reports from the Pacific (Hawaii) is unclear.

**Cladonia firma** (Nyl.) Nyl. (1861), non (Laurer) Kremp. (1868)

The single Peloponnesian collection that I have referred, tentatively, to this species was not in good condition, so no description is provided. For published descriptions, see: 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. convoluta*.

Scattered, with no really clear pattern. On non-calcareous soil, less commonly directly on non-calcareous rock, at altitudes 20 - 700 m.

Much of southern and central Europe, just reaching southern Scandinavia. Also Macaronesia (widespread), Asia (Turkey, Mongolia, China), Malesia (PNG), Africa (Morocco, Algeria), N. America (California), perhaps S. America (Uruguay).

**Cladonia florkeana** (Fr.) Flörke (1828)

The earliest name may be *Cenomyce curcata* Ach. (1810), but the synonymy is disputed.

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.) Willld. (1878)

The name *Lichen alcicornis* Lightf. (1777) is illegitimate, being a superfluous name for *Lichen foliaceus* Huds., and most of the names supposedly based on it are also illegitimate, since the epithet *foliaceus* was available.

*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 is able to grow more robustly because of the calcareous substrate.

Thallus: squamulose, forming large, prominent patches, to 20 cm diameter. Upper surface of squamules: grey-green to brown-green, not pruinose. Lower surface of squamules: pale yellow to very pale green-yellow. 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. 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 squamules or soredia, sometimes branched but not proliferating. Cups: always present on podetia, 0.4 - 0.65 mm diameter, regular. Upper 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 that are 6 - 9 µm wide and with a few small crystals. Lower cortex of squamules: absent. Pycnidia: nearly always present if cups are present, sessile on rim of cups, brown, 0.15 mm diameter; in section: 280 x 200 µm (height x diameter), wall brown, centrum colourless. Conidia: colourless, 6 - 8 x 0.5 µm, sometimes curved. Chemistry: cortex K-; medulla K-, C-, KC+ yellow, P+red-orange, UV+ very 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 means that this very common species is unlikely to be confused with any other.

Throughout Greece. Usually on calcareous soil, less commonly on other substrates, at altitudes 0 - more than 2000 m, but with a definite preference for lower altitudes. About half of all reports are from altitudes below 400 m.

Present in most of Europe. Also Macaronesia, Asia (widespread), northern Africa (Morocco, Algeria, Tunisia, Egypt, Mauretania). Reports for N. and S. America are incorrect.
Cladonia furcata (Huds.) Baumg. (1790)
in: Fl. Lips. 577; Lichen furcatus Huds. (1762) in: Fl. Angl. 458-459; Cenomyce racemosa (Hoffm.) Ach.; Cladonia coniocraea f. truncata (Flörke) Dalla Torre & Sarnth.; Cladonia furcata var. corymbosa (Ach.) Nyl.; Cladonia furcata f. foliola (Delise) Vain.; Cladonia furcata v. foliosa (Delise) Mont.; Cladonia furcata f. foliola auct. grac. (probably lapsus for 'foliola').

Description: see the protologue.
in: De Cladon. 140-141

Cladonia glauca Flörke (1828)
in: 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. Reports for elsewhere are doubtful. On bark of Quercus cerris and on terricolous bryophytes at altitudes of about 800 - 1700 m.

Widely distributed in northern and central Europe, but rare south of the Alps. Also Asia (widespread), N. America (Alaska to northern USA).

Cladonia graeca Sipman & Ahti (2011)
in: Mycosistema 30(6): 879

Description: see the protologue.
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 from northern Greece to Crete but not common. On soil, wood or siliceous rock from sea level to alpine levels.

Most of Europe. Also Macaronesia, Asia (widespread; not restricted to eastern Asia as some have suggested), Africa (Algeria, Ethiopia), N. America (widespread, especially in USA), southern S. America (Falkland Is; probably also elsewhere), Australasia (temperate parts), Antarctica.

Cladonia macilenta Hoffm. (1796)
in: Deutschlands Flora, 2: 126; Cladonia macilenta var. squamigera (Vain.) de Lesd.; Cladonia macilenta var. styracella (Ach.) Rabenh.

Cladonia macilenta Hoffm. has been conserved with a conserved type. The name Baeomyces bacillaris Ach. (1803), which is now considered a synonym of C. macilenta, is also conserved, with a conserved type.

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Scattered in northern Greece, at altitudes 300 - 1300 m. Most often reported from soil, but also known from wood and, once, bark of Pinus nigra.

Widely distributed in Europe, but absent from areas of true Mediterranean vegetation. Also Macaronesia, Asia (widespread), Malesia (probably widespread), Africa (widespread outside humid tropics), N. America (widespread except in hot regions), Caribbean (PR), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (moister parts), Pacific (Hawaii, Tahiti, Solomon Is).

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. Terricolous, at altitudes of 100 - 750 m.

Southern Europe, plus a few records from strongly oceanic sites in the NW (Brittany, Cornwall). Also Macaronesia, western Asia (Turkey), N. Africa (Morocco).

Cladonia monomorpha Aptroot, Sipman & van Herk (2001)
in: Lichenologist 33(4): 273-278; (?) Cladonia neglecta 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.

C. monomorpha is reliably reported from northern and central Europe, and northern Greece. Perhaps also Asia (Mongolia).

Cladonia ochrochlora Flörke (1828)
in: De Cladon. 75-79. The name has a conserved type, and thus typified this species is close to, but distinct from, C. coniocraea. Also conserved against Cenomyce carneopallida (Flörke) Sommerf. (1826), which is based on Capitularia pyxidata var. carneopallida Flörke (1810).

Thallus: squamulose, 5 x 3 cm. Upper surface of squamules: blue-grey to green-grey, not pruinose. Lower surface of squamules: white, sometimes slightly sorediate. 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 their length, often corticate at base, corticate area sometimes with podetal squamules, coarsely sorediate in upper part. Cups: sometimes present, irregular, to 1.2 mm diameter. Upper 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. Lower cortex of squamules: absent. 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-.

The sorediate podetia easily separate this species from C. furcata and C. rangiformis. If the limited material seen to date is representative, C. ochrochlora has much more robust podetia than C. coniocraea, has coarser soredia, and about half the podetia have cups whereas C. coniocraea entirely lacks cups. For a careful comparison with C. coniocraea see Nash et al. (2002).

Very scattered on the mainland. There are no reports for any of the islands. On soil, bark or wood at altitudes from sea level to over 2000 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), E. Africa (Kenya, Tanzania, S. Africa), N. America (northern regions of both coasts; rare or absent in continental interior), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (temperate parts), Pacific (Hawaii, New Caledonia), Antarctica (Prince Edward Is). Some reports may be unreliable owing to confusion with C. coniocraea.

**Cladonia parasitica** (Hoffm.) Hoffm. (1796)


*Lichen delicatus* Ehrh. (1794) is a nomen nudum. *Lichen delicatus* Ehrh. ex Ach. (1799) is a superfluous name for *Lichen parasiticus* Hoffm., and all later *delicata* names at the ranks of species and variety are also superfluous.

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 probably restricted to upland areas. Also Macaronesia (only Azores), Asia (fairly widespread in cooler regions), N. America (southern Canada, widespread USA), perhaps Caribbean, perhaps S. America (Bolivia).

**Cladonia phyllophora** Hoffm. (1796)

in: Deutschlands Flora 2: 123; *Cladonia degenerans* (Flörke) Spreng.

Descriptions: Ahti et al. (2013); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Macedonia. 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), perhaps Malesia (Java - old report), perhaps Africa (Reunion Is), N. America (widespread in cooler regions), perhaps S. America (though some records - e.g. Falkland Is, Colombia - certainly incorrect), Antarctica (subantarctic islands). Reports for Australasia (NZ), Pacific (Hawaii) are incorrect or doubtful.

**Cladonia pocillum** (Ach.) Grognot (1863)


Most contemporary lichenologists treat *C. pocillum* at the rank of species, perhaps because it is the current fashion in lichenology to treat everything at species rank. I have followed the majority view here, though I am not comfortable with it. *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 is a topic that is very difficult to investigate in lichens. The fact that the two taxa have a similar distribution is consistent with there being some gene flow between them, though it does not prove it. If we follow the well thought out concepts for infra-specific taxa suggested in Lücking (2008) it would be recognised at a rank no higher than that of form. *C. pocillum* could even be merely a response of perfectly ordinary *C. pyxidata* to calcareous substrata. Molecular investigations may shed some light on the matter.

Thallus: squamulose, to 8 cm diameter, sometimes ±rosette-forming. Upper surface of squamules: 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 of squamules: white. 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 in number, 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
corticat at base and sometimes further up, corticate part sometimes with a few small squamules, upper part with
course, corticate granules, 0.15 - 0.25 (0.3) mm diameter, never sorediate. Cups: always present on podetia, 0.7 - 4.5
mm diameter, always wider than podetia, regular, inside with coarse corticate granules, 0.2 - 0.4 mm diameter, usually
noticeably larger than granules on exterior of podetia. Upper cortex of squamules: present, 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, formed of
hyphae oriented predominantly perpendicular to surface; both layers K-. Medulla of squamules: white. Lower cortex of
squamules: absent. Pycnidia: usually present on rim of cups, sessile, brown; however all those sectioned were
immediate. 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.

Possibly just an ecotype of *C. pyxidata* that is able to grow more robustly because of the calcareous substrate, but as
this has not yet been demonstrated conclusively I prefer to distinguish them.

*C. pocillum* is easily distinguished from *C. fimbriata* and *C. chlorophaea* by its coarse corticate granules, rather than
fine sorediate. 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. Usually on calcareous soil, less often overgrowing bryophytes on calcareous substrates, rarely
directly on limestone. Reports from other substrates are doubtful. At all altitudes. The facultatively lichenicolous
lichen *Diploschistes muscorum* and *Megaspora verrucosa* have been reported from this species.

Subcosmopolitan outside tropical regions. Throughout Europe. Also Macaronesia, Asia (widespread), Malesia
(PNG), Africa (Morocco, Algeria, E. Africa, S. Africa), N. America (widespread except in warmer regions), C. America
(Mexico, Guatemala), S. America (probably widespread in cooler regions), Australasia (both islands of NZ), Antarctica
(widespread).

### Cladonia polydactyla (Flörke) Spreng. (1827)

in: Syst. Veg. 4(1): 274; *Cenomyce polydactyla* Flörke (1821) in: Deutsche Lichenen Fasc. 10, pp13-14. The basionym is
conserved against *Lichen ventricosus* Huds. (1762), *Lichen difformis* Huds. (1762), and *Cenomyce conglomerata* Dufour
(1821). It is not conserved against *Capitularia flabelliformis* Flörke (1808), which may be synonymous.

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.

Widely distributed and common north of the Alps; rare in southern Europe. Also Macaronesia, Asia (Russia). Reports for N. America refer to var. *umbricola*. Reports for southern S. America appear to be doubtful.

### Cladonia prolifica Ahti & S. Hammer (1990)

in: Hammer & Ahti, in: *Mycotaxon* 37: 342

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.

Portugal, Spain and Greece. Also western N. America (BC, California).

### Cladonia pseudopityrea Vain. (1887)

in: Monogr. Cladon. 1: 452-453


Very scattered, in the islands. Not yet reported for the mainland. On bark and soil at altitudes 20 - 800 m.

Mediterranean regions of Europe, plus a couple of outlying records for Switzerland. Also western Asia (Turkey).

### Cladonia pyxidata (L.) Hoffm. (1796)

in: Deutschl. Fl. 2: 121; *Lichen pyxidatus* L. (1753) in: Sp. Plant. 1151; *Cenomyce pyxidata* (L.) Ach.; *Cenomyce
pyxidata var. simplex* (Roth) Ach.; (?) *Cladonia neglecta* var. *scyphosa* Schae.; *Cladonia pyxidata f. staphylea* (Ach.)
Nyl.

Greek reports of *C. neglecta* and *C. pyxidata* var. *neglecta* are discussed under *C. monomorpha*.

Thallus: squamulose, to 12 cm diameter. Upper surface of squamules: green to brown, not pruinose. Lower surface:
white. Squamules: to 3 x 3 mm but usually less, erect or at least ascending at margins, rarely adpressed, sometimes
slightly overlapping but never coalescing, not rosette-forming, usually abundant but sometimes distributed only sparsely
over substrate, 160 - 220 µm thick; margins usually slightly incised, but 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, the 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 soredia, 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, granules occasionally becoming slightly squamule-like. Cortex of squamules: 17 - 30 µm thick (swelling by about 50% in K), colourless, of hyphae orientated predominantly perpendicular to surface; K-. Medulla of squamules: white; in section: 65 - 70 µm thick, of rather broad hyphae about 1 µm wide not soluble in K. Lower cortex of squamules: absent. Apothecia: rare; on short proliferations 0 - 0.5 (0.7) mm long from rim of cups, rounded, strongly convex, not pruinose, 0.35 - 0.5 mm diameter. Disc: pale brown. Exciele: excluded early. Thalline margin: absent. Pycnidia: usually present on rim of cups, brown, sessile, 0.1 - 0.15 mm diameter; in section: globose, 160 x 170 µm (height x width), wall pale brown, centrum colourless. Conidia: colourless, 5 - 10 x 1 µm, sometimes slightly curved. Chemistry: medulla K- or K+ faintly brownish, C-, KC-, P+ orange to red, I-; podetia and squamules K-, C-, KC-, P+ orange to dark red, UV-. Photobiont: green, cells globose, 7 - 15 (20) µm diameter, forming a ±continuous layer (though sometimes with some clumping of cells) 25 - 30 µm thick.

C. pyxidata is easily distinguished from C. fimбриata and C. chlorophorea by its coarse corticate granules, rather than fine soredia. The uniformly widening, funnel-shaped podetia also help distinguish it from C. fimбриata. 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 to C. pocillum. A black sporodochium of an unidentified lichenicolous hyphomycete was present on one Peloponnesian collection.

Subcosmopolitan outside tropical regions. Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (probably widespread), Africa (widespread), N. America (widespread except in southern USA), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (SE Australia, both islands of NZ), Pacific (Marquesas; reports for Hawaii may be incorrect), Antarctica (probably widespread).

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. Not yet reported for the mainland. On soil and rock at altitudes 130 - 300 m.

Subcosmopolitan. Throughout Europe, though in the south probably restricted to moist or upland regions. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), Africa (Morocco, E. Africa, S. Africa; also Ascension Is, St Helena), N. America (widespread), Caribbean (PR; perhaps also Bahamas and Bermuda), C. America (CR, Guatemala, Mexico, Panama), S. America (widespread), Australasia (southern and eastern Australia; reports for NZ may be incorrect), Pacific (widespread).

Cladonia rangiformis Hoffm. (1796)
in: 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) Vain.; 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 basal squamules are usually inconspicuous. Squamules: sometimes present if the bases of the podetia have not decayed, to 6 x 2.5 mm but usually smaller. Surface of podetia: usually grey-green, sometimes grey-brown or brown in upper parts. Podetia: always present, to 15 mm tall, 0.5 - 0.7 mm wide near base and not narrowing much except after branching, hollow, 150-210 µm thick (surface to central hollow), branching at all levels (branching usually dichotomous, ±isotomically, widely divergent, 60-90°), axes sometimes open, without soralia, sometimes with podetial squamules, occasionally with longitudinal holes, without cups, apices closed. 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- but pigment dissolves, formed 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, formed of hyphae embedded in a gel, orientation of hyphae various but predominantly perpendicular to surface; 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 but 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 (but reaction often faint and in some specimens easily recorded as K-), P- or (in about 40% of specimens) P+ red, UV-. Photobiont: green, cells egglobose, 6 - 10 µm diameter, distributed throughout the medulla and not forming a really distinct photobiont layer independent of the medulla.

Two Peloponnesian collections bears cilia-like or rhizine-like structures on the margins of the podetial squamules, sometimes also at the apex of the podetia (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 podètions." One of the authors collections displaying this phenomenon 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 C. furcata, but overall is a less robust species with narrower and more richly branched podetia, and resembling even more closely the growth form seen in subgenus Cladina. It is best separated from C. furcata by the areolation of the cortex that develops in C. rangiformis, but this may not be very apparent in some podetia. In Peloponnesian material seen to date, the axes between branches are often open in C. rangiformis, but never open in C. furcata; however, Purvis et al. (1992) state that the opposite is the case (presumably in 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. The 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 is often confused by mobilisation of cortical pigment. A specimen with a P-medulla belongs to C. rangiformis, but some specimens of that species 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 species.

Throughout Europe. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, S. Africa, perhaps Reunion Is). Reports for N. America are said to be erroneous, and reports for Caribbean, S. America seem doubtful to me.

**Cladonia rei** Schaeer. (1823)

in: Lich. Helv. Spic. 34; *Cladonia nemoxyra* (Ach.) Arnold

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Only known for 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 southern Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread in E. Africa, also present in S. Africa), N. America (widespread, but avoiding warmer parts of USA), perhaps Caribbean (Bermuda), perhaps S. America (Uruguay), Australasia (both islands of NZ, perhaps Australia), Pacific (Hawaii), Antarctica (S. Georgia).

**Cladonia scabriuscula** (Delise) Nyl. (1876)

in: *Comptes Rendus Séances Acad. Sci., sér. D, Paris* 83: 88. (The combination appears also to have been published by Leighton in the same year, and I do not know which appeared first.); *Cenomyce scabriuscula* Delise (1830) in: Duby, Bot. Gall. 2: 623

Descriptions: Ahti et al. (2013); Burgaz & Ahti (2009); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Only known for a single locality in northern Greece, at an altitude that was probably around 1000 m. No substrate was reported.

Mostly central and northern Europe; there are hardly any reports from south of the Alps. Also Asia (widespread), N. America (widespread from Alaska to northern USA), Caribbean (Haiti), C. America (CR, Guatemala, Mexico), perhaps S. America (Argentina, Brazil, Chile, Peru), Australasia (widespread in cool to temperate parts), Antarctica (subantarctic islands, Antarctic Peninsula). Reports for N. Africa (Morocco), Pacific (Hawaii) are doubtful.
Cladonia squamosa Hoffm. (1796) var. squamosa
in: Deutschl. Fl. 2: 125

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 of squamules: mostly brown, but green where shaded. Lower surface of squamules: white. Squamules: 0.6 - 1 x 0.3 - 0.7 mm, erect, 160 - 220 µm thick, margins usually crenulate.


Although my only collection lacked podetia, the morphology, chemistry and ecology all fit C. squamosa, and I am reasonably confident that the material is correctly determined. 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. The Peloponnesian collection was on non-calcareous soil at an altitude of 1750 m.

Subcosmopolitan in cold and temperate regions. Throughout Europe, but in the south probably restricted to the mountains. Also Macaronesia, Asia (widespread), Malesia (Java, PNG), Africa (widespread in E. Africa, also S. Africa, Madagascar), N. America (widespread), C. America (CR, Guatemala, Mexico, Panama), S. America (widespread), Pacific (Hawaii, Marquesas, New Caledonia, Tahiti), Antarctic (subantarctic islands, Antarctic Peninsula). Incorrectly reported for New Zealand (so reports for Australia may also be incorrect).

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 western Asia (Turkey, Iran, Kazakhstan, Russia), N. Africa (Morocco), perhaps N. America. A report for Malesia (PNG) is very disjunct and 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).

Macedonia, on soil at an altitude of about 1400 m.

Common in northern and central Europe, rare in the south. Also Macaronesia (Canary Is, Madeira), Asia (widespread), Africa (Morocco; reports from S of the equator are incorrect), N. America (widespread), Australasia (Australia, both islands of NZ.), Antarctic (subantarctic islands, Antarctic Peninsula). Reports for S. America and for the Pacific are probably incorrect.

Cladonia symphycarpa (Ehrh. ex Schrad.) Fr. (1826)

The epithet is symphycarpa not, as often written, 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, but its range does not penetrate far into truly Mediterranean regions. Also Asia (widespread), N. America (widespread), southern S. America (Argentina, Chile, Falkland Is).

Cladonia uncialis subsp. biuncialis (Hoffm.) M. Choisy (1951)
in: [need to investigate - title of paper not known]; Cladonia biuncialis Hoffm. (1796) in: Deutschl. Fl. 2: 116-117

The earliest name may be Lichen ceranoides Neck. (1768), but it does not have priority at the rank of subspecies.

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.

in: Nova Hedwigia, Beihefte 79: 319

Type: C. monticola (Ach.) Hafellner & Bellem. Family: Lecideaceae. Literature: Meyer (2002) monographed the genus. Good descriptions of the four widespread species are also readily available elsewhere, e.g. in Clauzade & Roux (1985) or Smith et al. (2009).

Thallus: crustose, often poorly developed, without vegetative propagules. Apothecia: dark red-brown to black, without a thalline exciple. Exciple: black, persistent; in section: very dark brown at least in outer part, not closed below, hyphae generally with distinct elongated lumina in upper part. Epithecium brown or orange-brown, with the same pigment as the exciple but at lower concentration. Ascii: Porpidia type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, medium sized (generally in the range 10 - 20 \( \mu m \) long), with a prominent perispore. Chemistry: apothecial pigment K-, N+ reddish when present in quantity, soluble in N but not in K. Photobiont: green.

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 Apothecia sessile, often becoming strongly convex, not pruinose. Ascospores 8 - 12 \( \mu m \) long.
   22 Epithecium K-. C. monticola
   2 Epithecium with granules reacting K+ purple or red-purple; reaction often faint (Note 1). See Protoblastenia lilacina

1 Apothecia immersed in thallus or substrate, flat or at most slightly convex, pruinose or not. At least some ascospores usually more than 12 \( \mu m \) long.
   22 Thallus superficial, thick. Apothecia 0.5 - 1.5 mm diameter, immersed in thallus. Ascospores 8 - 16 \( \mu m \) long. C. chondrodes
   2 Thallus immersed (Note 2). Apothecia 0.3 - 0.8 mm diameter, immersed in pits in substrate. Ascospore length various. Note 3.
   33 Ascospores mostly 10 - 16 (18) \( \mu m \) long. Apothecia sometimes slightly pruinose. C. immersa
   3 Ascospores mostly (15) 16 - 20 \( \mu m \) long. Apothecia not pruinose. C. metzleri

(1) Only the granules in the epithecium react K+ purple. The brown-orange epithecial 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 very helpful, as there is too much overlap. These 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 \( \mu m \), versus about 1 \( \mu m \)) - 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. In addition, 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)
in: Stapfia 76: 151 (a 1985 combination by Clauzade & Roux was not validly published); Biatora chondrodes A. Massal. (1855) in: Symm. Lich. Nov. 39-40; Protoblastenia chondrodes (A. Massal.) Zahlbr.; Protoblastenia cyclisca (A. Massal.) Szatala

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in the southern half of the Aegean and adjacent coasts of the mainland, on calcareous rock at altitudes 0 - 600 m.

Mostly southern and central Europe. Present in British Is, but not the Nordic Countries. Also western Asia (Israel), N. Africa (Morocco, Algeria, Tunisia), N. America, C. America.
Clauzadea immersa (Hoffm.) Hafellner & Bellem. (1984)

The earliest name is Lichen immersus Weber (1778), but it is not legitimate owing to the older L. immersus Huds. (1762).

Thallus: crustose, immersed and inconspicuous, to 4 cm diameter. Apothecia: usually completely immersed in pits in substrate, sometimes slightly emergent (about 75% immersed), 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, not closed below, formed 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 partly dissolving in N but not in K. Hymenium: 65 - 100 µm tall, colourless, sometimes brown in upper part. Hypothecium: 50 - 100 µm tall. colourless to pale brown, never dark brown (except where exciple extends into it). Paraphyses: simple, 1 µm wide at base, 2 µm at apex, sometimes slightly capitulate or moniliform. Ascii: 75 x 18 µm, Porpidia type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 16 x 5 - 10 µm, sometimes uniseriate in ascus; perispore distinct, about 1 µm thick. Chemistry: in spot tests, thallus K-, C-, KC-, P-. Photobiont: green, of globose cells 6 - 9 µm diameter; photobiont layer apparently continuous (when surface of limestone scraped).

For separation from C. metzleri, see under that species. Apart from C. metzleri, could only be confused with Rinodina immersa, but that has very different ascospores.

Widely distributed and common in the southern half of Greece, rarer in the north. On calcareous rock at all altitudes. Widely distributed to as far north as British Is and southern Sweden. Also Macaronesia, western Asia (Turkey, Lebanon, Israel, Syria), N. Africa (Morocco, Algeria, Tunisia). A report for Caribbean (Bahamas) may be in need of confirmation.

Clauzadea metzleri (Körb.) Clauzade & Cl. Roux ex D. Hawksw. (1992)
in: Coppings, James & Hawksworth, in: Lichenologist 24(4): 367 (a 1985 combination by Clauzade & Roux was not validly published); Biatora metzleri Körb. (1860) in: 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. Exciple: black, persistent; in section: 60 - 90 µm wide, dark brown to almost black in outer part, ±colourless in inner part, not closed below; 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. 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 capitulate. Asci: narrowly clavate, 80 - 100 x 17 - 22 µm, Porpidia type. Ascospores: colourless, simple, 8 per ascus, usually ellipsoid, occasionally pyriform, 15 - 20 x 6 - 9 µm; perispore usually distinct, 1 - 2 µm wide. 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.

Widely distributed 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. Widely distributed to as far north as southern Scandinavia. Also Asia (Turkey, Israel, southern Siberia), N. Africa (Tunisia), N. America.

Clauzadea monticola (Ach.) Hafellner & Bellem. (1984)

Thallus: crustose, pale brown, 2 cm diameter, immersed or very thinly superficial. Apothecia: sessile, ±flat, 0.3 - 0.65 mm diameter, not pruinose. Disc: black. Exciple: black, persistent often shiny; in section: 75 - 100 µm wide, dark brown (almost opaque, so structure hard to observe), not closed below, K-, N+ slightly reddish, pigment partly dissolving in N but not in K. Thalline margin: absent. 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: 1 - 1.5 µm wide, sometimes branched, not capitate or moniliform. Ascii: 60 x 15 µm, almost cylindrical, Porpidia type.
Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 12.5 (15) x 6 - 7.5 µm, perispore 1 µm.
Can be confused with *Protoblastenia lilacina*, but that species has epithecial 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. Many of the reports for the Peloponnese in Abbott (2009) were incorrect and refer to other species, but *C. monticola* is present in the Peloponnese.

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 (scattered from Alaska to NE USA), S. America (Chile), Australasia (NZS).

**Clypeococcum D. Hawksw. (1977)**


Type: *C. cladonema* (Wedd.) D. Hawksw. Family: *Dacampiaceae*. 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).

Description: As I have seen only one species in the Peloponnese, see the description of *C. psoromatis* below.

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 cartilaginea*. **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).

Epiro, 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)**


Fungus forming circular dark patches, 0.25 - 0.5 mm diameter in thallus of *Squamarina cartilaginea*, 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. Ascii: 85 x 20 µm, ±cylindrical. Ascospores: brown, 1-septate, one cell often distinctly narrower than the other, 8 per ascus, 16 - 23 x 6 - 10 µm, sometimes with visible ornamentation.

The patches of black, immersed perithecia in the thallus of *Squamarina cartilaginea* are distinctive.

Peloponnese, at altitudes 150 - 260 m. Given the abundance of the host, this fungus is probably more common than the few records to date suggest.

Mediterranean regions and the Atlantic margin of Europe to as far north as British Is. Also Macaronesia (Canary Is), N. Africa (Morocco), perhaps N. America. Greece is its most easterly known locality.

**Coenogonium Ehrenb. (1820)**


Type: *C. linkii* Ehrenb. 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 Lücking (2008).

About 50 species, mostly tropical or subtropical. Only 2 are reported for Europe, with another 2 in Macaronesia.
They usually occur on bark or moss in humid habitats. The genus is very rare in Greece.

11 Apothecia 0.4 - 1.5 mm diameter. Disc orange-yellow. Ascospores 8 - 11 µm long. **C. luteum**

1 Apothecia 0.2 - 0.4 mm diameter. Disc white to dull yellow or pink. Ascospores 9 - 14 µm long.

2 Base of apothecia not constricted. Disc white to dull yellow. Hymenium 70 - 90 µm tall. Ascospores 2 - 5 µm wide. **C. pineti**

2 Base of apothecia constricted. Disc brown-pink. Hymenium 100 - 120 µm tall. Ascospores 2 - 3.5 µm wide. (C. tavaresianum)

**Coenogonium luteum** (Dicks.) Kalb & Lücking (2000)


Descriptions: Clauzade & Roux (1985); Egea et al. (2004); Nash et al. (2004); Smith et al. (2009), all as *Dimerella lutea*.

Rare, in the northern half of Greece, near the coast, at altitudes 0 - 100 m. No substrate information is available.

Widely distributed in moister parts Europe; rare south of the Alps. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, Tanzania, S. Africa), N. America (southern Canada, widespread in USA), perhaps Caribbean (Bahamas, Bermuda, Guadeloupe, St Lucia), C. America (CR, El Salvador), S. America (widespread), Australasia (eastern side of Australia, both islands of NZ), 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 obvious pattern, on bark at altitudes around 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 (southern Canada, widespread in parts of USA that are not too dry), perhaps S. America (Paraguay), Australasia (SE Australia), Pacific (Hawaii, New Caledonia).

**Collema F. H. Wigg.** (1780)

in: Prim. Fl. Holsat. 89. The name is conserved against *Gabura* Adans. (1763) and *Kolman* Adans. (1763).

Type: *C. lactua* (Weber) F. H. Wigg. (= *C. nigrescens*). Family: *Collemataceae*. Literature: Degelius monographed the European species in *Symb. Bot. Upsal* 13(2): 1-499. 1954 [not seen]. There is a key to all the world's species in Degelius (1974). However, a more accessible starting point is Jörgensen in Ahti et al. (2007), though this should be supplemented by Clauzade & Roux (1985) and Smith et al. (2009) for species that have a southern distribution.

Between them, these three publications cover all the taxa likely to occur in Greece, except for *C. furfuraceum* and C. polycarpon subsp. corcyrense, both of which are included in the key in Degelius (1974). For *C. polycarpon* subsp. corcyrense see also Wasser & Nevo (2005). There is much information on the genus in Greece in Degelius (1956); this paper remains, to this day, the only thorough study in the field in Greece of a group of lichens by a specialist in that group.


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. I do not yet know whether all Collema species have exactly this type of ascus. In some of the material that I have examined the ascus structure appears to differ from this form, but the differences may just represent stages in development. More material needs to be studied to clarify this point.

Collema has about 82 species. It is very well represented in Greece, and forms a significant part of the lichen flora in some habitats: 25 species plus a few infra-specific taxa are reported, and some of them are widespread and common.

Although it is usually easy to recognise a specimen as belonging to Collema as presently delimited, the true relation of the genus to some parts of Leptogium remains rather unclear. Also, Collema is very heterogeneous, as Degelius (1974: 12) remarked and as is clear even from just the taxa present in the Peloponnese. The group Collema + Leptogium does appear to be monophyletic, but the traditional delimitation of the two genera is artificial: see Otálora et al. (2010).

Except for a few very distinctive species, determination of Collema specimens is often difficult, as some species are very variable. It is advisable 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, a significant proportion of all collections, perhaps 20%, simply can not be determined with any confidence; and although one can sometimes make an educated guess as to the identity of these difficult collections, confirming evidence is lacking.

Keys are modeled closely on Degelius (1974).

**Key to Collema main groups**

1 Isidia present.

222 Mature isidia distinctly squamulose (Note 1). Group 1.
22 Mature isidia ±globose (Note 1). Group 2.
2 Mature isidia cylindrical or coralloid (Note 1). Group 3.

1 Isidia absent. Note 2.

2 Thallus with prominent longitudinal ridges and/or pustules. Lobes rounded, often more than 5 mm wide at the tips. Group 4.
2 Thallus without prominent ridges or pustules. Lobes less than 5 mm wide at the tips, sometimes indistinct.

33 Ascospores septate (no longitudinal septa). Group 5.
3 Ascospores submuriform or muriform. Group 6.

(1) Examine mature isidia at the centre of mature lobes. Others are usually globose.
(2) Only a few species in this branch can be determined reliably when sterile. The keys assume that apothecia are present.

**Key to Collema group 1: With squamulose isidia.**

11 Thallus with prominent longitudinal ridges and/or pustules. Usually on bark. Rare morphs of C. nigrescens

1 Thallus without prominent longitudinal ridges and/or pustules. On various substrates.

2 Lobes (3) 5 - 15 mm wide at tips, ±rounded. Apothecia usually absent. C. flaccidum

2 Lobes 0.5 - 3.5 (6) mm wide. Apothecia often present (Note 1).

33 Exciple cellular. Lobes repeatedly branched, often overlapping. Ascospores subglobose or ±cuboid, submuriform. On rock. C. latzelli

3 Exciple subcellular or hyphal. Lobes ±rounded, not repeatedly branched. Ascospores ellipsoid or fusiform, septate or muriform. On various substrates.

444 Ascospores 1-septate. Thallus usually less than 1 cm diameter. Usually on bark. C. italicum

44 Ascospores usually 3-septate. Thallus to 5 cm diameter. Usually on calcareous rock or soil, rarely on bark.

Note 2. C. crispum

4 Ascospores muriform. Thallus to several cm diameter. On calcareous rock. Note 2. C. furfuraceolum

(1) Sterile collections are difficult to determine.
(2) C. furfuraceolum and C. crispum can perhaps also be separated by the thickness of the lobes. Those in the former are 65 - 130 (200) μm thick when wet, according to Degelius (1974). Those in the latter are thicker, 70 - 200 μm according to Nash et al. (2004). However, I do not know whether these two sets of measurements were made in a consistent way.
Key to Collema group 2: With globose isidia

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 (Note 2).
   22 Lobes ±narrow and linear, usually convex or plane. On calcareous rock.
      33 Lobes tomentose, at least at tips. **C. fragile**
   3 Lobes smooth.
      44 Thallus to 1.5 cm diameter. Lobules 0.1 - 0.4 mm wide. Isidia to 0.1 mm diameter. **C. parvum**
   4 Thallus larger. Lobules wider. Isidia larger. (C. euthallinum)

2 Lobes either rounded, or linear and concave. On various substrates (Note 2).
   33 Lobes (at least at tips) swollen and ±pleated. Usually on calcareous rock or soil.
      44 Lobes ±raised on edge. Exciple subcellular. On calcareous rock. **C. polycarpon subsp. corcyrense**
   4 Lobes not raised on edge. Exciple hyphal. Terricolous, usually on calcareous soil.
      55 Ascospores 1 (3) -septate. (C. coccophorum)
   5 Ascospores usually 3-septate, sometimes submuriform. **C. tenax**

3 Lobes not swollen and pleated. On various substrates (Note 2).
   44 Lobes 5 mm or more wide at tips, ±rounded.
      55 Thallus usually brownish, 200 - 500 µm thick when moist, often finely striated. Isidia not very fine, 0.08 - 0.15 mm diameter. Ascospores submuriform. Usually on bryophytes on calcareous rock, sometimes directly on calcareous rock; rarely on bark and then usually associated with bryophytes. **C. auriforme**
   5 Thallus usually olive-green, to 130 µm thick, not striated. Isidia usually fine, about 0.05 mm diameter. Ascospores 5 - 7 -septate. Usually on bark. **C. subflaccidum**

4 Lobes to 5 mm wide at tips, rounded or not. Note 3.
   55 Lobes linear and ±deeply channelled, ±narrow, to 3 mm wide; margins sinuose. Ascospores submuriform. Usually on calcareous rock. **C. cristatum**
   5 Lobes either rounded, or linear but not deeply channelled. Ascospores septic or submuriform. On various substrates.
      66 Thallus swelling when wet to 200 - 500 µm thick (most easily observed in thin section). Lobes usually 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. **C. auriforme**
   6 Thallus to about 200 µm thick when wet. Lobes usually blackish (may be brownish near margins), concolourous with isidia or not. Ascospores septic or submuriform. Usually directly on calcareous rock.
      77 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. **C. undulatum var. granulosum**
   7 Ascospores submuriform, ±ellipsoid 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. **C. fuscovirens**

(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) Usually only **C. subflaccidum** occurs on bark.
(3) 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 and other characteristics of the lobes, but scanty or juvenile material generally can not.

Key to Collema group 3: With cylindrical or coralloid isidia.

11 Thallus with prominent longitudinal ridges and/or pustules. Usually on bark. **C. furfuraceum**
1 Thallus ±smooth, without ridges or pustules; surface of lobes at most slightly undulating.
   22 Lobes ±rounded, not deeply divided. On bark or overgrowing bryophytes, from sea level to the uplands, but not
subalpine. \textit{C. subflaccidum}

2 Lobes ± elongate, deeply divided. On rock at subalpine levels. \textit{C. glebulentum}

**Key to Collema group 4:** Isidia absent. Lobes with prominent longitudinal ridges.

11 Ascospores ± fusiform (to ellipsoid). On siliceous rock. \textit{C. ryssoleum}

1 Ascospores acicular or bacilliform or irregularly clavate. Usually on bark.

22 Ascospores usually 3-septate, to 40 \(\mu\)m long. Very rare. (C. curtisporum)

2 Ascospores more than 3-septate, usually more than 40 \(\mu\)m long. Common.

33 Ascospores usually curved, 4 - 5 (7) -septate, (5) 6 - 6.5 \(\mu\)m wide, ± clavate (or irregularly clavate). Disc 0.8 - 1.5 mm long. \textit{C. subnigrescens}

3 Ascospores straight or curved, (4) 5 - 12 -septate, 3 - 5 \(\mu\)m wide, acicular or bacilliform (sometimes slightly clavate). Disc 0.4 - 1 mm long. \textit{C. nigrescens}

**Key to Collema group 5:** Isidia absent. Lobes without ridges. Ascospores always or often septate.

111 Ascospores usually 1-septate. On bark or soil.

22 Thallus distinctly lobate, not swollen. On bark. \textit{C. italicum}

2 Thallus indistinctly lobate or with small lobules, ± swollen. On bark or soil.

33 On soil. Lower surface concolourous with upper surface. Ascospores 6.5 - 8.5 \(\mu\)m wide. Conidia 4.5 - 6 \(\mu\)m long. \textit{C. coccophorum}

3 On bark. Lower surface usually paler than upper surface. Ascospores 3 - 4.5 \(\mu\)m wide. Conidia 3 - 4 \(\mu\)m long. \textit{C. conglomeratum}

11 Ascospores 3-septate (sometimes submuriform). On various substrates.

22 Lobes (at least at tips) ± swollen and pleated.


44 Lobes 1 - 2 mm wide, numerous. Apothecia crowded, 0.3 - 1.5 mm diameter. Ascospores 18 - 28 \(\mu\)m long.

Isidia absent. \textit{C. polycarpon subsp. polycarpon}

4 Lobes 2 - 6 mm wide, less numerous. Apothecia sparse, 1.5 - 3.5 mm diameter. Ascospores 15 - 34 \(\mu\)m long. Isidia sometimes present. \textit{C. polycarpon subsp. corcyrense}

3 Lobes not raised on edge. Excirole hyphal. On various substrates.

44 Ascospores to 12 \(\mu\)m wide. On calcareous rock. \textit{C. confertum}

4 Ascospores to 8.5 \(\mu\)m wide. Only rarely saxicolous.

55 On bark.

66 Thallus to 2 cm diameter. Ascospores 6.5 - 8.5 \(\mu\)m wide. \textit{C. ligerinum}

6 Thallus to 5 cm diameter. Ascospores 4 - 6.5 \(\mu\)m wide. \textit{C. conglomeratum}

5 On soil or decaying vegetation on the ground, or overgrowing bryophytes on soil or rock; less commonly directly on calcareous rock. \textit{C. tenax}

2 Lobes not swollen and pleated.

33 Excirole subcellular. Ascospores usually 13 - 15 \(\mu\)m wide. \textit{C. crispum} s. lat.

44 Thallus distinctly foliose, to several cm diameter. \textit{C. crispum var. crispum}

4 Thallus almost crustose, to 0.5 cm diameter. \textit{C. crispum var. metzleri}

3 Excirole cellular. Ascospores to 9 \(\mu\)m wide.

44 Ascospores to 3 \(\mu\)m wide. (C. leptaleum)

4 Ascospores more than 3 \(\mu\)m wide.

55 Lobes ± narrow and linear; upper surface ± convex. \textit{C. multipartitum}

5 Lobes not as above.

66 Margin of apothecia depressed. Ascospores 6.5 - 9 \(\mu\)m wide. \textit{C. undulatum var. undulatum}

6 Margin of apothecia not depressed. Ascospores 4 - 5 \(\mu\)m wide. (C. leptaleum)

1 Ascospores 4- or more -septate. On bark.

22 Excirole hyphal. Ascospores acicular or vermiform. \textit{Arctomia fascicularis}

2 Excirole ± isodiametric cells. Ascospores bacilliform. (C. leptaleum)

(1) Most collections of \textit{C. polycarpon} can easily be determined to subspecies, but a few are ambiguous.
Key to Collema group 6: Isidia absent. Lobes without ridges. Ascospores usually submuriform or muriform.

11 Lobes ± swollen and often pleated.

22 Thallus crustose to subfoliose, forming a thin film. Ascospores 4 per ascus. On damp, ± calciferous clay or sandy soil. C. limosum

2 Thallus ± foliose, ± well-developed. Ascospores usually 8 per ascus. On various substrates. C. confertum and C. tenax, keyed in Group 5.

1 Lobes not swollen and pleated.

22 Thallus crustose to subfoliose.

33 Ascospores ± ellipsoid. On rock. C. callopismum

3 Lobes ± elongated and narrow, flat or convex (not concave). On calcareous rock.

44 Thallus to 1 cm diameter. Lobules 0.2 - 0.5 mm wide, ± pubescent. (C. leptogioides) Greek report doubtful. 4 Thallus to 5 cm diameter. Lobules wider, smooth. (C. euthallinum)

3 Lobes not as above. On various substrates.

44 Ascospores only rarely submuriform (usually 3-septate). Exciple hyphal or subcellular. C. crisatum

44 Ascospores usually muriform. Exciple ± cellular.

55 Thallus small, to 3 cm diameter but usually less. Usually on bark. C. fragrans

55 Thallus often more than 3 cm diameter. Usually on calcareous rock.

66 Apothecia usually more than 1 mm diameter. Ascospores ellipsoid. C. cristatum

6 Apothecia to 1 mm diameter. Ascospores variable; oval-subglobose or ± cuboid. C. latzeli
Alberta, BC, Arizona), perhaps C. America.

**Collema coccophorum** Tuck. (1862)

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Crete, on calcareous soil at an altitude of 1000 m.

Most reports are from central Europe, but also known as far north as northern Sweden, north of the Arctic Circle. Scarcely recorded from south of the Alps; Crete is a substantial southward extension of its range. Also Asia (widespread as far east as northern India), Africa (widespread), N. America (Alberta, BC, widespread in USA), C. America (Mexico), S. America (Argentina, Chile, Paraguay), Australasia (widespread in temperate parts), Antarctica (S. Shetland Is).

**Collema confertum** Hepp ex Arnold (1859)
in: *Flora* 42: 145

This species in not well understood. Some authors have regarded it as a synonym of *C. tenax*, perhaps because the differences from *C. tenax* seem minor. However, Degelius regarded it as a good species. According to Nash et al. (2002) it may belong in *Lempholemma*.

Descriptions: Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Southern Peloponnese, and island of Kalimnos. Both records were from close to the sea. On rock at altitudes 0 - 100 m.

A rare species which is thinly scattered through Mediterranean and western Europe as far north as British Is. Absent from Baltic States, the Nordic Countries and most of Eastern Europe. Not reported for other continents.

**Collema conglomeratum** Hoffm. (1796)
in: *Deutschl. Fl.* 2: 102

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern, on bark at altitudes 400 - 1000 m. Reported from *Olea europaea, Platanus orientalis* and *Quercus* at altitudes 400 - 1000 m.

Southern and central Europe. Almost absent from northern regions; reaches British Is but there is only a single report for the whole of Scandinavia. Also central Asia (Tajikistan, southern Siberia), Africa (Kenya), N. America (widespread in USA), C. America (Mexico), perhaps Pacific (New Caledonia - 19th century report).

**Collema crispermum** (Huds.) F. H. Wigg. (1780) var. crispum

The holotype of *Collema sublimosum* is a mixture of *Collema crispum* and a small *Leptogium* species, according to Degelius (1974). So far as I am aware, the name has not yet been lectotypified.

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Fairly common throughout Greece. On calcareous rock or soil, rarely overgrowing bryophytes on soil. Reports on bark are probably incorrect determinations. At altitudes 0 - 2200 m, but commonest below 1000 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside the tropics), N. America (widespread, mainly in the west), Caribbean (PR), C. America (Mexico), S. America (Chile), Australasia (NZN).

**Collema crispermum** var. metzleri (Arnold) Degel. (1954)

There are earlier names, but they do not have priority at the rank of variety.

Description: Carvalho (2012); Clauzade & Roux (1985).

Scattered throughout Greece. Less common that var. *crispermum* (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), N. America (California).
Collema cristatum (L.) F. H. Wigg. (1780)

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 my collections. However, there are many intermediate forms, and I prefer not to accept these varieties.

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, always 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 exciple, 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. Exciple: not usually visible externally; in section: 25 - 40 µm wide, distinctly cellular, cells typically 6 - 7 µm wide. Thalline margin: present, persistent; in section: 80 - 180 µm wide. Epithecium: orange-brown to brown, K-, pigment not soluble in K. Hymenium: colourless, sometimes pale orange-brown in upper part, 85 - 130 µm tall. Hypothecium: 60 - 145 µm tall, colourless to pale orange-brown, usually formed of two fairly distinct layers; upper layer 30 - 35 µm tall, very pale yellow-brown to pale brown, formed of small cells about 3 µm diameter; lower part colourless, of large angular cells 7 - 12 (19) µm wide, clearly contiguous with exciple. Paraphyses: 2 - 3 µm wide at base, 3 µm wide at apex, not capitate, simple, often with visible septa. Asci: subcylindrical, 90 - 100 x 15 - 25 µm, Collema type (with a central KI+ blue plug, surrounded on each side by an extension formed of a thin inner and outer KI+ blue layer between which is sandwiched a thin KI- layer, the KI- layer thus forming an annulus). Ascospores: colourless, submuriform (usually with 3 transverse septa), 19 - 30 x 8 - 13 (15) µm, usually ±ellipsoid, one or both ends sometimes slightly pointed, (4) 8 per ascus. Photobiont: Nostoc; cells globose, 4 - 5 µm diameter, in chains, not forming a distinct layer. Easily separated from C. nigrescens by the concave, and usually rather narrow, lobes, which lack ridges or pustules, and by the much much broader ascospores, which are are submuriform rather than ±3-septate.

The narrow, linear, concave and distinctly channeled lobes that are characteristic of this species make many collections easy to determine. However, C. cristatum is a very variable, and thus sometimes confusing, species. In case of difficulty, fertile specimens can be separated unambiguously from other common species that grow directly on limestone by its 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), N. America (widespread, but mainly in the western half), C. America (Mexico).

Collema flaccidum (Ach.) Ach. (1810)
The earliest name is Lichen rupestris Sw. (1781), but that name is illegitimate, being a later homonym of L. rupestris Scop. (1772). Acharius introduced the name Lichen flaccidus as a nomen novum for Lichen rupestris Sw.

Thallus: foliose, to 4 cm diameter. Lobes: 3-7 mm wide, about 100 µm thick when dry, swelling to 120 - 180 µm when wet, rounded, 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 mm diameter, later distinctly squamiform, 0.05 - 0.3 mm wide; well-developed squamiform isidia ±confined to central parts of older lobes. 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; the pigment does not dissolve 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 any sort of longitudinal ridges on the lobes also helps separates 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.

Present in most of Europe. Also Macaronesia, Asia (widespread), Africa (Tunisia, Socotra, Mozambique), N. America (southern Canada, widespread in USA), perhaps Caribbean (Bahamas, Bermuda), Australasia (SE Australia), Pacific (Hawaii, Tahiti), Antarctica (Kerguelen Is).

Collema fragile Taylor (1836)
in: Mackay, Fl. Hibern. 2: 109

Descriptions: Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009).

Rare, but probably scattered thinly throughout Greece. On calcareous rock at altitudes 0 – 1200 m. Degelius (1956) remarks that in Greece *C. fragile* is found in the lowlands and lower mountains.

A rather rare species, present in Europe as far north as British Is but absent from those parts of eastern Europe with a continental climate. Outside Europe it seems to be known only for the island of Socotra.

Collema fragrans (Sm.) Ach. (1814)
in: Syn. Meth. Lich. 311 (as fragans); *Lichen fragrans* Sm. (1808) in: Smith & Sowerby, in: Engl. Bot. 27, Tab. 1912

Descriptions: Carvalho (2012); Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).

Western Crete, on bark of *Platanus* at altitudes 300 – 600 m.

Throughout Europe. Also Asia (Russia, Mongolia), N. Africa (Morocco, Algeria), N. America (eastern and central USA), C. America (Mexico).

Collema furfuraceum "(Arnold) Du Rietz (1929)"

There is a nomenclatural problem. The supposed basionym is in fact a combination from *Collema crispum* (indefinite rank) *furfuraceum* Schae. in Enum. Crit. Lich. Eur. 257. 1850. Schae rer's name is thought to be a synonym of *Collema crispum*, on the authority of Mudd (1860: 40). Schae rer cited the same collection (Lich. exs. n. 426) which he had previously named *Parmelia crispa* b. (= f.) *fuliginea* in Lich. Helv. Spic. 536. 1842. This collection needs to be examined, to determine whether conservation is required.

Thallus: foliose, homoiomerous, to 4.5 cm diameter. Lobes: rounded, weakly adpressed but sometimes ascending at margins, sometimes slightly overlapping, 3 - 11 mm wide, 50 µm thick when dry, swelling to 130 µm thick when wet, with prominent longitudinal ridges or pustules that are typically 0.1 - 0.25 mm wide. Upper surface: black, not pruinose. Lower surface: grey to dark grey, without rhizines or hairs. Isidia: always present, often abundant and crowded, mostly laminal, rarely marginal, developing at first on the ridges but later spreading to cover much of the central parts of the lobes; initially globose, later becoming cylindrical or coralloid, 0.04 - 0.2 x 0.04 mm. Upper and lower cortex: absent; in section the lobes are colourless to yellow-brown, the most pigmented parts usually near the upper surface; pigment K-, not soluble in K; hyphae 1.5 - 2 µm wide, only rarely with visible septa. Photobiont: blue-green; cells 5 µm diameter, in chains, not forming a distinct layer.

The prominent longitudinal ridges clearly place this species in the 'nigrescens' group. The small, cylindrical isidia ensure that well developed specimens can not be confused with any other species in that group.

Throughout Greece, though there are few records for the extreme north. Nearly always on bark, though there are single reports from wood and siliceous rock. It can evidently tolerate a wide range of bark characteristics, and has been recorded from many species. At altitudes 20 - 1400 m.

Most of Europe except for arctic regions. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, widespread in E. Africa; also Ascension Is), N. America (widespread), C. America (Mexico, perhaps CR), S. America (Brazil, Chile, Galapagos Is), Pacific (Hawaii). These reports refer to var. *furfuraceum*, the only European variety.

Collema furfuraceolum Müll. Arg. (1889)
in: *Flora* 72: 142

Description: Degelius (1974).

Peloponnese, on calcareous rocky ground at an altitude of 610 m.

In Europe, known only from Italy, Croatia and Greece. Also south and east Asia (India, China, Japan, Vietnam).
This is an unusual distribution, and merits further investigation.

**Collema fuscovirens** (With.) J. R. Laundon (1984)

The earliest name is *Lichen pulcher* Leers (1775), but Withering's name has been proposed for conservation. 

Thallus: foliose, to 2 cm diameter, not stratified. Lobes: 2 – 5 mm wide, elongate or rounded, not channeled, not adpressed, without ridges but sometimes with ± circular (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 and 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 are 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 distinguished from *C. subflaccidum* by its narrower, less adpressed and much less 'tidy' lobes, by its much coarser isidia, and by its substrate. Can be confused with *C. auriforme* and isidiate forms of *C. polycarpon* subsp. *corcyrense*, but both of these have a thallus that swells markedly when wet. *C. cristatum*, which occurs in the same habitat, has much more obviously channeled lobes. Sterile specimens can be difficult to separate from *C. undulatum* var. granulosum.

Probably scattered thinly throughout Greece. Usually on calcareous rock, sometimes overgrowing bryophytes on rock, once on bark of *Juglans*. At altitudes 0 - 2850 m.

Present in much of Europe. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa; also Socotra, S. Africa), N. America (widespread), Pacific (Marquesas).

**Collema glebulentum** (Nyl. ex Cromb.) Degel. (1954)

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. The Greek report is the only one from further south. Also Asia (northern Urals, China), N. America (widespread in cold regions).

**Collema italicum** de Lesd. (1937)

Description: Carvalho (2012); Clauzade & Roux (1985); Swinscow & Krog (1988).

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).

**Collema latzeli** Zahlbr. (1909)

Descriptions: Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009).

Very scattered, and most of the few records were said by their authors to be tentative. On calcareous rock at altitudes 0 - 1200 m.

Southern Europe, plus one rather anomalous record for SW England (Cornwall). Also Asia (Turkey, Japan), N. Africa (Morocco, Tunisia). Except for the disjunct report for Japan (by Degelius) this would appear to be basically a circum-Mediterranean taxon. Perhaps it should be subsumed under *C. cristatum*.

**Collema ligerinum** (Hy) Harm. (1905)

The earliest name is *Lathagrium conglomeratum* A. Massal. (1856), but the epithet is not available in *Collema* owing to *Collema conglomeratum* Hoffm.

Description: Carvalho (2012); Clauzade & Roux (1985).

Rare and scattered in western parts of Crete and the mainland. On bark of *Platanus* at altitudes 75 - 425 m.

Widely distributed in central and southern Europe. Also Macaronesia (Cape Verde Is), Asia (southern Siberia).
Collema limosum (Ach.) Ach. (1810)

The earliest name may be *Collema glaucescens* Hoffm. (1796), but the synonymy is not certain.
Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009). Rhodes, on soil close to sea level.

Present in most of Europe, but nowhere common. Also Asia (fairly widespread), perhaps Africa, N. America (scattered in Canada, fairly widespread in USA).

Collema multipartitum Sm. (1814)
in: Smith & Sowerby, English Botany 36, tab. 2582; (?)*Lathagrium multipartiens* (Nyl.) Kremp. (as 'Lethagrium'); *Lathagrium multipartiens f. pruinosum* Szatala (sometimes as 'Lethagrium'), nom. invalid.

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009).

Very scattered, with no clear pattern. On calcareous rock at altitudes from 100 to at least 2300 m.

Present in most of Europe, though rare in the south. Also western Asia (Turkey, Syria, Tajikistan, southern Siberia), northern Africa (Morocco, Algeria, Socotra), N. America (Alaska, Alberta, and perhaps elsewhere).

Collema multipunctatum Degel. (1954)

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; most of thallus formed of hyphae that are loosely interwoven, 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. Proper exciple: not visible externally; in section: 20 µm wide, subcellular. Thalline margin: present but rather indistinct; in section: about 50 µm wide. Hymenium: mostly colourless, sometimes pale orange-brown in upper part, 90 - 100 µm tall. Hypothecium: colourless, 20 µm tall, formed of cells that are elongated horizontally. Paraphyses: 1 µm wide at base, scarcely widening towards apex, simple. Asci: subcylindrical, 75 x 15 µm, K+ blue in a crescent at the top (but details not well seen). Ascospores: colourless, muriform, 13 - 15 x 10 µm, almost rectangular. Photobiont: Nostoc; cells globose, 3 - 5 µm wide, in chains, not forming a distinct layer.

The small, immersed apothecia, the unusual shape of the ascospores, and the solubility in K of the epithelial pigment clearly distinguish this species from other Greek species of the genus.

Scattered, but usually avoiding strongly inland localities. On bark at altitudes 0 - 900 m. Recorded from *Olea europaea*, *Platanus orientalis*, *Quercus coccifera* and *Q. pubescens*.

Basically a species of southern Europe, though there are also records for France and Bulgaria. Also Macaronesia.

Collema nigrescens (Huds.) DC. (1805)

The name *Lichen vespertilio* Lightf. (1777) is illegitimate, being a superficial name for *Lichen nigrescens* Huds. All the *vespertilio* names derived from it are also superfluous names.

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. "Medulla": 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-, colour unchanged in K. Hymenium: 70 - 80 µm tall, colourless. Hymenial hyphae: 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: clavate, 60 x 15 µm. Ascospores: colourless, 5 - 8 -septate, 33 - 63 x 3 - 5 (6) µm, widest part often displaced towards one end, sometimes slightly curved, one end sometimes slightly pointed, 8 per ascus. Pycnidia: sometimes present but easily overlooked, 100% immersed, laminal, pale brown, 0.15 mm diameter; in section: colourless, globose or with a flattened top, 140 - 180 µm tall, 160 x 200 µm wide. Conidia: colourless, 3 - 4 x 1 µm, ± oblong but narrower in central part than
at ends. 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 are very close to C. subnitigrescens and are sometimes difficult to separate from that species as the characters distinguishing 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 species; occasionally on rock.

Most of Europe outside arctic regions. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread, but generally avoiding centre of continent), perhaps Caribbean (Bahamas, Bermuda), C. America (CR, Mexico), S. America (Brazil), Pacific (Kiribati, Marquesas, Micronesia, W. Samoa).

**Collema occultatum** Bagl. (1861)

The earliest name is *Collema byssinum* B (= var. juniperinum) Sommerf. (1826) but it does not have priority at the rank of species.

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009).

Scattered, on Crete and the mainland. On bark at altitudes 0 - 1100 m. Recorded from *Abies cephalonica*, *Juglans regia* and *Platanus orientalis*.

Present in most of Europe. Also Asia (Russia, Mongolia), Africa (Morocco, Algeria, Namibia), N. America (scattered in USA).

All Greek records belong to var. occultatum. The other variety, *populinum*, seems to be rare in Europe, and has never been reported for any part of southern Europe. However, in N. America var. *populinum* occurs in warmer regions, and it has been claimed to be present in N. Africa too, so it might be present in Greece.

**Collema parvum** Degel. (1954)

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009).

Rare, in northern Greece, at altitudes 1000 - 1100 m, on rock.

Essentially a species of northern and central Europe; south of the Alps it is rare and confined to the mountains. Also western Asia (Syria).

**Collema polycarpon** Hoffm. (1796) subsp. *polycarpon*
in: Deutschl. Fl. 2: 102; *Collema polycarpon* Hoffm. (1796) subsp. *polycarpon* (Hoffm.) Arnol. (sometimes as 'Lethagrium polycarpon'); (?) *Lethagrium polycarpon* f. *pulvinatum* (Kremp.) Szatala (as 'Lethagrium polycarpon f. pulvinatum').

The epithet *stygium* has sometimes been applied incorrectly to this lichen, but *Collema stygium* Rabenh. is a superfluous name (via *Parmelia stygia* Schae.) for *Synalissa symphorea*.

Thallus: foliose, to 4 cm diameter. Lobes: 1 - 2 (3) mm wide, without ridges or pustules, occasionally weakly channeled, 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 formed 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: dark brown to dark red-brown when young, and then often shiny; brown to orange brown when mature, and then matt. Exciple: not visible externally; in section: thin, 10 - 15 µm wide, usually ±subcellular, but sometimes only weakly so and then appearing almost hyphal. Thalline margin: present, but thin (except in very immature apothecia) and eventually becoming almost closed; in section: 75 - 90 µm wide. Epithecium: pale brown, K-, pigment not soluble in K. Hymenium: colourless, 120 - 130 µm tall. Hypothecium: very pale yellow-brown, 60 µm tall. Paraphyses: 2 µm wide at base, 3 µm at apex, simple, not capitulate. Asci: subcylindrical to narrowly clavate, 58 x 16 µm. Collema type (apex KI+ blue in two narrow crescents separated by a thin KI- region). Ascospores: colourless, 3-septate, 8 per ascus, 18 - 28 x (5) 7 - 8 (10) µm, ends slightly to strongly pointed. Photobiont: Nostoc, not forming a distinct layer; cells globose, 3 - 4 µm diameter, in unbranched chains which may contain up to 50 cells.

Note: Two common species on limestone with which *C. polycarpon* s. lat. could be confused are *C. crispum* and *C. cristatum*. Both of these species have lobe margins that are not swollen, but this character is not always clear-cut. However, *C. crispum* also has much broader ascospores. *C. cristatum* has at least some submuriform ascospores, and its lobes are distinctly elongate and channeled; in *C. polycarpon* although some lobes may be slightly elongated and some may be ±channeled, the majority tend to be ±rounded and not channeled. *C. tenax*, which may occasionally occur
Collema polycarpon subsp. corcyrense (Arnold) Pišút (1968)

In the past, this taxon was usually treated at the rank of variety. However it differs quite markedly in morphology from subsp. polycarpon and it also has a very 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 that the rank of subspecies is appropriate.

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 ±adpressed. 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. Exciplle: present, ±subcellular. Thalline margin: present, becoming almost excluded. Ascospores: colourless, 8 per ascus, 3-septate, broadly fusiform, 20 - 27.5 x 6 - 9(10) µm, one or both ends slightly to distinctly pointed.

This seems to be a rather variable taxon, but I have not yet seen enough material to describe the variability adequately. For separation from species with which it may be confused, see the note under subsp. polycarpon.

Differ 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.

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 in northern Europe, and has even been reported for Svalbard. Also Asia (widespread), N. Africa (Algeria).

Collema ryssoleum (Tuck.) A. Schneid. (1898)
in: Guide Study Lich. 181; Collema nigrescens subsp. ryssoleum Tuck. (1866) in: Lich. Calif. 34; Collema meridionale Hue

Thallus: foliose, homoiomeric, 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 (in material seen to date), 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. Exciplle: present but not visible externally and thin and poorly developed in section; hyphal. Thalline margin: present, raised, prominent in young apothecia but later becoming thin and almost excluded, 35 - 55 µm wide in section.

Epithecium: orange-brown, K-, pigment not soluble in K. Hymenium: colourless, 80 µm tall (in water - swells slightly in K). Hypothecium: colourless to very pale orange-brown, 65 - 75 µm tall. Paraphyses: 1 - 2.5 µm wide, not capitate or moniliform, sometimes with visible septa. Asci: narrowly clavate, 65 x 12 µm; apex K+ blue in a crescent shape at the top and extending a little way down the sides; in the downward pointing arms of the crescent the K+ region sometimes splits into two, sandwiching a thin KI- region (in 3 dimensions, this KI- region will form an annulus). Ascospores: colourless, (3) 5 - 7-septate, 28 - 37 x 5 - 8 µm, fusiform, usually straight (rarely slightly curved), ends pointed. Pycnidia: usually present, 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, 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 in this group by its short, broad ascospores, the absence of isidia, and its ecology.

Fairly widely distributed in the southern half of the country, but uncommon in the north. Never very far from the thallus.
sea. On non-calcareous rock at altitudes 0 - about 950 m.

 Mostly southern European, though there are a few records from central Europe (France, Bulgaria, Ukraine). Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (scattered in eastern USA).

**Collema subflaccidum** Degel. (1974)


The earliest name for this taxon is *Leptogium olvaevum* var. granulatum F. Wilson, described from Australia, but Degelius's epithet has priority at the rank of species.

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: uncommon, forming pale spots on the upper surface of the lobes, about 0.25 mm diameter; in section they are 100% immersed, asubglobose but with a rather flat top, 230 µm tall, 270 µm wide, colourless. Conidia: colourless, 4 x 1 µm, distinctly narrower in the middle than at the ends. Photobiont: *Nostoc*; cells globose or subglobose, 4 - 5 µm diameter, in chains (though this is not always obvious, as they are often closely packed), not forming a distinct layer.

The absence of longitudinal ridges or pustules (or, at least, of well developed ones), the fine isidia, the scarcity of apothecia, and the substrate are usually enough to separate this species from others in this group.

Probably throughout Greece. Usually on bark, with a clear preference for species of *Quercus*, occasionally overgrowing bryophytes on soil or rock. From sea level to about 1400 m.

Widely distributed in Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread), C. America (Mexico), Australasia (eastern Australia, both islands of NZ), Pacific (N. Marianas, Hawaii).

**Collema subnigrescens** Degel. (1954)


The earliest name is *Parmelia nigrescens* var. *caesia* Clemente (1807), but Degelius's name has priority at the rank of species.

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 axes. Apothecia: sessile, flat, 0.6 - 1.1 mm diameter, not pruinose. Disc: brown. Exciple: in section: 40 - 60 µm wide, colourless except for thin orange-brown surface layer, of loosely arranged hyphae. 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. 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.

Differs 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).

**Collema tenax** (Sw.) Ach. (1810)


**Lichen pulposus** Bernh., is a superfluous name for *Lichen frustatus* L., and so are most other *pulposum* names, though they have often been used incorrectly to refer to *Collema tenax*.

This is a very variable species, and at least 12 infra-specific taxa have been described. I am not persuaded that this is a constructive way to treat this variation, and I believe that most, and perhaps all, of these infra-specific taxa ought to be reduced to synonymy. 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 me to be merely a response to the physical characteristics of the substrate, unstable soil, on which it usually occurs. I prefer not to accept these varieties.

Thallus: foliose (but almost crustose in some specimens of **var. tenax**), to 4 cm diameter. Lobes: very variable; well developed or not, to 4 mm wide (but usually less than 1 mm wide in **var. tenax**), not ridged or channelled, 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. Exciple: present but not visible externally; in section: thin and inconspicuous, 10 µm wide, hyphal. Thalline margin: present, persistent; in section 100 - 300 µm wide. 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.

Can really only be confused with **C. polycarpon**, but in that species the lobes are usually erect on their edges. Throughout Greece. On calcareous rock or soil, or overgrowing bryophytes thereon. At all altitudes. Present in almost all of Europe. Also Macaronesia (widespread), Asia (widespread), Africa (widespread outside deserts and humid tropics), N. America (widespread), Caribbean (Haiti), C. America (Mexico), S. America (Argentina, Brazil, Chile, Uruguay), Antarctica (Signy Is, Antarctic Peninsula).

**Collema undulatum** Laurer ex Flot. (1850) **var. undulatum**

in: Linnaea 23: 161-162; Lathagrium undulatum (Laurer ex Flot.) Poetsch (as 'Lethagrium')

Descriptions: Ahti et al. (2007); Carvalho (2012); Clauzade & Roux (1985); Smith et al. (2009).

Scattered on the mainland and larger islands, but apparently absent from the smaller islands. On calcareous rock at altitudes 30 - about 2000 m. All but two reports are from altitudes above 1000 m, and the two lowland reports may be unreliable.

Present in much of Europe, but in the south probably confined to the mountains. Also Asia (widespread), N. Africa, N. America (widespread from Alaska to northern USA).

**Collema undulatum** var. granulosum Degel. (1954)


As is the case with several other taxa which are represented by both fertile morphs lacking vegetative propagules and infertile morphs with vegetative propagules, it is unclear how much justification there is for recognising the two morphs of **C. undulatum** as distinct taxa. Molecular investigations might clarify the picture.

Descriptions: Ahti et al. (2007); Nash et al. (2004); Smith et al. (2009).

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 central Asia (Tajikistan), N. America (widespread from Alaska to cooler parts of USA).

**Collolechia A. Massal. (1854)**

in: Geneac. Lich. 6

Type: **C. caesia** (Fr.) A. Massal. Family: Placynthiaceae. Literature: There is no monograph, and the genus is not very well known.

There is only one species.

**Collolechia caesia** (Fr.) A. Massal. (1854)


Descriptions: Ahti et al. (2007); Smith et al. (2009).

Mt. Olympus, on calcareous rock at altitudes 700 - 2300 m. Although **C. caesia** has often been confused with **Placynthium garovaglioi**, these reports seem plausible as **C. caesia** is most commonly found in ±alpine habitats. Scattered over quite a wide area of Europe, to as far north as southern Scandinavia. Also N. Africa (Algeria).
Cornicularia (Schreb.) Ach. (1803)

in: Methodus, 300; Lichen (unranked) Cornicularia Schreb. (1791) in: Gen. Pl. 2: 768

The generic name is sometimes said to have been published by Hoffmann in Descr. pl. cl. crypt. 2(2-4): 36-37. 1794. Hoffman does indeed mention the name there but it is not validly published, as there is no description, no reference to Lichen sect. Cornicularia Schreb., and the requirements for a descriptio generico-specifica are not met.

Type: C. tristis (Weber) Ach. (= C. normoerica). Family: Parmeliaceae. 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)
in: Mycotaxon 48: 302-309


Cresponea is a segregate of Lecanactis s. lat., with about 15 species, most of which occur on bark in tropical regions. Only two occur in Europe. As with all groups lichenised with Trentepohlia, there are very few Greek records.

11 Ascospores 11 - 17 µm long, 3-septate. If present in Greece, probably restricted to high mountains. (C. chloroconia)
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)
22 Apothecia not in thallus warts. Not parasitic. (C. inquinans), (C. karelicum), (C. lecideinum),
1 Thallus immersed. Parasitic on Pertusaria species on bark. C. sessile

Cresponea premnea (Ach.) Egea & Torrente (1993)

Descriptions: Clauzade & Roux (1985) as Lecanactis premnea; Egea & Torrente (1993b); Smith et al. (2009).

Very scattered, on the mainland. A rare species, known from altitudes 700 to 1000 m. No substrate information was provided with the Greek records.

Southern and central Europe, reaching the southern part of British Is, but not Baltic States or the Nordic countries. Also Macaronesia, Asia (Russia, Taiwan), N. Africa (Morocco, Algeria), N. America (SE USA), S. America (Argentina, Brazil), Pacific (Hawaii, New Caledonia, Western Samoa). Judging from the map in Egea & Torrente (1993b), some extra-European reports may be incorrect.

Cyphelium Ach. (1815)

Type: C. tigillare (Ach.) Ach. Family: Caliciaceae. 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 presently circumscribed, Cyphelium contains about 16 species, of which about 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)
22 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.
Widely distributed in northern and central Europe, but there are only a few records from south of the Alps. Also Asia (India), perhaps N. America.

Dactylospora Körb. (1855)
in: Syst. Lich. Germ. 271
About 45 saprobic, weakly lichenised and lichenicolous fungi, the latter not very pathogenic. About 33 are reported for Europe, but many have a distinctly northern distribution (as far as present information goes), and there are few Greek records.

D. verruculosa Hafellner is not included in the key, as I have insufficient information.

II

11 Ascospores strictly 1-septate.
  22 Ascii with more than 8 spores. (D. microspora)
  2 Ascii with 8 spores.
    33 Hypothecium red-brown, concolourous with exciple.
    44 Apothecium becoming convex and immarginate. On Lobaria. (D. lobariella)
    4 Margin of apothecia persistent. On other hosts. D. rimulicola
  3 Hypothecium colourless to brownish, paler than exciple.
  44 Ascospores 7 - 11 x 3 - 5 µm. (D. acarosporae), (D. homoclinella)
  4 Most ascospores larger than 11 x 5 µm.
    55 Apothecium arising from black spots on thallus of host. Ascospores not constricted at septum. (Abrothallus mairei)
    5 Apothecium not associated with black spots. Ascospores sometimes slightly constricted at septum.
      66 Apothecium 0.2 - 0.7 mm diameter, superficial at least when mature. D. saxatilis
      6 Apothecium 0.1 - 0.3 mm diameter, remaining at least partly immersed in thallus of host. (D. tegularum)
  1 At least some ascospores more than 1-septate.
  22 Parasitic or commensalistic on Ochrolechia or Pertusaria.
  2 On other hosts. (Some of these species may be saprophytic or perhaps weakly lichenised, not all are parasitic or commensalistic.) (D. attendata), (D. crassa), (D. mediterranea), (D. pseudourceolata)

Dactylospora parasitica (Flörke) Arnold (1887)
in: Flora 70: 159; Lecidea parasitica Flörke (1819) in: Deutsche Lichenen Fasc. 6, p3; Leciographa inspersa (Tul.) A. Massal.
Scattered, but never far from the sea, at altitudes 0 - 850 m. Usually paasitic on Pertusaria hymenea.
Widely distributed in Europe. Also Macaronesia, Asia (Russia), N. Africa, N. America (Minnesota, Washington), Australasia (NZN).

Dactylospora rimulicola (Müll. Arg.) Hafellner (1979)
Chios and eastern Peloponnese, at altitudes 20 - 670 m. Reported from Aspicilia intermutans, Lecanora 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).

Dactylospora saxatilis (Schaer.) Hafellner (1979)
Description: Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Nash et al. (2004).
Island of Samothraki at an altitude of 10 m, apparently (the text is unclear) parasitic on Caloplaca c.f. crenularia.
Widely distributed in Europe. Also Macaronesia (CVI), Asia (Turkey, Iran, Russia), perhaps N. Africa (Algeria, Tunisia), North America (widespread but scattered), perhaps S. America (Argentina, Chile), and Australasia (Australia).

Dactylospora verruculosa Hafellner (1979)
in: Nova Hedwigia, Beihefte 62: 151-152
Description: See the protologue.
Western side of Greece, from western Crete to Corfu, at altitudes 20 - 1070 m.
Known only from Greece.

Degelia Arv. & D. J. Galloway (1981)
in: Lichenologist 13(1): 28-31
Type: D. gayana (Mont.) Arv. & D. J. Galloway. Family: Pannariaceae. Literature: The two commonly recognised European species are treated in Burgaz et al. (2010), and Smith et al (2009). For the recently described D. cyanoloma, see below.
European species were recently transferred to the new genus Pectenia. 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 a dense mat of rhizines that become blue-black and eventually extend beyond the thallus in the manner of a hypothyallus. Upper cortex: cellular. Lower cortex: of longitudinal hyphae, often not sharply distinguished from medulla. 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.

11 With many wart-like, often ± coralloid isidia, not resembling lobules, sometime obscuring thallus and forming a ± areolate crust. Apothecia usually absent. D. atlantica

1 Isidia absent, or if present then rounded and resembling small lobules, not wart-like and coralloid. Apothecia usually abundant. D. plumbea s. lat. Sometimes subdivided as below, but this couplet does not work well in Greece. My collections generally display intermediate characters.
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. (D. cyanoloma) Greek report needs confirmation.
1 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 a yellow-brown tinge, thin, adpressed. D. plumbea s. str.

Degelia atlantica (Degel.) P. M. Jørg. & P. James (1990)
in: Bibl. Lich. 38: 264. (The name was accidentally repeated as basionym, but there was a full and correct reference to the correct basionym's place of publication, and the name is validly published.); Parmeliella atlantica Degel. (1935) in: Acta Phytopog. Suec. 7: 131-133
Thallus: foliose, to 3 cm diameter, olive-brown, matt, plate-like and firmly adpressed to substrate. Isidia: present over most of the upper surface, wart-like, irregularly globose, cylindrical or subcoralloid, 0.2 mm diameter. Rhizines: forming a very dense mat that resembles a hypothyallus, blue-black, extending about 0.5 mm beyond the margin of the 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, oriented perpendicular to surface. Medulla: white to pale brown, consisting 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 both layers. Lower cortex: of hyphae oriented predominantly horizontally (i.e. parallel to the substrate). Medullary hyphae 5 µm, often with distinct septa when oriented horizontally. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K- (K sometimes accentuates medullary pigmentation, but this seems to be purely a physical effect), C-, KC-, P-. Photobiont: blue-green, cells not in obvious chains. Photobiont layer 50 - 100 µm thick, with a very irregular upper margin.

Easily distinguished from D. plumbea by its isidia.

Scattered rather thinly throughout Greece, at altitudes 200 - 1400 m, on bark that is not strongly acidic. Reported from *Abies cephalonica*, *Castanea sativa* and *Quercus pubescens*. The record of *Parmeliella plumbea* var. *myriocarpa* in *Servit* (1935), for Mt. Panachaiko in the Peloponnese, probably refers to *Degelia plumbea*, not to this species, though the name has sometimes been misapplied to *Degelia atlantica*. The lichenicolous fungus *Toninia plumblina* has been reported from this host.


**Degelia cyanoloma** (Schauer.) H. H. Blom & L. Lindblom (2009)

Description: Blom & Lindblom (2009).

The only Greek report to date is from the island of Kefallonia, where it occurred on *Abies cephalonica* at an altitude of around 1400 m

Recently resurrected from the synonymy of *D. plumbea*, not well known, and doubtfully distinct from *D. plumbea* (see remarks below under that species). I list it independently here to encourage the collection of additional Greek material that may clarify the relation between *D. cyanoloma* and *D. plumbea*. All other records of *D. cyanoloma* are from western Europe, from Spain to Norway.

**Degelia plumbea** (Lightf.) P. M. Jørg. & P. James (1990)

Thallus: foliose, to 5 cm diameter, grey or yellow-grey, matt, ±monophyllous in central part but becoming divided into discrete, but contiguous, lobes in outer part. Lobes: (in outer part of thallus, where they are distinct) 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 the lower cortex; these hyphae then aggregate into fibres of parallel hyphae that are about 25 µm diameter; fibres usually soon becoming blue-black in colour but occasionally this colouration develops later and the rhizines remain white at the tips and pale orange-brown towards the base for a long time; the mass of rhizines eventually extends out beyond the margin of the thallus by 0.5 - 2 mm, by which time it resembles a hypothallus rather than an ordered structure of rhizines. The blue-black pigment in the rhizines and hypothallus reacts K-.

Lobules: often present in central parts of thallus, ±globose, 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, only occasionally elongated and then with long axis perpendicular to surface. Medulla: white to pale orange-brown, of hyphae that are sometimes oriented randomly, sometimes ±longitudinally; structurally not very distinct from lower cortex but appearing slightly darker in colour than lower cortex. Lower cortex: 25 - 50 µm thick, colourless, of longitudinally oriented hyphae. Apothecia: abundant in central part of thallus, often present but less frequent towards the margins, laminal, sessile, flat to convex, to 1.5 mm diameter, not pruinose, usually rounded by older ones sometimes becoming irregular. Disc: orange-brown to red-brown. Exciple: pale orange-brown to brown-orange, paler than disc, thin, persistent or becoming excluded; in section distinctly cellular, cells small in inner part but becoming larger in outer part, overall pattern is of cells organised on a radiating trend. Thalline margin: absent. Epithecium: colourless. Hymenium: 80 µm tall, very pale yellow, K- (but pigment dissolves), K+ blue. Hypothecium: pale yellow. Paraphyses: 1 - 2 µm wide in lower parts, 1.5 - 2.5 µm wide towards apex and sometimes slightly capitate, not moniliform, with clearly visible septa (at least in K), coherent. Asci: slightly clavate, 35 x 10 µm, the upper half staining K+ blue in two parallel layers with a KI- layer in between (as though the asci were double-walled). Ascospores: colourless, simple, ±ellipsoid but sometimes with one end slightly pointed, 8 per ascus, 15 - 18 x 6 - 7 µm. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K- (K sometimes accentuates medullary pigmentation, but this seems to be purely a physical effect), C-, KC-, P-. Photobiont: blue-green, cells not in chains; photobiont layer 45 - 80 µm thick, often with globose clumps of cells about 40 µm in diameter extending down into
medulla.

This is a distinctive species which is unlikely to be confused with any other.

Characters of all my collections are intermediate between those cited in the key for D. plumbea and D. cyanoloma. I am not convinced that D. cyanoloma is a good species; it may just be an extreme morph of D. plumbea.

Fairly widespread, though there are no records from the NE part of the country, perhaps because of its continental climate. From altitudes of 50 m to over 1500 m, but probably commonest in upland and montane forests. Usually on bark, most commonly of Abies or Quercus, but also known from Pinus and Ulmus. I have seen it once on wood of Juniperus oxycedrus. The lichenicolous fungus Toninia plumbina has been reported from this host.

Range similar to D. atlantica, but extending further north and east (map in Jørgensen & James 1990: 260).

Widespread in southern and western Europe, but absent from areas with a distinctly continental climate. Also Macaronesia (widespread), Asia (Turkey, Syria, Russia), N. Africa (Morocco, Algeria, Tunisia), and a small area of N. America (SE Canada, NE USA. Reports for S. Africa, S. America (Brazil) may be unreliable.

### Dermatocarpon Eschw. (1824)


Type: D. miniatum (L.) W. Mann. Family: Verrucariaceae. 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 (perhaps incorrectly) are transitional to other growth forms. The genus has about 50 species, of which about 20 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 Greek species commonly encountered, D. miniatum. Three other species have been reported for Greece, but there is some uncertainty about two of them.

11 Thallus foliose.

22 Lower surface with rhizine-like structures. (D. pellitum), (D. schaechtelinii), (D. vellereum)

2 Lower surface without rhizine-like structures.

33 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**

3 Thallus multi-lobed, attached by several scattered holdfasts.

44 Thallus bright green when wet. Medulla Meltzer’s I+ brown-red. On calcareous or siliceous rocks that are submerged or inundated for most of the year. Altitude range in Greece poorly known. **D. luridum**

4 Thallus not changing colour much when wet, never bright green. Medulla Meltzer’s I-. Not submerged, though may be associated with seepage tracks. At subalpine to alpine levels. **D. intestiniforme**

1 Thallus squamulose or squamulose-areolate.

22 Thallus squamulose, dark brown to black. Squamules convex. (D. convexum)

2 Thallus squamulose-areolate, with grey pruina. Areoles ±flat. **D. subcrustosum**

### Dermatocarpon intestiniforme (Körb.) Hasse (1912)

in: Bryologist 15: 46; Endocarpon intestiniforme Körb. (1859) in: Parerga Lichenol. 42; Dermatocarpon polyphyllum (Walk.) Dalla Torre & Sarnt.

The earliest name is Lichen polyphyllus Wulf. (1787), but it is not legitimate, being a later homonym. At species rank, the epithet has priority only from 1885.

Regarded as a synonym of D. miniatum by Moberg et al. (2017), but as I have not seen the evidence on which that view is based I prefer to retain the name as distinct for the present.

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. intestiniforme**, and there is a recent reliable report for Epiros Rare and scattered on the mountains of the mainland, on rock at altitudes 1800 - 2150 m. An old report from bark is almost certainly incorrect.

Widely distributed in Europe from the Alps northward, but south of the Alps confined to high mountains. Also Macaronesia (Madeira), Asia (scattered in cooler parts), N. America (scattered in cooler parts). 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 owing to *Dermatocarpon fluviatile* Herre. (1906), an illegitimate synonym of *D. luridum*. The next name is *Lichen aquaticus* Weiss (1770), but it is not legitimate (later homonym). Hoffmann combined Weiss's name into *Platismas*, as *Platismas aquaticum* Hoffm. (1794), but included the type of *Lichen luridus* With. within its circumscription. As a result, *Platismas aquaticum* Hoffm. and all subsequent *aquaticum* names at species rank are superfluous names and not legitimate.

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.

Widely distributed in Europe from the Alps to about the Arctic Circle; rare south of the Alps and usually confined to the mountains. Also Macaronesia, Asia (Turkey, widespread in Russia, Mongolia, NW China), N. Africa (Morocco), N. America (widespread, especially in cooler regions), perhaps C. America. 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 a holdfast, without vegetative propagules. Surface: pale grey, matt, not smooth, slightly white pruinose. Lower surface: brown, matt, smooth but with a faint network of low rounded ridges or folds. Perithecia: abundant everywhere on upper surface, though less common near centre of thallus, black, 0.01 - 0.5 mm diameter. Ascosporas: colourless, simple, ellipsoid, 10 - 13 x 7.5 μm. Photobiont: green.

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 very common. On calcareous or siliceous rock at all altitudes. About 35% of reports are from above 1800 m, but some of these high altitude reports might refer to *D. intestiniforme*.

Throughout most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), Caribbean (PR), C. America (Mexico), S. America (Colombia, Venezuela), Australasia (widespread in NZ; reports for Australia are incorrect).

Dermatocarpon subcrustosum  (Nyl.) Zahlbr. (1921)

The earliest name may be *Sagedia lugubris* Mont. (1849), in which case the correct name would be *Dermatocarpon lugubre* (Mont.) ined.


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 only reported in Europe and Greece. Also Macaronesia (Canary Is), western Asia (Israel, Jordan), N. Africa (Morocco, Algeria). If a good taxon, it seems to be Mediterranean/Macaronesian.

Didymellopsis  (Sacc.) Clem. & Shear (1931)


It has been suggested that the type species belongs in *Zwackhioniomyces*, which would make *Didymellopsis* a synonym of that genus. However, the correct placement of the two species in the key below would then be unclear, and for now I treat them under the name *Didymellopsis*.

A rather poorly known genus with about three species. There is only a single Greek record.
Two species, *D. collematum* and *D. pulposi*, both occur on *Collema*, and the descriptions that I have seen are so similar that I wonder if the names might be synonyms.

1 On Catapyrenium or Endocarpon. Perithecia 100 - 200 µm diameter. Exciple brown, without a violet tinge. (D. perigena)

(1) D. collematum has perithecia 200 - 400 µm diameter and a violet-brown exciple. Unfortunately, I do not have corresponding information for D. pulposi.

**Didymellopsis collematum** (J. Steiner) Grube & Hafellner (1990)

Description: Clauzade, Diederich & Roux (1989) as *Cercidospora collematum*.
The single Greek record is from the western part of Sterea Ellada, where it occurred on *Collema auriforme* at an altitude of about 500 m.

Reported from a few localities in Europe (British Is, Estonia, Netherlands, Czech Republic, and Greece), and Asia (arctic Siberia).

**Dimelaena** Norman (1852)


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.
Widely distributed in Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Zimbabwe, S. Africa), N. America (widespread), C. America (Mexico), southern S. America (Argentina, Chile).

**Dimelaena radiata** (Tuck.) Müll. Arg. (1884)
in: *Flora* 67: 466 (according to Nash et al. (2004), but I cannot check this, as page 466 is missing in my copy of volume 67 of *Flora*. The combination has often been ascribed to Hale & W. L. Culb.); *Buellia radiata* Tuck. (1866) in: *Lich. Calif.* 25

Rico et al. (2003) claim this species may be synonymous with *Buellia tesserata* Körb.
Islands of the southern Aegean, on siliceous rock at altitudes 50 - 250 m.
Strictly southern Europe (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)

Type: *D. canescens* (Dicks.) A. Massal. Family: *Caliciaceae*. 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 the *Physciaceae* in the presence of 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.
The number of species depends on how Diploicia is circumscribed, but I recognise two, only one of which is European. Two species, D. canescens and D. subcanescens, have traditionally been recognised in Europe, but here I consider them to be synonymous, as suggested by Molina et al. (2002).

Diploicia canescens (Dicks.) A. Massal. (1852)

Those who wish to distinguish D. canescens and D. subcanescens may note that none of the Greek records refer to the latter.

Thallus: placodioid with very 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 final 0.5 - 1 mm of marginal lobes), white pruinose everywhere though 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 readily visible); cells 3 µm wide. Medulla: white, of loosely interwoven hyphae that are 2 - 3 µm wide; in section the upper half is colourless but the lower half is 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). Photobiont: green; cells globose, 10 - 12 µm diameter, forming a layer 70 - 140 µm thick.

The neat rosettes of this species, together with the placodioid growth form and the colour mean that there are few species with which it might be confused. Lecanora pruinosa and Solenopora candidans both lack soralia and are usually fertile; also Lecanora pruinosa is C+ orange, and Solenopora candidans has a P+orange medulla.

Widely distributed, but nearly always near the sea. At altitudes 0 - 900 m, but uncommon above 400 m. Apparently rather indifferent as to substrate, and there are many records from both bark and rock (calcareaeous and siliceous). Occasionally found on wood.

Throughout Europe, except in the far north. As D. canescens also Macaronesia, Asia (widespread in N. Africa; also S. Africa, St Helena), N. America (only coastal California), perhaps Caribbean (Bermuda), C. America (Mexico), S. America (Galapagos Is), Australasia (widespread in temperate parts), Pacific (Hawaii). D. subcanescens, if distinguished, occurs in southern Europe, Macaronesia (widespread), Asia (Kuwait, Yemen), Africa (N. Africa, Socotra).

Diploschistes Norman (1852)
in: Conatus Praem. Gen. Lich. 20

Type: D. scruposus (Schreb.) Norman. Family: Graphidaceae. 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 less well developed 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, zellipsoid, 4 - 8 per ascus, medium sized to fairly large (20 µm or more long in most species). Chemistry: varied, but many species C+ red 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 49 species that have not been satisfactorily placed elsewhere, but at least 10 of these are poorly known and may be synonymous with better known species. 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 about 12 species, the genus shows a clear preference for the south of the continent, though a few species are widely distributed. The group of species near D. scruposus needs further study in Greece.

11 Disc of apothecia punctiform, opening only by a small ostiole, resembling perithecia. On rock.
22 Thallus C+ red. On calcareaeous 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 Most mature ascospores more than 30 µm long (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 a 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 a yellow pigment into solution. **D. diacapsis subsp. diacapsis**

5 Thallus K- or slightly K+ greenish, not diffusing a 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)

in: [need to investigate - don't know title of paper in Hedwiga 31:]. **Verrucaria actinostoma** Ach. (1810) in: Lichenogr. Universalis 288; (?) *Diploschistes actinostoma* var. electus J. Steiner as "actinostomus"; (?) *Diploschistes calcareus f. electus* (J. Steiner) Lettau; **Urceolaria actinostoma** (Ach.) Schaer.; **Urceolaria actinostoma** a. (= f.) **contracta** Schaer.

   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).

   Fairly widely distributed in the southern half of Greece. but never very far from the sea. On siliceous rock at altitudes 0 - 1100 m.

   Widely distributed in southern Europe; uncommon north of the Alps, just reaching southern England. Also Macaronesia, Asia (widespread), Africa (Morocco, Egypt, Socotra, Namibia, S. Africa), N. America (fairly widespread in USA) Caribbean (PR, St Croix, St Thomas), C. America (CR, Mexico), S. America (widespread), Australasia (widespread in Australia, NZS), Pacific (Hawaii, Kermadec Is).

**Diploschistes aeneus** (Müll. Arg.) Lumbsch (1989)


   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 Leeward Is), C. America (Mexico), S. America (Bolivia, Brazil, Paraguay, Uruguay),
Australasia (scattered in Australia).

**Diploschistes caesioplumbeus** (Nyl.) Vain. (1921)
in: *Bot. Mag. (Tokyo)* 35: 70; *Urecaria actinostoma var. caesioplumbea*Nyl. (1873) in: *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. caesioplumbea* (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 the disc, and 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. Epitheicum: ±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. Ascii: 105 x 25 - 30 µm, clavate, KI+ uniformly orange-brown, without apical apparatus. Ascospores: brown when mature, muriform, ellipsoid, 4 - 8 per ascus, (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). 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.

The small, imersed apothecia and the hairs on the exciple make this species easy to recognise.

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 (fairly widespread, but avoiding continental interior), Africa (Algeria, Morocco, S. Africa; Ascension Is, St Helena), N. America (Arizona, California), C. America (Mexico).

**Diploschistes candidissimus** (Kremp.) Zahlbr. (1924)
in: *Cat. Lich. Univ.* 2: 660; *Limboria candidissima* Kremp. (1865) in: Unger & Kochyl, in: [need to investigate - need better bibliographical data]; *Diploschistes actinostoma var. farinosus* (Anzi) Zahlbr. as "actinostomus"

There are earlier names, but they do not have priority at the rank of species.

Thallus: crustose, cracked (the 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 very difficult to study (may be a pseudocortex, not a true cortex), 30 - 40 µm thick, colourless to pale brown, K-, N-. Medulla: white (but brown where cracks descend into it), chalky. Apothecia: imersed, resembling perithecia, 0.25 - 0.3 mm diameter. Disc: not visible externally. Exciple: arched over the 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. Hypothecium: 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. Ascii: 110 x 25 µm, broadest at middle level, KI+ uniformly brown-orange, without any apical apparatus. Ascospores: brown when mature, muriform, ellipsoid, 4, 6 or 8 per ascus, 28 - 35 x 17 - 18 µm, with 5 - 7 transverse and 3 - 4 longitudinal septa; KI- even when mature. Chemistry: medulla K-, C+ red, P-, I+ grey; thallus UV+ faintly white. Photobiont: green, forming a continuous, regular layer 70 - 100 µm thick.

Easily recognised by the combination of punctiform apothecia, the C+ red thallus and the calcareous substrate.

Very scattered in theo southern half of Greece. On calcareous rock at altitudes 300 - 700 m.

Southern Europe and the more southerly parts of central Europe (Hungary, Bulgaria, Ukraine). Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Egypt), perhaps N. America, Australasia (S. Australia, Victoria).

**Diploschistes diacapsis** (Ach.) Lumbsch (1988) subsp. diacapsis

in: *Lichenologist* 20(1): 20; *Urecaria diacapsis* Ach. (1810) in: *Lichenogr. Universalis* 339; *Diploschistes albescens* Lettau; *Diploschistes albissimus var. coloratus* (J. Steiner) J. Steiner; *Diploschistes gypsaceus var. coloratus* J. Steiner; *Diploschistes scruposus var. albus* (Rabenh.) J. Steiner

Thallus: crustose, to several cm diameter, pale grey, white pruinose, often warted, 1 - 1.5 mm thick. Cortex: true cortex probably absent; layer above photobiont 12 - 30 µm thick, colourless but rather opaque, without distinct structure. Medulla: white. Apothecia: subimersed, concave, 1.5 - 3 mm diameter. Disc: black, white or grey pruinose. Exciple: visible externally as a thin, grey rim to the 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-. Thalline margin: externally a thalline exciple appears to be present, but in section it is not intimately part of the apothecium. Hypothecium: 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 colourless to pale brown in upper part. Paraphyses: simple, 1 µm wide, scarcely broadened at
apex. Asci: 150 x 15 - 23 µm, narrowly clavate, KI+ uniformly brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, narrowly ellipsoid, 8 per ascus, 25 - 32 x 12 - 15 µm, with 5 - 6 transverse and 1 - 2 longitudinal septa, KI-. Pycnidia: 100% immersed; in section: colourless, globose, 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 having 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 - 800, on soil. The few reports from higher altitudes, or from rock, may refer to other species.

Southern Europe and the more southerly parts of central Europe. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Egypt, Somalia, S. Africa), N. America (western USA), C. America (Mexico), S. America (Chile, Colombia, Peru), Australasia (NSW, S. Australia).

**Diploschistes diacapsis subsp. neutrophilus** (Clauzade & Cl. Roux) Clauzade & Cl. Roux (1989)
in: Bull. Soc. Linn. Provence 40: 110 (as neutrophila); *Diploschistes gypsaceus subsp. neutrophilus* Clauzade & Cl. Roux (1985) in: Likenoj de Okcidenta Eŭropo 823 (as neutrophila)
Description: Clauzade & Roux (1985) as *Diploschistes gypsaceus subsp. neutrophila*

Attica, on soil at an altitude of 1000 m.

Only mainland France, Corsica and Greece.

**Diploschistes euganeus** (A. Massal.) J. Steiner (1919)

Descriptions: Clauzade & Roux (1985); Nash et al. (2002).
Islands of the Aegean, including Crete, on calcareous rock at altitudes 50 - 400 m.

Mostly southern Europe; very 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 in Australia, NZN), Pacific (Easter Is).

**Diploschistes gypsaceus** (Ach.) Zahlbr. (1892)
in: [need to investigate - bibliographical data incomplete]; *Urceolaria gypsacea* Ach. (1810) in: Lichenogr. Universalis 338-339; *Diploschistes albissimus* (Ach.) J. Steiner: *Urceolaria albissima* (Ach.) Arnold

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

For separation from *D. scruposus*, see under that species.

Very scattered, with no clear pattern. On calcareous rock at altitudes 0 - 1200 m. Synonymy in *Diploschistes* is rather confused, and some reports, especially those from other substrates, may refer to other species. The report of Abbott (2009) for the Peloponnese is incorrect, but a report for the Peloponnese 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 (Saskatchewan, scattered in USA), S. America (Argentina, Colombia, Venezuela), Australasia (SE Australia, both islands of NZ).

**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 *Lecanora muralis*, not on *Cladonia*, and was said to have 2-spored asci. The latter character suggests *Ingviera bispora*, but that species is not known to be lichenicolous. The type collection needs to be examined.

Thallus: crustose, to 6.5 cm diameter, white to very pale brown, often warted, thick (about 0.7 mm). Prothallus: sometimes present, rather inconspicuous, white, brown or black, 0.3 - 0.5 mm wide when well developed. Cortex: true cortex probably absent; pseudocortex: 20 - 50 µm tall, colourless, sometimes with a 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. 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 the inner side of the uppermost part is a disconnected remnant of the thalline exciple), pigment K-, N-. Thalline margin: present. 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. Hypothecium: 20 - 25 µm tall, brown to dark brown, clearly contiguous with exciple, K-, N-. Paraphyses: simple, 1 µm wide, scarcely expanded at apices. Ascii: 75 - 85 x 15 - 20 µm, clavate, uniformly KI+ brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, ellipsoid, 4 per ascus. 21 - 27 x 9 - 14 µm, with 4 - 5 transverse and 1 - 2 longitudinal septa, KI- but appearing slightly KI+ red-purple when in ascus. Chemistry: medulla K-, usually C- (sometimes C+ red in uppermost part), KC-, P-, I+ grey (in spot tests; KI+ purple in section); thallus K-, C+ red, P-, UV+ white. Photobiont: green, cells globose, 10 - 12 µm diameter, forming a slightly irregular and sometimes discontinuous layer 30 - 70 µm thick.

Easily recognised in its early stages, when parasitic on Cladonia squamules. Later, its 4-spored asci will usually resolve any doubts.

Greek material belongs to subsp. muscorum. Subsp. bartlettii is (sub)tropical and not present in Europe.

Throughout Greece, at altitudes 0 - 1400 m, but 60 percent of records are from altitudes below 400 m. Initially parasitic on squamules of Cladonia species, 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 (Morocco, Algeria, S. Africa; Ascension Is, St Helena), N. America (widespread), Caribbean (Jamaica), C. America (Mexico, Guatemala), S. America (Argentina, Chile, Uruguay; Galapagos Is), Australasia (NZS), Pacific (Easter Is). Some southern hemisphere reports may refer to subsp. bartlettii, which is not present in Europe.

**Diploschistes ocellatus **"(Vill.) Norman" (1852)


Unfortunately Lichen ocellatus Vill. is illegitimate, being a later homonym of L. ocellatus Wulf. (1787). Villar's name was combined into Urecelaria 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 villarsii (Ach.) ined. All ocellatus names at species rank published after 1810 are superfluous names and illegitimate. Conservation is desirable.

Thallus: crustose, sometimes with an obscquely placioclid margin, very pale grey-brown, but appearing grey-white owing to pruina, to 8 cm (in material measured in lab; larger thallii seen in field), 0.5 - 1 (2) mm thick. Prothallus: sometimes obscurely 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 to give a rather obscurely 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. Exciple: not visible externally; in section: poorly developed, 10 - 25 µm wide, colourless to pale brown. Thalline margin: thick, persistent. Epitheicum: 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. KI-.

Hypothecium: poorly developed, colourless, 20 µm; in places there is little between the hymenium and the underlying medulla. Paraphyses: simple, 1 µm wide, scarcely expanded at apices. Ascii: 110 - 130 x 15 - 18 µm, narrowly clavate, KI+ brown-orange everywhere (but some asci have traces of a KI- outermost layer), without apical apparatus. Ascospores: brown when mature, muriform, narrowly ellipsoid to ellipsoid, 8 per ascus, 22 - 28 (37) x 10 - 15 µm, with 3 - 5 transverse and usually 1 longitudinal septa, KI-.

Chemistry: medulla K+ yellow > red (abundant crystals of norstictic acid 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 calcicaceous rock. There is a single report from soil (perhaps it had spread from adjacent limestone).

Widely distributed in southern Europe; range scarcely extending beyond the Alps and Pyrenees. Also Macaronesia, Asia (widespread), Africa (widespread in northern Africa; also Somalia, Namibia), Australasia (widespread). Reports for N. America are incorrect.

**Diploschistes scruposus **(Schreb.) Norman (1852)

Urceolaria scruposa (Schreb.) Ach.

Peloponnesian material is problematic. Some collections that I have referred have persistently 4-spored asci, but otherwise resemble D. scruposus (thallus not pruinose, hypothecium dark, substrate unambiguously siliceous). Another collection has 8-spored asci but a pruinose thallus. It is not clear to me whether D. scruposus is more variable than generally assumed, or whether undescribed taxa are involved. Unfortunately, because siliceous rocks are uncommon in the Peloponnese, I do not have enough collections to investigate the matter thoroughly.

The description below is based on a single collection with unambiguously 8-spored asci and a non-pruinose thallus.

Thallus: crustose, to several cm diameter, pale brown-grey, not pruinose. Cortex: true cortex probably present; pseudocortex: 15 - 30 µm thick, colourless, without distinct structure (in water or in K), K-.


Subhymenium: 25 µm tall, colourless. Hypothecium: 50 - 100 µm tall, brown, lower boundary against medulla very diffuse. K-, N-. Paraphyses: simple, 1 µm wide, scarcely broadening at apices. Ascii: 100 x 18 - 20 µm, cylindrical to narrowly clavate, uniformly KI+ brown-orange, without apical apparatus. Ascospores: brown when mature, muriform, narrowly ellipsoid, 8 per ascus, 20 - 25 x 9 - 10 microns, with 4 - 5 transverse and usually 1 longitudinal septa. Chemistry: medulla K-, C+ red, P-, I- in spot tests, mostly KI- in section but a few areas KI+ purple-red; thallus K-, C+ red, P+ faintly yellow, UV+ faintly pale green. Photobiont: green, cells globose, 8 - 15 µm diameter; photobiont layer: 75 - 130 µm thick, slightly irregular as cells tend to occur in large clumps, ±continuous.

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 (SE Australia, both islands of NZ), Pacific (Hawaii, Tahiti).

Diplotomma Flot. (1850)

in: Bot. Zeit. 8: 381-382. Often cited from Uebers. (often as "Jahreser.") Schles. Ges. vaterl. Cultur im Jahre 1849: 130. 1850, but there it is a nomen nudum

Type: D. alboatrum (Hoffm.) Flot. Family: Caliciaceae. 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 exciple. 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: usually some shade of brown. Paraphyses: 1 - 1.5 µm wide at base, simple, capitate, apical cell with internal brown pigment that is not soluble in K. Asci: clavate, Lecanora type. Ascospores: brown, 3-septate or submuriform, ±ellipsoid, 8 per ascus, medium sized (typically 12 - 25 µm long). Chemistry: norstictic acid present in some species. Photobiont: trebouxoid.

The ascospores are distoseptate, i.e. the septa are not continuous with the apothecial wall. This is sometimes apparent at x400, but it is not an easy character to observe.

Diplotomma was, for a time, used as a "dustbin" for species of Buellia s.lat. with multi-septate or submuriform asciopores. In that sense, it is an artificial assemblage. However, when restricted to the groups of species close to D. alboatrum, which is the sense adopted here, the name is biologically meaningful and, as shown by Molina et al. (2002), this group is sufficiently distinct from Buellia s. str. to merit generic status. Unfortunately, species concepts in Diplotomma are not clear, in part because Nordin (2000b) had a very broad concept of D. alboatrum. In contrast to Nordin's excessive 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 generally 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. Far more than is usually the case with lichen genera, 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.

11 Parasitic on other lichens.

222 Parasitic on Teloschistaceae. Note 1.

33 Ascospores to 16 µm long.

44 On Caloplaca verruculifera. (D. vezdanum)

4 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 foliaceous Physciaceae, especially Physconia muscigena. Host usually terricolous or saxicolous, rarely corticolous. Ascospores not curved. Inner part of exciple slightly more paler than outer part.

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 (norstictic 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. hedini**. 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 (norstictic 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 relationships between the four "species" in this branch is unclear. They may not all be distinct.

(2) This character is unmistakeable, 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 in which the medulla contained small brown or orange-brown inclusions. The inclusions 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, though they might be material incorporated from the substrate.

(5) Test in a 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)
in: Uebers. Schles. Gas. 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) in: 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 very well developed, K- Medulla: white. Apothecia: subimmersed to subsessile, flat to convex, 0.2 - 0.4 mm diameter, not pruinose. Disc: black. 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. Thalline margin: absent. Epithecium: brown to dark brown, K- (other apothecial pigment likewise), 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: 2 µm wide at base, simple, slightly capitulate, 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, 8 per ascus, 13 - 17.5 x 7.5 - 8 µm. Chemistry: medulla K-, l-; thallus K-, UV-. Photobiont: green, cells globose, 8 - 11 µm diameter. Photobiont layer: ±regular, but often discontinuous, 25 - 45 µm thick.

Appears to differ from *D. ambiguum* by the thinner thallus, the almost complete absence of a thalline exciple, and the substrate. However, it will be necessary to study more Greek collections than I have been able to do to establish whether *D. ambiguum* really 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. However, I have referred only corticolous collections to this name.

Distribution uncertain, as the name has been used in both a narrow and a broad sense. There are reports for most of Europe, and for Macaronesia, Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), C. America (Mexico, CR), S. America (Argentina, Chile, Falkland Is, Guyana - the last doubtful in my opinion), Australasia (widespread), Pacific (Hawaii).

Diplotomma ambiguum (Ach.) Flagey (1894)
in: [need to investigate]; *Lecidea ambigua* Ach. (1810) in: 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 parallel to surface (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. Exciple: present but sometimes very poorly developed, black, very thin; in section: (if apparent) to 50 µm wide but usually less, brown in outer 20 µm, colourless to pale brown in inner part, of parallel hyphae and similar to hymenium; some sections lack a well-developed exciple. Pseudo-thalline exciple: always present on some apothecia (though sometimes not well developed). Epithecium: brown to grey-brown, K-, pigment not soluble in K (& same for all other apothecial pigment). Hymenium: 70 - 90 µm tall, colourless to pale brown, KI+ blue. Hypothecium: 100 - 170 µm tall, pale brown to orange-brown. Paraphyses: 2 µm wide at base, simple, capitulate, 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, 8 per ascus, 15 - 22 x 8 - 12 µm. Pycnidia: 100% immersed, pyriform, 70 x 40 µm, mostly colourless but brown near ostiole. Conidia: colourless, ellipsoid, 2 x 1 µm. Chemistry: medulla K-, l-; 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 appear to be 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.

Widely distributed outside truly arctic regions, but commonest in the south. Also Macaronesia (only Azores), Asia (Turkey), N. Africa (Morocco), N. America (Nevada).

Diplotomma chlorophaeum sensu Szatala (1956)
in: Annales Hist.-Nat. Mus. Nat. Hung., s. n. 7: 280. Szatala intended to make a combination from *Lecidea chlorophaea* Hepp ex Leight., 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 chlorophoea* into *Diplotomma*, attempted to validate the combination, but the existence of Szatala's validly published 1956 name makes their combination an illegitimate later homonym. The best solution will be to lectotypify Szatala's 1956 name in a sense that is consistent with the usual usage of the name.

Priority of Leighton's name with respect to *Diplotomma porphyricum* Arnold also needs to be investigated.

Thallus: crustose, white to pale grey, occasionally with a slight brown tinge, not pruinose, usually in small patches 1 - 2 cm diameter, cracked or of ±continuous areoles, less commonly of dispersed areoles, 100 - 500 µm thick. Prothallus: usually absent; an inconspicuous, black prothallus 0.1 - 0.2 mm 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 a slight white pruina). Disc: black. Exciple: black, thin, often inconspicuous; in section: 25 - 40 µm wide, brown in outer part, paler brown in inner part. Pseudo-thalline exciple: sometimes present, especially in young apothecia. Epitheciun: brown to dark brown, K-, pigment between paraphyses dissolving in K but not internal pigment in apical cell. Hymenium: 55 - 110 µm tall, colourless or sometimes with a little brown pigment, KI+ blue. Hypothecium: about 80 µm thick, pale to dark brown. Paraphyses: 1 - 2 µm wide at base, simple, 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 to muriform, usually with 3 to 4 transverse septa, ellipsoid, 8 - 12 µm. Chemistry: medulla K+ red (norstictic acid), P-, UV-, I-; thallus K-, C-, P-, UV-. Photobiont: green, cells globose, 8 - 11 µm diameter. Photobiont layer: slightly irregular, sometimes continuous, 50 - 80 µm thick.

Easily separated from other closely related 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 but not the Nordic Countries or Baltic States. Also Macaronesia, Asia (Turkey, Russia), N. Africa (Morocco, Algeria), N. America (Washington), Australasia (NZS).

**Diplotomma epipolium** (Ach.) Arnold (1868)


In 1810, Acharius considered *Lichen intermedius* Schrad. (1794) to be synonymous. If this opinion is correct, then Schrad's epithet has priority. However, Schrad's name does not appear to have been typified and its application is uncertain.

Thallus: crustose, forming patches to about 2 cm diameter, white, chalky but not pruinose, continuous or lightly cracked, occasionally almost areolate, 300 - 500 µm thick. 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. Exciple: not visible externally; in section: not very well developed, 15 - 20 µm thick, pale brown to dark brown, K-, pigment between paraphyses dissolving in K but not internal pigment in apical cell. Hymenium: 55 - 110 µm thick, colourless to pale grey, of radiating hyphae. Pseudo-thalline exciple: present, often persistent. 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, 8 - 10 µm. Chemistry: medulla K-, C-, KC-, I-; thallus K-, C-, KC-, 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. hedini* 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 as far east as NW China), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (Alaska, Ontario, Michigan). However, some of the reports may refer to *D. hedini*.


Description: Smith et al. (2009).

Chios and Samothraki, on calcareous rock at altitudes 5 - 1280 m. The lichenicolos fungus *Arthonia rubescens* has been reported once from this lichen.

Scattered in temperate Europe, from the British Isles to Greece. Also Asia (Russia, Tajikistan, Mongolia, China), N. Africa (Tunisia), and the Americas. Perhaps more widely distributed than the few reports under this name suggest, as
some reports of *D. epipolium* may belong here.

**Diplotomma murorum** (A. Massal.) Coppins (1980)
Abbott (2009) regarded the only Greek report, from the mountains of the northern Peloponnesse, as in need of confirmation. The substrate was not clearly specified, but appears to be rock. This species is expected to be parasitic.

**Diplotomma nivele** (Bagl. & Car.) Hafellner (1995)

Much 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 inermis*. However, the taxon actually described by Sommerfelt was probably not that species, and has generally been considered to be a species close to *Buellia alboatra* (i.e. as belonging to *Diplotomma* in the sense in which that name is used here).

Descriptions: Alstrup & Hawksworth (1990); Clauzade, Diederich & Roux (1989); Clauzade & Roux (1985), all as *Buellia nivalis*.

Scattered with no clear pattern, at altitudes 0 to at least 2300 m. Most of the reports state that the substrate was rock, usually calcareous but on one occasion sandstone. One report indicated that the species was parasitic on an unspecified species of *Caloplaca*. This species is expected to be parasitic, usually on *Xanthoria elegans* but sometimes on species of *Caloplaca*. Reports from low altitudes are doubtful.

Widely distributed, but perhaps scattered, in northern and central Europe, and in the high mountains of southern Europe. Also Macaronesia (Canary Is), Asia (Turkey, Russia, Kazakhstan, Mongolia), N. America (widespread from Alaska to northern USA), and apparently S. America (Venezuela).

**Diplotomma pharcidium** (Ach.) M. Choisy (1950)

The earliest name is *Lecidea parasema* (= var.) *athroa* Ach. (1803), but it does not have priority at the rank of species.

Thallus: crustose, 1 cm diameter, cracked, pale grey or pale brown-grey, not pruinose, 100 - 200 μm thick. Cortex: 30 μm thick, colourless to very pale brown or very pale grey, often with a weak cellular texture in lower part, upper part without distinct structure, K-. Medulla: white. Apothecia: 0.3 - 0.7 mm diameter, flat to convex, not pruinose. Disc: black, entirely covered by exciple in young apothecia. Exciple: not apparent externally; in section: 30 μm wide, brown to dark brown, sometimes almost opaque, ±of radiating hyphae that develop broad lumina in outer parts. Pseudo-thalline exciple: present in young apothecia. Epitheicum: brown, K-, pigment not soluble in K. Hymenium: 60 μm tall, colourless, K+ blue. Hypothecium: dark brown. Paraphyses: 1 μm wide at base, simple, capitate, apical cell 3 - 5 μm wide with internal brown pigment cap. Asci: 75 x 13 μm, narrowly clavate, Lecanora type. Ascospores: brown, 3-septate, ellipsoid, sometimes curved, 8 per ascus, 17 - 23 x 7 - 8 μm. Chemistry: medulla K-, C-; thallus UV-. Photobiont: green, cells globose, 8 - 20 μm diameter, forming a continuous, ±regular layer 60 - 120 μm thick.

My only collection is rather small, so I have not made any spot tests.

Provided that young apothecia are observed, this species can not be confused with any other.

Widely distributed 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 species with strongly acidic bark.

There are scattered reports of *D. pharcidium* for much of Europe. Also Asia (Russia, Mongolia, Japan), N. Africa (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 and it is said to be present in Finland. I have not seen any reports for other continents.

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.

Exciple: excluded early; in section: 40 - 60 µm wide, dark brown, of radiating hyphae. Thalline margin: absent.

Epithecium: dark brown, K-, pigment not soluble in K. Hymenium: 80 µm tall, colourless. Hypothecium: 100 µm tall, pale brown to brown. Paraphyses: 1 µm wide at base, simple, capitate, apical cell to 5 µm wide with internal brown pigment. Ascospores: brown, 3-septate, ±ellipsoid, sometimes curved, 8 per ascus, 18 - 20 x 7 - 7.5 µm.

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.

Scattered throughout 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 (Iraq, Russia, Tajikistan, Nepal), N. Africa (Morroco), N. America (mostly western half, from Alaska to Colorado), S. America (Argentina, Chile).

Diplotomma scheideggerianum (Bricaud & Cl. Roux) Nimis (1993)

Description: See the protologue.

Sterea Ellada, on Caloplaca xantholyta at an altitude of 200 m. This report comes from the protologue, so is reliable (provided, of course, that D. scheideggerianum is a good species).

Most reports of D. scheideggerianum are from southern Europe, from Provence to Greece, but present in Austria and Poland. Also western Asia (Turkey).

Diplotomma venustum Körb. (1860)
in: Parerga Lichenol. 179-180; Buellia epipolia var. venusta (Körb.) H. Olivier; Buellia pulverulentata var. venusta (Körb.) Nyl.; Buellia venusta (Körb.) Lettau; Diplotomma epipolium 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. Exciple: sometimes visible externally as a thin black ring that is darker than the disc; in section: 30 µm wide, dark brown, formed of hyphae ±parallel to paraphyses, not continuous with hypothecium. Pseudo-thalline exciple: prominent, at least in young apothecia.

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 capitiate, apical cell 2.5 - 5 µm wide with internal brown pigment cap. Ascii: 50 - 55 x 15 - 17 µm, clavate, apex K+ blue. Ascospores: brown, 3-septate, ±ellipsoid or slightly curved, 8 per ascus, 17 - 21 x 8 - 10 µm. Chemistry: medulla K+ yellow > red (crystals of 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 abundant (at least in patches) norstictic acid are distinctive among non-parasitic species of the genus.

Widespread in the south and west of Greece, but so far not reported for the NE 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 (scattered in Canada, widespread in USA but avoiding the SE), C. America (Mexico).

Dirina Fr. (1825)
in: Syst. Orb. Veg. 1: 244

Type: D. repanda Fr. (= D. ceratoniae). Family: Roccellaceae. Literature: The genus was monographed by Tehler et al. (2013). Earlier publications may be misleading.

About 27 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. Except for D. ceratoniae, the Greek species occur on rock (usually calcareous).

111 On calcareous rock.
   22 Apothecia present.
      33 Apothecia sessile, with constricted base.
         44 Medulla with loose hyphae near substrate, elsewhere chalk-like. D. ceratoniae
         4 Medulla chalk-like throughout. D. massiliensis
   3 Apothecia immersed, or sessile but base not constricted.
      44 Apothecia in a stroma in groups of 3 - 10. D. cretacea
      4 Apothecia single. (D. candida)
   2 Apothecia absent. Soralia present. D. massiliensis

11 On siliceous rock.
   22 Apothecia immersed. Medulla C+ red. (D. insulana)
   2 Apothecia (if present) ± sessile. Medulla C-. D. fallax

1 On bark. D. ceratoniae

Dirina ceratoniae (Ach.) Fr. (1831)

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 hyphae oriented perpendicular to surface, often with distinct lumina and sometimes with a weak cellular texture, K-, 1-. Medulla: white. Apothecia: sessile, ± flat, 0.7 - 2 mm diameter when mature. Disc: heavily white pruinose, pruina C+ red. Exciple: not visible externally; in section: poorly developed, 15 - 25 µm wide, brown in lower part, colourless in upper part, hyphal. 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. Epithecium: brown, K-, N-, some (not all) pigment dissolving in K but not in N. Hymenium: 130 - 150 µm tall, colourless but upper part sometimes with some epithelial pigment, Ki+ blue in upper part but reaction not strong. Hypothecium: to 200 µm tall at centre of apothecia, dark brown, opaque, K- or almost (there is sometimes a faint green tinge in K). Paraphyses: simple, not capitate. Asci: narrowly clavate, Opegrapha type. Ascospores: colourless, 3-septate, 8 per ascus, 24 - 30 x 4 - 5 µm, sometimes slightly curved, ends usually rounded. 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 but sometimes straight, 6 - 14 x about 3 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.

Quite widespread at coastal sites the southern half of Greece, usually at altitudes below 200 m. Greek reports are all from bark (or no substrate was reported). Recorded from a wide range of trees and shrubs, with no clear preference. The lichenicolous fungus Milospium graphideorum has been reported once from this lichen.

Widely distributed in southern Europe, but not present north of the Alps. Also Macaronesia, Asia (Israel; perhaps elsewhere), Africa, (widespread in N. Africa, perhaps also Socotra). 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.
Soraria: absent. Cortex: true cortex absent; layer above photobiont: 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; when sectioned, individual apothecia are about 0.4 - 0.5 mm wide. Disc: black, but covered by white pruina, often elongate or irregular. Exciple: not visible externally; in section: 15 µm wide, formed of hyphal parallel to paraphyses, dark brown in outer part, colourless adjacent to hymenium, reactions of pigment as for epipitheciun. Thalline margin: present, persistent. Epithecium: grey to dark brown, K- or developing a slight green tinge, N-, pigment not soluble in K or N. Hymenium: 125 - 160 µm tall, colourless but sometimes with some epipithecial pigment in upper part, rather weakly KI+ blue at least in upper part. Hypothecium: 100 - 170 µm, dark brown, opaque, reactions as for epipitheciun. Paraphyses: simple, not capitate, 1.5 µm wide at base, 2 µm at apex. Ascii: 80 x 15 µm, narrowly clavate, Opegrapha type (rather weakly KI+ blue in a small region near the apex). Ascospores: colourless, 2-3-septate, narrowly ellipsoid to talaform, 8 per ascus, 18 - 28 x 6 - 8 µm. Chemistry: medulla K-, 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 are not easily wetted and contain many crystals. Adding K does not help much. I made my observations in 10% hydrochloric acid, which gives better (though still not very 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 - 320 m. Almost restricted to the eastern Mediterranean (especially former Yugoslavia and Greece, but also Italy and Cyprus), though the type is from Austria. 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, usually at altitudes below 400 m. I have assumed that reports from lava on Santorini belong here, but that needs to be confirmed.

Western Europe to as far north as England, and southern Europe to as far east as Greece. Also Macaronesia (Canary Is, Madeira), N. Africa (Morocco).

**Dirina massiliensis Durieu & Mont. (1847)**


The earliest name is *Lichen conspurcatus* Sm. (1802), but that name has been proposed for rejection. Then described as *Lecanora repanda* Fr. ex Duby (1830), in Bot. Gall. 2: 66, but the epithect 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. Soraria: abundant, well delimited, 0.3 - 0.5 mm diameter, flat when young, later becoming convex, white in fresh material, becoming pale brown in herbarium. Cortex: true cortex probably absent; layer above photobiont: 25 - 35 µm thick, colourless, K-. Medulla: white. Chemistry: medulla C+ red in upper part but C- in lower part; soralia C+ red; thallus K-, C+ red, P-, UV+ whiteish. Photobiont: cells globose, 10 - 12 µm diameter, forming a layer 50 - 70 µm thick.

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 more than half of records are from below 200 m.

The most widely distributed species in Europe. Commonest in the south, but present as far north as Norway and Sweden. Also Macaronesia (warmer parts), 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.

**Elixia Lumbsch (1997)**

in: *J. Hattori Bot. Lab.* 83: 62


A rather poorly known genus of two species of lirellate lichens that occur on bark or wood. Both occur in Europe, but one of them is northern and will not be present in Greece.
Elixia cretica T. Sprib. & Lumbsch (2010)
in: *Lichenologist* 42(4): 368-370
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)
in: *Geneac. Lich.* 13
Type: *E. elisae* A. Massal. Family: *Melaspileaceae.*
About 4 species. Two occur in Europe, but one of them has a very limited range in the eastern Alps.

Encephalographa elisae A. Massal. (1855)
Description: Clauzade & Roux (1985).
Greek reports are poorly localised, and cannot be mapped. The only substrate reported is calcareous rock.
Only southern Europe, from Portugal to Greece.

Endocarpon Hedw. (1789)
Type: *E. pusillum* Hedw. Family: *Verrucariaceae.*
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 genus needs a modern revision on a global scale. Species of *Endocarpon* 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 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).
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), N. America.
Endocarpon pallidum Ach. (1810)
in: Lichenogr. Universalis 301. (The name Endocarpon muscorum Pers. ex Ach. (1810) was published simultaneously, on page 300. In 1814, in Syn. Meth. Lich., Acharius treated it as a synonym of E. pallidum, thereby establishing the priority of that name.)

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. Excipulum 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, 2 per ascus, 47 - 57 x 20 - 22.5 µm. 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, and never very far from the coast. On soil. (The report for Evia was from serpentine rock, an unusual substrate for this species, and may not be reliable.)

Southern and central Europe, reaching British Is, but not Baltic States or the Nordic Countries. Also Asia (Iran, Russia, Chagos Is, China), Africa (Morocco, Algeria, Ethiopia; Ascension Is, St Helena), N. America (scattered in USA), C. America (Mexico), S. America (Bolivia, perhaps elsewhere), Australasia (scattered in Australia; reports for NZ appear to be incorrect).

Endocarpon pusillum Hedw. (1789)
in: Descr. Micr.-Anal. Musc. Frond. 2: 56-57 and Tab. XX; Dermatocarpon pusillum (Hedw.) Anzi

The earliest name appears to be Lichen trapeziformis J. König (1772), in which case the correct name is Endocarpon trapeziforme (J. König) Flagey.

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.

Widely distributed to about the Arctic Circle. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (fairly widespread in northern and southern Africa; also Ascension Is, St Helena), N. America (southern Canada, widespread in USA), C. America (Mexico, Guatemala), S. America (widespread), Australasia (widespread), Pacific (Hawaii).

Endococcus Nyl. (1855)

Type: E. rugulosus Nyl. Family: of uncertain position in Dothideomycetes. Literature: There is no comprehensive monograph, and information is very scattered.

As I have seen only one species of this genus in Greece, see the description of E. rugulosus below.

Endococcus is a large genus of lichenicolous fungi, with more than 30 described species. More than 20 occur in Europe. By the standards of lichenicolous fungi, there are quite a lot of records for Greece, but in the absence of 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 8 ascospores

22 Apothecia discolouring or forming galls on host lichen. On Usnea or Xanthoria. (E. apicicola), (E. parietinarius)
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. macrosorus
8 Not on Rhizocarpon. (E. perpusillus) Not correctly reported for Greece.
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 \( \mu \text{m} \). On Placidiopsis cinerascens. (E. incrassatus)
4 Wall of perithecium without irregular thickenings. Ascospores 12 - 16 (20) \( \mu \text{m} \) long, width various. On various hosts.
55 Ascospores 3 - 6 \( \mu \text{m} \) wide. Cells similar. E. exerrans
5 Ascospores 4 - 8 \( \mu \text{m} \) wide (at widest part). Cells very dissimilar. E. stigma

Endococcus exerrans Nyl. (1879)
in: 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. Scattered in northern and NW Europe. The Greek report is disjunct. I have not seen any reports for other continents.

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 (as Lecidea enteroleuca) is certainly incorrect.
Throughout Europe. Also Macaronesia, Asia (Turkey), N. Africa (Morocco), N. America (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.
Scattered throughout middle latitudes of Europe. Probably absent from truly arctic regions. In the south, probably restricted to the uplands. Also Macaronesia (Canary Is), 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 that name has not been typified. Hawksworth (1985a) argued that the name must be rejected, as it is based on "discordant elements", i.e. the original material consists of more than one species, but under the present Code it must be typified on one of those elements.
Islands of the Aegean, including Crete, at altitudes 225 - 750 m. The only host explicitly cited was Aspicilia 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, widespread in Russia, also Japan), N. Africa (Morocco, Algeria, Egypt), N. America (widespread), S. America (Argentina, perhaps 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 (1865), in Körber, in: Parerga 399 is also synonymous, but Hawksworth 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: Aspicilia calcarea (as Lecanora calcarea var. concreta), Lecidella scabra (as Lecidea scabra), and Tephromela atra (as Lecanora atra). Nash et al. (2004) seems to imply that Endococcus stigma is restricted to species of Acarospora.

Widely distributed in Europe, though in the south probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Ural Mts), N. Africa (Morocco), N. America (Arizona, California).

Endococcus verrucosus Hafellner (1994)

in: 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, 8 per ascus, 15 - 16 x 7 µm, rarely slightly constricted at septum, with prominent ornamentation at x400.

Difficult to compare with other species until the genus is better known.

Crete and Peloponnese, on species of Aspicilia at altitudes 35 - 1750 m.

Seems to be widely distributed in Europe, though there are not many records. Also Asia (Turkey), N. America (Arizona).

Enterographa Fée (1825)

in: Essai Crypt. Écorc. 57 (and pages XXIX and XXXII of the introduction).


Over 50 species, of which 8 occur in Europe. The genus is very rare in Greece.

11 Soredia present. (E. zonata)
1 Soredia absent.

22 Apothecia punctiform, rounded or shortly ellipsoid.
33 Ascospores 4 - 5 -septate, 22 - 30 µm long. On non-calcareous rock. (E. zaborskiana)
3 Ascospores 5 - 7 -septate, 27 - 39 µm long. On bark or non-calcareous rock.
44 Thallus areolate. Ascospores 5 - 6 -septate. Conidia 6 - 8 µm long. On non-calcareous rock. (E. pitardii)
4 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)

in: Essai Crypt. Écorc. XCl (in the introduction part); 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.

Widely distributed on the western side of Europe but, like most lichens with photobiont Trentepohlia, rare in more easterly regions, though it is present in Italy, where it is said to be rare, and former Yugoslavia. Also Macaronesia, eastern Asia (Japan), N. Africa (Morocco, S. Africa), perhaps Caribbean (Bahamas). Reports for S. America, Australasia probably incorrect.
Epiphloea Trevis. (1880)

Type: E. terrena (Nyl.) Trevis. Family: Collemataceae. 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 occurs in southern Europe.

Epiphloea terrena (Nyl.) Trevis. (1880)
Santorini, on non-calcareous soil at an altitude of about 200 m. However, this is an inconspicuous species, and it may be more widely distributed
All recent reports of E. terrena are from countries around the Mediterranean: from Spain to Cyprus in Europe, and N. Africa (Morocco). However, the type collection is from the French Pyrenees.

Evernia Ach. (1809)

Type: E. prunastri (L.) Ach. Family: Parmeliaceae. 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 the shape of the 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 examining ascospores (simple in Evernia, 1-septate in Ramalina), but Evernia species usually lack apothecia. In case of doubt, the most reliable way to separate the two genera is to examine the anatomy of the cortex, but in practice this requires wax embedding, as it is difficult to cut good thin sections from the flexible lobes.
Ten species, of which 4, or perhaps 5, occur in Europe. They are normally corticolous.

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. Evernia 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. Evernia prunastri

Evernia divaricata (L.) Ach. (1810)
in: Lichenogr. Universalis 441; Lichen divaricatus L. (1767) in: Syst. Nat. Ed. 12, 2: 713; Letharia divaricata (L.) Hue
Diffs 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 chemistry of the cortex (K- rather than K+). In the Peloponnese it probably also has a narrower ecological range than E. prunastri. Species of Ramalina that lack soralia are often fertile, whereas E. divaricata is rarely fertile.
Scattered on the mainland, at altitudes 400 - about 2300 m, though most records are from about 1000. Absent from
almost all of the islands, but recorded once in the 19th century for Ithaki. On acidic to neutral bark. Most reports are from Abies and Pinus, but also known from Fagus.

Fairly widely distributed in the cooler forests of Europe, from Scandinavia to the Iberian Peninsula. Also Macaronesia (only Azores), Asia (widespread), N. America (western mountains of Canada and USA). A very old report for Cape Province of South Africa may be unreliable.

**Evernia illyrica** (Zahlbr.) Du Rietz (1926)


Known from a few, scattered localities, none of them very far from the sea, at altitudes of 1100 - 1600 m. All records for which the substrate was clearly specified were from Abies cephalonica.

Apart from a disjunct report for Sweden, *E. illyrica* is a circum-Mediterranean species. Spain, Italy, Slovenia, and Greece. Also western Asia (Turkey), N. Africa (Morocco).

**Evernia prunastri** (L.) Ach. (1810)

in: Lichenogr. Universalis 442; *Lichen prunastri* L. (1753) in: Sp. Pl. 1147; *Borreria prunastri* (L.) Sibthorp; *Evernia prunastri* f. elongata (Gandog.) Szatala; *Evernia prunastri* f. gracilis (Ach.) Th. Fr.; *Evernia prunastri* y E. (= var.) gracilis Ach.; *Evernia prunastri* f. herinii (P. A. Duvign.) D. Hawksw.; *Evernia prunastri* f. munda H. Olivier; *Evernia prunastri* f. soredifera (Ach.) Harm.; *Evernia prunastri* var. vulgaris Körb., nom. inval.

At least 18 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 and 400 - 1000 µm thick, sparingly dichotomously branching, younger parts less wide, 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 is 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, but blue-grey in one specimen; 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 and occasionally spreading over much of the upper surface; soredia 20 - 40 µm diameter. Upper cortex: present, 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: present, 40 - 70 µm thick, colourless, without distinct structure. Chemistry: thallus K+ yellow, C-, KC-, P-, UV-; medulla C-, K-, KC-, P-, I-, UV+ blue-white; soralia C-, K-, KC-, P-. Photobiont: green, cells globose, 7 - 10 microns wide, with large central chloroplast. Photobiont layer: present below upper cortex, 25 - 80 µm thick, sometimes irregular 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 the upper and lower surfaces is not great and these specimens may be mistaken for a species of *Ramalina*, especially *R. farinacea*. Any colour contrast may be more evident if the material is examined in strong natural light. If this fails, note that the soralia in *E. prunastri* are usually flat to convex and they react K-, P-. In *R. farinacea* they are often slightly excrave and, in the chemotypes encountered to date in the Peloponnese, react K- or K++, but always P+.

Throughout Greece, at altitudes 0 to about 2000 m. Nearly always on bark and recorded from a very wide range of species, avoiding only strongly nutrient enriched bark. I have seen it once on wood, of *Juniperus oxycedrus*.

Subcosmopolitan in cool parts of the Northern Hemisphere, but absent from arctic and tropical regions. Present in most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread, mainly in cooler regions), C. America (Mexico). Reports for S. America (Argentina, Peru) may be in need of confirmation.

**Farnoldia Hertel (1983)**


Type: [need to investigate]. Family: *Lecideaceae*. Literature: There is no monograph, but Hertel (1967) discusses all the European species, under *Lecidea*. Clauzade & Roux (1985) also discuss them all, more briefly.
About 6 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. jurana**

1 Thallus superficial, areolate or verrucose-areolate. **F. micropsis**

**Farnoldia hypocrita** (A. Massal.) Fröberg (1989)

Several earlier names appear to refer to this lichen. *Lecidea lithyrga* Fr. (1846) and *Lecidea emergens* Flörke ex Flot. (1849) are not legitimate. *Lecidea hypocrira* A. Massal. (1855) in: Fram. Lich. 22; *Lecidea hypocrira* A. Massal. (1855) in: Fram. Lich. 22; *Lecidea ypocria* auct. Several earlier names appear to refer to this lichen. *Lecidea lithyrga* Fr. (1846) and *Lecidea emergens* Flörke ex Flot. (1849) are not legitimate. *Lecidea hypocrira* A. Massal. (1855) in: Fram. Lich. 22; *Lecidea ypocria* 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. Surprisingly, absent from British Is. Also Asia (Russia), N. America (Alaska, Alberta, Nunavut). These remarks refer to var. *hypocrira*. 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), N. America (scattered, from Alaska to northern USA). These remarks refer to subsp. *jurana*. Two other subspecies are also recognised, subsp. *bicincta* and subsp. *muverani*; 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 a northern and alpine species in Europe, though present in the high mountains of the south. Also Macaronesia, western Asia (Turkey, Tajikistan, Russia, Pakistan), N. America (scattered in montane regions in the west, from Yukon to Colorado). Nimis (1993) says that it is bipolar, but I have not seen any reports for the Southern Hemisphere; the only species of *Farnoldia* present in Antarctica is the closely related *F. dissipabilis*.

**Fellhanera Vězda** (1986)


A genus of about 90 species, best developed in humid tropical regions. There are few European species, and those few 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 & Séruš. (1991)

Description: Smith et al. (2009).

Macedonia, on bark of *Picea abies* at an altitude of about 1400 m.

Mostly NW and central Europe, but also present in Russian Caucasus. Also Asia (Urals and far eastern Russia, Chagos Is, Taiwan), N. America (BC).

**Flavoparmelia Hale (1986)**
in: *Mycotaxon* 25(2): 604

Type: *F. caperata* (L.) Hale. Family: Parmeliaceae. Literature: Many species now placed in *Flavoparmelia* are discussed in the monograph of *Pseudoparmelia*, Hale (1976c). That genus is no longer accepted and its species are now distributed among several other genera. There is no monograph of *Flavoparmelia* employing the contemporary concept of the genus. 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 simply, black rhizines. Pseudocyphellae: absent. Isidia: absent in European species. Soralia: present in all European species. Apothecia: not seen but said to be typical for *Parmeliaceae*. Conidiomata: not seen but said to be pycnidia.

Diffs from *Parmelia* in the colour of the upper surface. Diffs from other parmeliod genera with a green upper surface in the broad, rounded lobes.

About 34 species of which only 3 occur in Europe. Species of *Flavoparmelia* usually occur on bark, less commonly on siliceous rock, in areas with a temperate or warm-temperate climate.

The genus is rare in the Peloponnese, and it can hardly have been overlooked since thalli are large and conspicuous. It is very common in parts of southern Spain (personal observations), so may require more oceanic conditions than Greece offers.

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, 200 - 400 mm thick (measured in young lobe). Lobes: 7 - 11 mm wide, usually broadly rounded, margins sometimes slightly crenulate or incised, often wr inkled in central parts, weakly adpressed. 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 the top of the larger folds in the lobes; initially delimited, globose, 0.3 - 0.7 mm diam, but sometimes later becoming confluent; soredia granular, 40 mm diameter. Upper cortex: 15 - 20 mm thick, colourless, cellular; cells subrounded, 4 mm diameter; K-. Medulla: white, 100 - 110 mm thick, of loosely interwoven hyphae; hyphae much branched (but no obvious anastomoses seen), 3 mm wide, septa not apparent, rather sparsely covered in small (0.5 mm) colourless crystals. Lower cortex: 10 - 15 mm thick, brown, cellular (most apparent when viewed at right angles to surface); cells subangular, 5 mm 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, in a continuous layer 40 - 65 mm thick that is not sharply differentiated from upper cortex; cells globose, 8-12 mm diameter.

In Greece often sterile and sometimes without soralia, but easily recognised even then. The large rounded lobes and K- medulla are fairly 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 and uncommon on the mainland and immediately adjacent islands at altitudes 0 - 900 m, though most reports are from below 500 m. On bark. It has a preference for *Olea* (if this is not just a recording bias), but also occurs on *Pinus* and *Quercus*. The existence of several reports from *Pinus*, which is a rather hostile substrate for most lichens,
implies that F. caperata is not restricted in Greece by the availability of suitable substrates. It must be uncommon for climatic reasons.

Subcosmopolitan in temperate to warm regions that are not too dry. Widely distributed in Europe, but no further north than Scotland and southern Scandinavia. Also Macaronesia (widespread), Asia (widespread), Africa (widespread), N. America (widespread to as far north as southern Canada), C. America (Mexico, Guatemala), S. America (widespread), Pacific (widespread). Reports for Australasia (Australia) are incorrect.

Flavoparmelia soredians (Nyl.) Hale (1986)


Description: Smith et al. (2009).

There is a single, unlocalised report for Greece in James & Rose (1973e):479. No altitude or substrate was indicated.

Subcosmopolitan but more thermophilic than F. caperata. Quite widely distributed in Europe but distinctly more southern than F. caperata: e.g. in Britain is almost restricted to the south coast. Also Macaronesia, Asia (Turkey, Russia), Africa (widespread), S. America (Argentina, Chile, Venezuela), Australasia (widespread in temperate parts). Its status in N. America is disputed.

Fulgensia A. Massal. & De Not. ex A. Massal. (1855)

in: Alc. Gen. Lich. 10


The genus is an artificial and heterogeneous assemblage, incorporating those crustose species in the Teloschistaceae that have anthraquinones in the thallus and apothecia, but which have ascospores that are simple or septate (i.e. not conventionally polarilocular or clearly derived from a polarilocular state). The name is retained here merely for practical convenience. A detailed description would be inappropriate.

As presently delimited, Fulgensia contains about 15 species, 13 of which occur in Europe. They occur on rock or soil, or overgrowing bryophytes on rock or soil, in dry places, and the genus shows a clear preference for regions with a continental climate.

Because Fulgensia was defined on ascospore characters, the key was written assuming that collections are fertile. Only the more distinctive species, such as F. subbracteata, can be determined with confidence when sterile.

111 Thallus with distinct marginal lobes.

2 Centre of thallus with many small, ± globose isidia. Apothecia usually absent. Ascospores, if present, simple, ellipsoid, 9 - 12 x 4 - 5 μm. **F. subbracteata**

2 Centre of thallus without isidia.

33 Ascospores 0 (1) -septate. Not restricted to the uplands.

44 Ascospores with pointed ends, 17 - 24 x 7 - 8 μm. Overgrowing mosses on calcareous soil. **F. klementii**

4 Ascospores with rounded ends, to 20 μm long and to 6 μm wide. On rock, soil or bryophytes.

55 Ascospores 7 - 16 μm long, ellipsoid or ovoid, ± regular in shape, not strongly elongated. Usually on soil or overgrowing terricolous bryophytes; rarely on rock. **F. fulgens**

5 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. **F. fulgida**

3 Ascospores 1 (3) -septate. Restricted to the uplands.

44 Thallus egg-yellow, distinctly pruinose at centre. **F. pruinosa**

4 Thallus orange, not pruinose. **F. australis**

11 Thallus areolate or verrucose areolate.

22 Ascospores 0 (1) -septate.

33 Ascospores 12 - 16 x 3 - 5 μm, constricted at the waist. (F. poeltii)

3 Ascospores 9 - 13 x 4 - 7 μm, ellipsoid, not constricted at the waist. **F. bracteata**

2 Ascospores 1 (3) -septate. On soil.

33 Ascospores pyriform, with one end distinctly larger than the other. Very rare outside Macaronesia. (F. canariensis)
3 Ascospores ellipsoid, sometimes slightly constricted at septum. (F. 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. **F. schistidii**

(1) Ascospores in **F. fulgida** are very variable. For specimens that are not growing directly on limestone, it is advisable to examine many ascospores to exclude **F. fulgida** with certainty.

**Fulgensia australis** (Arnold) Poelt (1965)


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 any preferred orientation; K+ red, diffusing a red pigment into solution. Medulla: white; in section of very broad, rather densely packed hyphae. Apothecia: subsessile when young but soon becoming sessile, concave to flat, 0.5 - 1 mm diameter, not pruinose. Disc: dark orange. 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. Thalline margin: not apparent externally; in section: present on lower surface of apothecia. Epithecium: orange-brown; K+ purple-red, diffusing purple-red pigment into solution. Hymenium: 75 - 100 µm tall, colourless. Hypothecium: 150 - 175 µm tall, colourless. Paraphyses: 2 µm wide at base, broadening gradually to 3 µm at apex, simple, with distinct 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 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, this species might be confused with **C. flavescens** or one of the other placodioid *Caloplacas*, 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 from this lichen.

The core of the range of *F. australis* appears to be the Alps and adjacent regions, but also reported for the Iberian Peninsula (presumably the Pyrenees) and Ukraine. There is an old report for Bosnia, so it may also be fairly common in the Balkans, a region that is not well known lichenologically. Also N. Africa (Morocco). A report for Macaronesia (Canary Is) is doubtful.

**Fulgensia bracteata** (Hoffm.) Rääsänen (1931)


Scattered with no clear pattern on calcareous soil at altitudes 150 - 2100 m. The low altitude reports from Crete and Naxos were regarded with scepticism by Abbott (2009), but a reliable recent reported for Attica at an altitude of about 500 m (Hymettos) suggests that they may be correct. Possibly the Greek taxon differs in some way from the arctic-alpine one.

Widely distributed from the Alps to the high arctic. South of the Alps, only reported in modern times for Montenegro, Greece and Cyprus. (There is a very old, and perhaps unreliable, report for Portugal.) Also Asia (widespread), N. America (arctic areas, and mountainous regions of the interior), Australasia (scattered in Australia, NZS).

**Fulgensia fulgens** (Sw.) Elenkin (1907)

in: *Lichen fulgens* Sw. (1784) in: *Nova Acta Regiae Soc. Sci. Upsal.* 4: 246; *Caloplaca fulgens* (Sw.) Körb.; *Caloplaca fulgens* var. *campestris* (Th. Fr.) J. Steiner; *Fulgensia fulgens* var. *campestris* (Th. Fr.) Zahlbr.; *Lecanora fulgens* (Sw.) Ach.; *Placodium fulgens* (Sw.) DC.; *Psoroma fulgens* (Sw.) A. Massal.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).

Widely distributed but not very common. On calcareous soil or rock, or (less commonly) overgrowing bryophytes on calcareous substrates, at altitudes 0 - 2100 m. Care is required in interpreting published reports, as some of them may refer to **F. fulgida**.

Widely distributed in Europe 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
Fulgensia fulgida (Nyl.) Szatala (1938)
in: [need to investigate - bibliographical information incomplete]. (Szatala also validly published the combination in 1943, in Denkschr. Akad. Wiss., Math.-Nat. Kl. 105(1): 52; Placodium fulgidum Nyl. (1865) in: Flora 48: 212; (?) Caloplaca fulgens var. farinosa Sambo; Caloplaca fulgida(Nyl.) Zahlbr.; (?) Caloplaca subfulgens var. graeca Servit; (?) Fulgensia fulgens var. farinosa (Sambo) Szatala

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 the 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 the margins of the thallus they are oriented predominantly along the axis of the 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. Excircle: 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, so appearing cellular; lumina usually elongated but sometimes ±isodiametric. Thalline margin: often present in young apothecia, thin, usually soon excluded. Epithecium: orange to orange-brown, K+ red, pigment diffusing into solution and there forming minute crystals. Hymenium: 50 - 85 µm tall, colourless to very pale grey or very pale yellow, with abundant oil droplets at least in the 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 capitate or moniliform. Asci: Teloschistes type. Ascospores: colourless, simple, 8 per ascus, 12 - 18 x 4 - 6 µm, ends rounded, rather variable in shape (oblong with rounded ends, or slightly hourglass-shaped, or tadpole shaped, but never regularly ellipsoidal). Photobiont: green, cells globose, 10 - 15 µm diameter, forming a ±continuous layer 25 - 40 µm thick.

This species could be confused with F. fulgens; ascospores need to be examined carefully to separate the two species.

Probably throughout Greece, though less common in the northernmost parts of the country. Al altitudes 0 - 1600 m, on calcareous rock or, less commonly, calcareous soil; occasionally overgrowing bryophytes on calcareous substrates.

Widely distributed in southern Europe, ranging no further north than Provence, Croatia and Bulgaria. Also western Asia (widespread in warm regions as far east as Iran), N. Africa (Morocco, Tunisia).

Fulgensia klementii Kalb (1970)
in: Herzogia 1(4): 439


Mt. Olympus, on limestone at 1300 m altitude.

A rare species, only reported definitely for Andalucia in southern Spain, and Mt. Olympus in Greece.

Fulgensia pruinosa (Körb.) Poelt (1965)


Mt. Olympus, on soil above 1800 m altitude.

Most reports are from the Alps and nearby regions as far north as the Czech Republic and Slovakia, but present in the Iberian Peninsula (presumably the Pyrenees) and the Balkans (Serbia). Greece is at the SE limit of its range.

Fulgensia schistidii (Anzi) Poelt (1965)

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. Proper 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 (or perhaps anastomosed) hyphae. Thalline margin: sometimes thin and obscure, pale orange to orange-yellow; in section: with a distinctly cellular cortex. 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, rather variable in upper part, slightly moniliform to ±capitate, apex to 4 µm wide. Ascii: narrowly clavate, 52 - 62 x 14 -
18 μm, 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 the 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 Greenland. Also Macaronesia (Tenerife), Asia (Israel, Turkey, Armenia), N. Africa (Morocco, Tunisia).

Fulgensia subbracteata (Nyl.) Poelt (1961)

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.

The author's Peloponnesian collections lacked apothecia. For fuller descriptions see: Nash et al. (2004); Nimis & Martellos (2004).

The combination of abundant isidia and well-developed marginal lobes should be enough to separate this species from others in Fulgensia, even when sterile. The egg yellow, strongly pruinose thallus separates it clearly from Caloplaca.

Widely distributed in the southern half of Greece at altitudes 0 - 600 m, with a rather anomalous report from Chioa at 1280 m. Usually on calcareous soil, sometimes on calcareous rock.

Widely distributed in southern Europe, but ranging no further north than parts of France, Switzerland, Bulgaria and Ukraine. Also Macaronesia, Asia (widespread in warm, dry regions as far east as Afghanistan), N. Africa (Morocco, Tunisia, Egypt), N. America (Arizona, California, Nevada), C. America (Mexico), S. America (Argentina), Australasia (widespread in southern parts of Australia).

Fuscidea V. Wirth & Vězda (1972)

Type: F. aggregatilis (Grummann) V. Wirth & Vězda (= F. australa). Family: Fuscideaceae. 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. Most species occur on hard siliceous rock, but a few are corticolous. Greece is at the edge of the range for this genus and there is only a single Greek record.

11 Soralia present. (F. cyathoides), (F. praeruptarum)
1 Soralia absent. F. lygaea

Fuscidea lygaea (W. Mann) V. Wirth & Vězda (1972)

The basionym is not Lecidea lygaea Ach. in Syn. Meth. Lich. 34. 1814, as commonly cited, Acharius included within the scope of L. lygaea, via his b. (=f.) pelidna, the name Lecidea pelidna Ach. (1810), making L. lygaea illegitimate. However, L. lygaea Ach. is not automatically typified on L. pelidna (Article 7.5), so when Mann cited Lecidea lygaea (only) in synonymy he did not include the type of any other name within the scope of Biatora lygaea, and 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 at an altitude of 872 m.

Throughout northern and central Europe, but very rare south of the Alps. Perhaps also Asia (Siberia; an old report for Hong Kong is certainly incorrect).

Fuscopannaria P. M. Jørg. (1994)

Type: F. leucosticta (Tuck.) P. M. Jørg. Family: Pannariaceae. Literature: Jørgensen (1978) covers all the species that are included in the key below, under Pannaria. Another good starting point is the key to all European species in Jørgensen (2005b). Ahti et al. (2007), and Smith et al. (2009) are also useful.

Thallus: squamulose. Squamules: some shade of brown or grey, usually rather small, margin often crenulate.

Differs from Pannaria in the small-squamulose, rather than foliose, growth form, and in the absence of pannarin. Vahlia is similar in external appearance but has a different type of ascus.

As presently delimited, Fuscopannaria contains about 50 species, of which about 9 occur in Europe. Most show a clear preference for ± moist habitats. They may occur on a range of substrates, though Greek records are almost all from bark.

Identification to species within Fuscopannaria is often rather difficult, since some of the characters separating species are subtle and some of the species presently recognised are quite variable. (Some of these 'species' are probably complexes of several closely related species, but their taxonomy has yet to be worked out.) As a result, sterile or poorly developed specimens may be impossible to determine reliably.

11 Sordaria present.
22 Thallus 'swollen', olivaceous; soralia lead-grey, woolly. F. mediterranea
2 Thallus flat, brownish; soralia pale brown, not woolly. F. sampaiana
1 Sordaria absent. (If isidia present, see Vahlia.)

22 Squamules olivaceous or chestnut-brown with white felted margins. Thalline margin conspicuous. Usually on bark.
33 Thallus chestnut-brown. Exospore of ascospores with a broad point at each end. F. leucosticta
3 Thallus olivaceous. Exospores of ascospores with rounded ends. F. olivacea
2 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.
33 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
3 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 Vahlia.

Fuscopannaria ignobilis (Anzi) P. M. Jorg. (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. Proper exciple: not visible externally. Thalline margin: present but often discontinuous, becoming excluded. Epithecium: pale brown-orange. Hymenium: 110 µm tall, colourless in lower part, pale brown-orange in upper part, I+ blue-green. Hypothecium: 110 µm tall, colourless. Ascospores: colourless, simple, ellipsoid, 8 per ascus, ends pointed, 15 - 22 x 8 µm (including perispore, the thickness of which is rather variable), often ± uniseriate in ascus.
Scattered, on the mainland and Crete, but not reported for any of the smaller islands. On bark at altitudes 75 - 1200 (1600) m. Recorded from Abies cephalonica, Castanea sativa and Pinus nigra.
Atlantic and Mediterranean regions of Europe; absent from areas with an arctic or distinctly continental climate. Also western Asia (Turkey) and Africa (Morocco, Algeria, Tunisia, Kenya).

Fuscopannaria leucosticta (Tuck. ex E. Michener) P. M. Jorg. (1994)
Most Greek reports are probably unreliable, but there is a reliable recent record for Epiros in Spribille (2009). That report was from bark of Phillyrea latifolia at an altitude of 460 - 500 m.
A species of warm temperate to subtropical, humid regions that has never had more than a toehold in Europe. Apart
from the recent Greek report, the only confirmed records are for three areas in northern Italy and one in Slovenia. It has not been seen there since 1902, and may be extinct in Europe outside Greece. Also Macaronesia (Azores, probably Canary Is, but reports for Madeira are incorrect), Asia (widespread, but in western Asia only in Turkey), Malesia (PNG), Africa (reliably reported for Tanzania, reports for Morocco seem doubtful to me), N. America (widespread in eastern USA), Caribbean, C. America (reliably reported for Mexico), S. America (reliably reported for 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. Isidia: absent. Soralia: always present and usually abundant, dark grey (distinctly darker than thallus), usually not delimited, sometimes forming large convex clusters 0.1 - 0.7 mm diameter, initially marginal but later often spreading to cover the whole thallus; soredia 50 µm diameter. Upper cortex: 10 - 25 µm thick, colourless, not sharply differentiated from photobiont layer, cellular; cells subrounded, 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 it appears to avoid both strongly acidic and strongly basic bark.

Atlantic and Mediterranean parts of Europe. It reaches Scandinavia but is absent from arctic regions; also absent from central Europe. Also Macaronesia, Asia (Israel, Russia), N. Africa (Morocco, Tunisia), N. America (BC, scattered in western USA), perhaps S. America.

**Fuscopannaria olivacea** (P. M. Jorg.) 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. Exciple: present but not visible externally; in section it is about 25 µm wide, colourless except at the surface and there very pale yellow-brown, formed of broad radiating hyphae that appear cellular. Thalline margin: present, persistent but becoming thin, white felted. Epithecium: very pale yellow brown, K- (pigment not soluble in K). Hymenium: 110 µm thick, colourless, I+ blue slowly turning blue-green (in places). Hypothecium: of paraphyses. Paraphyses: 1.5 - 2 µm wide at base, 3 µm wide at apex, sometimes slightly capitate, septa clearly visible (at least in K). Asci: clavate, 60 - 70 x 22 µm, wall weakly KI+ blue, but an apical plug is strongly KI+ blue. Ascospores: colourless, ellipsoid, 13 - 17 x 8 - 12 µm, ends rounded, without ornamentation; 8 per ascus, often uniseriate. Chemistry: thallus C-, K-, KC-, P-. 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 trees from sea level to about 2000 m. Reported once from wood (of *Cupressus sempervirens*). This is the commonest species of the genus in Greece.

Mediterranean/Macaronesian. Southern Europe from Portugal to Cyprus. Also Macaronesia (Madeira), western Asia (Turkey, Syria), N. Africa (Morocco).

**Fuscopannaria sampaiana** (Tav.) P. M. Jørg. (1994)

The earliest name is *Pannaria craspidea* var. *isidiata* Harm. (1913), but it does not have priority at the rank of species.

Descriptions: Ahti et al. (2007); Burgaz et al. (2010); Jørgensen (1978) as *Pannaria ignobilis*; Smith et al. (2009).

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 state the 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; also absent from central Europe. Also N. Africa (Tunisia).

**Graphis Adans. (1763)**

in: Fam. Pl. 2: 11

Type: *G. scripta* (L.) Ach. Family: *Graphidaceae*. Literature: Most of the literature on this genus 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 over 300, mainly tropical, species. It appears to be heterogeneous, and is likely to be subdivided eventually. About six species occur in Europe, but only one is likely to occur in Greece.

**Graphis scripta** (L.) Ach. (1809)


Many (at least 37) infra-specific taxa have been described within this species, but probably none has any taxonomic value.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Rare and very scattered, on the mainland and Corfu. On bark at altitudes 0 - 1500 m. Recorded from: *Fagus sylvatica*, *Quercus* sp., and *Robinia pseudacacia*. This is a fairly conspicuous species, and the scarcity of records implies that it is genuinely uncommon in Greece.

Widespread in Europe outside distinctly arctic and distinctly Mediterranean environments. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread outside tropics), N. America (west coast, eastern half of USA, SE Canada, but absent from interior of continent), perhaps Caribbean (Bahamas, Bermuda, Guadeloupe), C. America (Mexico), S. America (probably fairly widespread, but range uncertain owing to confusion with other species), Pacific (apparently widespread). Reports for Australasia are incorrect.

**Gyalecta Ach. (1808)**


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 40 names at species rank are presently referred to *Gyalecta*, but several are poorly known and may not be good taxa. About 20 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 three of them have only been reported for Mt. Olympus and the other two are uncommon.

11 Apothecia deeply immersed, resembling perithecia. Hymenium, at least in lower part, with orange-yellow oil droplets. (*G. mediterranea*), (*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. Usually on bark. Not restricted to high altitudes. *G. ulmi*

4 Disc orange to brown, not pruinose. Usually terricolous. If present in Greece, probably restricted to high altitudes (above tree line). (*G. geoica*)

3 Ascospores 4 - 10 -septate. *G. leucaspis*

2 Ascospores muriform or submuriform, with at least some longitudinal septa.

33 Paraphyses not or scarcely broaden ing 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)
The earliest name appears to be Secoliga biformis Körb. (1860), in which case the correct name is Gyalecta biformis (Körb.) H. Olivier
Thallus: crustose, inconspicuous. Apothecia: 0.25 - 0.3 mm diameter, urceolate, immersed in substrate. Disc: brown.
The only Greek material that I have seen is very scanty, and a fuller description must await the collection of additional material. For published descriptions see: Egea et al (2004); Smith et al. (2009).
The distinctly urceolate apothecia without a thalline exciple, and the additional material. For published descriptions see: Egea et al (2004); Smith et al. (2009).

Gyalecta cupularis (Hedw.) Fr.
Photobiont: Trentepohlia.

Gyalecta 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. Perhaps also N. Africa (Morocco).

Gyalecta jenensis (Batsch) Zahlbr. (1924)
in: Cat. Lich. Univ. 2: 720; Peziza jenensis Batsch (1786) in: Elench. Fung. (continuatio prima) 219-221; Gyalecta cupularis (Hedw.) Fr.
Descriptions: Clauzade & Roux (1985); Egea et al (2004); Nash et al. (2004); Smith et al. (2009).
Mt Olympus, on calcareous rock at altitudes above 1000 m.
Throughout Europe, though south of the Alps restricted to the mountains. Also Macaronesia, Asia (Russia, northern India), N. America (scattered, mostly in temperate coastal regions of USA and southern Canada), 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 Is and the Nordic countries. I have not seen any reports for other continents.

Gyalecta truncigena (Ach.) Hepp (1853)
The earliest name at the rank of species may be Patellaria abstrusa Wallr. (1831), in which case the correct name for this species is Gyalecta abstrusa (Wallr.) A. Massal. The epithet truncigena only has priority from 1853.
Descriptions: Clauzade & Roux (1985); Egea et al (2004); Nash et al. (2004); Smith et al. (2009).
Very scattered, usually in localities not very far from the sea. Commoner on the islands than the mainland. On bark of Platanus and Quercus at altitudes 0 - 900 m.
Widely distributed in Europe to southern Scandinavia (and rarely further north). In most of southern Europe it is almost restricted to the mountains, and its presence at low altitude in several Greek islands is surprising. Also Macaronesia (only Gomera), Asia (Turkey, Syria, southern Siberia), N. America (scattered in USA), perhaps C.
Gyalecta ulmi (Sw.) Zahlbr. (1890)
in: Annal. k. k. naturhist. Hofm., Wien 5: 43; Lichen ulmi Sw. (1784) in: Nova Acta Regiae Soc. Sci. Upsal. 4: 247; Secoliga ulmi (Sw.) Szatala

earliest name is Lichen pallidus Hoffm. (1784), but is is a later homonym and not legitimate.

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.

Widely distributed, reaching the Arctic Circle in coastal Norway, but south of the Alps probably restricted to the uplands. Also Macaronesia (only Azores), Asia (Russia), N. Africa (Algeria), perhaps N. America.

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Haematomma A. Massal. (1852)


About 38 species, 5 of which occur in Europe. The genus is not common in Greece.

11 Thallus ±entirely leprous, 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.

22 Thallus pale yellow-green to yellow-grey, with usnic acid. H. ochroleucum var. ochroleucum

2 Thallus white to pale green-grey, with usnic acid. H. ochroleucum var. porphyrium

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 Apothecia immersed, at least when young. (H. fenzlianum)

2 Apothecia sub sessile to sessile. H. nemetzii

Haematomma nemetzii J. Steiner (1900)

Thallus: crustose, to 15 cm diameter, without vegetative propagules, not pruinose; central part pale brown-white, areolate, to 550 µm thick, outer part white, continuous to cracked, often with elongated radiating cracks (but no marginal lobes), 100 - 150 µm thick. Areoles: 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. Apothecia: sub sessile, 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. Exciple: not visible externally; in section: 25 - 50 µm wide, same colour as hymenium, of ±vertical hyphae. Thalline margin: present, persistent, 0.1 - 0.15 mm wide, with a rather soft granular texture; in section: 125 - 150 µm wide, upper part with few algal cells. 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 expanding to 1.5 µm at apex, not capitate or moniliform. Asci: 100 x 22 µm when mature, narrower when immature, clavate, KI+ blue in a broad arch at top. Ascospores: colourless, 3 - 7-septate (septa often more distinct in K), fusiform, 8 per ascus, 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. Pycnidia: common, appearing externally as bright red-orange dots 0.1 - 0.15 mm diameter, initially with a point-like ostiule, but soon developing 2 - 4 (most commonly 2) radial cracks, and ostiule 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 x 210 - 230 µm wide, orange-brown at surface, colourless elsewhere, without a 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-, I-; thallus K+ yellow, C-, KC (unchanged), 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 very distinctive, and can not be confused with any other Greek species. H. fenzlianum A. Massal., reported once for Europe (Minorca, as H. subpunicum), has slightly smaller apothecia and ascospores. 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.

Islands of the Aegean (including Crete), and nearby parts of the mainland. at altitudes 250 - 920 (1950) m. Most reports are from close to the sea, but it does also occur inland. Usually on siliceous rock but reported once from bark of Ficus carica. Greek reports of Ophioparma ventosa probably refer to this species.

Only SE Europe (Croatia, Bulgaria, Greece, European Turkey, Cyprus) and western Asia (Turkey).

**Haematomma ochroleucum** (Neck.) J. R. Laundon (1970) var. ochroleucum  

- **Description:** Clauzade & Roux (1985); Smith et al. (2009).
- Islands of the Aegean (including Crete), on limestone at altitudes 300 - 1100 m.
- Fairly widely distributed in western Europe, but much rarer eastwards. Also Macaronesia, western Asia (Turkey, Kazakhstan, Russia). Not present in N. America (though var. porphyrium is). H. ochroleucum has also been reported for S. America (Argentina), though it is not clear which variety is involved.

**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, all at low altitudes.
- Similar distribution in Europe to var. ochroleucum. Also Macaronesia, N. America (Colorado). The status of a report for S. Africa is not clear to me.

**Halecania M. Mayrhofer** (1987)  
in: Herzogia 7: 383-389

- **Type:** H. alpivaga (Th. Fr.) M. Mayrhofer. Family: Leprocaulaceae. Literature: van den Boom & Elix (2005) provide a key to all known species. Clauzade & Roux (1985) and Smith et al. (2009) give more details of the European species.
- About 17 species, 12 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)  
in: Lichenologist 33(2): 103-106

- **Description:** See the protologue.
- The only definite report is for Epiros, on siliceous rock at an altitude of 1580 m. The report of H. alpivaga for Attica, which might also belong here, was from siliceous rock at an altitude of 850 m.
- Only known for Portugal, Spain and Greece.

**Heppia Nägeli ex A. Massal.** (1854)  
in: Genecac. Lich. 7-8. (Cited in Hepp's Die Flechten Europas in 1853, but not validly published there.)

- **Type:** H. urceolata (Schaer.) Nägeli (= H. adglutinata). Family: Lichinaceae. Literature: Egea (1989) treats the European species, though often under synonyms. He also regards H. adglutinata and H. lutosas synonyms, which they are not. For a more modern treatment of some of these species, see: Jørgensen in Ahit et al. (2007); Nash et al. (2002).

- About 28 names at species rank are presently referred here, but many denote poorly known taxa that probably belong elsewhere. There are probably fewer than 10 good species. About 6 species occur in Europe. The genus is rarely encountered 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.

2 Upper surface of squamules reticulate and densely white pruinose. **H. solorinoides**
2 Upper surface not as above.

3 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.

4 Upper cortex poorly developed. Lower cortex distinct, formed by periclinally arranged hyphae. Hymenium I+ reddish. **H. adglutinata**
4 Upper cortex distinct, pseudoparenchymatous. Lower cortex absent, or limited to margins of squamules. Hymenium I+ blue (but reddish above tips of asci). (H. despreauxii)

**Heppia adglutinata** A. Massal. (1854)
in: Geneac. Lich. 8

*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.

**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) in: *Bull. Soc. Bot. Fr.* 83: 6

Nimis (2016) considered the name to be a synonym of *H. despreauxii*, but until I can find out more about *H. lobatoplicata* I prefer to reserve judgment.

Description: [none seen].

Crete, at altitudes 0 - 900 m. The substrate was not stated.

The Cretan records are the only ones that I have seen.

**Heppia solorinoides** (Nyl.) Nyl. (1858)

The earliest name is *Endocarpon reticulatum* Dufour (1831), but it is not legitimate, being a later homonym of *E. reticulatum* Steudel (1824). Dufour's epithet was not legitimated until 1871.


Crete and islands of the southern Aegean, on calcareous soil at altitudes 100 - 1000 m.

Southern Europe, from Portugal to Greece. Also Macaronesia (Canary Is), western Asia (widespread as far east as southern Siberia), and northern Africa (Morocco, Algeria, Tunisia, Socotra).

**Hertelidea Printzen & Kantvilas** (2004)
in: *Bibl. Lich.* 88: 541


The genus contains 5 species, but only one occurs in Europe.

**Hertelidea botryosa** (Fr.) Printzen & Kantvilas (2004)

Description: Nash et al. (2004); Smith et al. (2004).

Athos Peninsula, on wood at 800 m altitude. Not recorded for Greece since 1941.

Widely distributed, though not common, in central and northern Europe, but very rare south of the Alps. Also Asia (widespread in Russia), N. America (southern Canada, fairly widespread in USA).
Heterocephalacria Berthier (1980)


Type: *H. solida* Berthier, which is not lichenicolous. Family: *Carcinomycetaceae* (Tremellales, Basidiomycota).

Literature: Diederich (1996), as *Syzygospora*.

Four species, two of which are lichenicolous. There is only a single Greek report.

11 Basidia 10 - 18 µm long, with 1 - 2 basidiospores. On Parmeliaceae. Not yet reported for Europe. (*Syzygospora pamellicola*)

1 Basidia at least 24 µm long, with 2 - 4 basidiospores. On other hosts. Many European reports.

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 (Canary Is), Malesia (PNG), Africa (Ethiopia, Malawi, Rwanda), N. America (scattered), S. America (Colombia, Ecuador).

Heterodermia Trevis. (1869)


Type: *H. speciosa* (Wulf.) Trevis. Family: *Physciaceae*. 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 100 species, only 6 of which occur in Europe. Some are too oceanic to occur in Greece, and Greece is at the limit of the range of those species that have plausibly been reported from the country.

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 19th century, poorly localised, reports for Sterea Ellada. Both were from bark.

Basically oceanic in Europe, though occasional in areas with a more continental climate (southern Germany, Switzerland, Ukraine). Also Macaronesia, Asia (widespread in eastern Asia but no further west than India), Malesia (widespread), Africa (widespread), N. America (widespread on both coasts, but never far inland), Caribbean (Jamaica, PR; perhaps elsewhere), C. America (widespread), S. America (widespread), Australasia (Queensland, both islands of NZ), Pacific (Hawaii, Tahiti). Only subsp. *leucomelos* is present in Europe.

Heteroplacidium Breuss (1996)


Type: *H. imbricatum* (Nyl.) Breuss. Family: *Verrucariaceae*. Literature: The best starting point is probably Prieto et al. (2010).

Ascospores: colourless, simple, 8 per ascus, small to medium sized.

A recent segregate from *Catapyrenium* s. lat., distinguished from the remainder of that group by the cellular (paraplectenchymatous) structure of the medulla. The very well developed thallus distinguishes *Heteroplacidium* from most species of *Verrucaria*. There are 11 species, mostly saxicolous or terricolous, or parasitic on lichens on those substrates. Nine species occur in Europe. The genus is not very well represented in Greece.

11 Thallus ± squamulose.
22 Lower surface of squamules with rhizohyphae.

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. phaeocarpoideae)
2 Rhizohyphae poorly developed or absent. (H. endocarpoides)
1 Thallus crustose to squamulose-areolate.
22 Parasitic on *Aspicilia calcarea*, at least when young. Areoles to 1.5 mm wide. **H. fusculum**
2 Sometimes overgrowing other lichens, but not truly parasitic. Areoles to 4 mm wide; margin sometimes crenulate or lobed. **H. compactum**

**Heteroplacidium compactum** (A. Massal.) Gueidan & Cl. Roux (2008)
in: [need to investigate]; *Placidium compactum* A. Massal. (1856) in: Misc. Lichenol. 32; *Verrucaria compacta* (A. Massal.) Jatta
Treated as a synonym of *H. fusculum* by some authors, but I have not seen the evidence for the supposed synonymy and for the present I prefer to retain the name as distinct.
Descriptions: Clauzade & Roux (1985); Nash et al. (2007) - both as *Verrucaria compacta*; Prieto et al. (2010).
All modern reports are from the islands of the southern Aegean, at altitudes 0 - 200 m, but there is a 19th century report for the mountains of the northern Peloponnesse. On calcareous or siliceous rock.
Southern and central Europe, to as far north as Belgium. Also Asia (Israel, Iran, Mongolia), N. Africa (Algeria), N. America (scattered in USA), C. America (Mexico), Australasia (S. Australia, NZS).

**Heteroplacidium fusculum** (Nyl.) Gueidan & Cl. Roux (2007)
The name *Endocarpon areolatum* Nyl., which may be synonymous, was also published in 1853, in *Ann. Sci. Nat. Bot. sér. III, 20: 316*. I do not know which name has priority.
Thallus: crustose-areolate to almost subsquamulose, dark brown, not pruinose, usually forming small patches to 1 cm diameter on the host, but 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. Asci: 43 x 15 µm. Ascospores: colourless, simple, subglobose to broadly ellipsoid, 8 per ascus, 9 - 11 x 6 - 9 µm.
Fairly easily recognised by the dark brown areoles parasitic on *Aspicilia calcarea*.
Scattered in the southern half of Greece at altitudes 150 - 1300 m. Parasitic on *Aspicilia 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 Belgium. Also Asia (Turkey, Syria, Iran, southern Siberia), N. Africa (Morocco, Algeria).

**Heteroplacidium imbricatum** (Nyl.) Breuss (1996)
My only collection is rather scanty, so the description is not comprehensive.
Thallus: squamulose, 2 cm diameter (in only collection seen), brown, not pruinose, without vegetative propagules. Squamules: ±rounded, not adpressed (but not ascending either), overlapping, concave to convex, 2 - 2.5 mm diameter,
150 - 250 µm thick. Cortex: 50 - 60 µm thick, cellular throughout (except when an epinecral layer is present); cells subrounded to angular, 5 - 12 µm diameter. Medulla: white. Perithecia: laminal, appearing as black dots 0.12 mm diameter; in section: 380 µm tall x 300 µm wide, colourless throughout. Involucrellum: absent. Asci: clavate. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 15 - 17 x 8 µm, not uniseriate. Photobiont: green.

Diffs from the other Greek species of the genus in having a distinctly squamulose thallus. Known from a single site in the western Peloponnese, where it occurred on limestone at an altitude of 250 m. Southern Europe, from Portugal to Greece. Also Macaronesia (Canary Is), Asia (Turkey, Tibet, NW China), N. Africa (Algeria).

**Hydropunctaria** Keller, Gueidan & Thü (2009)

in: Gueidan et al., in *Taxon* 58(1): 193-194

Type: *H. maura* (Wahlenb. ex Ach.) Keller, Gueidan & Thü. Family: Verrucariaceae. Literature: For a discussion of the genus, see the protologue. Orange (2012) is also helpful. It is a segregate of *Verrucaria*, and its species are discussed under that genus in most standard Floras.

At present, 8 species have been transferred to this genus, but others may belong here. All occur in Europe. The poorly known *H. ligurica*, reported from Italy and Corsica, is not included in the key. It may be synonymus 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-calcareus rock.
33 Dark tissue in thalllus 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)

in: *Lichenologist* 44(3): 305 (A combination by Keller & Gueidan in *Taxon* 58: 194. 2009 was not validly published - basionym not cited); *Dermatocarpon adriaticum* Zahlbr. (1904) in: Annales Mycologici 2: 267

Description: Clauzade & Roux (1985) as *Verrucaria adriatica*; Orange (2012).
Cret and Corfu, on calcareous rock at sea level.

Only southern Europe: Portugal, Italy, Greece, Ukraine.

**Hymenelia** Kremp. (1852)

in: *Flora* 35: 24


As I have only seen a single species of this genus, see the description of *H. melanocarpa* below.

About 17 species, about 13 of which occur in Europe. Most are restricted to cold regions. All are saxicolous, and most show a clear preference for moist, or distinctly wet, rock. The genus is uncommon in Greece, where only 3 species have been reliably reported.

11 Photobiont Trentepohlia.
22 Apothecia pale pink or pale brown. Hymenium colourless. *H. epulotica*
2 Apothecia blackish. Hymenium blue-green in upper part. *H. melanocarpa*
1 Photobiont chlorococcoid.
22 Epithecium blue, N+ purple. Ascospores 6 - 15 µm long. (H. coerulea) Greek reports probably incorrect.
2 Epithecium yellowish, N-. Ascospores 14 - 25 µm long.
3 Ascospores 15 - 18 µm wide. Apothecia sessile when mature. Thalline margin becoming excluded. Thallus
superficial.  

Hymenelia epulotica  (Ach.) 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 (scattered from Alaska to northern USA).

Hymenelia melanocarpa  (Kremp.) Arnold  (1869)
in:  Flora 52: 255;  Hymenelia prevostii β (= f.) melanocarpa Kremp. (1852) in:  Flora 35: 25;  Ionaspis melanocarpa (Kremp.) Arnold

My only collection is rather scanty.  A fuller description must await the collection of additional material.

Thallus: crustose, white, almost entirely endolithic, forming a small patch (in the only collection seen) 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.  Epitheicum: pale green-blue, K- (some pigment dissolves), N+ red.  Hymenium: 85 - 125 µm tall, colourless in lower part, upper part with some green-blue pigment.  Hypothecium: colourless.  Asci: 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. Athos.  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)

Descriptions:  Clauzade & Roux (1985);  Smith et al.  (2009).

Reliably reported for Chios, where it occurred on limestone at an altitude of 375 m.  There are also reports for western Greece, but their status is uncertain.

Throughout Europe.  Also western Asia (widespread, but no further east than Oman), N Africa (Algeria).

Hymenelia similis  (A. Massal.) M. Choisy  (1951)
in:  need to investigate - there is inconsistent info about volume numbers & years for Bull mens soc linn Lyon 18:145;  Pinacisca similis A. Massal. (1854) in: Neagen. Lich. 5;  Aspicilia similis (A. Massal.) Anzi

Description:  Clauzade & Roux (1985).

Chios and Mt. Olympus, on calcareous rock at altitude 880 - 1000 m.

Southern and central Europe: not present in British Is, Baltic States or the Nordic Countries.  I have not seen any reports for other continents.

Hyperphyscia Müll. Arg.  (1894)

Type:  H. adglutinata (Flörke) H. Mayrhofer & Poelt.  Family:  Physciaceae.  Literature: The only European species is treated in Smith et al. (2009).

About 20 species, only one of which occurs in Europe.

Hyperphyscia adglutinata (Flörke) H. Mayrhofer & Poelt  (1979)

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, delimited 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 preferences.

Cosmopolitan outside cold regions. Throughout Europe except for the far north. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread in USA), Caribbean (DR, PR, St Croix; perhaps Bahamas), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, New Caledonia).

**Hypocenomyce M. Choisy (1951)**

in: [need to investigate - there is inconsistent info about volume numbers & years for bull mens soc linn lyon]

Type: *H. scalaris* (Ach.) M. Choisy. Family: Ophioparmaceae. 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, and often extending onto lower surface. Upper cortex: 20 µm thick, brown in upper half, colourless in lower half, structure rather indistinct; K-, but pigment dissolves 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. Exciep: black, sometimes slightly white pruinose, persistent; in section: 50 µm wide, dark brown, of radiating hyphae. Thalline margin: absent. Epithecium: blue-black to green-blue, K-, pigment not dissolving in K. Hymenium: 55 µm tall, colourless throughout or with epithelial pigment in upper part. Hypothecium: brown to dark grey. Paraphyses: 1.5 - 2 µm wide, not capitate or moniliform, without visible septa, usually simple. Chemistry: soralia and upper surface of thallus C+ red. Photobiont: green, of globose or subglobe cells 10 - 13 µm diameter, forming a continuous, regular layer 50 - 60 µm thick.

My only Greek collection lacked asci and ascospores.

The pale brown, sorediate squamules reacting C+ red can not be confused with any other species.

Scattered in mainland Greece. Also known from Corfu, but not from Crete or any of the Aegean Islands. On wood or acidic back (especially of Pinus), at altitudes (100) 800 - 1250 m. The lichenicolous fungus *Clypeococcum hypocenomycis* has been reported once on this host.

Throughout Europe except for the high arctic, though nowhere very common. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread, mainly in forested areas), C. America (CR, Mexico), Australasia (widespread in cool to temperate forested areas).

**Hypogymnia (Nyl.) Nyl. (1896)**

in: *Lich. Env. Paris* 39. [Need to investigate this some more. The genus is introduced indirectly, by means of the two new combinations *H. physodes* and *H. pertusa*, with a rather cryptic reference to two earlier publications, cited only as “L. P.” and “Syn.”. The former may refer to Nylander's Lichenes Pyrenaecorum Orientalium of 1891. The latter presumably refers to *Synopsis Methodica Lichenum*, which pre-dates the name *Parmelia* subgenus *Hypogymnia*. Nylander provided no description of the genus *Hypogymnia*, so for valid publication it will be necessary to trace a description via Nylander's cryptic references.]. *Parmelia* subgenus *Hypogymnia* Nyl. (1881) in: *Flora* 64: 537

Type: *H. physodes* (L.) Nyl. Family: Parmeliaceae. However, *Hypogymnia* is not close to the core of the family, and some authors have placed it, along with genera such as Menegazzia, in a separate family Hypogymniaceae. Literature: There is no monograph of the European species, but all but one of the species that might occur in Greece are treated in Clauzade & Roux (1985). There are better descriptions of some of them in Brodo et al. (2001), Nash et al. (2002), Smith et al. (2009), Swinscow & Krog (1988), and Thell & Moberg (2011). For *H. laminisonediata*, see Hawksworth (1973). Zeybek et al. (1993) treat the Turkish species, and is helpful for the chemistry of the Greek species.


Hypogymnia laminisorediata

Differs from Parmelia in having hollow and ± swollen lobes, and in lacking rhizines. Over 90 species worldwide, with a centre of distribution is North America and eastern Asia. Rather poorly represented in Europe, where at most 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 three of them are doubtful or in need of confirmation.

Hypogymnia farinacea

Differs from Parmelia in having hollow and ± swollen lobes, and in lacking rhizines. Over 90 species worldwide, with a centre of distribution is North America and eastern Asia. Rather poorly represented in Europe, where at most 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 three of them are doubtful or in need of confirmation.

(1) Juvenile or poorly developed specimens of H. laminisorediata may be impossible to separate from H. farinacea.

Hypogymnia farinacea

in: Die Flechtenstoffe 419: Hypogymnia bitteriana (Zahlbr.) Räusänen: 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 species. Unfortunately, H. laminisorediata was not included in the keys in Clauzade & Roux (1985), and H. laminisorediata keys out there as H. farinacea.

Present in most cool regions of Europe, but absent from truly arctic habitats; in southern Europe generally confined to the mountains. Also Asia (widespread), perhaps N. Africa (Morocco), N. America (scattered in USA), perhaps C. America. A disjunct report for S. America (Chile) is unexpected and perhaps in need of confirmation.

Hypogymnia laminisorediata

in: Hawksworth in: Lichenologist 5(5): 452-454

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 smooth. Rhizines: absent. Soralia: usually present in central part of thallus but often not well developed, laminar. 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, laminar, 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. Exciple: not visible externally, and poorly developed in section. Thalline margin: present, thin but persistent; in section 110 - 130 µm thick. Epithecium: pale orange brown, K- (but colour becomes paler in K). Hymenium: colourless, 45 µm thick. Hypothecium: colourless, about 100 µm thick in total but formed of two distinct layers; upper layer 25 µm thick and 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, 8 per ascus, with a distinct wall that is a lattier under 1 µm thick.
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 x 100 - 130 µm (height x width); wall dark brown everywhere, thin (and so easily appearing pale brown or even colourless if not properly in focus), about 5 µm wide. Conidia: colourless, bifusiform, 5 x 0.5 µm. Chemistry: cortex K+ yellow, C-, KC- (but medulla reaction may show through), 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 the Mediterranean and Macaronesian mountains, but I refrain from making the new combination until I have studied more material.

Montane forests of Peloponnese and Attica, at altitudes 980 - 1230 m, on bark (usually of conifers, but recorded once on Quercus coccifera) or on wood of Juniperus oxycedrus. One of the author's collections was parasitised by an undetermined species of Nesolechia s. lat.

In Europe, only southern Italy 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. The complete absence of H. physodes from the Peloponnese is puzzling, especially as H. tubulosa is sometimes very common in the montane forests. H. physodes is common throughout much of Italy, according to Nimis (1993).

Present in most of Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Kenya, Rwanda, S. Africa), N. America (widespread, but absent from southern and central USA), perhaps C. America (CR), perhaps S. America (Argentina). Reports for Australasia are probably incorrect.

Hypogymnia tubulosa (Schae.) Hav. (1918)

Thallus: foliose, to 7 cm diameter. Lobes: 1 - 3 mm wide, hollow, flat to convex, usually smooth but 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. Rhizines: absent. 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 a weakly cellular structure of rather rounded cells; K-, but brown pigment dissolves. Medulla: white, of very loosely interwoven hyphae that are 5 - 7 µm broad and encrusted with small crystals less than 1 µm diameter. Lower cortex: pale brown, weakly cellular. Apothecia: very rare (only seen in one collection, which had just a few), on short stalks 1 - 2 mm tall, concave to flat, 3 - 5.5 mm diameter. Disc: dark brown, slightly shiny, not pruinose. Exciple: not visible externally. Thalline margin: present, persistent slightly crenulate. 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, trebouxiod; 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. What may be laminal pycnidia were seen in several specimens, but they all lacked conidia and it was not possible to confirm that they were the pycnidia of the lichen, rather than belonging to a lichenicolous coelomycete. Those near the lobe tips appeared to be immature. Those distant from the lobe tips were sometimes associated with black spots that my have been necrotic, and (if not belonging to a parasite) appeared to be over-mature.

This species could only be confused with H. physodes, but the two species differ clearly in the morphology of the soralia.

Almost throughout Greece, though absent from Crete. Usually on bark, especially of conifers, only occasionally on wood. At all altitudes above 150 m where there are suitable substrates, but commonest in montane forests at 1000 - 1500 m. One of the author's collections was parasitised by an undetermined species of Nesolechia s. lat.

In most of Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Kenya), N. America (southern Canada, cooler parts of USA), C. America (Mexico). Apparently absent from the Southern Hemisphere.
Immersaria Rambold & Pietschm. (1989)


Type: *I. athroocarpa* (Ach.) Rambold & Pietschm.  Family: Lecideaceae. Literature: Calatayud & Rambold (1998) give a fairly good overview of the genus, though their paper is not a monograph and does not include descriptions of all species.

Nine species, 5 of which occur in Europe. Two of the European species (*I. mehadiana* and *I. olivacea*) are recently described and have a very restricted distributions as far as present information goes, but this may just reflect undercollecting.

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. 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-. Hypothecium brown in lower part. Ascospores 14 - 17 (19) x 8 - 11 µm.  *I. athroocarpa*
3 Thallus olive-brown, C+ pink. Hypothecium 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, in: Bibl. Lich. 34: 240; *Lichen athroocarpus* Ach. (1799) in: Lichenogr. Svec. Prodr. 77.  (Acharius used the spelling athrocarpus, but in later works he adopted athroocarpus, so athrocarpus can be regarded as a correctable orthographic error.)

Unfortunately, *Lichen athroocarpus* Ach. is a superfluous name for *Verrucaria fasciculata* Hoffm. (1796). 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. Widely distributed in Europe. Also Asia (widespread), Malesia (Sabah), Africa (N. Africa, S. Africa), N. America (Arizona), Australasia (widespread in temperate parts), Antarctica (Macquarie Is, Antarctic Peninsula).

Immersaria cupreoatra (Nyl.) Calatayud & Rambold (1998)

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. Scattered in northern Europe and the Alps, with a very few records for the mountains of southern Europe. Also Asia (widespread).

Ingvariella Guderley & Lumbsch (1997)
in: *Nova Hedwigia* 64: 152

Type: *I. bispora* (Bagl.) Guderley & Lumbsch.  Family: Stictidaceae. Literature: Nash et al. (2004) is the most convenient starting point.

The genus contains a single species.

Ingvariella bispora (Bagl.) Guderley & Lumbsch (1997)

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*.

Quite widely distributed, but not common, in southern Europe and the Alps. Also Macaronesia, Asia (Nepal, Japan), Africa (S. Africa), N. America (California), S. America (Argentina, Uruguay, perhaps also Brazil, Chile), Australasia (warm temperate Australia, NZS).

**Intralichen D. Hawksw. & M. S. Cole (2002)**

In: *Fungal Diversity* 11: 88­89


Four species of lichenicolous hyphomycetes, all of which are reported for Greece.

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. lichenum**

**Intralichen baccisporus D. Hawksw. & M. S. Cole (2002)**

In: *Fungal Diversity* 11: 89-90

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. The Greek report is disjunct. 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 (BC, Arizona, Nebraska), C. America (Mexico). This appears to be a common species, but according to Nash et al. (2004) it may be heterogeneous.

**Intralichen lichenicola (M. S. Christ. & D. Hawksw.) D. Hawksw. & M. S. Cole (2002)**


Crete, at 1970 m, on *Candelariella* sp.

Widely distributed in central and northern Europe; the Cretan report is the only one that I have seen for well south of the Alps and Pyrenees. Also Asia (Russia), S. America (southern Chile).

**Intralichen lichenenum (Diederich) D. Hawksw. & M. S. Cole (2002)**


Description: See the protologue.

Crete, at 1500 m, on *Candelariella unilocularis*.

Widely distributed in central and northern Europe, but the Cretan report is the only one that I have seen for well south of the Alps and Pyrenees. Also Malesia (PNG), N. America (Minnesota).
Ionaspis Th. Fr. (1871)

in: Lich Scand 1: 273. The name is validly published there, though it is a nomen subnudum since the only descriptive phrase is "gonidia concatenata". Fries there listed 8 names previously published in Aspicilia that he considered belong in Ionaspis, but did not, in my view, validly publish the combinations into Ionaspis, though admittedly the matter is not clear-cut.

Type: *I. chrysophana* (Körb.) Stein (= *I. suaveolens*). Family: Hymeneliaceae. Literature: There is no convenient monograph. The best starting point is probably Smith et al. (2009).

A rather poorly known genus, with about 17 species, though the status of some of these is uncertain. Most occur on siliceous rock.

11 On periodically submerged siliceous rock.  I. lacustris

1 Not aquatic.  I. ceracea

Ionaspis ceracea (Arnold) Hafellner & Türk (2001)

in: *Stapfia* 76: 153; *Aspicilia ceracea* Arnold (1859) in: *Flora* 42: 149

Arnold cited in synonymy "Gyalecta Acharii Zw. exs.". This would make his name superfluous if he believed that the specimen cited actually belonged to Acharius's taxon. As there is room for doubt, I prefer not to regard it as a superfluous name.

Description: Clauzade & Roux (1985) as *Hymenelia ceracea*.

Known from a single site in Macedonia, where it occurred on sandstone at an altitude of 1740 m.

Scattered in northern and central Europe, but very rare south of the Alps. Also Asia (Siberia), N. Africa (Morocco), perhaps N. America.

Ionaspis heteromorpha var. regelii Räsänen (1944)

in: *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, but very rare south of the Alps and Pyrenees. Also Macaronesia (Madeira), Asia (widespread), N America (widespread), S America (Brazil), Australasia (widespread).

Jamesiella Lücking, Sérus. & Vězda (2005)

in: *Lichenologist* 37(2): 165


This small genus was recently 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 record.


Descriptions: Clauzade & Roux (1985); Nash et al. (2004) bot as *Gyalideopsis anastomosans*; Smith et al. (2009). Naxos, on bark at an altitude of about 550 m.

Northern Europe, and central Europe as far east as Ukraine; rare south of the Alps. Also Macaronesia, western N. America (BC, California, Washington State, perhaps elsewhere), Australasia (both islands of NZ).
Julella Fabre (1879)

in: [need to investigate - need title of Fabre's publication]

About 12 species of corticolous ascomycetes, 7 of which occur in Europe. Though not lichenised, they are often encountered by lichenologists and are sometimes studied by them.

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)
in: Sydowia 38: 13; *Pleospora vitrispora* Cooke & Harkn. (1881) in: [need to investigate]; *Polyblastia sublactea* (Nyl.) Arnold; *Verrucaria sublactea* Nyl.

Description: Nash et al. (2002).
Corfu, on bark of *Olea europaea* at close to sea level.
Southern Europe, from Portugal to Greece. Also eastern Asia (Hong Kong), Malesia (PNG), N. America (California, Florida, Louisiana), Caribbean (PR), C. America (Mexico), S. America (Guyana), Pacific (Hawaii).

Karschia Körb. (1865)
in: Parerga Lichenol. 459-460
Type: *K. talcophila* (Ach.) Körb. Family: *Asterinaceae*. 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 records.

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. latypiza*)
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)
in: Parerga Lichenol. 460; *Lecidea talcophila* Ach. (1810) in: 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.
Widely distributed in Europe. Also Asia (China), N. Africa (Morocco), N. America (Arizona), C. America
(Mexico), S. America (Colombia), Australasia (Australia).

Koerberia A. Massal. (1854)
in: Geneac. Lich. 5-6

The genus contains two species, both of which occur in Europe. Only one has been reported for Greece.

11 Isidia present. Ascospores spirally twisted within ascus. On bark. K. biformis
1 Isidia absent. Ascospores not spirally twisted within ascus. On rock. (K. sonomensis)

Koerberia biformis A. Massal. (1854)
in: Geneac. Lich. 6; 'Koerbera' biformis auct.

Very scattered in the western half of Greece, on bark at altitudes 200 - 1000 m. Recorded from: Platanus orientalis, Prunus sp. and Quercus pubescens.

Scattered in southern Europe; not present north of the Alps. Also Asia (Turkey, southern Siberia), N. Africa (Morocco), western N. America (Arizona, California, Washington).

Labrocarpon Etayo & Pérez-Ortega (2010)
in: Lichenologist 42(3): 271-272

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 (reported as P. pertusa, but Pertusaria in Greece is in need of revision). The type collection, from Tenerife, was on an unidentified sterile crust growing on lava, but this species has also been recorded from corticolous Pertusaria in Turkey by Hafellner & John (2006).

Scattered in southern Europe, from Portugal to Greece. Also Macaronesia, western Asia (Turkey), S. America (Brazil), perhaps Australasia (Australia).

Lasallia Mérat (1821)
in: Nouv. Fl. Env. Paris 202

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 in the north, but with a single disjunct report for Crete. On siliceous rock at altitudes 500 -1800 m. This
is a conspicuous and distinctive species, so the scarcity of records implies that it is genuinely rare in Greece.

Throughout Europe except the far north, though in the south commonest in the uplands. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Tanzania, S. Africa). Reports for N. and C. America may be incorrect.

**Lecanactis Körb. (1855)**

Greek reports to date are doubtful, but the genus might be present in northern Greece, so a key is provided.

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

1 Thallus UV+ ice blue. Apothecia always absent. On rock. (L. latebrarum)

**Lecania A. Massal. (1853)**


Thallus: crustose, usually rather small and often poorly developed. Vegetative propagules: said to be present in a few species (not seen by me). 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. Exciele: often not visible externally; in section: of radiating hyphae, sometimes with visible lumina, brown at surface, colourless elsewhere. Thalline margin: present in most species, but usually rather thin. 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 capitulate, 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, 8 per ascus in most species, fairly small (10 - 20 µm long). Photobiont: green, trebouxioid.

*Bacidia* species 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 types of ascus. *Catillaria* species have an entirely different type of ascus, always lack a thalline exciple, and have a black disc.

About 100 species, in cold to warm-temperate regions, mainly in the Northern Hemisphere but present in the Southern Hemisphere. Species usually occur on bark or rock, less commonly on bryophytes, but are never terricolous. The genus is not especially well known, and new species continue to be described. There may be about 50 species in Europe. *Lecania* is difficult to study in Greece as most species are inconspicuous and not often collected. Several of the species treated below are known to me only from scanty and inadequate collections.

*L. heterocarpa* Zahlbr. is not included in the key, as I have insufficient information.

**Key to Lecania main groups**

111 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.

33 Cortex of thalline margin well developed, cellular. Asci with 8 spores. Most ascospores distinctly curved, often constricted at septa. Paraphyses weakly conglutinated, apices to 9 µm wide. (L. ephedrae)

3 Cortex of thalline margin not developed. Asci with 8 - 12 (16) spores. Most ascospores straight, usually not constricted at septa. Paraphyses strongly conglutinated, apices to 4 µm wide. **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)
   33 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. polycycla**
      4 Paraphyses coherent. Ascospores generally longer. Paraphyses capitate or not, apex pigmented or not.
      55 Apothecia convex and ±immarginate almost from the beginning; few algal cells present in section.
   66 On calcareous rock.
      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 immersed or superficial. **L. sylvestris** s. lat.
      88 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. umbratica**
   6 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 a distinct thalline margin, at least when young; many algal cells present in section.
   66 Asci 8-spored.
      77 Thallus pale; white, whiteish, white-grey or pale brown.
      88 Disc white pruinose, red-brown to black below pruina. **L. turicensis**
      8 Disc not pruinose, red-brown to dark brown.
      99 Thalline margin ±persistent. On calcareous or siliceous rock. **L. olivacella**. Note 2.
      9 Thalline margin soon excluded. On neutral or siliceous rock. (L. atrynoides)
7 Thallus dark; dark brown, grey-brown or black.

88 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**

8 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**

6 Asci 12 - 16 -spored. (L. belgica)

(1) **L. heterocarpa** is a poorly known species. I can not 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). This is a rather poorly known species. The limited information that I have seen suggests that it might be a synonym of **L. olivacella**.

No clear pattern, though the two reports to date are both from the southern half of Greece. On limestone at altitudes 100 - 275 m.

France (Paris), the Iberian Peninsula, and 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) in: *Lotos* 6: 77 and Sched. Crit. Fasc. 5-6: 122. (It is unclear which was published first.)

Descriptions: Nash et al. (2004); Smith et al. (2009).

Chios, on limestone at an altitude of 5 m.

Throughout Europe. Also Macaronesia (Azores), Asia (Israel, Siberia, India), northern Africa (Morocco, Mauretania), N Africa (a few states of the US), C America (Mexico).

**Lecania cyrtella (Ach.) Th. Fr. (1871)**
in: Lichogr. Scand. 294; *Lecidea cyrtella* Ach. (1803) in: 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. 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. Thalline margin: sometimes obscurely present. 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 epithecial 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 capitate. Asci: 37 - 40 x 12 - 14 µm, clavate. Ascospores: colourless, (0) 1 (3) -septate, ± ellipsoid but sometimes slightly curved, 8 per ascus, 10 - 12.5 x 3 - 4 µm. 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. cyrtella** 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**.

Widely distributed in Greece, but there are not many reports. Perhaps more common than records suggest, as it is inconspicuous and easily overlooked. On basic, or at least not strongly acidic, bark at altitudes 100 - 1300 m. Recorded from a wide range of phorophytes, with a mild preference for Quercus (36% of reports).

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N America (southern Canada, cooler parts of USA), perhaps S. America (Argentina), Australasia (S. and E. Australia, both islands of NZ).

**Lecania cyrtellina** (Nyl.) ? ined.
The combination is usually attributed to Sandstede, in *Abh. naturwiss. Verein Bremen* 21: 194. 1912, but Sandstede’s name was *Lecania cyrtella* *L.* (= subsp.) *cyrtellina*. I have not yet found any valid publication of the name *Lecania cyrtellina*; *Lecanora cyrtellina* Nyl. (1873) in: *Flora* 56: 18; *Lecidea albohyalina* auct. graec.

My only collection is rather scanty, so the description is incomplete. A better description must await the collection of additional material.

Thallus: crustose, green-grey, not pruinose, continuous, slightly granular in central part, forming a small patch 1 cm
diameter (in the only collection seen to date), without hairs or vegetative propagules. Apothecia: 0.15 - 0.25 mm diameter, flat when young, becoming moderately convex later, not pruinose. Disc: dark brown. Exciple: sometimes visible externally, pale brown, very thin; in section: rather poorly developed, outer part with brown pigment, K+ purple-brown. Thalline margin: sometimes present (algae sometimes present in section), pale brown, much paler than disc, becoming excluded. Epithecium: not well differentiated from hymenium, pale brown to red-brown. Hymenium: 40 µm tall, colourless in lower part, upper part generally with epithecial pigment. Hypothecium: ± colourless.

Paraphyses: simple, 1 µm wide at base, 2.5 µm at apex, apical cell not pigmented. Asci: 33 x 11 µm, clavate.

Ascospores: colourless, 0 - 1-septate, ellipsoid, straight, 8 per ascus, 10.5 - 12 (15) x 3 µm. Photobiont: green.

For separation from *L. cyrtella*, see under that species

Rare and scattered, with no clear pattern. (Perhaps under-recorded owing to confusion with *L. cyrtella*.) On basic bark at altitudes 100 - 1400 m. Reported from *Cupressus sempervirens*, *Platanus orientalis*, and *Rhamnus* sp.

Widely distributed in Europe to as far north as southern Scandinavia; in the south it is widespread but uncommon and may be restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia), N. America (at least Colorado)

**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 explicitly reported was *Fagus*.

Widely distributed in central and northern Europe to as far north as mid Scandinavia, but very rare south of the Alps. Also Asia (Iran, Russia, Kazakhstan), perhaps N. Africa (Morocco), N. America (southern Canada, northern USA).

**Lecania erysibe** (Ach.) Mudd (1861)


Throughout Greece, On calcareous rock at altitudes 0 to at least 1700 m.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia, Egypt), N. America (widespread), S. America (Argentina), Australasia (scattered in Australia, both islands of NZ).

**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 (Algeria, Morocco), N America (widespread).

**Lecania heterocarpa** Zahlbr. (1905)

Description: See the protologue

Corfu, on limestone at an altitude of 500 m.

Known only from 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 the Nordic Countries. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco, Algeria), N. America (at least California), Australasia (SE quadrant of Australia, both islands of NZ).

**Lecania koerberiana** J. Lahm ex Körb. (1859)
in: Parerga Lichenol. 68-69

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, but absent from British Is. Also Asia (widespread as far east as NW China), N. Africa (Morocco), perhaps S. America (Argentina).

**Lecania naegelii** (Hepp) Diederich & van den Boom (1994)

My only confirmed collection is very scanty, so the description is incomplete.

- **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. Exciplle: 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. Thalline margin: absent, even in section. 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. Ascii: 45 x 10 µm, clavate, Biatora type. Ascospores: colourless, 3-septate (when mature, but appearing simple for a long time), narrowly ellipsoid, straight, 8 per ascus, 17 - 27 x 4 µm.

- 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, with a mild preference for *Quercus* (one-third of reports).

- Widely distributed in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Tunisia), N. America (eastern half of Canada, widespread in USA), Australasia (NZN).

**Lecania olivacella** (Nyl) Zahlbr. (1928)
in: Cat. Lich. Univ. 5: 739; *Lecanora olivacella* Nyl. (1875) in: *Flora* 58: 298
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 low altitude. The other collection cited in Abbott (2009) was incorrectly determined.

- A rare species with a very scattered distribution: England, Norway, France, Austria, Iberian Peninsula, Sardinia, Greece. Perhaps also N. Africa.

**Lecania polycycla** (Anzi) Lettau (1912)

- The only collection was very scanty and the description is incomplete. For a published description see Nash et al. (2004).

- **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 the tips of the paraphyses. Hymenium: 45 µm, colourless, KI+ blue. Hypothecium: 50 µm, colourless. Paraphyses: not coherent, 1.5 µm wide at base, capitate, apical cell 5 µm with internal black pigment in upper half. Ascii: 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.

- Known from a few countries in southern and central Europe. Also N. Africa, N. America (Arizona).

**Lecania rabenhorstii** (Hepp) Arnold (1884)

- **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: subsessile to sessile, flat to convex, 0.4 - 0.55 mm diameter, sometimes blue-white pruinose. Disc: brown. Exciplle: 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. Thalline margin: present, white, becoming excluded in convex apothecia; in section: 50 µm wide. Epithecium: mostly brown, in a few places with a pink or red tinge, brown pigment K-, soluble, reddish pigment K+ slightly violet, not soluble. Hymenium: 55 - 65 µm, tall, basically colourless but sometimes with epiphtichial pigment in upper part. Hypothecium: 110 µm tall, colourless. Paraphyses: simple, 1 µm wide.
at base, not to slightly capitately, apical cell 2 - 5 µm wide, without pigment. Ascii: 35 x 11 µm, clavate. Ascospores: colourless, 1-septate (when mature), narrowly ellipsoid, 8 per ascus, 9 - 14 x 4 - 5 µm. Photobiont: green.

The thin, dark brown, areolate but often discontinuous thallus seems to be characteristic.

Fairly common in the south of the country, rare in the north. On calcareous rock. Reported from all altitudes, but more than half of all records are from below 200 m altitude.

Widely distributed 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, both islands of NZ).

**Lecania spadicea** (Flot.) Zahlbr. (1914)


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 convexus 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. Exciple: brown, paler than disc, persistent or not; in section: 25 - 50 µm wide, colourless to pale brown, K-. Thalline margin: present in some collections, sometimes persistent; in section: 150 - 250 µm wide. Epithecium: 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, sometimes with visible septa, not to slightly capitately, 1.5 µm wide at base, to 3 µm at apex, apical cell with some internal brown pigment not soluble in K. Ascii: 45 x 10 - 12 µm, ±cylindrical to narrowly clavate, ±Bacidia type, though with a rather broad ocular chamber. Ascospores: colourless, (0) 1 (2) -septate, septum thin, ellipsoid to narrowly ellipsoid, ends sometimes slightly pointed, 8 per ascus, 7.5 - 13 x 3 - 5 µm. Pycnidia: sometimes present, black, 0.07 mm diameter, 100% immersed in slight depressions in squamules; in section: multi- chambered, 200 µm tall x 230 µm wide, mostly colourless, wall in upper part sometimes grey. Conidia: colourless, 15 - 20 x 3.4 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 *Tonia* but lacks the strongly capitately paraphyses of that genus.

Widespread and fairly common in coastal sites with a maritime climate in the southern half of Greece. On rock, usually calcareous; reported once from calcareous soil. At altitudes 0 - 600 m, but 75% of reports are from below 200 m.

Basically a species of southern Europe, from the Iberian Peninsula to Cyprus, though also known from Bulgaria and Ukraine. Also Macaronesia, Asia (Syria, Russia), N. Africa (Morocco, 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 very 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 widely distributed 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)


The earliest name, *Biatorina proteiformis* var. *umbratica* Arnold (1874), in *Flora* 57:569, is a nomen nudum.


Chios and Crete, on calcareous rock at altitudes 5 - 55 m.
Var. umbratica has a more southerly distribution, 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 the single collection seen), of scattered, rounded areoles. Apothecia: sessile, flat, 0.35 mm diameter. Disc: dark brown. Thalline margin: present; in section: 50 µm wide. Epithecium: dark brown to red-brown, developing a slightly purple-brown tinge in K. Hymenium: 60 µm tall, colourless. Exciple: in section: of small cells, 2 - 3 µm diameter. Paraphyses: 1 µm wide at base, 3 - 5 µm at apical cell, clavate or slightly capitate. Ascospores: colourless, 0 - 1 -septate, ellipsoid, 8 per ascus, 11 - 13 x 5 µm.

Photobiont: green.

The separation from L. olivacea merits further study. They appear to be distinguished mainly by the pruinosity of the apothecia, but in most groups of lichens pruinosity is a notoriously variable character.

Widely distributed in the southern half of Greece, but almost absent from the north. On calcareous rock, usually at low altitude (to 400 m), though there are scattered reports up to 1500 m.

Widely distributed in Europe to as far north as British Is and Baltic States, but absent from the Nordic Countries. It avoids the most 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, mainly in the SW), C. America (Mexico, Guatemala), Australasia (scattered in Australia, NZS).

Lecanographa Egea & Torrente (1994)
in: Bibl. Lich. 54: 116-117

Type: L. lyncia (Sm.) Egea & Torrente. Family: Lecanographaceae. 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.

11 Ascospores asymmetric, narrower at one end than the other, central cell larger than the others.

22 Parasitic on Dirina or Roccella. (Thalli of these hosts C+ pink.) L. grumulosa

2 On rock, not parasitic. Thallus C-. (L. subgrumulosa)

1 Ascospores symmetric, all cells similar.

22 On bark. Thallus C-.

33 Ascospores 3 (5) -septate. (L. amylacea)

3 Ascospores 7 - 8 (12) -septate. L. lyncia

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 known from Corfu. There are no reports from the mainland, and this species obviously requires a maritime climate. On rock (calcareaous or siliceous) or parasitic on Roccella phycoptis.

Widely distributed in southern and central Europe; it reaches Scotland, but it is absent from Baltic States and the Nordic countries. Also Macaronesia, western Asia (Israel), Africa (widespread in N. Africa; also Socotra, Senegal), perhaps N. America (Louisiana), Caribbean, C. America (Mexico).
Lecanographa lycnea (Sm.) Egea & Torrente (1994)
in: Bibl. Lich. 54: 142; Lichen lycnea Sm. (1801) in: Smith & Sowerby, English Botany 12, table 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 europaea, at altitudes 0 - 20 m.

Widely distributed in Europe, to as far north as Scotland and southern Sweden (map in Egea & Torrente, 1994). Also western Asia (Syria, Yemen), Africa (Morocco, Algeria, Socotra, S. Africa), N. America (California), C. America (Mexico), southern S. America (Chile, perhaps Argentina).

Lecanographa werneri (Faurel, Ozenda & Schotter) Egea & Torrente (1994)
in: Bibl. Lich. 54: 163; Opegrapha werneri Faurel, Ozenda & Schotter (1953) in: [need to investigate]

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)

Type: L. subfusca (L.) Ach.; designated in Choisy (1929: 522). The precise application of the name is uncertain, as the name Lichen subfuscus L. has to be lectotypified on a Dillenian illustration. Jørgensen, James & Jarvis (1994) suggest that it may be a synonym of Lecanora horiza, though the very common L清晰 encourage seems just as likely to me. (It is probably not a synonym of L. allophana, as sometime claimed.) However, it is clear enough what constitutes the "core group" of Lecanora, so there is no need for a conserved type.

Family: Lecanoraceae. Literature: There is no single monograph of the European species. 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 (not necessarily of the European species, but including material relevant to Europe) include: Dickhäuter et al. (1995) (the subcarnea group); Guderley & Lumbsch (1999) (species with multi-spored asci); Lumbsch, Pfümper et al. (1997) (corticolous species with pruinose discs); Printzen (2001) (corticolous species with usnic or isousnic acid); Sliwa (2007a) (the dispersa group); van den Boom & Brand (2008) (the saligna group).

As presently delimited Lecanora contains several hundred species. It is rather heterogeneous. Some natural divisions within it are often given informal designations (e.g. the "dispersa group"), but it is not yet clear how best to subdivide the genus as a whole. The "muralis group" is sometimes recognised as the genus Protoparmeliopsis, but in my view it may be premature to start segregating small genera until the structure of the whole group is better understood. Mainly for that reason, here I use Lecanora in the traditional, broad sense. Because of the heterogeneity, a detailed description would be pointless, and the following description just notes characters common to all, or nearly all, species.

Thallus: crustose, varying from poorly developed and immersed to very well developed, a few species with radiating marginal lobes. Vegetative propagules: usually absent, but a few species with soralia. Apothecia: small to medium sized, usually with a thalline exciple at least when young. Asci: with a KI+ blue apex containing a KI- central region that reaches to the upper surface (Lecanora type). Ascospores: colourless, simple, ellipsoid, usually 8 per ascus, small to medium sized (typically 8 - 15 \( \mu \)m 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. Some groups are in need of revision in SE Europe, most obviously the muralis aggregate, which is variable and hard to understand.

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 Disc distinctly pruinose. Group 5A.
7 Disc not, or only very slightly, pruinose.
88 Not corticolous or saxicolous. Group 5B.
8 On bark or wood. Group 5C.
9 On rock. Group 5D.
6 Thallus and thalline margin K- (Note 1). Group 6.
5 Thallus ±green or brown. Group 7.

(1) An red spot test reaction is diagnostic. However, if norstictic acid is present in low concentrations a spot test may yield an orange or yellow colour, or may even appear negative. Doubtful specimens should be tested in thin section, when the present of norstictic acid is easier to detect. 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 *Squamarina* could cause confusion, but they are distinctly squamulose, at least in places.

11 Soredia present. See (Coscinocladium gaditanum)
1 Soredia absent.
2222 Thallus C+ red. (L. chaffiniana), (L. negevensis)
222 Thallus C+ orange.
33 Medulla P+ yellow. **L. cerebellina**
3 Medulla P-
44 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. Disc initially pale brown, brown or red brown and C+ orange, later blackish and C-. Probably restricted to the uplands. **L. reuteri**
See Note 1.
4 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. Disc brown, sometimes blackening with age, always C-. Not restricted to uplands. **L. pruinosa** See Note 1.
22 Thallus C+ yellow. (L. sphaerela)
2 Thallus C-.
333 Thallus appearing ±white, without any green tinge.
44 Thallus ±densely white pruinose everywhere, P-. Apothecia green to brown. On calcareous or siliceous rock; not restricted to alpine or subalpine level. (L. valesiaca)
4 Thallus chalky, chalk-white to yellow-white, P+ yellow. Apothecia brown to black. On calcareous rock at subalpine to alpine levels (L. admontensis)
33 Thallus grey-brown to grey (usnic acid absent), P-. On siliceous rock. **L. klauskalbii**
3 Thallus green, grey-green, yellow-green or yellow-brown (but pruina, if present, may be white), P+ yellow or P-. On calcareous or siliceous rock.
44 Marginal lobes strongly adpressed. Medulla probably P- in most species (but some groups not well understood).
55 Disc ±same colour as thalline margin and thallus. On non-calcareous rock. If present in Greece, probably restricted to alpine levels. (L. concolor)
5 Disc much browner than thallus. On calcareous or non-calcareous rock. Not restricted to alpine levels.
66 Marginal lobes almost as broad as long. Thallus ±shiny, not pruinose. On non-calcareous rock. (L. muralis var. subcartilaginea)
6 Marginal lobes distinctly longer than broad.
77 Areoles with prominent black margin. On non-calcareous rock. **L. bolcana**
7 Areoles without prominent black margin (Note 2).
88 Lobes flat to convex. Thallus grey-green. \textit{L. macrocyclos}
8 Lobes flat to concave. Thallus yellow-green or white-green.
99 Thallus white-green, with a white, pruinose marginal zone. On calcareous rock. \textit{L. muralis var. versicolor}
9 Thallus yellow-green, without a white marginal zone, not or only slightly pruinose. Not restricted to strongly calcareous substrates.
AA Areoles with several apothecia. \textit{L. muralis var. serpentini}
A Areoles usually with only one apothecium. \textit{L. muralis var. muralis}

4 At least some marginal lobes not strongly adpressed. Medulla P+ yellow or P-.
55 Medulla P+ yellow. Thallus with a brown or yellow tinge. On calcareous or siliceous rock. \textit{L. graeca}
5 Medulla P-. Thallus various. Usually on non-calcareous rock.
66 Thallus of small granules that transform into small, umbilicate squamules. (L. vaenskaei)
6 Thallus never granular.
77 Thallus attached to substrate by very long, prominent rhizines. (L. rhizinata)
7 Thallus without rhizines.
88 Lobes swollen and sinuous. \textit{L. garovaglii}
8 Lobes not swollen or sinuous. \textit{L. muralis var. dubyi}

(1) Some publications imply that \textit{L. pruinoss} has discs that never blacken with age, but that is not true.
(2) A black hypothallus may be present between the areoles. In \textit{L. macrocyclos} the lobe tips only may be greyish or even black.

\textbf{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. \textit{L. expallens}
2 On calcareous rock. Thallus lepatrioid, sorediate everywhere. Apothecia unknown. (L. rouxi)
1 Thallus C-.
222 Apothecia absent. Consider \textit{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 or decaying vegetation on the ground. At subalpine levels or above. \textit{L. epibryon}
33 On rock.
44 Disc C+ yellow. \textit{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. \textit{L. umbrosa}
3 On bark or wood.
44 Soredia in well-defined, confluent soralia. \textit{L. impudens}
4 Thallus granular rather than truly sorediate, without confluent soralia. \textit{L. strobilina}

\textbf{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. \textit{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.
4 On calcareous rock. \textit{L. congesta}
11 Thallus or thalline margin, C+ orange or very yellow.
222 On bark or wood.
33 Apothecia 0.3 - 1.5 mm diameter, convex from an early stage. \textit{L. symmicta}
3 Apothecia 0.2 - 0.4 mm diameter, flat or slightly convex. \textit{L. conizella}
22 On calcareous rock.
33 Thallus well developed, C+ yellow or red.  
44 On calcareous rock. (L. antiqua)
3 On siliceous rock.  L. conferta

3 Thallus poorly developed, immersed or forming small patches around some apothecia, C-.  L. 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.  L. 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 grey or white.  L. rupicola subsp. subplanata

7 Thallus yellow-green.  L. rupicola subsp. sulphurata

5 Thallus rather poorly developed. (L. 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 not soluble, or 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 subimmers to sessile, 0.3 - 2.0 mm diameter. Thallus and thalline margin with psoromic acid (P+ yellow if concentration high enough, but my collections 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.  L. semipallida
3 Thallus well developed. Apothecia strongly white pruinose. On non-calcareous rock.  L. rupicola subsp. rupicola

(1) The 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 5C: 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.

11 Epithecium with large grains, K+ red (norstictic acid). Probably restricted to sites with a warm, maritime climate. **L. rubicunda**
1 Epithecium without norstictic acid.
  22 Epithecium with crystals or granules that rotate the plane of polarisation of light.
    33 Medulla of thalline margin with large crystals not soluble in K. (Small crystals soluble in K may also be present, especially in cortex.)
      44 Epithecium with coarse crystals, typically 1 - 2 µm diameter. Thallus P- (or almost).
        55 Disc pale brown medium brown or red-brown.
          66 Thalline margin distinctly warted and irregular. Thallus distinctly warted. Apothecia often exceeding 1 mm diameter. **L. rugosella**
          6 Thallus margin smooth to slightly crenulate. Thallus smooth to moderately warted. Apothecia only occasionally exceeding 1 mm diameter. **L. chlorotera**
        5 Disc usually dark brown to black (Note 1). **L. meridionalis**
        4 Epithecium with only fine crystals or granules generally less than 1 µm diameter (though they may aggregate to form clumps more than 1 µm diameter). Thallus P- or P+.
          55 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)
          5 Cortex of thalline margin not usually exceeding 40 µm wide. Thallus P- or P+. Disc and ascospores various. Not restricted to (sub)alpine levels.
            66 Thallus and thalline margin P+. Usually (but not exclusively) on bark of conifers or on wood.
              77 Thallus P+ red. Most apothecia less than 1 mm diameter. **L. pulicaris**
            7 Thallus P+ yellow-orange. Most apothecia more than 1.5 mm diameter. (L. paramerae)
            6 Thallus and thalline margin P- or almost (may be faintly +yellow if atranorin present in high concentration). Usually on deciduous trees. **L. hybocarpa**
      3 Thalline margin with only small crystals soluble in K (Note 2).
        44 Thallus or margin exciple P+ red, orange, pale orange or yellow-orange. **L. intumescens**
        4 Thallus and thalline margin P- or almost (may be faintly +yellow if atranorin present in high concentration). **L. strobilina**
  2 Epithecium without polarising crystals or granules.
    33 Pycnidia usually present, containing two types of conidia. (L. quercicola)
    3 Pycnidia usually absent.
      44 Thalline margin with large crystals not soluble in K (some small soluble ones may also be present). **L. argentata**
      4 Thalline margin with only small crystals soluble in K (Note 2).
        55 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.
        5 Cortex of thalline margin 30 - 100 µm wide, not clearly separated from medulla by a crystal-free zone. Disc not shiny, convex to concave. Apothecia 0.5 - 2.5 mm diameter. Ascospores various.
          66 Apothecia 1 - 2.5 mm diameter, concave, constricted at base. Ascospores 12 - 20 µm long. Thallus continuous or verrucose-areolate. **L. allophana**
          6 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 chlarotera usually has a pale brown disc, but what seems to be the same species may have a darker brown (but not very dark brown) disc, perhaps in response to environmental factors. I have seen a few apothecia of what seems to be L. meridionalis with a medium brown disc (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 5D:** Thallus without marginal lobes or soralia; all parts C-, without norstictic acid; thallus grey to white, with atranorin; discs not pruinose; on rock.

11 Epithecium some shade of brown.
   22 Epithecium with crystalline granules.
      33 Apothecia 0.2 - 0.6 mm diameter. **L. ripartii**
      3 Apothecia mostly more than 1 mm diameter. **L. cenisia**

2 Epithecium 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.) Prothallus present or absent. Thallus subsquamulose or not. Ascospores various. 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. Epithecium 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.
   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. campestris**. 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 Epithecium not brown.
   22 Thalline margin soon becoming excluded. Thallus often with a yellow tinge.
      33 Epithecium yellow-green to green black. On calcareous rock at alpine levels. **L. atromarginata**
      3 Epithecium blue-black. Disc black. **L. marginata**.

2 Thalline margin persistent. Thallus without a yellow tinge. Epithecium 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.

11 Apothecia sessile, even when young.
   22 Apothecia not pruinose, disk black, or darkening with age and eventually becoming ±black.
      33 On bark or wood.
      44 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.
      5 Hymenium 55 - 75 μm tall. Asci Lecanora type. Ascospores 4.5 - 5.5 μm wide. **L. aitema**

4 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.

3 On calcareous rock. **L. prominens**

2 Apothecia either pruinose, or disc not black; colour of disc not varying much with age.

33 On bark or wood.

44 Ascis with 16 - 32 ascospores. **L. sambuci**

4 Ascis with 8 ascospores.

55 Thalline margin very thick, persistent. (L. populicola) Greek reports uncertain, but discussed below.

5 Thalline margin thin, eventually almost excluded.

66 Epithecial with few to many polarising granules (Note 1).

77 Thallus with a slight yellow tinge (isousnic acid). This is the saligna group.

888 Ascospores 6 - 8.5 x 2.5 - 3.5 µm. **L. subinintricata**

88 Ascospores 3.5 - 5 µm wide, mostly more than 8 µm long.

99 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**

9 Margin of apothecia often excluded. Epithecium brown, N+ red-violet. Macroconidia absent or not as above. (L. pseudosarcopidoides), (L. subsaligna)

8 Many ascospores more than 5 µm wide. (L. calabrica), (L. laxa)

7 Thallus white or grey, without any yellow tinge, or entirely immersed. This is the dispersa group.

88 Epithecial granules not soluble in N. Disc usually pruinose. Thalline margin paler than disc. (L. juniperina)

8 Epithecial granules soluble in N.

99 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. **L. persimilis**

9 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. **L. hagenii**

6 Epithecial entirely without granules. **L. horiza**

33 On calcareous rock (or on other lichens on calcareous rock). Note 2.

44 Thalline margin regularly and evenly crenulate; crenulations separated by distinct radial striations. Disc usually pruinose. Thallus immersed to thinly superficial. Epithecial granules coarse. **L. crenulata**

4 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.

55 Thallus superficial, usually well developed, forming small patches, areolate.

66 Thallus patches to about 1 cm diameter. Areoles often discrete, pruinose, thin (to 0.3 mm), not hard. **L. albescens**

6 Thallus to 4 cm diameter. Areoles contiguous, chalky but not pruinose, thick (0.5 - 1 mm), hard. **L. prophetae-eliae**

5 Thallus immersed or poorly developed (Note 3).

66 Epithecial granules not soluble in K. **L. dispersa**

6 Epithecial granules soluble in K. **L. semipallida**

3 On siliceous rock.

44 Prominent white prothallus usually present. Thallus well-developed, areolate. **L. subcarnea**

4 Prothallus absent. Thallus poorly developed or not areolate.

55 Thallus of dispersed, rounded granules. (L. salina)

5 Thallus usually inconspicuous. **L. hagenii**

1 Apothecia ± immersed, at least when young.

22 Apothecia black, even when young. On calcareous rock.

33 Apothecia remaining immersed. **L. agardhiana subsp. agardhiana**

3 Apothecia eventually immersed above level of thallus. (L. agardhiana subsp. catalaunica)

2 Apothecia pale, at least when young. On various substrates.

33 On bark. (L. populicola) Greek reports uncertain, but discussed below.

3 On rock near the sea,

44 Apothecia ± immersed even when mature. Usually on calcareous rock. **L. bandolensis**

4 Mature apothecia not immersed.
55 On calcareous rock. *L. poeltiana*
5 On siliceous rock. (*L.* helicopsis) 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!
(2) This group needs much further study in Greece. This part of the key is very provisional.
(3) 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.

**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. mugicola*
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 the base. (*L. coniferarum*), (*L.* laxa)
7 Cortex of thalline margin (if present) not thickening towards the 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*

2 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. *L. 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 a distinct indented darker rim. Black hypothallus sometimes present. Apothecia mostly immersed, sometimes sessile. Disc green, green-black or green-brown. *L. intricata*
5 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 sub sessile later. Disc often with a blackish tinge. Usually on slightly nutrient-enriched rock. *L. sulphurea*

**Lecanora agardhiana** Ach. (1814)
in: Syn. Meth. Lich. 152; (?) *Lecanora agardhiana var. ciliophthalma* A. Massal.; *Lecanora agardhiana var. pacnodes* (A. Massal.) Zahhr. (often as *pachnodes*)

Descriptions: Clauzade & Roux (1985); Sliwa (2007a); Smith et al. (2009).

Definitely present in Greece, and reliably reported from Chios. There are reports from many parts of the country, on calcareous rock at all altitudes, but most reports 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.

Widely distributed in Europe to as far north as British Is and Baltic States; absent from the Nordic Countries. Also western Asia (widespread to as far east as Iran), N. Africa (Morocco, Algeria, Egypt), N. America (Oklahoma), Australasia (Campbell Is).

**Lecanora aitema** (Ach.) Hepp (1853)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Crete, on bark at an altitude of about 1970 m.

Very scattered: it appears to be a primarily a species of the western parts of central Europe, though it reaches British Is and southern Scandinavia to the north, and the Mediterranean mountains to the south. Absent from most of the eastern half of Europe. Also Asia (Turkey, scattered in Russia), perhaps N. America.

**Lecanora albella** (Pers.) Ach. (1810)

The earliest name is *Lichen pallidus* Schreb. (1771) but Rabenhorst's 1845 combination into *Lecanora* is not legitimate owing to the earlier *Lecanora pallida* Chev. (1826). The next name is *Lichen betulinus* Wulf. (1787), but it is not legitimate, being a later homonym of *Lichen betulinus* Huds. (1778).

Descriptions: Lumbsch, Plümpfer 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), N. America (Ontario, widespread in USA), C. America (Mexico), S. America (Brazil, Chile), perhaps Pacific (Hawaii). Reports for Australasia are incorrect.

**Lecanora albellula** Nyl. (1866)

The earliest name appears to be *Lecanora effusa f. glauccella* Flot. [date not known, but before 1855], but the epithet *glauccella* does not have priority at the rank of species. The next epithet comes from *Lecanora piniperda* Körb. (1859), and at the rank of species *piniperda* has priority over *albellula* if *Lecanora piniperda* is legitimate. I would argue that it is legitimate, though the matter is debatable and some authors have argued otherwise. Within *Lecanora piniperda* Körber included "*Lecanora aitema* Hepp" (via *L. piniperda* var. *subcarnea*). That fact, if taken alone, would appear to make *L. piniperda* a superfluous name, but it is necessary to consider all the evidence. On page 87 Körber treated "*Lecanora varia* L. aitema Kbr. S.L.G. 147" under *Lecanora varia var. muscorum*. Both *aitema* names, when used correctly, are based on *Lecidea aitema* Ach., a name that Körber did not cite in either case. It seems to me that both of Körber's citations of *aitema* names are to be understood as *sensu* citations. On that view, *L. piniperda* is legitimate.

My only collection is too scanty to permit an adequate description. For published descriptions see: Nash et al. (2004); Smith et al. (2009).

Crete and the Peloponnese. On bark of conifers or on wood at altitudes 700 - 1400 m. (A report for Evia, from an altitude of just 25m, seems doubtful to me.)

Throughout most of Europe, though uncommon in the south and restricted to the mountains. Also Macaronesia, Asia (widespread), N. America (widespread from Alaska to cooler parts of USA), C. America (Mexico).

**Lecanora albenscens** (Hoffm.) Branth & Rostrup (1869)
in: Bot. Tidskr. 3: 196. (The combination by Flotow in *Flora* 11(2): 633. 1828, is not validly published, as the name was merely cited as a synonym.); *Psora albenscens* Hoffm. (1796) in: Deutschl. Fl. 2: 165; *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: opaque (so difficult to study), filled with very fine polarising granules, individual crystals not visible except for surface pruina. Medulla: crystals as for cortex. Apothecia: submersed to subsessile, flat, 0.4 - 0.6 mm diameter, not to slightly pruinose. Disc: pale brown. Exciple: not visible externally, poorly developed in section. 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. Epithecium: brown to pale grey-brown, K- (some brown pigment soluble in K), polarising effect as for exciple. Hymenium: 60 µm tall, colourless to very pale grey-brown, upper part often polarising, KI+ blue. Hypothecium: 50 - 70 µm tall, colourless. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 8 - 10 x 5 - 6 microns. Chemistry: disc C-; thallus and thalline exciple K-, C-, KC-.

The small rounded patches with discrete areoles are distinctive, and this species is unlikely to be confused with any other. Lecanora pruinosa has a continuous, thicker thallus and reacts C+ orange.

Common in the southern half of Greece, less so in the north. On rock, usually calcareous. Recorded from all altitudes, but two-thirds of reports are from below 400 m, and most reports are from sites near the sea.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia, Egypt), N. America (SE Canada, NE USA, perhaps elsewhere), S. America (Argentina), Australasia (both islands of NZ).

Lecanora allophana (Ach.) Nyl. (1872)
in: Flora 55: 250; Lecanora subfuscus g. (= f.) allophana Ach. (1814) in: Syn. Meth. Lich. 158; (?) Lecanora allophana f. subvirens J. Steiner; Lecanora chlorona f. geographica (A. Massal.) Zahlbr.; Lecanora subfuscata f. geographica (Flagay) 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 subfuscus var. flexuosa Ach., P. subfuscus var. pallida Ach. and P. subfuscus var. pellaea Ach., all of which date from (1803). Next, we may have Lecanora leucopis Ach. (1810), but application of this name is disputed.

When, Acharius published the basionym he cited in synonymy three varietal names that he had published earlier, in 1803. The 1810 name is therefore a 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 the choice has not already been made in some earlier publication). Brodo & Vitikainen (1984):284 offered some evidence to suggest that Parmelia subfuscus var. flexuosa Ach. is the most natural choice to make, although they themselves did not designate a type.

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.

Throughout most of Europe to as far north as mid Scandinavia, but apparently absent from British Is. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (SE Canada, widespread in USA), C. America (Mexico, perhaps elsewhere), perhaps S. America (Argentina; reports for Colombia are incorrect), perhaps Pacific (Hawaii, Tahiti, Tuamotu). Reports for Australasia are incorrect.

Lecanora argenteata (Ach.) Malme (1897)
in: Lich. Suec. Exs., no. 5. (Sometimes said to have been published by Degelius, as Nilsson, in 1931, but information in Sayre (1969) seems to imply that new combinations in Malme's exsiccatae are validly published.). Parmelia subfusca η (= var.) argenteata Ach. (1803) in: Methodus 169; Lecanora subfuscata H. Magn.; (?) Lecanora subfuscata f. melacarpa (Harm.) Szatala; Lecanora subrugosa Nyl.

Acharius's epithet does not appear to have been used at species rank until 1897. The name Lecanora subrugosa Nyl. (1875) has been considered to be synonymous, and would have priority, but the synonymy is disputed.

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 the Arctic Circle. Also Macaronesia, Asia (widespread), perhaps Malesia (Java - old report), Africa (Algeria, S. Africa), N. America (Saskatchewan, scattered in USA especially in the east), C. America (Mexico, Guatemala, perhaps elsewhere), S. America (widespread, but avoiding humid tropics - an old report for Brazil seems doubtful to me), 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. A species of northern Europe. There are no reports for Central Europe, and the Greek report represents a substantial range extension. Also Asia (Russia), N. America (Alberta, Washington State), Antarctica (S. Shetland Is, Antarctic Peninsula).

Lecanora bandolensis de Lesd. (1954)
Description: Clauzade & Roux (1989).
Chios and Samothraki, on limestone at altitudes 5 - 200 m. This is a rarely recorded species known from the Iberian Peninsula and Italy (Sardinia, Sicily) (and perhaps also France).

Lecanora bicincta Ramond (1827)
Northern Peloponnesse, on siliceous rock at about 2000 m altitude.
Widely distributed in Europe to as far north as mid Scandinavia, though south of the Alps it is restricted to high mountains. Also Asia (widespread as far east as Mongolia), southern Africa, N. America (western USA), C. America (Mexico), S. America (Argentina), Australasia (NSW, NZS).

Lecanora bolcana (Pollini) Poelt (1958)
This is a member of the muralis aggregate, characterised by black margins to the areoles. Like other entities in the muralis aggregate, the boundaries between taxa are not always clear, and I prefer not to provide a description. The whole group is in need of a monographic treatment.
Scattered throughout Greece. On siliceous rock at altitudes 0 - 2600 m. Southern Europe, from Italy to Cyprus, and the southern parts of central Europe, from Hungary to southern Russia. Apparently not reported for western Europe (but it may have been subsumed under L. muralis by workers in those regions). Also Macaronesia (Canary Is, Madeira), Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria).

Lecanora campestris (Schaer.) Hue (1888)
in: [need to investigate - title & page range not known]; Parmelia subfuscaθ (= var.) campestris Schaeer. (1839) in: Lich. Helv. Spic. 8: 391; Lecanora subfusca f. campestris (Schaer.) Ny1.; Lecanora subfusca h. (= var.) campestris (Schaer.) Rabenh.
The earliest name is Lecanora atra var. expansa Ach. (1810), but it does not have priority at the rank of species.
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 but sometimes becoming irregular when old, 0.55 - 1.4 mm diameter, not pruinose. Disc: brown to dark brown, sometimes with a slight reddish tinge. Exciple: not visible externally; in section: 10 - 15 μm wide, colourless except at surface. 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. Epithecium: brown to orange-brown, without crystals. Hymenium: 50 - 80 μm tall, colourless, or with some epithecial 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-. Photobiont: green.
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.

Widely distributed in Europe to about the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (scattered in USA), C. America (Mexico, perhaps elsewhere), perhaps S. America (Uruguay). Reports for Australasia, Pacific are incorrect.

**Lecanora carpinea** (L.) Vain. (1888)

in: [need to investigate - title & page range of publication not known]; *Lichen carpinea* L. (1753) in: Sp. Pl. 1141; *Lecanora angulosa* (Schreb.) Ach.; *Lecanora caerulata* (Ach.) Szatala (as coerulata); *Lecanora pallida* auct. graec. p.p.

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. Exciple: not visible externally; in section: 10 - 15 µm wide, colourless except at surface, of anastomosed hyphae on an overall radiating trend. Thalline margin: present, persistent but sometimes becoming very thin; in section: 70 - 80 µm wide, with a 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. 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, 8 per ascus, 10 - 12 x 6 - 8 µm, with distinct Lecanora-type wall. 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 lichenarine 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 acid bark. However, many of these reports, especially older ones, may be unreliable owing to confusion with *L. leptyrodes* and *L. subcarpinea*. Some of the Peloponnesian reports of Abbott (2009) were based on field observations, and some of these may be errors for *L. leptyrodes*.

Subcosmopolitan outside the tropic. Throughout Europe except for the high arctic. Also Macaronesia, Asia (widespread), Africa (Morocco, Socotra, S. Africa), N. America (widespread in USA), C. America (Mexico, perhaps elsewhere), perhaps S. America (Chile), Australasia (both islands of NZ). Old reports for Brazil, Pacific (New Caledonia) are probably in need of confirmation.

**Lecanora cenisia** Ach. (1810)

in: Lichenogr. Universalis 361-362 (often cited as cenisea); *Lecanora transcends* (Nyl.) Arnold

Description: Nash et al. (2004); Roux (2007); Smith et al. (2009). The description in Clauzade & Roux (1985) is misleading, and should not be used.

Crete, northern Greece and perhaps Chios. On bark or, less commonly, siliceous rock, at altitudes (420) 775 - 2150 m. The only phorophyte explicitly mentioned is *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; but reports for Colombia incorrect). Reports for Australasia (NZ) appear to be 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. Otherwise only known from Bulgaria and Yugoslavian Macedonia.

**Lecanora chlorogeta** Nyl. (1872)


Thallus: crustose, white to grey, smooth to slightly warted, without vegetative propagules. Apothecia: sessile, flat to
slightly convex, 0.35 - 1.0 (1.6) mm diameter, usually not pruinose. Disc: pale brown to brown or orange-brown, only occasionally darker brown. Exciple: not visible externally; in section: 15 µm wide, formed of thin hyphae ±parallel to paraphyses. Thalline margin: present, persistent, 0.01 - 0.1 mm wide, smooth and regular to slightly crenulate; in section: 100 - 110 µm wide, of which cortex (15) 25 - 40 (50) µm; 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. Epithecium: brown or dark brown, K-, pigment soluble in K; with abundant coarse crystals, usually 1 - 2 µm wide but sometimes smaller, usually forming a distinct layer above the 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, 8 per ascus, 11 - 14 x 5 - 8 (9) µm, with a distinct Lecanora-type wall.


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 do 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 epithecium. L. meridionalis has much darker discs. For separation from L. hybocarpa see under that species.

Throughout Greece, at all altitudes where there are suitable substrates. Nearly always on bark, though reported once from wood. 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.

Throughout Europe to about the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (Mexico), S. America (widespread), perhaps Pacific (Hawaii). Reports for Australasia appear to be incorrect.

Tentatively reported for the Peloponnese in Abbott (2009), but the material does not belong to that species. Its identity remains uncertain. It seems close to the rather poorly known L. hypoptoides (Nyl.) Nyl., but there are some discrepancies from published descriptions of that species.

Lecanora complanens van Herk & Aptroot (1999)
in: Lichenologist 31(6): 544
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. Widely distributed in Europe. Also Africa (St. Helena).

Lecanora conferta (Duby) Grognot (1863)

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; absent from the British Is. Also N. Africa (Morocco, Algeria).

Lecanora configurata Nyl. (1884)
in: Flora 67: 389
Description: Poelt & Vézda (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.

Chios and Patmos, on 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 congesta Clauzade & Vêzda (1969)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009). The relation of this poorly known species to L. contractula auct. medit. (see below) needs to be investigated.

Chios, on coastal limestone at an altitude of about 5 m.

Ireland, France (Provence), Spain (Catalonia) and Greece.

Lecanora conizella Nyl. (1875)
in: 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. 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. Thalline margin: absent, even in section. Epitheicum: 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, K+ blue. Hypothecium: colourless. Paraphyses: occasionally branched, 2 µm wide, not capitulate, with internal green-back pigment cap; this pigment not soluble in K. Asci: 50 x 13 µm, subcylindrical, apex K+ blue. Ascospores: colourless, simple, usually ellipsoid but rather variable in shape, 8 per ascus, 10 x 5 µm. 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.

L. conizella is a poorly known taxon reported for Iberian Peninsula, France and Greece only.

Lecanora contractula auct. medit. (? non Nyl.)
This is probably the taxon discussed under the name Lecanora contractula by Nimis (1993) and Nimis & Poelt (1987).

Thallus: crustose, forming small patches to 1 cm diameter, occasionally well developed but more usually very thin and inconspicuous or almost absent, 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. Exciple: not visible externally; in section: 25 µm wide, poorly developed and scarcely distinguishable from hymenium. Thalline margin: white, smooth, persistent, often rather narrow; in section: 50 µm wide. Epitheicum: brown to orange-brown, K-, pigment soluble in K; crystals apparently absent (though there is some polarisation in upper part of hymenium below epithecium). Hymenium: 50 - 55 µm tall, colourless or with some epithecial pigment in upper part, K+ blue. Hypothecium: colourless. Paraphyses: simple, or branched in upper part, occasionally anastomosed, sometimes slightly capitarte or slightly moniliform. Asci: 40 - 45 x 21 - 24 µm, clavate to subglobose, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 8 - 12 x 5 - 6 µm, without a prominent wall. 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.

L. contractula Nyl. appears to be an arctic species. The Mediterranean taxon is known from Tuscany, Sicily and the southern Peloponnese. It is probably more widely distributed, but is inconspicuous and easily overlooked.

Lecanora crenulata Hook. (1833)
in: Engl. Fl. 5(1): 190; (?) Lecanora crenulata f. macra (Sommerf.) J. Steiner

The earlier names Lichen crenulatus Dicks. (1793) and Parmelia crenulata Wallr. (1831) are both later homonyms, and not legitimate. The epithet tigrina would priority at the rank of species if the supposed synonymy with Verrucaria contigua (indefinite rank) tigrina Hoffm. (1796) could be confirmed.

Description: Sliwa (2007a) is best; or see Nash et al. (2004); Smith et al. (2009).

Scattered throughout Greece, on calcareous rock at all altitudes.

Widely distributed in Europe to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Algeria, Egypt), N. America (widespread, but mainly in western half), C. America (Mexico), perhaps S. America (Argentina), Australasia (NZ, present in Australia according to Sliwa, 2007a).

Lecanora dispersa (Pers.) Flörke (1815)
in: Deutsche Lichenen Fasc. 3, p4; Lichen dispersus Pers. (1794) in: 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 var. pruinosa Anzi; Lecanora hagennii var. lithophila (Wallr.) Flot.; Lecanora hagennii var.
saxigena J. Steiner

Description: Pending a revision of Peloponnesian collections, see Śliwa (2007a) or Smith et al. (2009). (Some of the material on which the description in earlier versions of the Flora was based may belong to *L. hagenii.*)

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 *L. dispersa,* apart from the cracks the exciple is regular (or at most slightly wavy in very old apothecia). Also, *L. 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. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (throughout all sub-regions of the continent), N. America (widespread), and S. America (Argentina, Chili, Bolivia, Australia (widespread), New Caledonia, Antarctica (S. Shetland Is).

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*Lecanora dispersella* J. Steiner (1905)
in: *Ann. k. k. naturhist. Hofmus.* 20: 377

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.
Southern Europe, from Iberian Peninsula to Crimea. Also Asia (widespread from Turkey to Tajikistan).

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*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.

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*Lecanora epibryon* (Ach.) Ach. (1810)

Description: Clauzade & Roux (1985); Smith et al. (2009).

Known from a single site in Epiros, where it occurred on calcarceous soil at an altitude of 2100 m.

Widely distributed in northern and central Europe, with a very few reports from the mountains of the south. Also Asia (Russia, Kazakhstan, Mongolia, New Guinea), N. America (widespread in cold regions), S. America (Argentina, Falkland Is, perhaps elsewhere), Australasia (scattered in cool parts of Australia), Antarctica (subantarctic islands, Antarctic Peninsula).

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*Lecanora expallens* Ach. (1810)

My two collections fit published descriptions of *L. expallens,* but both are 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 to wait until fertile material is available before providing 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 (Morocco, Algeria, Rwanda, S. Africa; St Helena), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (Mexico), S. America (Chile, Paraguay), Australasia (NZN), Pacific (New Caledonia) Reports for S. America, Pacific are all old, and perhaps in need of confirmation.

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Description: Smith et al. (2009).

Known from a single site in Epiros, where it occurred on calcarceous rock at an altitude of 2100 m.

Northern and alpine Europe. The Greek report represents a considerable range extension. Also Asia (Russia, Nepal, Japan).
Lecanora fugiens Nyl. (1873)
in: *Flora* 56(19): 289

Descriptions: Clauzade & Roux (1985); Sliwa (2007a); Smith et al. (2009).

Chios on siliceous rock at an altitude of 110 m.

Throughout Europe where there are coastal siliceous rocks. Also Macaronesia (Terceira in Azores), North America (widespread), C America (Mexico), S America (Argentina).

Lecanora gangaleoides Nyl. (1872)
in: *Flora* 55: 354

The earliest name is *Lecanora frutulosa f. ocellulata* A. Massal. ex Arnold (1868), but it does not have priority at the rank of species.

I have a single Peloponnesian collection that may belong here, but it seems slightly atypical: apothecia slightly pruinose, very few large crystals in exciple. The epithecium has too much of a green tinge to fit *L. cenisia*. I prefer not to provide a description until I have seen typical material. For published descriptions see: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Islands of the Aegean, including Crete; rarely elsewhere. On siliceous rock at altitudes 10 - 800 m. (The Peloponnesian collection was at 1750 m.)

Widely distributed in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (Arizona, California), C. America (Mexico), S. America (Chile), Australasia (NSW).

Lecanora garovaglii (Körb.) J. Steiner (1899)
in: *Öst. Bot. Z.* 49: 254; *Placodium garovagliii* Körb. (1859) in: Parerga Lichenol. 54; *Placolecanora garovaglii* (Körb.) Räsänen

The epithet could be amended to *garovaglioi*, following Recommendation 60C.1(a), but the result is so ugly, and *garovaglii* has been used for so long, that I would appeal to Article 60C.2 and retain Körber's spelling.


Crete and northern Greece, with no clear pattern. On calcareous or siliceous rock at altitudes 300 - 1850 m.

Widely distributed in southern Europe and the southern parts of central Europe. Also Macaronesia (Tenerife), Asia (widespread), N. Africa (Morocco), N. America (Saskatchewan, widespread in western half of USA), C. America (Mexico), S. America (Bolivia, Chile, Peru).

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 from *Abies, Fagus, Ficus, Olea* and (wood of) *Pinus*.

Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread, but avoiding continental interior), Africa (Morocco, S. Africa, N. America (SE Canada, scattered in USA), perhaps S. America (apparently widespread, but all reports old), perhaps Pacific (New Caledonia - old report).

Lecanora graecae J. Steiner (1919)

Thallus: placodioid, central parts areolate to subsquamulose, to 3 cm diameter, 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 ±convex, 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 half, colourless in lower part, subcellular (broad elongated hyphal lumina oriented mostly perpendicular to surface often visible; individual hyphae sometimes discernible). Medulla: white. Apothecia: sessile, usually flat, sometimes slightly convex when old, 0.8 - 1.8 mm diameter, not pruinose. Disc: orange-brown to brown. Exciple: sometimes visible externally 0.05 mm wide, same colour as disc; in section: 50 - 80 µm wide, rather poorly developed. Thalline margin: present, thin and eventually often restricted to lower part of apothecium; in section: 200 µm wide. Epithecium: brown, K-, pigment soluble in K. Hymenium: 70 µm tall, mostly colourless but 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 capitulate. Ascii: 55 x 11 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 15 x 5.5 - 7 µm, with prominent Lecanora-type wall. Chemistry: medulla K-, C-, KC-, P+ yellow, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells
Lecanora hagenii (Ach.) Ach. (1810)

Thallus: crustose, inconspicuous to immersed, without vegetative propagules. Apothecia: sessile, flat, 0.45 - 0.75 mm diameter. Disc: brown, slightly white pruinose on disc (in the small amount of material seen to date). Excle: not visible externally and poorly developed in section. Thalline margin: present, white, persistent, 0.1 mm wide, slightly irregular but not crenulate; in section: 90 - 105 µm wide, of which cortex [\[? pseudocortex\]] 40 - 50 µm wide; cortex with abundant small crystals 1 - 2 µm wide. 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, 8 per ascus, 10 - 11 x 5 - 7 µm, with a fairly distinct Lecanora-type wall. Chemistry: disc C-, thalline exciple K-, K- P-. Photobiont: green.

Corticolous or lignonicolous 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 *L. 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 lecanae* has been reported once on this lichen.

Throughout Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Egypt), N. America (widespread), C. America (Mexico), S. America (Argentina, Colombia, perhaps Chile), Australasia (NZS). Status in Antarctica is unclear owing to possible confusion with closely related taxa.

Lecanora horiza (Ach.) Linds. (1869)

The earliest name may be *Lichen subfuscus* L. (1753), but that name has been formally rejected.

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 zwell developed to 250 µm thick, without vegetative propagules. Cortex: poorly developed; 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. Excie: usually not visible externally; in section: thin, 12 - 20 µm wide, poorly developed, with epithelial pigmen in outermost part, colourless elsewhere, formed of hyphae ±parallel to paraphyses. 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. Epithecium: brown-orange to orange-brown, without crystals, K-, pigment mostly soluble in K. Hymenium: 60 - 85 (100) µm tall, colourless, K1+ 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 only slightly capitate. Asc: 55 - 65 x 17 -23 µm, clavate. Ascospores: colourless, simple, ellipsoid, 8 per ascus, (10) 11 - 17 x 6 - 8 (9) µm, with a distinct Lecanora-type wall. 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 epithelial 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 couple of records from wood. The lichenicolous fungus Vouauxiella verrucosa has been reported several times from this lichen and Vouauxiella lichenicola has been reported once.

Southern and central Europe, just reaching British Is but absent from Baltic States and the Nordic Countries. Also Asia (widespread), Africa (Morocco, Algeria, Tunisia, Sudan), N. America (scattered in USA, mainly in the west), C. America (Mexico, perhaps elsewhere). The few reports for S. America are all old and 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 Peloponnesian 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, in sites close to the sea, on bark at altitudes of 0 - 500 m. Reported from a wide range of phorophytes, with no clear preference.

Southern Europe and the western parts of central Europe. It reaches British Is, but not Baltic States or the Nordic Countries. Also N. America (widespread).

**Lecanora hypopta** (Ach.) Vain. (1899)


Thallus: crustose, thin and inconspicuous, smooth, pale grey to pale brown, to 1.5 cm diameter, without vegetative propagules. Apotheca: abundant, sometimes crowded, sessile, slightly concave to flat when young, becoming strongly convex later, 0.2 - 0.3 mm diameter, not pruinose. Disc: black. Exciplle: 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). Thalline margin: sometimes obscurely present in external view; in section: sometimes present, 0 - 95 µm wide. Epithecium: orange-brown to brown, without crystals. Hymenium: 45 µm tall, colourless or with some epithelial pigment in upper part. Hypothecium: 50 µm tall, colourless. Paraphyses: simple, 1.5 µm wide at base, 3 µm at apex, clavate to slightly capitate. Asc: said to be Catillaria type. Ascospores: colourless, simple, 8 per ascus, 10 - 3 - 4 µm. Chemistry: thallus K-, C-, P-. Photobiont: green.

This species does not belong in *Lecanora* and its true affinities are uncertain. I have treated it here merely for convenience, because in the single collection that I have seen a thalline exciple is weakly present in some apothecia, and one's first impression is of a species close to *Lecanora* (though admittedly not typical of that genus).

SE Peloponnesse, 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. Very rare and scattered in the Mediterranean.

**Lecanora hypoptoides** (Nyl.) Nyl. (1872)


A species that keys out here occurs in the Peloponnesian 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.

Widely distributed, but apparently rather scattered, in central and northern Europe. Its status south of the Alps is unclear, though there is a recent report for Calabria. Also N. America (scattered in Canada and USA, but there is some doubt as to whether all reports really do refer to this species).
Lecanora impudens Degel. (1944)
in: Svensk Bot. Tidskr. 38: 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., a species of Aspicilia.
   Macedonia, at an altitude of 600 m. The substrate was not reported.
   Most reports are from central Europe, but it ranges as far north as southern Scandinavia and there are a very few reports for south of the Alps. Absent from British Is. Also Asia (widespread in Russia), N. America (widespread).

Lecanora intricata (Ach.) Ach. (1810)
in: Lichenogr. universalis 380; Parmelia intricata Ach. (1803) in: 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), N America (widespread), S America (Argentina, Bolivia, Colombia), Australasia (widespread outside drier parts), Antarctica (at least S Shetland Is).

Lecanora intumescens (Rebent.) Rabenh. (1845)
   The earliest name is Lichen tumidulus Pers. (1794) but it is illegitimate (later homonym), and the first legitimate use of that epithet at species rank was in 1870.
   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 klauskalbii Sipman (2007)
   Description: See the protologue.
   Evia and Samothraki, on siliceous rock at altitudes 20 - 250 m.
   Endemic to Greece.

Lecanora laatokkaensis (Räsänen) Poelt (1958)
   Thallus: crustose, 2 - 4 cm diameter, areolate, pale green, not pruinose, without marginal lobes, without vegetative propagules. Areoles: scattered, flat, subrounded, with only a 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 the areoles, black. Cortex: 35 - 45 µm thick, colourless in lower part, brown in upper part, formed of a network of anastomosed hyphae (at least where structure not obscured by crystals), 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 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. 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). Thalline margin: present, persistent; in section: 40 - 60 µm wide, cortex not very well developed, 10 - 20 µm wide; with abundant small polarising granules in cortex, not soluble in K. Epithecium: 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. Hypothecium: 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 member of the Lecanora muralis group 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 (Syria, Tajikistan), N. Africa (Morocco), N. America (Arizona).

Lecanora leptyrodes (Nyl.) Degel. (1931)

Thallus: crustose, white to white-grey, thin, 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). Exciple: not visible externally; in section: poorly developed, not very distinct from hymenium, 15 - 18 µm wide, colourless except at surface. Thalline margin: present, smooth, 0.05 mm wide, sometimes becoming excluded in convex apothecia; in section: 50 - 95 µm wide, with pseudocortex 20 - 55 (80) µm wide, algal zone 30 - 55 µm wide; crystals: abundant throughout pseudocortex and sometimes also in algal zone, small, not (or not all) soluble in K. Epithecium: brown to grey, K-, pigment soluble in K; with abundant small crystals soluble in K. Hymenium: 60 - 70 µm tall, colourless, KI+ blue. Hypotheicum: 50 µm tall, colourless. Paraphyses: usually simple, sometimes sparingly anastomosed, 1 µm wide at base, 2 µm at apex, not capitate. Asci: 50 - 55 x 13 - 15 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 12 x 5.5 - 7.5 µm, with distinct Lecanora-type wall about 1 µm wide. 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 much more abundant than records suggest, and many reports of L. carpinea probably belong here. In the Peloponnese this is the commonest species in the L. carpinea-leptyrodes-subcarpinea group.

Widely distributed in Europe to as far north as mid Scandinavia, but absent from British Is. Also Macaronesia, Asia (Turkey, Israel, widespread in Russia).

Lecanora lividocinerea Bagl. (1879)
in: N. Giorn. Bot. Ital. 11: 75; Lecanora cengiae-samboe Szatala

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. Exciple: sometimes visible externally as a very thin ring ± concolourous with disc; in section: 12 µm wide, of radiating hyphae. Thalline margin: prominent, persistent, smooth; in section: 60 µm wide, cortex 12 µm wide; large crystals present, not soluble in K. Epithecium: brown to green-brown or green-black. K-, pigment sometimes anastomosed between paraphyses (but not internal pigment) soluble in K; with small crystals that are soluble in K. Hymenium: 50 - 60 µm tall, colourless, KI+ blue. Hypotheicum: 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 capitate, apical cell with a thin crescent of internal pigment. Ascii: 40 - 50 x 10 µm, narrowly clavate, apex K+ blue. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 12 - 14 x 4 - 5 µm, with prominent Lecanora-type wall. 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 fact that the K reaction is variable in spot tests suggests that lichen substances are sometimes present 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 macrocyclos (H. Magn.) Degel. (1932)


Known from a single site in Epiros, on serpentine rock at an altitude of 2100 m.

Mostly in northern Europe, with a very few reports from further south. Also Asia (Turkey, Siberia).

Lecanora marginata (Schaer.) Hertel & Rambold (1985)
Lecanora meridionalis H. Magn. (1932)
in: Acta Horti Gothob. 7: 82; Lecanora chlorotera subsp. meridionalis (H. Magn.) Clauzade & Cl. Roux

The name Lecanora subfuscus 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. chlorotera but apothecia with dark brown to black discs. For published descriptions see: Clauzade & Roux (1985) as Lecanora chlorotera 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 the Iberian Peninsula to Cyprus, with a very few reports from the Alps and regions just northwards. Also Macaronesia, Asia (Turkey, Iran, southern Siberia, Nepal), N. America (Alberta, scattered in USA mostly in the west).

Lecanora mughicola Nyl. (1872)

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.

Widely distributed in central Europe, and there are a very few reports from further north (Scotland, Norway). South of the Alps it is rare and mostly confined to the mountains. Also Macaronesia, Asia (Turkey, Russia, Mongolia), N. America (western USA).

Lecanora muralis (Schreb.) Rabenh. (1845) var. muralis
in: Deutschl. Krypt.-Fl. 2(1): 42; Lichen muralis Schreb. (1771) in: Spic. Fl. Lips. 130-131. (The name has a conserved type.): Lecanora albomarginata (Nyl.) Cromb.; Lecanora muralis f. areolata (Leight. ex Mudd) J. Steiner; Lecanora muralis var. diffraecta (Ach.) Rabenh.; Lecanora saxicola (Pollich) Ach.; Lecanora saxicola f. areolata (Leight. ex Mudd) Zahlbr.; Lecanora saxicola var. diffraecta (Ach.) Branth & Rostr.; Placodium albomarginatum (Nyl.) Cromb.; Placodium saxicola var. albomarginatum Nyl.; Squamaria albocrypta f. nudiuscula (J. Steiner) Szatala; Squamaria albomarginata (Nyl.) Räsänen; Squamaria diffraecta (Ach.) Duby; Squamaria diffraecta f. areolata (Leight. ex Mudd) Szatala; Squamaria diffraecta var. areolata (Leight. ex Mudd) Szatala; Squamaria muralis (Schreb.) Elenkin; Squamaria versicolor var. schneebergensis (Zahlbr.) Szatala; Squamaria albomarginata (Nyl.) H. Kleinig, nom. inval.; Squamaria diffraecta (Ach.) H. Kleinig, nom. inval.; Squamaria muralis (Schreb.) H. Kleinig, nom. inval.

The muralis aggregate in SE Europe is in need of a revision. Existing taxonomic concepts are difficult to apply and many collections have intermediate characters. Because of these uncertainties I prefer not to provide a description of this taxon yet. For published descriptions see e. g. Smith et al. (2009) or Wasser & Nevo (2005), but note that descriptions from areas outside SE Europe must be applied with care here.

Some of the Peloponnesian collections referred here in Abbott (2009) belong to L. bolcana or to L. muralis var. versicolor, but others do belong to this taxon as I understand it.

Distribution and ecology in Greece uncertain owing to the likelihood of confusion with other taxa. There are reports (as var. muralis and as Lecanora muralis without indication of variety) from most of Greece. On calcareous or siliceous rock at all altitudes. The lichenicolous lichens Diploeschistes muscorum and Placocarpus schaereri have each been reported once from this host, as has the lichenicolous fungus Stigmatidium squamariae.

L. muralis s. lat. is subcosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Paraguay), Australasia (S. Australia), Pacific (Hawaii).

Lecanora muralis var. dubyi (Müll. Arg.) Poelt (1958)

Descriptions: Clauzade & Roux (1995); Nash et al. (2004) - both as subsp. dubyi.

Reported from a single site in Attica at an altitude of about 700 m.

France, Germany, Iberian Peninsula, Italy. Also Asia (scattered to as far east as India), North Africa (Morocco),
Lecanora muralis var. serpentini Poelt (1958)

Description: see the protologue. The status of this taxon is not clear to me.

Known only from the type collection.

Lecanora muralis f. subsulphurata J. Steiner; (?) Lecanora muralis var. subsulphurata (J. Steiner) J. Steiner; (?) Lecanora muralis f. sulphurata J. Steiner; Lecanora saxicola var. albopulverulenta (Schaer.) Zahlbr.; Lecanora saxicola var. versicolor (Pers.) Th. Fr.; (?) Lecanora muralis var. versicolor (Pers.) Zahlbr.; (?) Lecanora saxicola var. albo pulverulenta (Schaer.) Zahlbr.; (?) Lecanora muralis var. subsulphurata (J. Steiner) Zahlbr.; Placodium muralae var. versicolor (Pers.) Kremp.; Placodium saxicola var. versicolor (Pers.) Flot.; Protoparmeliopsis versicolor (Pers.) M. Choisy; Squamarina versicolor (Pers.) H. Kleinig nom. inval.

The combination is sometimes ascribed to Tuckerman (1882), but Tuckerman's name was at the rank of form.

Similar to var. muralis, but more pruinose. However, the muralis aggregate is variable and in need of a monographic treatment. Some collections are hard to place.

Scattered throughout Greece. On calcareous rock at all altitudes.

Southern and central Europe. Also Asia (Turkey, Iran, China), Africa (Algeria, perhaps elsewhere), perhaps N. America (apparently scattered in eastern half of USA), perhaps S. America (Argentina).

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.

Known only from Greece.

Lecanora persimilis (Th. Fr.) Arnold (1872)

Descriptions: Sliwa (2007a); Smith et al. (2009).

Northern half of Greece, on bark at altitudes 0 - 1100 m.

Widely distributed in Europe to about the Arctic Circle. Also Asia (Turkey, Russia), N. America (southern Canada, NW USA).

in: *Nova Hedwigia, Beihefte* 79: 188

*Lecanora latzelli* Zahlbr. might be an earlier name, but the synonymy is not certain.


Islands of the southern Aegean, on calcareous rock at altitudes 250 - 300 m.

Only Mediterranean Europe, from Spain to Greece.

Lecanora polytropa (Hoffm.) Raben. (1845)
in: Deutschl. Krypt.-Fl. 2(1): 37; *Verrucaria polytropa* Hoffm. (1796) in: Deutschl. Fl. 2: 196. (The earlier *Lichen polytropus* Ehrh. (1793) is a nomen nudum.); *Lecanora polytropa f. campestris* Arnold

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. 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. Thalline margin: not visible externally (in Greek material seen by me); in section: present on lower surface of apothecia, 50 - 70 µm wide. Epithecium: 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, expanding gradually to 2 - 2.5 µm at apex, not capititate or moniliform. Ascii: 35 - 40 x 14 - 15 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per
ascus, 10 - 12 x 6 μm. 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 Cercidiospora epiphytophyla and Nesolechia oxyphorica have each been reported once from this lichen.

Subcosmopolitan outside tropical regions. Throughout Europe. Also Macaronesia (widespread), Asia (widespread), Malesia (PNG, Sabah), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (SE Australia, widespread in NZ), Pacific (Hawaii), Antarctica (subantarctic islands, Antarctic Peninsula). The absence of reports for Africa is surprising.

**Lecanora aff. populicola**

I am using this name for a taxon that is distinctive and well defined, and which keys out as *L. populicola* (DC.) Duby, a species that is 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 its identity remains uncertain at present. A full description will be provided when more material has been seen.

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)

in: *Flora* 56: 19; *Lecanora pomensis* Zahlbr.; *Lecanora sardoa* Bagl.; *Lecanora schistina* (Nyl.) Arnold

The earliest name is *Lecanora gangaleoides* subsp. *schistina* Nyl. (1872), but it does not have priority at the rank of species.

Thallus: crustose, pale grey, warted, 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 and rather friable; in section: with a dense mass of crystals, the smaller ones like those in the pseudocortex, dissolving in K to reveal many larger crystals 5 - 8 μm diameter (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. Proper exciple: not visible externally; in section: 15 - 25 μm wide, colourless in inner part, orange-brown at surface, hyphal. Thalline margin: pale grey, persistent but becoming very thin; in section: 125 - 150 μm wide in upper part of apothecium. Epitheicum: orange-brown, pigment soluble in K; K- (see note below), diffusing a yellow pigment into solution. Hymenium: 70 - 90 μm tall, colourless. Hypotheicum: 50 - 100 μm tall, ±colourless. Paraphyses: 1 μm wide at base, 1 - 1.5 μm at apex, anastomosed, not capitiate or moniliform, without visible septa. Asc: 50 x 11 - 12 μm, ±cylindrical to narrowly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 9.5 - 10 x 5.5 - 7 μm, with prominent wall 34 μm thick. 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 the material that I have 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 some apothecia (about 1 in 3) but it is present at low concentration and very few crystals are formed. In the other epithecium 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).

**Lecanora prominens** Clauzade & Vězda (1966)

in: [need to investigate - bibliographical details incomplete]

Description: Clauzade & Roux (1985).

Islands of the Aegean, including Crete. On calcareous (or at least ±basic) rock at altitudes 0 - 1280 m. Only southern Europe, from Spain to Greece.

**Lecanora prophetae-eliae** Sipman (2007)


Description: See the protologue.

Islands of the southern Aegean (including southern Evia), on calcareous rock at altitudes 300 - 500 m. Known only from Greece.
Lecanora pruinosa  Chaub.  (1821)
in: Saint-Amans, Fl. Agen. 495;  
Lecanora lagostana Zahlbr.; Lecanora sulphurella (Körb.) Zahlbr. nom. inval (non Th. Fr.);  
Squamaria pruinosa (Chaub.) Duby; Squamaria sulphurella (Körb.) H. Olivier; Squamaria sulphurella (Körb.) H. Kleining. 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: absent or poorly developed. Medulla: white, chalky. Apothecia: subsessile to sessile, flat to slightly convex, rounded at first but sometimes contorted later, 0.3 - 1.1 mm diameter. Disc: pale brown to dark brown, sometimes almost black, often slightly white pruinose. Exciple: not visible externally; in section: rather poorly developed, 15 - 20 µm wide, not very different from paraphyses, colourless. Thalline margin: prominent, 0.12 mm wide, usually black, often slightly white pruinose. Hymenium: 40 - 75 µm tall, usually colourless, sometimes very pale brown, KI+ blue. Hypothecium: 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. Ascii: 55 - 60 x 8 - 10 µm, cylindrical, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 8 - 12 (15) x 4 - 7 (8) µm, often uniseriate, wall thin and not very prominent (not typical Lecanora type). Chemistry: thallus K-, C+ orange (colour sometimes stronger in KC), P-, I-, UV+ orange. Photobiont: green.

This species can not be separated from other similar species. 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. Material that I have tentatively referred to L. reuteri does not form such regular rosettes and its disc reacts C+ orange.

Widespread and common in the southern half of Greece, rare and scattered in the north. On calcareous rock from sea level to 1200 m, but commonest at low altitudes.

Commonest in southern Europe, though there are scattered occurrences to as far north as England. Also Asia (widespread as far east as Tajikistan and southern Siberia), Africa (Algeria, Tunisia, Socotra). Reports for N. America may be incorrect.

Lecanora pulicaris  (Pers.) Ach.  (1814)
in: Syn. Meth. Lich. 336;  
Lecanora coilocarpa (Ach.) Nyl.; Lecanora pinastri (Schaer.) H. Magn.; Lecanora subfuscus § L. (= var.) coilocarpa Ach.;  
Lecanora subfuscus e. (= var.) pinastri (Schaer.) Rabenh.

There are earlier names that are, or may be, synonymous but only one is at the rank of species, namely Verrucaria detrita Hoffm. (1796) If the synonymy is confirmed, then the correct name for this taxon is Lecanora detrita (Hoffm.) Ach. (1810).

I have referred a single Peloponnesian collection here, but the determination is tentative as the material was scanty and the P reaction was weak. For descriptions see: 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, especially Pinus (Abies cephalonica, Cupressus sempervirens, Pinus heldreichii, P. nigra and P. sylvestris), reported once from Quercus frainetto; less common on wood.

Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread in N. Africa; also Socotra, S. Africa), N. America (widespread), perhaps Pacific (W. Samoa). Reports for S. America may be incorrect and those for Australasia are incorrect.

Lecanora puniceofusca  Bagl.  (1879)

Descriptions: Discussed briefly in Elix & Lumbsch (1996), and Nimis & Poelt (1977). Close to L. campestris, but lacks atranorin and has smaller ascospores.

Islands of the southern Aegean, on siliceous rock at altitudes 25 - 50 m.

Known only from 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 granulare-areolate (emphasis mine).

Rhodes and Athos, on wood at altitudes 700 - 1200 m.

Known only from Greece.
Lecanora reuteri Schae. (1850)
Crete and Macedonia, on calcareous rock. The report from Crete and one of the reports from Macedonia were at low altitude, and are probably unreliable. More plausible is Szatala's report from Mt. Olympus, at altitudes 1700 - 2400 m.
Southern Europe and the southern parts of central Europe. Also Asia (Tajikistan), N. Africa (Morocco, Algeria).

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.
Known from France, Germany, Sardinia and Greece. Perhaps also North America (Tennessee).

Lecanora ripartii Lamy ex Nyl. (1879)
in: 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 that appears to be restricted to southern Europe (Italy to Greece) and Macaronesia (Tenerife).

Lecanora rubicunda Bagl. (1879)
The earliest name is Lecanora subfusca f. sylvestris Nyl. (1868), but it does not have priority at the rank of species.
Description: Clauzade & Roux (1985).
Corfu, on bark of Olea europea at an altitude of 20 m.
Probably circum-Mediterranean/Macaronesian. Southern Europe from Portugal to Greece. Also Macaronesia, N. Africa (Morocco). Reports for elsewhere (S. Africa, N. America) appear to be unconfirmed.

Lecanora rugosella Zahlbr. (1928)
in: Cat. Lich. Univ. 5: 524; Lecanora chlorota f. rugosella (Zahlbr.) Poelt; Lecanora subfusca var. rugosa (Nyl.) Th. Fr.
The first name is Lichen rugosus Pers. ex Ach. (1810), but it is not validly published (cited as synonym). The earliest validly published name is Lecanora subfusca f. rugosa Nyl. (1861). The combination at species rank, made by Nylander in 1872, is an illegitimate later homonym of L. rugosa Ach. (1810), and thus a nomen novum was required. The name Lecanora subfusca var. coronata A. Massal. may also be synonymous, but the epithet has not been used at species rank.
Similar to L. chlorota, 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. chlorota that they can not possibly be the same species. The situation is likely to remain unclear pending a revision of the chlorota group in SE Europe.
Scattered throughout Greece, but less common than L. chlorota. 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.
Widely distributed in Europe to as far north as mid Scandinavia. Also Asia (widespread), N. America (widespread).

Lecanora rupicola (L.) Zahlbr. (1928) var. rupicola
in: Cat. Lich. Univ. 5: 525; Lichen rupicola L. (1767) in: Mant. Pl. 132; Lecanora glaucoma (Hoffm.) Ach.; Lecanora rimosala a. (= var.) sordida (Pers.) Rabenh.; Lecanora rupicola f. decussata (Cromb.) Zahlbr.; (? Lecanora rupicola var. pseudosubcarnea (Harm.) Zahlbr.; Lecanora sordida (Pers.) Th. Fr.; Lecanora sordida f. decussata (Cromb.) J. Steiner
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, subrounded to angular. Prothallus: usually absent; occasionally with a white prothallus 0.5 - 1.5 mm wide, less commonly with traces of a black prothallus to 0.5 mm wide. Cortex: no well-developed cortex, but 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 and 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, but usually obscured by dense white pruina. Exciple: not visible externally; in section: 25 - 40 µm wide, colourless except in a thin surface layer which is brown, of radiating hyphae, without crystals. 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 an obvious cortex, with abundant fine crystals everywhere, soluble in K. Epithecium: brown-grey, K-, pigment soluble in K. Hymenium: 60 - 65 µm tall, colourless, KI+ blue. Hypothecium: 100 µm tall, colourless. Paraphyses: simple (said to be sparingly branched sometimes), cylindrical, 1 µm wide, not capitate or moniliform. Asci: 50 x 20 µm, clavate, Lecanora type. Ascospores: colourless, simple, usually ellipsoid, occasionally dacroform, 8 per ascus, 11 - 15 x 4.5 - 8 µm, with a distinct but rather thin Lecanora-type wall. Chemistry: pruina of disc C+ persistent yellow, orange-yellow or orange; medulla K-, C-, KC-, P-, I-; thallus K+ faintly yellow (diffusing a yellow pigment in solution), C-, KC- or remaining yellow, P-, UV+ faintly orange. Photobiont: green, cells globose, 10 - 12 µm diameter. Photobiont layer: 50 - 70 µm 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, Rimaria insularis three times and, once each, Caloplaca inconnexa and Rinodina insularis.

Subcosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread, but rare in eastern USA), S. America (Argentina), Australasia (NSW, both islands of NZ), perhaps Pacific (Hawaii).

*Lecanora rupicola var. efflorens* Leuckert & Poelt (1989)
in: *Nova Hedwigia* 49(1-2): 151

Description: Smith et al. (2009).

Epiros, on serpentine at an altitude of 1100 m.

Apart from the Greek report, var. *efflorens* is restricted to the western half of Europe: from Spain to Italy in the south, and from the British Is to Austria further north. I have not seen any reports for other continents.

*Lecanora rupicola subsp. subplanata* (Nyl.) Leuckert & Poelt (1989)
in: *Nova Hedwigia* 49(1-2): 152; *Lecanora subplanata* Nyl. (1881) in: *Flora* 64: 530; *Lecanora subradiosa* (Nyl.) Nyl.

The earliest name is *Lecanora glaucoma** L. subradiosa* Nyl. (1872) in *Flora* 55: 549. It was Nylander's normal practice to use this style to denote the rank of subspecies, and if the 1872 name is taken to be at that rank, then the epithet *subradiosa* has priority at that rank. However, in the 1872 publication itself I can not find any definite statement that this style as intended to denote 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.

Scattered in the western half of Europe, from Iceland to Sicily, but absent from those parts of eastern Europe with a continental climate. Also western Asia (widespread as far east as Kazakhstan), N. Africa (Algeria).

*Lecanora rupicola subsp. sulphurata* (Nyl.) Leuckert & Poelt (1989)

The earliest name is Parmelia glaucoma var. sulphurea Clemente (1807) in Ensayo 301. Parmelia glaucoma var. sulphurata Ach. (1814), in Syn. Meth. Lich. 166, is a superfluous name for Parmelia glaucoma var. sulphurea. Nylander's name is based on that of Acharius, but the epithet *sulphurata* is legitimate at the rank of species (and also subspecies).

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 Europe, with a few records from central Europe. Also Macaronesia, western Asia (Turkey, Syria).

*Lecanora saligna* (Schrad.) Zahlbr. (1928)
in: Cat. Lich. Univ. 5: 536; *Lichen salignus* Schrad. (1794) in: Spic. Fl. Germ. 84-85; (?) *Lecanora prosechoides f. obscurior* (Nyl.) J. Steiner

My only collection is referred to this species with some uncertainty, so no description is provided. For published descriptions see: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Lecanora sambuci (Pers.) Nyl. (1861)
Descriptions: Clauzade & Roux (1985); Sliva (2007a); Smith et al. (2009).
Rare and scattered, with no clear pattern. On bark at altitudes 350 - 800 m.
Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (Turkey, Lebanon, Russia), N. Africa (Morocco, Algeria), N. America (southern Canada, cooler parts of USA).

Lecanora scrupulosa Ach. (1810)
in: Lichenogr. Universalis 375
Reported for Greece but, as pointed out by Brodo & Vitiainen (1984), the epithecial of the type has been destroyed, and as a result the name is of uncertain application.

Lecanora semipallida H. Magn. (1940)
in: Lich. Central Asia 89; Lecanora xanthostoma Wedd. ex Cl. Roux
Thallus: crustose, usually inconspicuous (? immersed), only well developed in small patches around some apothecia, white, to 3 cm diameter (judging from distribution of apothecia). Apothecia: sessile, zflat, 0.4 - 0.6 mm diameter, not pruinose. Disc: brown to olive-brown. Exciple: not visible externally; in section: 15 µm wide, colourless except right at surface, of anastomosed hyphae on an overall radiating trend, without crystals. 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 outer part obscured by crystals. Epithecial: brown, K-, with abundant but generally discrete crystalline granules, 1 - 3 µm wide, soluble in K. Hymenium: 50 µm tall, colourless. Hypothecium: 50 µm tall, colourless. Paraphyses: simple, 1 µm wide at base, to 2 µm at apex, not capitate. Asci: 40 - 45 x 12 - 13 µm, clavate. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 12 x 4 - 5.5 µm, with prominent Lecanora-type wall. Chemistry: thalline exciple K-, C+ yellow. Photobiont: green, cells globose, 8 - 12 µm diameter.
The C+ reaction makes this a fairly distinctive member of the Lecanora dispersa group. However, it may be faint, and in one collection that seems fairly definitely to belong here I could not demonstrate it convincingly at all. The species is also well characterised by the brown crystalline granules, soluble in K, in the epitheicum.
Rare and scattered (or perhaps just overlooked) with no clear pattern. On calcareous rock at altitudes 400 - 1050 m.
Distribution not well known, but seems to be present in much of Europe. Also Macaronesia, Asia (Russia, Tajikistan, Mongolia, China), N. America (widespread, but absent from SE USA), Australasia (Australia, NZ), Antarctica.

Lecanora strobilina (Spreng.) Kieff. (1895)
The earliest name may be Lecanora varia var. betulina Ach. (1810), but it does not have priority at the rank of species. The name Lecanora strobilina was published by Acharius in 1814, but not validly published, as later in the same publication he rejected the name.
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. Exciple: smooth, becoming excluded; in section: 25 µm wide, colourless in inner part, brown in outer part, of radiating hyphae. Thalline margin: rather obscurely present on under surface of apothecia; in section: outer part with abundant small crystals, soluble in K. Epithecial: brown to pale grey-brown, K-, pigment soluble in K; with abundant small crystals that are soluble in K. Hymenium: 45 µm tall, colourless. Hypothecium: 35 µm tall, colourless. Paraphyses: 1 µm wide at base, 2 µm at apex, slightly capitulate. Ascospores: colourless, simple, ellipsoid or slightly curved, 8 per ascus, 10 x 3 µm. 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 patter. On bark or wood at altitudes 25 - 1300 m. On bark, especially of Pinus, or wood. The lichenicolous fungus Vouauxiella lichenicola was reported once from this lichen.
Throughout much of Europe to as far north as southern Scandinavia, but avoiding those parts of eastern Europe with a distinctly continental climate. Also Macaronesia, Asia (Turkey, southern Siberia), N. Africa (Morocco, Algeria), N. America (SE Canada, widespread in USA but generally avoiding continental interior), C. America (Mexico), S.
America (Ecuador, perhaps Chile). Reports for Australasia are incorrect.

**Lecanora subcarnea (Lilj.) Ach. (1810)**


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 and almost a pseudocortex, 12 - 25 µm thick, colourless, without distinct structure in water, sometimes with a weak cellular texture in K; K-. Medulla: white. Apothecia: 0.3: 0.7 mm diameter, flat, sessile, often with a narrow base, Disc: pale brown, but usually obscured by white pruina. Excircle: 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. Thalline margin: white 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. Epithecium: brown, K-, some pigment dissolving in K leaving a greyish residue (?pruina). Hymenium: 50 - 70 µm tall, colourless, K+ 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, 8 per ascus, 12.5 - 13 x 6 - 7.5 µm, often with 2 locules. Chemistry: disc C-; medulla K-, P-, I-; thallus K-, C-, 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 Peloponnesean 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), Africa (S. Africa), N. America (at least California), C. America (Mexico), perhaps Pacific (Marquesas). Reports for Australasia are incorrect.

**Lecanora subcarnea Szatala (1954)**


Abbott (2009) reported this species for Greece only tentatively. It is definitely present in the Peloponnesse on the basis of two collections now determined with certainty. (Two others are referred here only tentatively.)

Thallus: crustose, white, slightly cracked, forming small patches 0.8 - 2.5 cm diameter, without vegetative propagules. Prothallus: absent. Apothecia: abundant, subsessile to sessile, flat to slightly convex, 0.7 - 2 mm diameter, strongly white pruinose. Disc: pale brown to pale pink-brown (below pruina). Excircle: not visible externally; in section: 15 µm wide, poorly developed and scarcely distinguishable from hymenium, colourless except right at surface. 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. Epithecium: brown, K-, pigment soluble in K; with abundant small crystals soluble in K. Hymenium: 100 µm tall, colourless, K+ 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, 8 per ascus, 12 - 13 x 5.5 - 7.5 µm, with distinct Lecanora-type wall. 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 Peloponnishe. The two confirmed collections were from bark of *Quercus* (*Q. cocifera* and *Q. frainetto*) at altitudes of 950 - 1050 m.

Basically a species of central Europe to as far north as Estonia. Its well-documented range extends only a little south of the Pyrenees (Asturias) and Alps (Slovenia). However, it may have been overlooked. Also Asia (Turkey, southern Siberia), N. Africa (Algeria).

**Lecanora subintricata (Nyl.) Th. Fr. (1871)**


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Mt. Olympus, on wood at altitudes 1700 m and above. Widely distributed in Europe from the Alps to about the Arctic Circle. The very few confirmed reports from south of the Alps are for the highest mountains: a report for Cyprus seems doubtful to me. Also Asia (Russia, Kazakhstan, Japan), N. Africa (Morocco, Algeria), N. America (widespread from Alaska to cool parts of USA).

**Lecanora sulphurea** (Hoffm.) Ach. (1810)

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: subimpressed to sessile, flat to convex, 0.4 - 2 mm diameter, sometimes slightly white pruinose when young. Disc: pale yellow-brown to black. Exiple: not visible externally; in section: 25 - 40 µm wide, colourless to pale blue-green in inner part, brown in outer part, of branching or sometimes anastomosing hyphae on an overall radiating trend; with abundant fine polarising granules soluble in K. Thalline margin: absent or poorly developed; if present soon excluded, or present only as a 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. Epithecium: brown, green-brown or green-black, K- or K+ intensifying green (presumably brown pigment soluble in K), N+ red-purple, green pigment soluble in N; with a few fine polarising granules (like those in exciple). Hymenium: 50 - 60 µm tall, colourless, K+ blue. Hypothecium: 100 - 150 µm tall, colourless, K+ 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 capitulate, apex surrounded by a thin, dull greenish pigment hood. Ascii: Lecanora type. Ascospores: colourless, simple, narrowly ellipsoid, 8 per ascus, 10 - 13 x 4 - 5 µm. Pycnidia: visible externally as black dots, 0.05 - 0.1 mm diameter; in section: 100% immersed, 100 - 125 µm tall, 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 subimpressed black apothecia ± without a thalline exciple make this species easy to recognise. *Rhizocarpon geographicum* is a much greener green, has very different ascospores, and occurs only on nutrient-poor siliceous rock.

Fairly widely distributed in the southern half of Greece, less common common in the north. On siliceous rock, especially when slightly nutrient enriched, at altitudes 0 - 1400 m. Once reported (Serví, 1933) overgrowing, and apparently parasitic on, *Tephromela atra*.

Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America, perhaps S. America (Argentina). Reports for Australasia are incorrect.


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 very rare south of the Alps and Pyrenees, and there restricted to the mountains. Also Macaronesia (Canary Is), Asia (Turkey, Armenia, Russia as far east as central Asia; subsp. nylanderi also in Syria), North America (Arizona), Australasia (widespread in cool and temperate regions).

**Lecanora symmicta** (Ach.) Ach. (1814)

The earliest name appears to be *Verrucaria maculiformis* Hoffm. (1796), in which case the correct name for this species would be *L. maculiformis* (Hoffm.) Nägeli ex Hepp. If the synonymy is confirmed, then conservation will be required.

The Peloponnesian collection of Abbott, cited in Abbott (2009), was incorrectly determined and belongs to *L. streblina*. I have another collection that may belong here, but I would like to study additional material before providing a description. 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 the high arctic. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread), C. America (Mexico), Australasia (scattered in Australia, widespread in NZ), perhaps Pacific (Hawaii), Antarctica (subantarctic islands).

**Lecanora umbrosa** Degel. (1943)
in: [need to investigate - title & page range of paper not known]; (?) *Lecanora subfasca* var. *variolosa* auct. graec.; (?) *Lecanora variola* auct. graec.


Athos, on bark of *Quercus* at an altitude of 400 m.

Widely distributed from the Alps northwards. Present but very rare in the Balkans and a few parts of southern Europe. Also N. America (scattered in cold regions).

**Lecanora varia** (Hoffm.) Ach. (1810)
in: Lichenogr. Universalis 377; *Patellaria varia* Hoffm. (1790) in: Descr. Pl. Cl. Crypt. Vol. 1 part 2 (fascicles 3 and 4), page 102. (The earlier *Lichen varius* Ehrh. (1785) is said to be a nomen nudum.); *Lecanora varia* var. *abbrevians* Hedl.; *Lecanora varia* var. *subvaria* (Nyl.) H. Olivier

**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. *Exciple:* not visible externally; in section: poorly developed, 15 µm wide. *Thalline margin:* present, prominent, persistent, regular, 0.08 mm wide, often with a 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. *Epithecium:* dark brown, with abundant small polarising granules. *Hymenium:* 65 µm tall, colourless. *Hypothecium:* 95 µm tall, colourless. *Ascospores:* colourless, simple, ellipsoid, 8 per ascus, 10 x 5 µm, with distinct wall. *Chemistry:* disc C-; thallus and thalline exciple K+faintly yellow, C-, P+ yellow, UV- (or almost). Photobiont: green.

In the single Peloponnesian collection seen to date 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, but commonest above 1000 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria; an old report for S. Africa may be unreliable). 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)
in: Methodus 32-33

**Type:** *L. fuscoatra* (L.) Ach. Family: Lecideaceae. Literature: 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. fusca*, *L. graeca*, *L. halacysyi*, *L. separanda*, *L. tessellata var. caesia*, and *L. tringiana* there is little alternative to consulting the protologues.

Because the genus is still heterogeneous, and also because I have seen rather few collections, a detailed description would not be appropriate. However, the main characters are as follows. Thallus: crustose. Apothecia: rounded, black in most species, usually without a thalline exciple. Asci: wall weakly KI+ blue, an apical spot strongly KI+ blue (Lecidea type). Ascospores: colourless, simple, small to medium-sized, generally ellipsoid, 8 per ascus. Photobiont green, trebouxoid.

Lecidea was at one time used as a 'dustbin' genus for a wide range of 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. In that circumscription, it contained about 1000 species. The name is now understood in a much narrower sense and comprises perhaps 100 - 150 species, but is probably still heterogeneous. Lecidea sensu strictu, i.e. *L. fuscoatra* and closely related species, appears to be restricted to siliceous rocks in temperate and cool climates.

11111 On other lichens (Note 1).
22 On Aspicilia.
33 Epithecium blackish. (L. dispersula)
3 Epithecium greenish. **L. tessellata** s. lat.
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. halacsyi**

111 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**)

111 On bark or wood.
222 Thallus C+ red. Apothecia black. **L. aegaeca** Note 2.
22 Thallus C-, KC+ orange. Disc pale yellow-brown to dark red-brown. (**L. varians**) Greek report incorrect.
2 Thallus C-, KC-.
33 Ascospores globose or subglobose, 4 - 7 µm diameter. (**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. holopolia**)
5 Thallus strictly crustose. Exciple without rounded cells with thick gelatinous sheaths.
66 Soralia present. (**L. pullata**)
6 Soralia absent.
77 Epithecium with minute pale granules, giving apothecia a pruinose appearance when wet; granules soluble in K. **L. turgidula**
7 Epithecium without minute granules. (**L. erythrophaea**) Greek report needs confirmation.

11 On calcareous rock.
22 Hypothecium colourless or pale brown. **L. tessellata v. caesia**
2 Hypothecium dark brown. (**L. umbonata**) Greek report incorrect. Note 3.
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. confluentula**) 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. confluentula**) See discussion below.
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. obluridata)

4 Thallus pale (white or pale grey) or entirely endolithic.

55 Hypothecium colourless or pale brown.

66 Ascospores 2.5 - 5 \( \mu \)m wide. Thallus immersed or superficial; if superficial then grey, not white.

77 Thallus immersed. Apothecia 0.6 - 1.4 mm diameter. **L. laboriosa**

6 Outer part of exciple K+ purple.

55 H. dark brown to black.

66 Outer part of 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. graeceae 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 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.) Schaer. (1828)


Very scattered, on the mainland and on Crete, but not recorded for any of the smaller islands. Commonest in northern Greece. At altitudes from 200 to about 2150 m, on siliceous rock. The lichenicolous fungus *Sphaerellothecium abditum* has been reported from this host.

Throughout central and northern parts of Europe, but rare south of the Alps. Also Macaronesia, Asia (widespread), perhaps N. Africa (Morocco), N. America (widespread, mainly in the western half), C. America (Mexico), S. America (Chile), Australasia (SE Australia), Pacific (Hawaii), Antarctica (widespread).

**Lecidea confluentula** Müll. Arg. (1872)

The protologue for *Buellia olympica*, in Müller (1879a) says that it was collected together with *Lecidea confluentula* from “Mt. Olympus” on granite at an unspecified altitude. However, it is not clear whether this means Mt. Olympus in Greece or the Mt. Olympus in Turkey. At present, *L. confluentula* can not be accepted as a Greek species.

**Lecidea diducens** Nyl. (1865)

in: *Flora* 48: 148; *Lecidea auriculata* β (= var.) diducens (Nyl.) Th. Fr.

Description: 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 parts of Europe, but very rare south of the Alps. Also Asia (Turkey, Russia, Nepal, Japan), N. America (scattered, mainly in the west, from Alaska to cooler parts of USA), S. America (Chile), Australasia (SE Australia, NZS).

**Lecidea ecrustacea** (Anzi ex Arnold) Arnold (1876)

Description: Clauzade & Roux (1985) as *Lecidea lactea var. ecrustacea*.
Thessaly, at about 1400 m altitude, on schist. Not recorded since the 19th Century.
Most reports of this rather poorly known species are from north of the Alps, but it is present in Sardinia. Also Asia (Russia), N. America (Alaska).

**Lecidea fuliginosa** Taylor (1836)
in: Mackay, in: Fl. Hibern. 2: 131
Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Chios and Samothraki, on siliceous rock at altitudes 440 - 600 m.
Throughout northern and central Europe, but very rare south of the Alps. Also Asia (Siberia, Tajikistan, Mongolia), N. America (scattered in eastern half of USA).

**Lecidea fuscata** (Lam.) Ach. (1810)
in: Lichenogr. Universalis 211; *Lichen fuscatus* Lam. (1792) in: Encycl. 3: 478
Descriptions: Acharius (1810, 1814).
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 its application is not clear to me.

**Lecidea fuscoatra** (L.) Ach. (1803)
in: Methodus 44 (as *fusco­atra*); *Lichen fuscoater* L. (1753) in: Sp. Pl. 1140 (as *fusco­ater*);

Thallus: crustose, areolate, usually pale brown but sometimes green-grey or brown-grey, usually not pruinose but some collections have a moderate development of white pruina. Areoles: usually subrounded, 0.3 - 1.3 mm wide (the larger ones tending to occur nearer the margin of the 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 (probably formed of hyphae oriented perpendicular to surface), K- (but pigment dissolves); cortex is 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: submersed to sub sessile, not often distinctly sessile, flat to moderately convex, 0.4 - 1.6 mm diameter, usually not pruinose, sometimes with a faint trace of white pruina. Disc: black. Exciple: black, persistent but becoming very thin; in section: 30 - 50 µm wide, dark brown (too dark for structure to be easily seen). Thalline margin: absent. 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, K+ blue. Hypothecium: 125 µm tall, dark brown. Paraphyses: simple, coherent. Asci: with a KI+ strongly blue spot near the apex, walls weakly KI+ blue (Lecidea type). Ascospores: colourless, simple, ellipsoid, 8 per ascus, 15 x 5 µm. Chemistry: in spot tests 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 records for calcareous rock probably refer to other species. The lichenicolous lichen *Rimularia furvella* has been reported once from this species.
Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (scattered from Alaska to cooler parts of USA), C. America (Mexico), perhaps S. America (Argentina, Bolivia), Pacific (Hawaiian).

**Lecidea graeca** J. Steiner (1893)

Description: See the protologue. Steiner's description is quite comprehensive, but unfortunately his material lacked properly developed ascospores ("sporae nunquam evolutae"), so speculation about the identity of this lichen is hazardous. Unless authentic material still survives, the name will remain 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, vorsügßlich in Schlesien, nos. 141 - 142. (It is claimed that the 1830 name is not a nomen nudum. Otherwise, the basionym is Lecidea fusca B. (var.) grisella Flörke ex Schäer. (1850) in Enum. Crit. lich. Eur. 110, and the combination at species rank was made by Branth in Bot. Tidsskr. 2: 85. 1868.; Biatora fusca var. grisella (Flörke) Flot.; Lecidea fuscoatra var. grisella (Flörke) Nyl.

Thallus: crustose, to many cm diameter, continuous in marginal parts, cracked (but 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: subimmersed, flat, 0.6 - 1.4 mm diameter. Disc: black, moderately white pruinose. Exciple: black but thin, persistently, 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. Thalline margin: absent. Epithecium: grey to green-grey, basically K- but green tinge accentuated, N+ slowly red. Hymenium: 90 µm tall, colourless, KI+ blue. Hypothecium: dark brown. Paraphyses: simple, 1 - 1.5 µm wide at base, 2 µm at apex, without visible septa, not capitulate or moniliform. Asc: 60 x 14 µm, narrowly clavate. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 12 x 7 µm. Chemistry: in spot tests: 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 than L. fuscoatra but colour alone can be misleading when trying 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 Lecidea 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 (Algeria, perhaps Morocco), N. America (California).

Lecidea halacsyi 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. Reports of Carbonea halacsyi sensu Hafellner & Sancho for the Iberian Peninsula refer to Carbonea intrudens.

Lecidea laboriosa Müll. Arg. (1874)


Attica at about 200 m altitude; substrate not stated. The single Greek record was made by Hertel, a specialist in Lecidea, and may be presumed to be reliable.

A rather poorly known species known from a few countries scattered across Europe. Also Asia (Kazakhstan, Nepal, Mongolia), N. America (scattered in western Canada and western USA), C. America (Mexico), S. America (Chile).

Lecidea lapicida (Ach.) Ach. (1803) var. lapicida

The nomenclature needs to be investigated, as Lichen lapicida Ach. appears to be a superfluous name and thus illegitimate.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Most reports are from NW Greece, though there is an outlier in the Peloponnesse. On siliceous rock at altitudes about 1800 - 2150 m, though there is one anomalous, and perhaps incorrect, report from just 20 m. The lichenicolous fungus Mutellera pygmaea has been reported once from this lichen.

Throughout central and northern parts of Europe. Rare south of the Alps and confined to high mountains. Also Macaronesia, Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread from Alaska to cooler parts of USA), S. America (Argentina, Chile, Columbia, Venezuela; perhaps elsewhere), Australasia (montane SE Australia, NZS), Antarctica (widespread). Reports for C. America (CR), Pacific (New Caledonia) seem doubtful to me.

Lecidea lapicida var. pantherina (Hoffm.) Ach. (1808)
It was almost certainly Acharius's intention to make a combination from *Verrucaria pantherina* Hoffm. Although Acharius did not cite that name in synonymy in 1808, he did so in 1810 in *Lichenogr. Univ.* 159.

If *Lecidea lapicida* var. *cyanea* Ach. (1803) is synonymous, as some authors have suggested, it would be the correct name 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) 800 - 2150 m.

The European distribution of var. *pantherina* is basically the same as that of var. *lapicida*. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (scattered from Alaska to cold parts of USA), S. America (Argentina, Colombia), Australasia (SE Australia, NZS).

**Lecidea praenubila** Nyl. (1873)

in: *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 in cold regions). I am sceptical of a report for Pacific (Hawaii).

**Lecidea promiscens** Nyl. (1872)

in: *Flora* 55: 358; *Lecidea promiscua* var. *promiscens* (Nyl.) Clauzade & Cl. Roux

Descriptions: Clauzade & Roux (1985) as *Lecidea promiscua* var. *promiscens*; Nash et al. (2004); Smith et al. (2009).

Very scattered, with no pattern. On rock at altitudes 200 - 2200 m. Probably some of the reports are incorrect, but this species is certainly present in Greece; the report for Crete was made by Hertel, a specialist in *Lecidea*, and may be presumed to be reliable. The lichenicolous fungus *Muellerella erratica* has been reported once from this lichen.

Commonest in temperate latitudes, but reported as far north as Sweden. Rare south of the Alps and confined to high mountains. Also Asia (widespread), N. Africa (Morocco), N. America (Arizona, Colorado, perhaps elsewhere), southern S. America (Argentina, Chile), Australasia (SE Australia).

**Lecidea promiscua** Nyl. (1872)

in: *Flora* 55: 357-358

Thallus: crustose, grey, areolate, rather thin (170 - 210 µm). Areoles: subrounded to angular, 0.25 - 1 mm wide. Cortex: 20 - 25 µm thick, ±colourless, without distinct structure even in K. Medulla: white, I+ blue. Apothecia: sessile, flat, 0.25 - 0.6 mm diameter, not pruinose. Disc: black, matt. Exciple: black, rather thin but persistent; in section: colourless in inner part, dark brown in outer part (sometimes pale purple-brown in between), of ±radiating hyphae. C- Thalline margin: absent. Epithecium: very dark brown, often with a green tinge, basically K- but green tinge predominating 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, with a pigmented cap. Asci: 40 x 12 µm, clavate, wall diffusely KI+ blue and an apical spot more strongly KI+ blue (probably Lecidea type). Ascospores: colourless, usually simple (occasionally appearing 1-septate with a very thin septum), 8 per ascus, 8 - 12 x 3 µm. 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; it is the only Peloponnesian species of *Lecidea* occurring on siliceous rock that has these characters. However, it belongs to a group of species that are said to be difficult to separate.

Scattered, on the mainland and Evia. On siliceous rock at altitudes 1100 m and above. The lichenicolous fungus *Muellerella erratica* has been reported once from this lichen.

A rather poorly known species scattered from Sweden southwards, but south of the Alps rare and probably confined to the mountains. Also Asia (Kazakhstan, Russia).

**Lecidea sarcogynoides** Körb. (1855)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered, with no clear pattern, on siliceous rock at altitudes 100 - 2000 m. The report for the Peloponnesian was from calcareous rock, and is probably incorrect.

Widely distributed to as far north as southern Sweden, but avoiding regions with a truly Mediterranean climate; in southern Europe probably confined to the uplands. Also Africa (Algeria, Angola, S. Africa, perhaps elsewhere), S. America (probably widespread in cool and montane regions), Australasia (widespread). A report for Asia (Kuwait) seems doubtful to me.
**Lecidea separanda** J. Steiner (1898)

Description: See the protologue. This species is known only from the type collection. It was said to be identical to *Lecidea tringiana* expect for having shorter, broader conidiophores ("sterigmata") and shorter conidia. Quite 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*.

M. Panachaiko in the Peloponnesian, on siliceous rock.

**Lecidea tessellata** Flörke (1819)
in: Deutsche Lichenen Fasc. 4, p5

The earliest name is *Lecidea pantosticta* var. *spilota* Ach. (1808), but it does not have priority at the rank of species.

Thallus: crustose, areolate, slightly zoned, mostly grey but outermost 1 mm white, 1150 µm thick. Areoles: ± angular, 0.5 - 1 mm diameter, marginal ones very slightly radiating. Prothallus: present but faint, blue-black to black. Cortex: true cortex probably absent; layer above photobiont cells 15 - 20 µm thick, ±colourless, entirely structureless and including 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. Exciple: black, persistent; in section: 30 µm wide, sometimes dark brown in outer part and colourless in inner part, but in some sections only epithelial pigment present. Thalline margin: absent. Epithecium: blue-green, K-, N+ purple. Hymenium: 75 µm tall, mostly colourless, but upper part sometimes with epithelial pigment. Hypothecium: 75 µm tall, colourless to very pale brown, N-. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 8 - 12 x 5 µm, with a distinct wall about 0.7 µm thick.: 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.

The only Peloponnesian collection is difficult to interpret, as it 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).

Very scattered, on the mainland, on siliceous and calcareous rock at altitudes 1000 - 2700 m.

Widely distributed 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 (Argentina, Bolivia, Peru, Venezuela).

**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).

Peloponnesian, on limestone at about 2200 m altitude. The only Greek report was made by Hertel, a specialist in *Lecidea*, and may be assumed to be reliable.

Similar distribution in Europe to var. *tessellata*, but less frequently reported. Also Asia (Japan), 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, the precise application of the name is likely to remain uncertain unless authentic material still exists.

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.

Widely distributed in central and northern parts of Europe, but south of the Alps confined to the uplands. Also Macaronesia, Asia (Russia, Mongolia, Japan), N. Africa (Morocco), N. America (fairly widely distributed from Alaska to cooler parts of USA), Australasia (Tasmania).
Lecidella Körb. (1855)


Type: L. viridans (Flot.) Körb. 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. Several important papers and monographs (not seen) exist in German.

Thallus: crustose, thin to well-developed, continuous to areolate, white, grey, brownish or greenish. Vegetative propagules present in only a few species. Apothecia: without a thalline exciple; 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, 8 per ascus, small to medium sized (typically 10 - 18 µm long). Pycnidia; not seen. Chemistry: variable, but many species C+ orange. Photobiont: trebouxioid.

About 50 species, mostly outside the tropics, of which about 32 are present in Europe. Lecidella is quite well represented in Greece, and a few of the species are very common. Most species occur on bark or rock.

L. atrosanguinea (Hoffm.) R. Sant. is not included in the key, as the information I have is inadequate.

1111 Parasitic on other lichens. (L. vorax)
111 On bryophytes or plant remains. (L. wulfenii)
11 On bark or wood.

222 Blastidia present. Blastidia K+ yellow, C+ orange. Apothecia common. L. pulveracea
22 Blastidia absent, but soredia present. Reactions various. Apothecia common or not.
33 Soralia continuous; thallus ±leprose. Thallus K+ yellow, C-. L. albida
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+.
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 Soralia or blastidia present.
33 Thallus ±entirely sorediate or blastidiate. (L. meiococca)
3 Thallus with delimited soralia. L. scabra
2 Soralia and blastidia absent.
33 Hypothecium colourless or ±colourless.
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 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
6 Exciple blue-green, green-black, or black-green. On calcareous or siliceous rock. L. stigmatea (Note 1)
3 Hypothecium some shade of brown, at least in lower part.
44 Thallus C+ orange or red 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 geographicaly 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 KC+ orange, but the reaction can be faint. The KC+ reaction is stronger. Unfortunately, both can be patchy, demonstrable in some parts of a thallus but not others. (This can make determination of scanty collections difficult.) I only determine a collection as L. euphorea if it reacts KC- in several different places.

**Lecidella aegaea Knoph & Sipman** (1999)

in: *Myctaxon* 72: 74-76

Thallus: crustose, white, cracked, with a 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. Exciple: thin, black; in section: 15 μm wide, brown. Thalline margin: absent. 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, 8 per ascus, 13 x 5.5 μm. 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. asea* (var. *asea*). The description is based only on collections that undoubtedly 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 albida** Hafellner (2001)

in: Hafellner & Türk, in: *Stapfia* 76: 153; *Lecidea alba* Schleich. ex Sch aer.

Hafellner published the name as a *nomen novum* for *Lecidea alba* Schleich. ex Sch aer. (1833), an illegitimate name (later homonym). However, Sch aerner’s name is said to have been combined into *Biat ora* by Hepp (in his exsiccat Die Flechten Europas), and the name *Biat ora alba* Hepp, if validly published, is (probably) legitimate. *Lecidella albida* Hafellner may prove to be a superfluous name.

Description: Clauzade & Roux (1985) as *Lecidella alba*.

Corfu, on bark of *Olea europae a* at close to sea level, and mountains of northern Peloponnese on *Pinus* at high altitude

Alps and nearby regions (Austria, Switzerland, southern Germany, Czech Republic, Slovenia) and Greece only.

**Lecidella anomaloides** (A. Massal.) Hertel & H. Kilias (1980)


Several earlier names may refer to this taxon. Those that would have priority at the rank of species are: (1) *Lecidea immersa* var. *goniophila* Flörke (1809). The epithet was first used at species rank by Sch aerer, in 1850, as *Lecidea goniophila*. (2) *Patellaria cyanea* Flörke ex Duby (1830).

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
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 to 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.

Widely distributed in the western half of Europe as far north as the Arctic Circle, but absent from those parts of eastern Europe with a distinctly continental climate. Also Macaronesia(widespread), Asia (widespread), N. Africa (Morocco), N. America (cooler pats of USA), C. America (Mexico), Australasia (Victoria, Western Australia).

Lecidella asema var. elaeochromoides (Nyl.) Nimis & Tretiach (1996)


The earliest name at the rank of variety is Lecidea enteroleuca (= var.) flavida Fr. (1822), if the synonymy can be confirmed.

Description: Clauzade & Roux (1985) as Lecidella subincongrua var. elaeochromoides; Smith et al. (2009); Wasser & Nevo (2005).

Islands of the Aegean and adjacent coasts of the mainland. On siliceous rock at altitudes 0 - 450 m, but usually below 200 m.

Basically Mediterranean-Atlantic in Europe, though also known for Germany and Austria. Spain to Cyprus, and along the Atlantic margin to as far north as British Is. Also Macaronesia, Asia (Turkey, Syria, Israel in the west; China, Japan in the east; but absent from continental interior), N. Africa (Morocco, Algeria), N. America.

Lecidella carpathica Körb. (1861)

in: Parerga Lichenol. 212; Lecidea carpathica (Körb.) Szatala; (?) Lecidea latypea auct. graec.

Thallus: crustose, pale grey to grey, not pruinose, areolate, often warted, without vegetative propagules, 0.5 - 1 mm thick. Areoles: ±contiguous, 0.2 - 0.5 mm wide, flat to slightly convex. Cortex: 25 - 50 µm thick (including epicortex), colourless, usually ±cellular; cells small, subrounded, 2 - 4 µm diameter; over lain by a colourless, structureless epicortex 5 - 8 (20) µm thick. Medulla: white. Apothecia: subsessile to sessile, flat at first, sometimes becoming convex later, 0.25 - 1.25 mm diameter, not pruinose. Disc: black, matt. Excircle: 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 a trace of blue-green pigment, K+ purple-brown. Thalline margin: absent. 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 (sometimes underlain by a rather poorly developed subhymenium, about 30 µm tall), colourless or with some epithelial pigment in upper part; oil droplets absent (or very few). Hypothecium: 250 µm tall, mostly brown to dark brown, sometimes colourless in upper part, K+ 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. Asc: 60 x 15 µm, narrowly clavate, Lecidella type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 15 x 6 - 7.5 µm, sometimes with a distinct Lecanora-type wall, ¾ µm wide, when mature. Chemistry: medulla K-, C-, KC-, I-; thallus K+ faintly 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. I have seen too little material to have an opinion on whether that is a good taxon, and for the moment have not recognised that variety.

Easily separated from L. stigmatea, 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 Carbonea latypizodes 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 (warmer parts), Asia (widespread), Africa (Morocco, Egypt, Madagascar), N. America (widespread, but not eastern USA), C. America (Mexico), S. America (Argentina, Chile, Venezuela), Australasia (scattered in Australia, both islands of NZ), Pacific (Hawaii).
Lecidella elaeochroma (Ach.) M. Choisy (1950) f. elaeochroma

in: Bull. Mens. Soc. Linn. Lyon 19: 19. The name is sometimes said to have been published by Huzslinszky in 1884. Lecidea paraphyta (= var.) elaeochroma Ach. (1803) in: Methodus 36; Lecidea elaeochroma (Ach.) Ach.; Lecidea elaeochroma f. geographica (Bagl.) Zahlbr.; Lecidea enteroleuca auct. graec. (corticolous); Lecidea enteroleuca β L. (= var.) rugulosa (Ach.) Anzii; Lecidea euphorea f. rugulosa (Ach.) ined.; Lecidea goniophila f. enteroleuca auct. graec.; 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. athalitina (H. Olivier) Sandst.; Lecidea parasema f. atrorubens (Fr.) Arnold; Lecidea parasema f. limitata (Scop.) Vain.; Lecidea parasema c. (= f.) rugulosa (Ach.) Ach.; Lecidea parasema δ L. (= var.) rugulosa Ach.; (?) Lecidea parasema var. zonata H. Olivier; Lecidella achristerota (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 Lecidella 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 olivacea Hoffm. (1796) is a later homonym, and the first legitimate use of the epithet at species rank was by Arnold, in 1858, as Lecidella olivacea. (4) Lichen parasemus Ach. (1799) is a superfluous name for Lichen limitatus Scop. (5) Patellaria leucoplasta DC. (1805). The synonymy 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.) Köhr. However, the application of the name Lecidea enteroleuca Ach. has been disputed, and it may be a synonym of Melaspilea urceolata. I have not found any lectotypification of this name. (7) Lecidea parasema var. rugulosa Ach. (1810). The epithet was not used at species rank until 1852.

The status of Lecidea enteroleuca is uncertain, but it has often been regarded as a synonym of Lecidella elaeochroma, and I do so here (though saxicolous records under that name obviously belong elsewhere). 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 (1934: 260) published the name L. goniophila f. enteroleuca he explicitly excluded the name L. enteroleuca Ach., and he 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 becoming convex later, 0.2 - 1.1 mm diameter, not pruinose. Disc: usually black, matt. Exciple: present, 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. Thalline margin: absent. 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, without crystals. Hymenium: (40) 60 - 85 (120) µm tall, colourless, or upper part sometimes with epiphytic pigment, sometimes with oil droplets especially in lower part. Hypothecium: 60 - 100 (120) µm tall, pale brown to dark brown, occasionally colourless or grey in uppermost part. Paraphyses: usually simple, occasionally branched in upper part, 1 - 1.5 µm wide at base, 2 - 3 µm at apex, not or only slightly capitulate, apical cell sometimes with a thin crescent of pigment. Ascii: ±clavate, 57 - 70 x 20 - 22 µm, ±Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 11 - 14 (17) x 6 - 9 (10) µm, with a distinct wall about 3 µm wide, without a perispore. Chemistry: thallus K+ yellow (reaction sometimes very faint and may be recorded as K-), C+ orange (reaction sometimes very faint and may be recorded as C-), KC+ orange, P-, UV+ orange. Photobiont: green, trebouxia; cells globose, 8 - 15 µm diameter, forming a continuous, ±regular layer 60 - 170 µm thick.

Usually easily recognised even without microscopic examination by the slightly greenish thallus, often delimited by a black hypophysis, and the distinctive shiny exciple of at least the young apothecia. The positive spot-test reactions vary greatly in intensity, sometimes even within the same thallus, which can make separation from L. euphorea 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 (93% of records), sometimes on wood. Recorded from a very wide range of phorophytes with no obvious preference. A common pioneer species on twigs, though not restricted to that situation. The lichenicolous fungi *Stigmidium congestum* and *Stigmidium lecidellae* have each been reported once from this species.

Cosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, perhaps Socotra; also an old report for Cape Province), N. America (widespread), perhaps Caribbean (Bahamas, Bermuda), C. America (Mexico, perhaps CR), S. America (widespread), Australasia (SE Australia, both islands of NZ), Antarctica (widespread in subantarctic islands).

**Lecidella elaeochroma var. flavicans** (Ach.) Hertel [date not known]


Description: Clauzade & 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 ceticum*.

Southern Europe, from Iberian Peninsula to Greece. Reports for northern France (Paris) might refer to *L. elaeochroma*. I have not seen any reports from outside Europe.

**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, with no clear pattern. On bark at altitudes 0 - 900 m.

Scattered throughout Europe. It may be commoner in northern regions, but it is not recognised by all lichenologists, so there may be some regional bias in recording. I have not seen any reports from outside Europe.

**Lecidella euphorea** (Flörke) Krempl. (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 variations. It is not clear to me whether *L. euphorea* is a good species or should be subsumed within the range of variation of *L. elaeochroma*.

*L. euphorea* has the same distribution and ecology in Greece as *L. elaeochroma* f. *elaeochroma*, but is less common.

Widely distributed in Europe, but absent from some western regions including the British Is. Also Macaronesia., Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread, though apparently uncommon in eastern half), C. America (Mexico), perhaps S. America (Argentina, Uruguay).

**Lecidella flavosorediata** (Vézda) Hertel & Leuckert (1969)


Description: Smith et al. (2009); Tønsberg (1992a).

Epips, 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.) Knopf & Leuckert (2000)


*Lecidea lactescens* Leight. (1869) may be the earliest name, but its application has not been established with certainty.


Islands of the southern Aegean, on siliceous rock at altitudes 5 - 250 m.
In Europe, definitely reported only for Portugal and Greece, but probably more widely distributed in southern Europe. Also Asia (Turkey), Africa (S. Africa; St Helena), N. America (Arizona, California, Colorado), C. America (Mexico), S. America (Chile, Peru, Venezuela), Australasia (NSW, Tasmania, Norfolk Is, NZN).

**Lecidella laureri** (Hepp) Körb. (1855)
in: Syst. Lich. Germ. 246; *Biatora laureri* Hepp (1853) in: Flecht. Eur. no. 4
Description: Foucard (1990).
Known from a single locality in Macedonia, where it occurred on bark of *Platanus orientalis* at an altitude of 340 m.
Throughout Europe, but rare in Mediterranean regions. Also Asia (Turkey, Russia, Tajikistan), N. Africa (Morocco), perhaps 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 the highest mountains. Also Asia (widespread), perhaps Africa, N. America (widespread in Canada and cooler parts of USA), C. America (Mexico), perhaps S. America (Argentina, Venezuela), Antarctica (S. Orkney Is, continental Antarctica).

**Lecidella pulveracea** (Schaeer.) P. Syd. (1887)
The determination of my only collection is tentative, so no description is provided. For published descriptions, see: 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. Perhaps Macaronesia (Tenerife); also in N. America.

**Lecidella scabra** (Taylor) Hertel & Leuckert (1969)
The correct name may be *Lecidea protrusa* (Fr.) Körb.
I have referred a single Peloponnesian collection here, though in the present state of our knowledge of sterile crustose lichens in Greece the determination must be regarded as slightly tentative.
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 m, but commonest below 200 m (two-thirds of records).
Widely distributed 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 stigmatet* (Ach.) Hertel & Leuckert (1969)
Thallus: crustose, inconspicuous and ± immersed to well developed, to a few cm diameter; continuous, cracked or areolate, pale brown to green-grey, without vegetative propagules. Apothecia: subimmersed to sessile, usually flat, sometimes convex, 0.2 - 1.2 mm diameter, rarely with slight white pruina. Thalline margin: absent. Disc: usually black, sometimes very dark red-brown or red-black, matt. Exciple: black, sometimes slightly shiny, 0.05 - 0.1 mm wide, persistent or sometimes becoming excluded 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 hyphae, without
crystals. Epithecium: blue-green, blue-black or green-black, a brown pigment sometimes also present, K+ purple-brown, 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, colourless or almost (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, 8 per ascus, 9 - 17 x 5 - 10 µm, with a fairly distinct wall ½ µm wide.

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, but apparently absent from the small islands. On calcareous rock at all altitudes, but uncommon below 1000 m (only 10% of records) Subcosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), C. America (Mexico), S. America (Argentina, Chile, Peru, Venezuela), Australasia (widespread in Australia; NZS), perhaps Pacific (Hawaii), Antarctica (widespread). 

Lecidella viridans (Flot.) Körb. (1855)
in: Syst. Lich. Germ. 242; Lecidea sabulétorum var. viridans Flot. (1828) in: Flora 11(2): 697-698; Lecidea viridans (Flot.) Anzi

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, N. America (Arizona, perhaps elsewhere), C. America (Mexico), S. America (Bolivia, Chile, Venezuela).

Lecidella xylophila (Th. Fr.) Knoph & Leuckert (1997)
in: Bibl. Lich. 68: 131; Lecidea xylophila Th. Fr. (1874) in: Falck, Om östra Blekinges lufflora 16
Description: Clauzade & Roux (1985) as Lecidea xylophila. Western Crete at an altitude of 1100 m. No substrate was reported. An uncommon and rather poorly known species, with a very scattered distribution: Sweden, Germany, Switzerland, mountains of central Italy, and Crete. I have not seen any confirmed reports from outside Europe, though it may be present in Taiwan.

Lemmopsis (Vain.) Zahlbr. (1906)
Type: L. arnoldiana (Hepp) Zahlbr. Family: Lichinaceae. 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.

Lemmopsis arnoldiana (Hepp) Zahlbr. (1906)
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 very common, immersed in thallus, slightly concave, 0.2 mm diameter, 1 per areole, not pruinose. Disc: dark brown-black to black. Exciple: black; in section: 30 - 50 µm wide, dark brown, structure obscured by pigment (even in K). Thalline margin: absent. Epithecium: pale orange-brown, K-, pigment not soluble in K. Hymenium: 90 µm tall, mostly 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 capitulate. Ascii: 50 x 12 µm, wall scarcely thickened at apex, outermost part of wall KI+ slightly blue. Ascospores: colourless, simple, 8 per ascus, 14 - 15 x 7 - 7.5 µm, ±ellipsoid but with slightly pointed ends, with a thin (<1 µm) but distinct wall; 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 850 m altitude. The author's determination of the only Greek collection was confirmed by Dr. Burkhard Büdel. This species may be more common than the single record suggests, since in the field it could easily be overlooked as Verrucaria nigrescens.

Most reports are from middle latitudes of Europe, but present as far north as the Arctic Circle. Present but rare in Italy. The Greek locality is rather disjunct, but this species is easily overlooked. Also N. America (Arizona), perhaps C. America.

**Lempholemma Körb. (1855)**

in: Syst. Lich. Germ. 400


A rather poorly known genus with about 23 species, of which about 14 occur in Europe. Few are likely to occur in Greece, where the genus is very rarely encountered.

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.

33 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.

Widely distributed north of the Alps, to the Arctic Circle, but rare in southern Europe. Also Macaronesia, western Asia (Turkey, Syria, Yemen), N. Africa (Algeria).


in: 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.

**Lempholemma polyanthes (Bernh. ex Schrad.) Malme (1924)**

in: [need to investigate - cited info not consistent with my info on Malme's exsiccate]; *Lichen polyanthes* Bernh. ex Schrad. (1797) in: *Ann. Bot.* (Usteri) 22: 82

The earliest name may be *Lichen myriococcus* Ach. (1795), in which case the correct name would be *Lempholemma myriococcum* (Ach.) Th. Fr.

Descriptions: Ahti et al. (2007); Nash et al. (2004); Nimis & Martelllos (2004); Smith et al. (2009).

Crete, at an altitude of 500 m. The substrate was not recorded.

Widely distributed in Europe, but never common. Also western and central Asia (widespread), N. America (southern Canada, fairly widespread in USA), perhaps S. America (Chile) Australasia (SE Australia).

**Lepraria Ach. (1803)**

in: Methodus 3. The name is conserved over *Conia* Vent. and *Pulina* Adans.

Type: *L. incana* (L.) Ach. 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 68 species worldwide, and about 34 in Europe. All species lack ascomata and have an entirely leprose thallus. They occur on a wide range of substrates. There are few useful morphological characters, and species are delimited mainly on chemical grounds. Unfortunately, the chemistry cannot be adequately investigated using spot tests alone, and chromatography or other sophisticated methods are essential. This makes critical study of this genus impossible for those workers who, like myself, do not have access to a well-equipped chemical laboratory.

Early workers did not recognize most of the species now known to be present in the genus and, as a result, a high proportion of reports before about 1985 are likely to be unreliable.

If it were known with certainty which species occur in Greece, and what their ecological requirements are in Greece, it might be possible to construct a workable key that did not depend on chromatography. As this is not, at present, the case, I do not provide any key here. Workers with access to facilities for chemical analysis should use the key in Saag et al. (2009).

Abbott (2009) did not accept the Greek reports of *Lepraria antiquitatis* (L.) Ach., *L. incana* (L.) Ach. and *L. lactea* (L.) Hue, and those species are not discussed further here.

**Lepraria eburnea** J. R. Laundon (1992)
in: *Lichenologist* 24(4): 331-332

Description: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009); Tønsberg (1992a).

Scattered in NW Greece at altitudes 700 - 930 m. On bark.

Widely distributed in Europe, though rare south of the Alps and probably restricted to the uplands. Also Asia (Turkey, Russia), N. America (BC, cooler parts of USA), perhaps C. America, Australasia (widespread in cool and temperate parts), Antarctica (Kerguelen Is).

**Lepraria elobata** Tønsberg (1992)
in: *Sommerfeltia* 14: 197-198

Description: Hash 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.

Widely distributed in Europe to as far north as southern Scandinavia, but avoiding regions with a Mediterranean climate. Also Asia (Russia), N. America (BC, cooler parts of USA), 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).

**Lepraria isidiata** (Llimona) Llimona & A. Crespo (2004)

Description: Saag et al. (2009).

Very scattered, with no clear pattern, at altitudes 100 - 800 m. On soil on calcareous rock or directly on calcareous rock.

Southern Europe, from Spain to Cyprus. Also N. Africa (Morocco), perhaps N. America.

**Lepraria impossibilis** Sipman (2004)

Greek reports are tentative, and this species can not yet be admitted to the Greek list.

**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 Belgium. Also N. Africa (Morocco), S. America (Peru).
Lepraria lobificans Nyl. (1873)
in: 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. On all substrates, but commonest on bark. At altitudes below 1000 m.
Cosmopolitan. Throughout Europe, and reported from all continents.

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 Platanus orientalis.
Widely distributed in Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Zimbabwe, perhaps elsewhere), N. America (southern Canada, probably widespread in USA but some reports unreliable), Australasia (Tasmania, NZS). Many, perhaps all, reports for S. America are incorrect.

Lepraria neglecta (Nyl.) Lettau (1958)
in: Feddes Rep. 61: 127; Lecidea neglecta Nyl. (1859) in: [need to investigate - bibliographical information incomplete]; Lepraria alpina (de Lesd.) Tretiach & Baruffo; Lepraria caesioalba (de Lesd.) J. R. Laundon; Leproloma cacuminum auct.
Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009); Tønsberg (1992a).
Scattered, in the northern half of Greece. Usually on rock, less commonly on saxicolous bryophytes or on bark, at altitudes 350 - 1600 m.
Widely distributed in Europe, though rare south of the Alps. Also Macaronesia, Asia (widespread), N. America (widespread), C America (Mexico), S. America (widespread), Australasia (widespread in cool to temperate parts), Pacific (Easter Is), Antarctica (widespread).

Lepraria nivalis J. R. Laundon (1992)
in: Lichenologist 24(4): 327. (This 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. graec.
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, at altitudes 0 - 1000 m, but commonest below 400 m.
Widely distributed in Europe. Also Macaronesia, Asia (widespread), perhaps N. Africa (Morocco), N. America (Arizona), 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.
Widely distributed in central and northern Europe, but rare south of the Alps. Also Asia (Turkey, Armenia, Russia), perhaps N. Africa, N. America (scattered in USA), perhaps C. America, S. America (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.
Probably throughout Europe, but rare south of the Alps. Also Asia (widespread), Malesia (PNG), Africa (Ethiopia, Orange Free State), N. America (scattered in USA), Caribbean (DR), C. America (Mexico, Guatemala), S. America (widespread), Australasia (SE Australia, NZS), Pacific (Hawaii), Antarctica (subantarctic islands, Antarctic Peninsula).

Leprocaulon Nyl. ex Lamy (1880)
Type: L. nanum (Ach.) Nyl. ex Lamy (= L. microscopicum). Family: Leprocaulaceae. Literature: Smith et al.
in: [need to investigate - don't know title of paper by Hawksworth & Skinner]; Lichen microsopicum Vill. (1789) in: Hist. Pl. Dauphiné 946; Stereocaulon microsopicum (Vill.) Frey; Stereocaulon nanum (Ach.) Ach.; Stereocaulon quisquiliarum (Leers) Hoffm.

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 corallloid 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. Ascomata: not known. Conidiomata: not known. 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.

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 (BC, scattered in western USA), C. America (Mexico), S. America (Venezuela), Australasia (widespread in Australia).

Leptochidium M. Choisy (1952)
in: [need to investigate - don't know title of Choisy's paper]

Type: L. albociliatum (Desm.) M. Choisy. Family: Massalangiaceae. 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 laminae, 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. Exiciple: 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. Thalline margin: present, persistent but very thin, smooth; in section: 100 µm wide, with distinct cellular cortex. 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 exiciple. Paraphyses: simple, with conspicuous septa, expanding gradually from 1.5 µm at base to 3 µm at apex, not capitate, sometimes very slightly moniliform. Asci: 60 x 20 µm, rather variable in shape, cylindrical, narrowly clavate, or bulging at the middle, K1+ 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, 8 per ascus, 25 - 30 x 8 - 10 µm. 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, where it occurred on bryophytes over siliceous rock at an altitude of 920 m. The site is a north-facing slope 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 to this species, but it is scanty and in very poor condition, and the determination is tentative.
Widely distributed, but probably nowhere very common. 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. Also Macaronesia, western Asia (Turkey, Syria), N. Africa (Morocco, Algeria), N. America (western half from Alaska to California and Arizona; reports from central and eastern regions may be unreliable).

**Leptogium (Ach.) Gray (1821)**


Type: *L. lacerum* (Sw.) Gray (= *L. lichenoides*). However, it has been proposed to re-typify the genus on *L. azureum*, a tropical species. Whether or not that proposal is accepted, many species will eventually have to be placed elsewhere, as Leptogium as presently circumscribed is heterogeneous. Family: Collemataceae. Literature: There is no monograph of the European species overall. Clauzade & Roux (1985) cover many of the species included in the keys below, though without much detail and sometimes under different names. Jørgensen in Ahti et al. (2007) is an excellent treatment of 23 species, but inevitably has a northern bias, as does Smith et al. (2009). There are also some helpful papers dealing with groups of species: Jørgensen & James (1983) treat the azureum group in Europe; Jørgensen (1994a) has a key to the small species north of the Alps; and Jørgensen (1997) covers many of the hairy species. Nash et al. (2004) also has much useful information. Those species not in Clauzade & Roux (1985) are treated in fairly accessible publications: for *L. austroamericanum*, *L. coralloideum* and *L. subaridum* see Nash et al. (2004); for *L. intermedium* see Ahti (2007), Jørgensen (1994a) or Nimis & Martellos (2004); for *L. quercicola* see Otálora et al. (2004); and for *L. subtorulosum* see Jørgensen & James (1998).


As presently delimited, Leptogium differs from Collema in possessing a cortex, which is one cell thick in most of the species. In practice, the colour, thickness and texture of the thallus often suffice to separate the genera; the thallus is usually brown or red-brown, thin and sometimes almost papery in Leptogium, but black or green-black, thick and leathery in Collema. The traditional delimitation of the two genera is now known to be artificial, but has not yet been superceded.

Around 175 species, as presently delimited, about 42 of which occur in Europe. Leptogium is quite a difficult genus, as many of the smaller species are poorly known and some of the larger ones are variable and not always easy to separate.

I have not been able to find much information in the literature on the morphology of some of the smaller species, so parts of these keys may be unsatisfactory. I have placed taxa in the keys as best I can, but if a specimen with fairly small lobes fails to key out, then try other possible branches in the key.

**Key to Leptogium main groups**

111 Thallus foliose.

22 Lobes large, 1 - 20 mm wide.

33 Lower surface densely covered in white hairs. Group 1

3 Lower surface without dense covering of white hairs (a few scattered hairs may be present, or hairs may be present in the central part only).

44 Upper surface of lobes with isidia. Group 2

4 Upper surface of lobes without isidia. (Some species have many marginal extensions of the lobes which vaguely resemble isidia, but there are few or no such structures laminally.) Group 3

2 Lobes small, less than 1 mm wide. Group 4

11 Thallus small-squamulose. Group 5

1 Thallus ±crustose. Group 6
Key to Leptogium group 1: Thallus foliose; lobes large; lower surface with white hairs

11 Isidia present.
   22 Isidia ±granular. Surface ±smooth.
      33 Isidia ±uniformly distributed over surface of lobes. Upper surface dark green-black, smooth. Lower surface with tomentum and a few long rhizines. **L. saturninum**
      3 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.
   2 Mature isidia mostly cylindrical to coralloid (young isidia may be ±granular). Surface smooth or wrinkled.
   33 Upper surface often wrinkled. Isidia brown, often with minute pit in swollen apex. **L. furfuraceum**
   3 Upper surface usually smooth, rarely with a few wrinkles near margin. Isidia slate grey, darker than lobes. (L. burnetiae var. burnetiae), (L. burnatiae var. hirsutum)
   1 Isidia absent. (L. hildenbrandii)

Key to Leptogium group 2: Thallus foliose; lobes large; lower surface without white hairs; isidia present

11 Upper surface with distinct ridges. Lobes often fusing.
   22 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**
   2 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**
   1 Upper surface smooth or wrinkled, but without distinct ridges. Lobes discrete or overlapping, but not fusing.
   22 Thallus olive-brown. **L. subaridum**
   2 Thallus grey or blue-grey.
      33 Thallus 100 - 200 (300) µm thick, distinctly wrinkled. (L. austroamericanum) Note 1.
   3 Thallus to 35 - 110 µm thick, smooth. **L. cyanescens**

(1) L. austroamericanum is a subtropical species reported in Europe only for the Iberian peninsula. It does not seem very likely to occur in Greece, but I include it in the key as its European status is poorly known.

Key to Leptogium group 3: Thallus foliose; lobes large; lower surface without white hairs; isidia absent

11 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.
   22 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).
   33 Lobes 2 - 6 mm long, lead grey, brown-green or blue-green, densely grouped but not forming convex cushions. **L. lichenoides**
   3 Lobes 0.5 - 2 mm long, dark brown, in very convex cushions.
      44 Outgrowths true isidia, with a dark pit at apex; sometimes also laminal. **L. subaridum**
      4 Outgrowths not true isidia, without a dark pit at apex; never laminal. **L. pulvinatum**
   2 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.
   33 Lobes with downturned margins that form tube-like structures. **L. palmatum**
   3 Lobes not forming tube-like structures.
      44 Lobes mostly erect. Apothecia common. **L. gelatinosum**
      4 Lobes often horizontal. Apothecia uncommon. **L. aragonii**
   1 Thallus not cushion-forming; lobes adpressed or upturned, but not erect.
   22 Lobes 3 - 6 mm wide. Usually on bark, or overgrowing bryophytes on bark.
      33 Thallus with folds and pustules. Usually with many apothecia. On bark. (L. corticola) Greek reports incorrect.
      3 Thallus without folds or pustules. Apothecia usually absent. On bryophytes on bark, occasionally on rock. **L. cochleatum**
   2 Lobes to 3 (4) mm wide. On rock or soil.
   33 Thallus to 2 cm diameter. See Group 4 key (**L. ferax** and (**L. subtorulosum**))
3 Thallus 2 - 10 cm diameter. **L. plicatile**

(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 Leptogium species.

**Key to Leptogium group 4**: Thallus foliose; lobes small

1 Lichen forming dense, fruticolous cushions.
   22 Lobes 0.1 - 0.2 (0.3) mm wide.
      33 Thallus cellular throughout (Note 1). Horizontal lobes (not isidia) to 0.2 mm wide. On various substrates. **L. teretiisculum**
      3 Thallus not cellular throughout. Horizontal lobes (not isidia) to 0.1 mm wide. Corticolous, on Quercus. (L. quercicola)
   2 Lobes 0.3 - 1 mm wide.
      33 Isidia absent or few, globose or squamulose if present. Terricolous in calcareous grassland. **L. ferax** and **L. schraderi** Note 2.
   3 Isidia frequent, cylindrical to coralloid, often with distinct dark apical pit. Usually on bark, but it can occur on other substrates. **L. subaridum**

1 Lichen not forming dense, fruticolous cushions.
   22 Lobes erect, almost entirely covered with isidia. **L. microphyloides** Nyl., non auct. Note 3.
   2 Lobes forming radiating, flat thalli. Isidia absent.
      33 Branches glossy, smooth (but outer branches grooved), with distinct upper cortex. On exposed calcareous rock, not aquatic. **L. massiliense**
      3 Branches dull, roughened, upper surface uneven, with indistinct cortex (pseudocortex). On rocks in river banks. (L. subtorulosum) Greek reports doubtful.

(1) One can often recognise a distinct, 1 cell thick, upper and lower cortex which lacks photobiont cells, as in other species of Leptogium. However, the interior of the lobes is unambiguously cellular everywhere, not hyphal.
(2) The distinction between L. schraderi and the rarely recorded L. ferax is not clear to me.
(3) The only description of L. microphyloides 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.

**Key to Leptogium group 5**: Thallus small-squamulose

11 Thallus smooth, without distinct wrinkles, cellular throughout.
   22 Squamules with shiny, blackish, erect isidia-like structures along margins. Usually on bark. **L. microphyloides auct.**, non Nyl.
   2 Squamules marginally lacerated or with nearly cylindrical, horizontal blue-brown marginal lobes. Usually terricolous.
      33 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. **L. subtile**
      3 Apothecia few, concave, to 1.2 mm diameter. Thallus better developed, lobes to 2 mm wide. Among bryophytes on calcareous ground. **L. tenuissimum**
   2 Lobes 3 mm wide, very thick. Upper surface matt, uneven. Without a distinct cortex (pseudocortex only). Usually on seepage rocks. **L. plicatile**
   3 Lobes to 1 mm wide, thinner. Upper surface shiny. With a distinct cortex. In calcareous grassland. **L. turgidum**

**Key to Leptogium group 6**: Thallus ~crustose

11 Thallus of blackish, discrete, placoid areoles, often forming radiating patterns. On dry calcareous rocks or walls. **L.
**Lephtogium diffractum**

1. Thallus less well developed, without radiating marginal lobes. On rock or soil.
2. Thallus crustose or sub-squamulose. Apothecia sessile, concave. Ascospores 24 - 32 x 13 - 16 µm, usually with 2 transverse septa. Usually on calcareous rock, sometimes on calcareous soil. **L. biatorinum**


**Leptogium aragonii** Otálora (2008)  
in: *Taxon* 57(3): 915  
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. Possibly more common, but may have been reported as *L. lichenoides* in the past.

Widespread in central Europe (at least Estonia, Belgium, Germany), and obviously extending to at least cooler parts of southern Europe.

**Leptogium biatorinum** (Nyl.) Leight. (1879)  

If *Leptogium cretaceum* is a synonym, as some have suggested, it would be the correct name.

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 but sometimes with slight white pruina on lower surface of thalline exciple. Disc: brown. Exciple: not visible externally; in section: 70 µm tall, colourless, cellular. Thalline margin: present, red-brown, smooth, persistent, 0.05 mm wide; in section: 50 µm wide, cortex cellular. Epithecium: orange-brown, K-, pigment not soluble in K. Hymenium: 70 µm tall, colourless. Hypothecium: 60 µm tall, colourless to very pale yellow-brown. Paraphyses: 1 µm wide, not broadening at apices, simple or sparingly anastomosed. 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, 8 per ascus, 24.5 x 13 µm. Photobiont: blue-green.

Crete and Peloponnese. On calcareous, or at least not strongly acidic, rock at altitudes 50 - 700 m. Widely distributed in Europe, but uncommon south of the Alps. Also Asia (southern Siberia), N. America (California, Oregon), perhaps C. America.

**Leptogium brebissonii** Mont. (1840)  
in: *Plantes Cellulaires* Sistens 130; *Leptogium chloromelum* auct. grae.; *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 widely distributed in humid parts of southern Europe, but also present in France, British Is and, surprisingly, Iceland. Also Macaronesia, Asia (widespread), Africa (widespread in E. Africa, also present in S. Africa), N. America (BC, Oregon, Washington), S. America (Argentina, Brazil, Chile, Paraguay). Reports for NZ appear to be incorrect.

**Leptogium cochleatum** (Dicks.) P. M. Jørg. & P. James (1983)  

The earliest name is *Lichen tremelloides* L. fil. (1782), but it is not legitimate, being a later homonym of *L. tremelloides* Weiss (1770).

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 (except for a rather doubtful report for Hungary). Also Macaronesia, Asia (widespread, but not western Asia), Africa (widespread), Caribbean (Bahamas, Bermuda, Guadeloupe, Martinique), C. America (widespread), S. America (widespread), Australasia (NSW), Pacific (Hawaii, New Caledonia, Tahiti, W. Samoa).

**Leptogium coralloideum** (Meyen & Flot.) Vain. (1915)  
The names *Collema proboscidale* Mont. (1842) and *Homodium pernigratum* Nyl. (1885), both of which are synonyms, have been formally rejected. At species rank both would otherwise have priority over the epithet *coralloideum*.

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.

The European distribution is mapped in Jørgensen (1994a). Basically a southern species, with a few outlying localities in the British Is. Also Macaronesia, Asia (India, Thailand), Malesia (Philippines, PNG), Africa (widespread in E. Africa; Angola, S. Africa), N. America (Arizona), perhaps Caribbean (Guadeloupe, St Lucia), C. America (CR, Mexico, Panama), S. America (widespread), Australasia (eastern Australia, both islands of NZ), Pacific (Tahiti).

**Leptogium cyanescens** (Ach.) Körb. (1855)


The earliest name is *Collema cyanescens* C. (= var.) β *caesium* Ach. (1810), but it does not have priority at the rank of species.

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 cyanescens* 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.

Subcosmopolitan where the climate is suitable. Present throughout those regions of Europe with a ±humid climate. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (CR, Guatemala, Mexico, Panama), S. America (widespread), Australasia (widespread), Pacific (widespread).

**Leptogium diffractum** Kremp. ex Körb. (1865)

in: *Parerga Lichenol.* 424. (Nomen nudum by Arnold in *Flora* 44: 258. 1861.)

The name was published in November 1865. The name *Leptogium placodiellum* Nyl., in *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).

Very scattered, on the eastern side of the mainland. On rock at altitudes 1200 - 1400 m.

Southern and central Europe, just reaching Sweden. I have not seen any reports for other continents.

**Leptogium ferax** (Durieu & Mont.) Rabenh. (1871)


Description: Clauzade & Roux (1985).

Crete, on rock at an altitude of 50 m.

A rather poorly known species. France, Greece, Portugal, Slovakia, southern Spain. Also Macaronesia (Canary Is), N. Africa (Algeria).

**Leptogium furfuraceum** (Harm.) Sierk (1964)


Thallus: foliose, homoiomeroerous. Lobes: 4 - 6 mm wide, rounded, ±smooth or (near margins) sometimes with a 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: laminar, initially globose and 0.05 mm diameter, later cylindrical to coralloid, 0.2 x 0.05 mm, with a distinct pit in the 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 abundant hairs on the lower surface and 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 *Leparia* sp. on bark of *Platanus orientalis*.

Scattered, mostly in southern Europe (Portugal, Spain, France, Austria, southern Italy, Croatia, Greece). Also Macaronesia, Asia (southern Siberia, India), E. Africa (Ethiopia, Kenya, Tanzania), N. America (scattered in western Canada and western USA), C. America (CR, Mexico), S. America (Venezuela).
Leptogium gelatinosum (With.) J. R. Laundon (1984)
Lichen sinuatus Huds. is a superfluous name for Lichen gelatinosus With. Acharius combined Hudson's name into Parmelia, as P. scotina β P. (= var.) sinuata Ach., and that name is legitimate because of the change in rank. It provides a legitimate basionym for later sinuata names, although those at species rank remain superfluous.
Thallus: foliose, to a 7 cm diameter, usually dark red-brown, sometimes with a grey tinge 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. Cortex: 10 - 15 μm thick, colourless to pale brown, formed of a single layer of rather square-ish to rectangular cells, K-. Lower cortex: similar to upper cortex, but paler in colour. Apothecia: frequent, laminal, sessile, 0.25 - 0.5 mm diameter, not pruinose. Disc: dark red-brown. Thalline margin: present, pale red-brown to red-brown, smooth, persistent; in section: 30 - 75 μm wide, cortex 5 - 10 μm, 1 cell thick. Exciple: present, hard to distinguish from disc in external view; in section: 25 - 40 μm wide, red-brown near surface, colourless elsewhere, zellular 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, zellipsoid but with elongated ends, 8 per ascus, 35 - 50 x 12 - 17 μm, ends rounded or pointed. 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 rock. Some reports may be unreliable owing to confusion with other species of the genus.
Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria). N. America (scattered, mainly in the west, from Alaska southwards)). A report for S. America (Brazil) seems doubtful to me.

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 intermedium (Arnold) (1885)
in: Flora 68: 212; Leptogium minutissimum a (= indefinite rank) intermedium Arnold (1867) in: Flora 50: 122
Descriptions: Ahti, Jørgensen et al. (2007); Nimis & Martellos (2004); Smith et al. (2009).
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 western Asia (Turkey, Russia), N. America (BC, Washington, Wisconsin).

Leptogium lichenoides (L.) Zahlbr. (1924)
in: Cat. Lich. Univ. 3: 136; Tremella lichenoides L. (1753) in: Sp. Pl. 1157. (Spencer et al. (2009) claim that the name is not validly published, but I disagree.); Collema lacerum DC.; Leptogium lacerum Gray, nom. superfl.; Leptogium lichenoides f. atelium (Ach.) Zahlbr.; Leptogium lichenoides f. fimбриatum (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, formed of a layer 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 outgrows 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), N. Africa (Morocco, Algeria), N. America (widespread, but avoiding the most continental parts of the interior and the deserts of SW USA), C. America (Mexico), S. America, Australasia (NSW).
**Leptogium massiliense** Nyl. (1879)

in: *Flora* 62: 354

Thallus: foliose (to almost subfruticose), to 1 cm diameter, ±homoioemerous. 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. Hymenium in interior of lobes: 3 - 5 µm wide, rarely with visible septa. Apothecia: present only in one of the two specimens seen, slightly concave at first, becoming flat later, 0.4 - 0.7 mm diameter, not pruinose. Disc: brown, paler than thallus. Exciple: present but visible externally only in very mature apothecia, and then appearing as a very thin, pale brown ring, paler than disc; in section: 25 µm wide, cellular. Thalline margin: present, becoming almost excluded; in section: 70 - 100 µm wide. Epithecium: very pale brown, K- but pigment partly dissolving in K. Hymenium: colourless, 90 µm tall, 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 distinguish this species very clearly 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).

**Leptogium microphylloides** auct., non Nyl.

This is the taxon treated as a growth form of *L. teretiusculum* at couplet 10 in the key in Jørgensen (1994a). It is distinct from *L. 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*.

I have not seen any other published records of this taxon.

**Leptogium microphylloides** Nyl. (1858), non auct.

in: *Flora* 41: 337-338

Description: Clauzade & Roux (1985).

Crep and SE Peloponnesse, on bark of *Platanus orientalis*.

Southern Europe, from Portugal to Greece, and western Asia (Turkey, Syria). However, there has been much confusion around the names *L. microphyllodes* auct., *L. microphylloides* Nyl. and *L. teretiusculum*, and many published reports may be unreliable.

**Leptogium palmatum** (Huds.) Mont. (1840)


The nomenclatural situation is complicated. The earliest name is *Tremella corniculata* With. (1776). *Lichen palmatus* Huds. is based on the same type as *Tremella corniculata* With, an illustration in Dillenius (1742), and Laundon (1984b) argued that *Lichen palmatus* Huds. is illegitimate as a result. However, Laundon appears to have overlooked the existence of the validly published name *Lichen corniculatus* Lightf. (1777), a synonym of *Corniculata normoerica*. Because of Lightfoot's name, Hudson could not use the epithet *corniculatus* in the genus *Lichen*, and Hudson's name is therefore a legitimate nomen novum for *Tremella corniculata*. On combining the name into another genus Withering's epithet would normally apply, but the epithet *corniculatum* is not available in *Leptogium* as it has been used for *Leptogium corniculatum* (Hoffm.) Bosch (1853), a name which is based on *Collema corniculatum* Hoffm. (1796). Hoffmann's name, though probably a synonym of *Tremella corniculata* With., can not, according to Jørgensen & Nash, in Nash et al. (2004), be proved to be a homotypical synonym "because the type is not available". As a result, the earliest epithet available in *Leptogium* for the lichen under discussion is Hudson's *palmatus*.

Thallus: foliose, 4 - 7 cm diameter, ±homoioemerous. Lobes: rather elongate, lateral margins often revolute (sometimes strongly so) so that the lobe forms a tube, 1 - 6 mm wide, sometimes finely wrinkled, 75 - 110 µm thick when wet. Lobe margins: smooth to wavy, never lacerate. Upper surface: usually red-brown, but 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 µm thick, brown; cells rectangular when viewed transversely; when viewed from above they are squareish to polygonal, 8 - 10 µm wide, forming a closed network. Lower cortex: present, 1 cell thick, 10 µm thick, colourless; cells rectangular when viewed transversely. Hymenium in central part of lobes: 1 µm wide. Apothecia: frequent but often immature, laminal, sessile, 0.3 - 0.8 mm diameter, not pruinose. Disc: orange-brown. Exciple: cellular. Thalline margin: present, brown, darker than disc. Ascospores:
Leptogium pulvinatum (Hoffm.) Puget (1866)

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, only rarely grey (in shade specimens), not pruinose, surface finely wrinkled, erect, 80 - 120 µm thick when wet. Lobe margins: finely divided, extensions usually flattened. Lower surface: grey, sometimes with distinct, rib-like wrinkles, without hairs. Isidia: true isidia absent, but marginal extensions may resemble isidia. Cortex: present, brown, 10 µm thick, consisting of a layer precisely 1 cell thick. Lower cortex: present, colourless, 5 - 16 µm thick, consisting of a layer usually 1 cell thick (rarely 2 cells in places). Photobiont: Nostoc; cells subglobose to globose, 3 - 7 µm diameter, forming short chains.

The compact, brown cushions are distinctive. *L. lichenoides* is more open, and is often grey. *L. gelatinosum* has less finely divided lobes, and is usually fertile. *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.

Widely distributed, but absent from those parts of eastern Europe with a distinctly continental climate. Also Macaronesia, N. Africa (Algeria), perhaps N. America (Alaska).

in: Lichenologist 36(3): 199-202; *Leptogium pulvinatum* var. *quercicola* (Otálorá at al.) Otálorá

Description: See the protologue.

A specimen growing directly on bark of *Quercus pubescens* (and not associated with bryophytes) collected at a site in the western Peloponessse (author's collection number 22-Mar-2000/48) seems close to *Leptogium quercicola*, described recently from Spain. However, it does not match the description of that species exactly, and it also lacks apothecia.

Scattered on the mainland, on bark of *Platanus orientalis*, at altitudes 75 - 1125 m.

Elsewhere known only from Spain.

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 mountains. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), Caribbean, C. America (Mexico), perhaps Pacific (Hawaii). Reports for S. America (Chile), Australasia (NZ) are incorrect.

**Leptogium schraderi** (Bernh.) Nyl. (1854)


Some authors, e.g. Smith et al. (2009), regard *L. turgidum* as a distinct taxon.

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Quite widely distributed 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 western Asia (Turkey, Syria, Iran, southern Siberia), N. Africa (Morocco, Algeria), perhaps N. America (BC).

**Leptogium subaridum** P. M. Jørg. & Goward (1994)

in: *Acta Bot. Fenn.* 150: 76

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 the 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.

The description is brief, as I only recently recognised this species in my collections, and I do not have much material. For a published descriptions see Nash et al. (2004).

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. On bark at altitudes 20 - 1280 m. Recorded from *Castanea sativa*, *Olea europaea*, *Platanus orientalis*, *Quercus macrolepis* and *Q. pubescens*.

Spain, Sardinia and Greece. Also Macaronesia (Canary Is), N. Africa (Morocco), N. America (BC, western USA).

**Leptogium subtile** (Schrad.) Torss. (1843)


The earliest name is *Lichen byssinus* Hoffm. (1784) but it is not legitimate, being a later homonym of *L. byssinus* Scop. (1772). The epithet was validated by Baumgartner in 1790. However it is not available in *Leptogium* because of *L. byssinus* (Hoffm.) Zwackh ex Nyl. (1857), based on *Collema byssinum* Hoffm. (1796). It is possible that Hoffmann intended the name *Collema byssinum* to be a combination from *Lichen byssinus*, and my own comparison of the two descriptions suggests that he did, but as he did not cite any earlier names or publications this can not be demonstrated with certainty. Jørgensen (1994a) regarded the two names as distinct.

Descriptions: Ahti et al. (2007); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).

Fairly widely distributed on the mainland and Crete. On bark at altitudes 0 - 700 m. Recorded from *Olea europaea*, *Platanus orientalis* and *Robinia pseudacacia*.

Widely distributed in Europe, but becoming less common south of the Alps. Also Asia (Iran, Russia, Tajikistan, Japan), N. America (widespread in Canada and cooler parts of USA), perhaps C. America.

**Leptogium tenuissimum** (Dicks.) Körb. (1855)


Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).

Scattered, in the southern half of Greece. On bark, bryophytes on bark, or soil at altitudes 0 - 1400 m, though most records are from below 800 m.

Widely distributed in Europe. Also Asia (widespread), N. Africa (Morocco), N. America (widespread, but not southernmost USA), perhaps Caribbean (Bermuda), C. America (Mexico).

**Leptogium teretiusculum** (Wallr.) Arnold (1892)

Authorship of the basionym is sometimes ascribed to Flörke, but this is incorrect. Wallroth ascribe to Flörke only the name *Collema teretiusculum*, but that name was not validly published as it was merely cited as a synonym.

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 the margins start to become lacerate, not radiating, 50 - 70 µm thick when wet. Lobe margins: strongly lacerate, developing numerous erect extensions that resemble isidia; extensions cylindrical or flattened. Upper surface: brown to grey-brown, not pruinose. Isidia: true 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 the upper and lower cortex by its 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. Exciple: 15 µm wide, cellular. Thalline margin: present, sometimes with small outgrowths; in section: 35 µm wide. Epithecium: 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), but also on rock (usually non-calcareous), occasionally overgrowing bryophytes on rock. At altitudes 0 - 1500 m, but scarce above 1000 m.

Widely distributed in Europe. Also Macaronesia, Asia (widespread), N. America (Alberta, BC, scattered in cool, humid parts of USA), perhaps C. America.

**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. Usually on Olea. **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. On Prunus. (L. *parameca*)

2 Perithecia circular, not surrounded by dark basal fringe. Ascospores 1 - 3 -septate, 25 - 32 µm long. On Populus. **L. atomaria**

**Leptorhaphis atomaria** (Ach.) Szatala (1927)


Corfu, on bark of *Opuntia ficus-indica* at an altitude of 50 m.

Widely distributed in Europe, but rare in truly Mediterranean vegetation. Also Asia (widespread), N. Africa (Algeria), N. America (Arizona, Illinois, Michigan), S. America (Paraguay). Probably not all of these reports are reliable.

**Leptorhaphis oleae** (A. Massal.) Körb. (1865)

in: Parerga Lichenol. 386; *Sagedia oleae* A. Massal. (1855) in: Framm. Lichenogr. 24


Evia, on bark of *Quercus ilex* at an altitude of 200 m.

Only southern Europe, from Portugal to Greece, and N. Africa (Algeria).

**Lethariella** (Motyka) Krog (1976)


About 6 species, only one of which occurs in Europe.

**Lethariella** intricata (Moris) Krog (1976)

Description: Clauzade & Roux (1985).

Eastern side of the mainland, and islands of the southern Aegean (including Crete). Never very far from the sea. On bark of conifers or on siliceous rock, occasionally on wood, at altitudes 830 to about 2000 m.

Scattered in southern Europe, from Iberian Peninsula to Greece and Ukraine. Also Macaronesia (Canary Is), and western Asia (Turkey). An old report for Africa (Sierra Leone) probably refers to some other species.

**Lichenochora** Hafellner (1989)
in: *Nova Hedwigia* 48(3-4): 358

Type: *L. thallina* (Cooke) Hafellner (= *L. obscuroides*). Family: *Phyllachoraceae*. Literature: The best starting point is the key to all species in Etayo & Navarro-Rosinés (2008), on which the key below is based.

About 32 species, of which about 25 occur in Europe.

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 (= Aspicilia) 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, Aspicilia or Psora.
    22 Ascospores narrowly elliptical; length/width ratio 3 or more.
        33 Ascospores 4.5 - 6 µm wide. On Fuscopannaria. (*L. lepidiota*)
        3 Ascospores 6 - 9 µm wide. On other hosts.
            44 On Mycobiline berengeriana. Asci with 4 - 8 ascospores. (*L. inconspicua*)
        4 On Aspicilia. Asci usually with 4 ascospores. (*L. aprica*)
    2 Ascospores subglobose to broadly elliptical; length/width 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 Perithecium more than 200 µm diameter. On Fulgensia. **L. constrictella**
            5 Perithecium 120 - 170 µm diameter. On Bilimbia sabulotorum. (*L. paucospora*)
    3 Asci with 8 ascospores.
        44 Ascospores with distinct perispore, eventually becoming finely granular. On Physcia. (*L. aipoliae*), (*L. polycocoides*)
        4 Ascospores without perispore, remaining colourless.
            55 Ascospores 10 - 12 µm long. On Physconia. **L. weillei**
    5 Ascospores 12 - 21 µm long
        66 Most ascospores 4 - 8 µm wide. Perithecium 80 - 200 x 50 - 180 µm.
            7777 On Trapelia coarctata. Ascospores 15 - 18 x 5 - 6 µm. (*L. coarctatae*)
            77 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. Perithecium (130) 200 - 320 x (95) 130 - 240 µm.
        77 Asci 13 - 20 µm wide. Ascospores 8 - 11 µm wide. On terricolous Fulgensia. (*L. epidesertorum*), (*L. epifulgens*)

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)
   There is an unlocalised record for "Greece" with no further details.
   Only Iberian Peninsula and Greece.

Lichenochora constrictella (Müll. Arg.) Hafellner (1989)
   Eastern Crete, on a species of Fulgensia, perhaps F. subbracteata, at close to sea level.
   Scattered, from Norway to Crete. Also Asia (Russia)

Lichenochora obscurooides (Linds.) Triebel & Rambold (1992)
Lichenochora thallina (Cooke) Hafellner; Pharcidia thallina (Cooke) Lettau
   Description: Clauzade, Diederich & Roux (1989) as Pharcidia thallina; Nash et al. (2004).
   Chios, on Phaeophyscia orbicularis at an altitude of 450 m, and Epiros on Phaeophyscia ciliata at an altitude of 665 m..
   Probably throughout Europe, except for arctic regions. Also Asia (Ural Mts.), N America (BC, several states of US), 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. Asc: cylindrical, 45 - 57 x 7.5 µm. Ascospores: colourless, 1-septate, ellipsoid but often constricted at septum, 8 per ascus, 12.5 - 13 x 7 µm, uniseriate in ascus, sometimes adhering in groups of 2 - 4 after discharge.
   SE Peloponese, on Physconia distorta at 900 m altitude.
   Widely distributed in Europe, from the arctic to Mediterranean regions. Also Macaronesia, Asia (Russia), N. Africa (Morocco), N. America (Canada), S. America (southern Chile).

Lichenocornium Petr. & Syd. (1927)
in: Feddes Rep., Beihefte 42: 432
   About 14 species of lichenicolous coelomycetes, of which at least 10 occur in Europe. Although some are common and widespread, there are very few Greek records.

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 amulliform, gradually tapering. On Lobaria pulmonaria or Physcia aipolia.
      44 Conidia 10.5 - 13.5 x 6.5 - 8 µm. On Lobaria pulmonaria. (L. vollmannii)
      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.
Lichenosporium 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.
Widely distributed in Europe. Also Macaronesia (Azores), Asia (widespread), N. America (widespread from Alaska to cooler parts of USA), S. America (Bolivia, Chile), Antarctica (S. Shetland Is).

Lichenodiplis Dyko & D. Hawksw. (1979)


Lichenodiplis contains 10 species of lichenicolous coelomycetes, most of which are either uncommon or of rather restricted distribution (so far as present records indicate). Five are reported for Europe. By far the commonest and most widely distributed species is L. lecanorae, the only one that is known for Greece.

11 Conidia more than 9 µm long. If present in Greece, then probably restricted to the mountains. (L. lichenicola)
1 Conidia less than 8 µm long. Not restricted to mountains.

Lichenodiplis lecanorae (Vouaux) Dyko & D. Hawksw. (1979)

Some earlier names are, or may be, synonymous, but they are all either not at species rank or the synonymy is not certain.
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 Peloponnesse, but that may be an artefact. At altitudes 100 - 1400 m. Most reports are from Caloplaca (C. cerinella, C. cerinelloides, C. haematites, C. pyracea), but also reported once from Lecanora hagenii.
Throughout Europe. Also Macaronesia, Asia (Turkey, Russia), N. Africa (Morocco), N. America (widespread, especially in USA), C. America (Mexico), southern S. America (Argentina, Chile), Australasia (both islands of NZ).

in: Mycotaxon 83: 36

Type: L. hudsoniana (Jennings) Redhead, F. Lutzoni, J. M. Moncalvo & Vilgalys. Family: Tricholomataceae (Basidiomycota). Literature: Barrasa & Rico (2001) discuss all the species that are likely to occur in Greece, though they do so under the generic name Omphalina.
About 8 species of lichenised basidiomycetes, 5 of which occur in Europe. All have rather northerly distributions. Greek reports to date are doubtful, but the genus could occur in northern Greece. Except for L. hudsoniana, which has a lichenised thallus that "looks like a lichen", they are easily overlooked by lichenologists, and so a key is provided to "raise the profile" of these organisms.
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 an indistinct, intracellular pigment. Basidia 45 - 60 x 9 - 13 \( \mu \)m. Basidiospores subglobose to broadly elliptical, 8 - 10 x 6 - 7.5 \( \mu \)m. (L. umbellifera) Greek reports very doubtful.

2 Hyphae in cortex of top part of mushroom more distinct, external. Basidia 16 - 30 x 4 - 7 \( \mu \)m. 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)

Lichenostigma Hafellner (1983)

in: Herzogia 6: 301


The genus contains 25 species, of which 15 are known in Europe. It is probably fairly common in Greece, though there are few records.

11 Ascospores predominantly 3-septate. On Aspicilia. (L. triseptatum)

1 Ascospores 1-septate. On various hosts.

22 With cushion-like ascomata; if ascomata connected to hyphal strands then those strands immersed in the host. This is subgenus Lichenostigma.

33 Hyphal strands absent or rare.

44 Mature ascospores with deep irregular fissures forming a rough areolate pattern. On Diploschistes. (L. rugosum)

4 Mature ascospores finely ornamented. On many genera of ±fruticose lichens. L. maureri

3 Hyphal strands common; extending downwards from ascomata and mostly immersed within the host.

44 On Pertusaria pertusa. (L. epiirupestre)

44 On vagrant Aspicilia species. (L. radicans)

4 On brown species of Acarospora. (L. anatolicum)

2 With globose or elongated ascomata connected to black, simple or multi-hyphal vegetative strands growing superficially on host thallus or apothecia. This is subgenus Lichenogramma.

33 Vegetative strands mostly formed by a single row of cells. Apothecia subglobose or very slightly elongated.

44 Ascospores brown (when mature).

55 Macroconidia present on the hyphal strands. Ascospores 9 - 10 x 4.5 - 5 \( \mu \)m. On Lecanora sulphurella. (L. episphurium)

5 Macroconidia not present on the hyphal strands. Most ascospores slightly more than 10 \( \mu \)m long. On other hosts.

66 On Lobothallia. Ascospores 10 - 11 x 6.6 - 6 \( \mu \)m. (L. iranica)

6 On Diplotomma. Macroconidia absent. Ascospores 10 - 12 x 5.5 - 7 \( \mu \)m. (L. epipolinum)

4 Mature ascospores mostly colourless.

55 Vegetative hyphae sunken in fissures of host thallus. On Buellia epigaea and related species. (L. semiimmersum)

5 Vegetative hyphae superficial. On Xanthoparmelia. (L. cosmopolites)

3 Vegetative strands formed of several hyphae. Apothecia irregularly rounded to elongated.

44 Vegetative strands clearly radiating (at least when young).

555 On Acarospora. Ascospores 1-septate. (L. gracile)

55 On Pertusaria rupicola. Ascospores 1 - 2 (3) -septate. (L. rupicola)

5 On Diploicia. Ascospores submuriform. (L. diploicia)

4 Vegetative strands not radiating.

555 On Aspicilia or Lobothallia. Ascospores 1-septate. L. elongatum

55 On Acarospora cervina. Ascospores 1 - 2 -septate. (L. svandae)
5 On Squamarina. Ascospores 1 - 3-septate. **L. rouxii**

**Lichenostigma elongatum** Nav.-Ros. & Hafellner (1996)
in: *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 radios* and *Aspicilia* sp.
Widely distributed 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 maureri** Hafellner (1982)
in: *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, Russia, Georgia), perhaps Malesia (PNG), N. America (widespread), C. America (CR), S. America (widespread).

**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.
Known only from ±southern Europe.

**Lichina C. Agardh (1817)**
in: Syn. Alg. Scand. 9. The name is conserved against *Pygmaea* Stackh

Type: *L. pygmaea* (Lightf.) C. Agardh. Family: *Lichinaceae*. Literature: There is no monograph, but the two European species are adequately discussed in all the standard Floras.
About 9 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)
in: Spec. Alg. 1(1): 105; *Lichen confinis* O. F. Müll. (1782) in: [need to investigate - need better bibliographical data for Icon. plant. dan.]

Descriptions: Ahti et al. (2007); Clauzade & Roux (1985); Smith et al. (2009).
Crete, on siliceous rock at altitudes 35 - 40 m.
Present along most of the coast of Europe where there are hard, siliceous rocks, but probably much less common in the Mediterranean than on cold Atlantic coasts of NW Europe. Also Macaronesia, western Asia (Turkey), N. America (Newfoundland, Nova Scotia, Massachusetts), perhaps S. America (Chile), Australasia (widespread outside hot regions), perhaps Pacific.

**Lichinella Nyl. (1873)**

Type: *L. stipatula* Nyl. Family: *Lichinaceae*. Literature: Information is scanty. Clauzade & Roux (1985) treat all the 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 21 species, though the status of some is not very clear. About 9 are known for Europe. Four have been reported for Greece, but there are not many records.
The following key should be used with caution. It may be unsatisfactory in places, as I lack adequate information on many species.

1111 Thallus foliose.

22 Thallus umbilicate-foliose. Lobes more than 5 mm wide.
333 Asci with 8 ascospores. Tiny isidia present. See **Thallinacarpon nigritellum**
33 Asci with 12 - 24 ascospores. Ascospores 7 - 9 µm long. Lobes of thallus not pruinose. **L. cribellifera**
3 Asci 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 - 4 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, 3 - 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.

22 Ascospores ellipsoid, 5.5 - 7.5 x 2.5 µm. **L. stipatula**

2 Ascospores subglobe, 4 - 5 µm diameter. (L. robusta)

**Lichinella cribellifera** (Nyl.) P. Moreno & Egea  (1992)


Islands of the Aegean, including Crete, on siliceous rock at altitudes 40 - 480 m. Widely distributed, but scattered, in southern Europe from Portugal to Greece; also present just north of the Alps in Hungary. Also Macaronesia, western Asia (widespread in warm, dry regions as far east as Oman), northern Africa (Morocco, Algeria, Socotra), N. America (scattered in USA), C. America (Mexico).

**Lichinella iodopulchra** (Croz.) P. Moreno & Egea  (1992)

The epithet is sometimes written "jodopulchra". Whether or not this is correct depends on the details of Crozal's publication, which I have not seen, but "iodopulchra" is philologically preferable.

Descriptions: Nash et al. (2007).

Crete, on calcareous rock at sea level.

Quite widely distributed, but not common, in southern Europe. Also western Asia (widespread as far east as Iran), northern Africa (Morocco, Algeria, Socotra), N. America (Arizona, perhaps Nebraska), 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).

**Lichinella stipatula** Nyl. (1873)


Islands of the southern Aegean, including Crete, on siliceous rock at altitudes 100 - 480 m.

Scattered in southern and central Europe. Also Macaronesia, Asia (widespread as far east as Mongolia), Africa (widespread outside tropics), N. America (BC, scattered in western USA), C. America (Mexico).

**Lobaria** (Schreb.) Hoffm. (1796)

Type: *L. pulmonaria* (L.) Hoffm. Family: *Lobariaceae*. Literature: The best introduction is Burgaz & Martínez (2003), though it does not treat *L. linita* in any detail. Jørgensen, in Ahl et al. (2007) is also excellent. Clauzade & Roux (1985) cover all the species that are included in the key below, though only briefly. The two European species that are not included in any of these publications, *L. sublaevis* and *L. variegata*, are known in Europe only from Macaronesia. Schumm (2003), who treats the genus in Madeira, also has much helpful information.

Thallus: foliose, to several cm diameter. Lobes: large: to several cm long, and about 10 - 20 mm broad, with wavy to incised margins. Upper surface: grey, green-grey or grey-green. Lower surface: usually white at the margins, often darkening towards the centre; often tomentose. Cephalodia: said to be present in all species (but only seen in *L.*

About 76 species, of which 9 occur in Europe. They are usually corticolous, but may occur on other substrates. All require fairly humid conditions.

11 Thallus coralloid fruticos, 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. linita) 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 grey-green 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.) Forsell (1883)
Dendriscocaulon bolaxium (Ach.) Nyl.: Dendriscocaulon dendroides (Nyl.) R. Sant. ex H. Magn.; Dendriscocaulon umhausense (Auersw.) Degel.; Parmelia glomulifera Ach. (sometimes as 'glomerulifera'; Ricasolia amplissima (Scop.) De Not.

The earliest name is Lichen laciniatus Huds. (1762), but the epithet laciniata is not available in Lobaria owing to Lobaria laciniata (Sw.) Trevis. (1869).

Thallus: foliose, to 8 cm diameter. Lobes: 7 - 20 mm wide, ±rounded in overall shape but margins strongly incised (though never lacerate or ragged), usually slightly overlapping; thickness 450 - 530 µm. Upper surface: grey to blue-grey, matt, usually not pruinose (a thin white pruina was present near the tips of the lobes in one specimen). Lower surface: white at the margins, darkening inwards and becoming pale brown, brown or black near the centre; tomentose, at least near the lobe margins; usually with a few rhizines. Cephalodia: sometimes present though never abundant, forming coralloid structures, like small trees, to a few mm diameter (largest one seen was 7 mm long, 5 mm wide and about 3 mm tall); containing cyanobacterial cells. Isidia: absent. Rhizines: often present but few in number, white to pale brown when young but later darkening to brown, 0.5 - 1.0 x 0.1 - 0.25 mm, discrete; usually ±simple (though hyphae near the 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, lower half colourless in section, upper half pale brown; with a distinct cellular structure except in the top 8 - 12 µm, which is rather structureless; cells rather varied in shape but usually ±square to ±rectangular. 6 - 8 x 5.5 - 6 µm. Medulla: 270 - 330 µm thick (but may be thicker than this just above a rhizine), of loosely interwoven hyphae that are about 4 µm wide and without visible septa. Tomental layer: 25 - 40 µm thick, colourless to very pale brown in section, of hyphae that are much more densely aggregated than in the medulla; from this layer there extend numerous single hyphae or groups of conjoined hyphae to a distance of about 25 µm; these extending hyphae are about 5 µm wide, with distinct septa about every 5 µm, and rounded lumina. Apothecia: not common (only seen in one collection), laminal, sessile, concave to slightly concave, not pruinose. Disc: brown, sometimes slightly shiny when young, but becoming matt later. Exciple: not visible externally; in section it is present but not well developed, about 25 µm wide, of radiating hyphae. Thalline margin: present, ±smooth, persistent; in section it is present but not 175 µm wide; cortex 75 µm wide, distinctly cellular. Epithecium: orange-brown. Hymenium: colourless, 150 µm tall. Hypothecium: colourless, 75 µm tall. Ascospores: colourless, obviously developing towards a septate state but distinctly septate ones not seen, 40 - 50 x 5 µm, 8 per ascus. Pycnidia: often present, laminal on the lobes, in small convex warts about 0.5 - 0.7 mm diameter that are concolourous with the upper surface except at the pycnidium itself; in external appearance dark brown to black, 0.1 - 0.2 mm diameter; in section 100% immersed, colourless except near the ostiole which is brown, ±globose, 730 x 660 µm (height
x width). Conidia: colourless; usually ± rectangular but sometimes broadening at one or both ends, and extreme examples can appear like a narrow triangle; 3 - 7 x 1 - 1.5 µm. Chemistry: medulla K-, C-, KC- or, less commonly, KC+ pink or brown-orange in a thin layer at the extreme base of the medulla, P-; thallus K+ yellow, UV+ pale orange in short-wave UV (the fluorescence usually becoming less intense after a few seconds); the same fluorescence is sometimes present with long-wave UV, but sometimes one gets only a rather indistinct + greyish colour. Photobiont (of cephalodia): blue-green, of globose to subglobose cells, 5-8 microns diam, apparently with a gelatinous sheath about 1 µm wide; cells 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 a distinct speckly ornamentation at a scale of about 1 µm visible at x400; photobiont later 50 - 100 µm thick, continuous, though cells show some tendency to aggregate into clumps, often with a rather irregular upper boundary.

Differs from L. pulmonaria most obviously in the presence of prominent external cephalodia. Also differs in the absence of isidia and of ridges on the upper surface of the lobes, and in having distinctly more indented lobe margins.

Probably throughout Greece wherever 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, and appear to be restricted to the most undisturbed habitats.

Widely distributed, but never common, in oceanic areas of Europe and in the Mediterranean mountains. Also Macaronesia, Asia (Turkey, Russia, India, China), N. Africa (Morocco, Algeria), N. America (widespread but scattered in humid regions), Caribbean (Haiti), C. America (Mexico, perhaps CR), perhaps Australasia (NZ - all as Dendriscocaulon spp.; perhaps a different taxon).

**Lobaria pulmonaria** (L.) Hoffm. (1796)


*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. The status of Greek collections reported under that name *L. pulmonaria* var. *meridionalis* is unclear, but they just be 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 a prominent, reticulate network of ridges. Lobe margins: smooth to ± wavy, but never incised. Upper surface: green-grey. Lower surface: white to pale brown at the margins, and also in the central parts on the 'bumps' corresponding to depressions between ridges on the upper surface; elsewhere pale brown to dark brown; tomentose except on the 'bumps'. Cephalodia: not seen. Isidia: often absent until thallii are several cm in diameter, but usually abundant in mature thalli; green-grey in lower part, brown at tip; usually laminal and confined to the ridges, but sometimes marginal, rarely occurring in the depressions between ridges; cylindrical, 0.3 - 0.5 x 0.1 mm, nearly always simple (branched ones very rare), often very crowded. Rhizines: often absent; if present then rather sparse and usually only near the tips of the lobes; when young white or resembling outgrowths of tomentum, squareose, 0.3 x 0.1 mm; when mature dark brown to black, simple or retaining just a few white squareose extensions near the base, 0.5 x 0.1 mm. Upper cortex: 22 - 35 µm thick, colourless in lower part, pale brown in upper part, ± cellular except in the top 5 µm, which is poorly structured; cells not very well developed, with thick walls and rounded lumina that are 5 x 2.5 - 3 µm; K-.

Medulla: white, 150 - 160 µm thick, of loosely interwoven hyphae that are 2.5 - 3.5 µm wide and without visible septa. Tomental layer: 25 µm thick, pale brown, of tangled hyphae; from this layer tomental hairs, usually formed of several conglutinated hyphae, extend outwards about 80 - 120 µm. Apothecia: rare (only seen in one collection), laminal, especially on the ridges, sessile, 0.5 - 0.8 mm diameter. Exciple: not visible externally. Thalline margin: present. Chemistry: thallus K-, C-, KC-, P-, UV+ faintly dull white; medulla K+ yellow > orange-yellow (but reaction often faint), C-, KC- (bleaches), P+ faintly orange, I-.

Photobiont: green; cells globose, 8 - 10 µm diameter; photobiont layer 35 - 50 µm thick, continuous, with a rather irregular lower boundary.

All material seen by me has few or no soralia and, when mature, abundant longish isidia; it corresponds to *f. papillaris* (Delise) Hue. (*F. pulmonaria* has abundant soralia intermixed with short isidia.) I am unsure whether this form merits formal recognition.

Throughout Greece, except for low-lying islands. Probably commonest in little-disturbed upland forests that are not dominated by species of *Pinus*. On bark of a wide range of phorophytes, but 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 they were probably merely overgrowing it.

Almost throughout Europe, but sensitive to air pollution and extinct in large parts of its former range. In southern
Europe it is, and always has been, restricted to upland areas. Also Macaronesia, Asia (widespread), Malesia (PNG, Philippines), Africa (widespread in warm temperate regions), N. America (widespread), C. America (Mexico, Panama, perhaps CR). Reports for Australasia, and probably those for S. America, are incorrect.

**Lobaria scrobiculata** (Scop.) DC. (1805)

Thallus: foliose, to 10 cm diameter. Lobes: rounded to slightly elongate, 10 - 25 mm wide, often with distinct folds; lobe margins wavy. Upper surface: grey to yellow-green, matt. Lower surface: white, but in central parts of lobes often hidden below a thick cover of brown tomentum; tomentum white to pale brown and fine at lobe margins, becoming denser and browner towards centre of lobes, in central parts often completely absent in numerous small, ± circular patches where the 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 and soon becoming confluent; soredia granular. Upper cortex: 40 - 50 µm thick, colourless, distinctly cellular; cells subrounded, 6 - 10 µm diameter. Medulla: white, 110 - 140 µm thick, of loosely interwoven hyphae; 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-, KC- (unchanged), P+ brown-orange (reaction sometimes faint and some specimens appearing P-); thallus UV+ pale greenish. Photobiont: blue-green, cells not in chains; in a ± continuous layer 50 - 60 µm thick that is sometimes rather irregular as the cells tend to form clumps.

Differs from *L. pulmonaria* most obviously in having a blue-green, rather than green, photobiont. *L. scrobiculata* often has folds on the upper surface, and when well-developed these might be called ridges, but it lacks the distinct network of ridges that are always present in *L. pulmonaria*. *L. scrobiculata* also differs in usually having well-developed soralia.

Throughout Greece, except for low-lying islands, but much rarer than *L. pulmonaria*. On bark, or overgrowing bryophytes on bark or rock, at altitudes 400 - 1800 m. In the Peloponnese it occurs only in small, particularly favourable localities within the least disturbed upland forests, often together with other demanding species such as *Lobaria amplissima* and *Peltigera collina*. The lichenicolous fungi *Nectriopsis lecanodes* and *Plectocarpon scrobiculatae* have been reported from this host in Epiros.

Commonest in oceanic parts of Europe, but occasionally recorded elsewhere (e.g. Bulgaria, Ukraine). Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, S. Africa), N. America (widespread in oceanic regions from Alaska to northern USA), perhaps S. America (Argentina, Brazil), Australasia (SE Australia, both islands of NZ).

**Lobothallia** (Clauzade & Cl. Roux) Hafellner (1991)


Similar to *Aspicilia*, but thallus placodioid and Aspicilia green pigment absent from apothecia or present only in small amounts.

*Lobothallia* is a segregate from *Aspicilia*, characterised by a lobate margin. Until *Aspicilia* s. lat. is itself better understood it is difficult to assess whether this is an adequate character on which to base a genus. It's ecology is as for *Aspicilia*. At present it contains 5 species, all of which occur in Europe.

*L. controversa*, not yet reported for Greece, is keyed out under *Aspicilia*.

11 Lichenicolous. Medulla K+ yellow or orange (stictic acid). Note 1. **L. parasitica**
1 Not lichenicolous. Medulla K-, or K+ yellow > red (norstictic acid).
22 Thallus and/or medulla K+ yellow > red (norstictic acid) (Note 2); P+ yellow. On dry rock (calcareous or siliceous).
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 the 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 dry calcareous rock or wet siliceous rock.

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) **L. parasitica** is not well known, but is thought to be parasitic on Acarospora, Aspicilia and Caloplaca. It seems to prefer non-calcareous, or weakly calcareous rock, but may not be restricted to them as it has been reported from Aspicilia calcarea. It may be restricted to strictly Mediterranean vegetation.

2) The reaction may be patchy and some sections may have no demonstrable norstictic acid. The reaction tends to be restricted to the upper part of the medulla and/or the hyphae in the algal layer. 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.

**Lobothallia alphoplaca** (Wahlenb. ex Ach.) Hafellner (1991)


Thallus: placodioid, 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 only weakly adressed. Cortex: 20 - 35 µm thick, colourless to pale brown, K-, cellular; cells subrounded, 5 - 7 µm diameter. Medulla: white. Apothecia: sub sessile, flat, 1 - 1.5 mm diameter, not pruinose. Disc: very dark brown to black, slightly shiny. Exciple: not developed; not visible externally and scarcely distinguishable in section. Thalline margin: prominent, persistent, 0.1 mm wide. Epithecium: green with a little brown pigment, K- (green pigment mostly dissolves), N+ dull green. Hymenium: 70 µm tall, mostly colourless, some green pigment in uppermost part. Hypothecium: 50 µm tall, colourless. Paraphyses: simple, with visible septa throughout, 1.5 µm wide at base, moniliform, apex 5 µm. Chemistry: in spot tests medulla K+ yellow > orange, P+ yellow, both reactions patchy and confined to upper part of medulla, a few crystals of norstictic acid present in K in section, especially in hyphae in algal layer, medulla I-. Thallus 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 distinctly convex marginal lobes that are not adpressed.

NE Peloponnese, on siliceous rock at an altitude of 1750 m. There is also a report from Attica on calcareous rock at 1400 m, but that is not the usual substrate and the report may be unreliable. A 19th Century report from 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 the west, from Alaska to cooler parts of USA), C. America (Mexico), perhaps S. America (Argentina), Australasia (southern Australia).

**Lobothallia parasitica** (de Lesd.) ined.


Description: Loppi & Mariotti (1995) as Aspicilia parasitica.

Island of Aegina, on rock at an altitude of 110 m.

Known only from a few localities in southern Europe: France, Italy, Bulgaria, Greece. It may be overlooked, being easily confused with *L. radiosa*.

**Lobothallia praeradiosa** (Nyl.) Hafellner (1991)


Rare in northern Greece, on non-calcareous rock at altitudes 1100 - 1740 m.

Mainly central Europe, though recorded for Norway. Not in British Is. South of the Alps rare and restricted to the mountains. Also Asia (widespread to as far east as Mongolia), N. Africa, N. America (scattered in SW USA), C. America (Mexico),
Lobothallia radiosa (Hoffm.) Hafellner (1991)

The name *Lecanoria subcincinata* var. *myrrhina* J. Steiner (1898) must be treated as new, as Steiner explicitly excluded *Parmelia fuscata* var. *myrrhina* Ach. The name is validated by Fries's description of *Parmelia circinata* var. *myrrhina*.

The name *Lecanoria subcincinata* f. *melanaspis* (Ach.) Harm. is a synonym of *Lobothallia melanaspis*. The single Greek report was from high altitude, so might belong there, but more likely to belong to the very common *Lobothallia radiosus*.

Thallus: well developed, placodioid, central parts areolate, to 6 cm diameter, usually grey to dark grey when fresh (rarely with a brown tinge) but sometimes becoming brown in herbarium, usually not pruinose but 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 sub sessile, usually flat, rarely slightly convex, 0.35 - 1.7 mm diameter, not pruinose. Disc: usually black, sometimes very dark brown. 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 continuation with hypothecium. Thalline margin: present at least in mature, sub sessile apothecia, persistent; in section: about 125 µm wide. Epithecium: usually brown without any Aspicilia green pigment, K-, N-, brown pigment not soluble in K or N; in a few collections small amounts of Aspicilia green also present, N+ dull green. Hymenium: 50 - 120 µm tall, colourless, KI- blue. Hypothecium: 50 - 120 µm tall, colourless. Paraphyses: usually simple, rarely branched, with visible septa throughout, 1.5 µm wide at base. moniliform, apex 3 microns. Ascii: 55 - 70 x 16 - 22 µm, clavate, KI-. Ascospores: (often absent or immature), colourless, simple, subglobose to ellipsoid, 8 per ascus, 8 - 13 x 6 - 11 µm. Pycnidia: appearing externally as black dots, 0.03 mm diameter; in section: 100% immersed, ±globose or slightly flat-topped, colourless, 80 µm diameter. Chemistry: medulla C-, I-, upper part (only) K+ yellow > red, P+ yellow (reactions may be faint in spot tests, but norstitic acid always apparent in section); thallus C-, UV-. Photobiont: green, present below apothecia (though often only intermediately); 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.

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. Placodioid species of *Lecanora* are never grey in colour.

Throughout Greece. On rock, usually calcareous, at all altitudes. The lichenicolous fungi *Cercidospora lobothalliae* (1 record) and *Lichenostigma elongatum* (4 records) have been reported from this lichen.

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, both islands of NZ).

Loxospora A. Massal. (1852)

Type: *L. elatina* (Ach.) A. Massal. Family: *Sarrameanaceae*. Literature: There is no monograph, but Clauzade & Roux (1985) treat the two widespread European species, under *Haematomma*.

About 10 species in cool and temperate regions. They are usually epiphytic. Two species occur in Europe, but one is too northern to occur in Greece.

Loxospora elatina (Ach.) A. Massal. (1852)
Descriptions: Clauzade & Roux (1985) as *Haematomma elatinum*; Smith et al. (2005). Macedonia, on bark at an altitude of 800 m.

Widely distributed in central and northern Europe, but rare south of the Alps. Also Macaronesia (only Azores), Asia (Russia), N. America (SE Canada, scattered in USA), perhaps S. America (Argentina).

**Megalaria Hafellner** (1984)

in: *Nova Hedwigia, Beihefte* 79: 302


About 31 species, 4 of which occur in Europe. They are usually corticolous. Only one species 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.

Widely distributed in Europe, avoiding only the far north and strongly Mediterranean regions, but not common. Also Macaronesia, Asia (Ural Mts), perhaps N. America (New Brunswick, Nebraska), southern S. America (Argentina, Chile), Australasia (widespread).

**Megaspora** (Clauzade & Cl. Roux) Hafellner & V. Wirth (1987)


Type: *M. verrucosa* (Ach.) Hafellner & V. Wirth. Family: *Megasporaceae*. The genus is not closely related to *Aspicilia*, with which it was at one time grouped. Literature: *M. verrucosa* s. lat. is discussed in all the standard Floras. For var. *mutabilis*, which is not recognised by many authors, see Clauzade & Roux (1985) or Nash et al. (2007).

*Megaspora* has two species, only one of which has been reported for Europe, though the other was described form western Asia so might occur in Europe. They are corticolous or terricolous.

11 Soredia present. Apothecia uncommon. (M. rimisorediata)
1 Soredia absent. Apothecia usually present.
22 Terricolous, on mosses or plant debris in the alpine zone (i.e. above tree level). M. verrucosa var. verrucosa
2 On bark. Upland, but not alpine. M. verrucosa var. mutabilis

I can not find any clear morphological or anatomical differences between Peloponnesian material of the two varieties, except that the thallus in var. *verrucosa* is less regular. This difference may just reflects the different substrates. At present, I only have a single Peloponnesian collection of var. *verrucosa* for study, so it seems premature to synonymise the two varieties, and in any case the substrate preferences seem very distinct. According to Nash et al. (2007), var. *verrucosa* has a more granular thallus, taller hymenium and slightly larger ascospores than var. *mutabilis*. This does not match Peloponnesian material, all of which has the tall thallus and larger ascospores which Nash et al. say is characteristic of var. *verrucosa*, together with a non-granular thallus which they say is characteristic of var. *mutabilis*.

**Megaspora verrucosa** "(Ach.) Hafellner & V. Wirth var. verrucosa (1987)"


The name has been misapplied. The nomenclatural situation is confused, and is the subject of a conservation proposal. Until the Nomenclature Committee for Fungi reports on that proposal I use here the conventional, though incorrect, authorship.

As I only have a single collection of this variety, the description is not as thorough as that for var. *mutabilis*.

Thallus: crustose, thick, continuous, to 2.5 cm diameter, grey, strongly white pruinose everywhere. Apothecia: ±impressed in thallus, concave to ±flat, 0.7 - 0.8 mm diameter. Disc: black, not pruinose. Exciple: sometimes visible
externally as a distinct ring within the thalline exciple, 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, made of hyphae ±parallel to paraphyses. Thalline exciple: prominent, persistent, strongly pruinose; in section: 125 µm wide, cortex well developed, 60 µm wide, outermost 35 µm poorly structured, inner 25 µm of ±isosidometric cells, fairly well delimited from algal layer. Epithecium: green, K- but becoming paler green in K. Hymenium: 240 µm tall, colourless. Hypothecium: 40 µm tall, almost colourless. Paraphyses: frequently anastomosed. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 45 - 50 x 30 - 33 µm, with a prominent wall 6 µm thick. Chemistry: thallus K-, C-, KC- in spot tests. Photobiont: green.

Even externally, M. verrucosa s. lat. is easily recognised; the immersed apothecia 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.

The distribution of this taxon in Greece is uncertain, as many authors have not distinguished the two varieties. Probably scattered 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.

The global distribution of var. verrucosa is uncertain for the same reason, but it appears to be widely distributed in Europe. Also Macaronesia, Asia (widespread in cool regions), N. America (widespread, especially in western half), S. America (Colombia, Venezuela; perhaps also Argentina, Chile), Australasia (NZS), Antarctica (subantarctic islands, Antarctic Peninsula).

**Megaspora verrucosa var. mutabilis** (Ach.) Nimis & Cl. Roux (1993)


At the rank of variety the epithet *urceolaris* has priority from 1845, via *Parmelia verrucosa* a (= var.) *urceolaria* (Fr.) Tuck., which may give it priority over *mutabilis*.

Thallus: crustose, thick, usually continuous, sometimes slightly cracked, pale grey but generally appearing white owing to a thick layer of pruina, forming large patches to 7 cm diameter; in section: about 700 µm thick. Cortex: 28 - 55 µm thick, with an outer part 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 parallel to surface; pigments K-, not dissolving in K. Medulla: white, chalky, structure not discernible in section, either in water or in K. Apothecia: always abundant, immersed to subimmersed, 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. Exciple: sometimes visible externally as a brown to black ring within the thalline exciple; in section: 25 - 100 µm wide, pale brown, sometimes with oil droplets, not sharply delimited from hymenium or thalline exciple, formed of hyphae parallel to paraphyses. Thalline margin: usually well developed, thick, persistent, but occasionally almost absent; in section: 100 - 150 µm wide, cortex 30 - 50 µm. Epithecium: usually green, sometimes green-black, K- but becoming paler 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 as base, 3 µm at apex, not capitate or moniliform. Asci: 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, 8 per ascus, 42 - 50 x 25 - 35 µm, with a distinct wall 3 µm thick. Chemistry: thallus K- , C- , KC- , P- , UV+ white to green-white; medulla K- , C- , KC- , P- , I-. Photobiont: green, trebouxioid, cells globose, 10 - 12 µm diameter, forming a ±continuous, ±regular layer 30 - 50 µm thick; photobiont cells not present below apothecia.

According to Smith et al (2009) the ascii are Bia tora type, but this is scarcely apparent in Peloponnesian material; staining of the ascus wall in KI is both very faint and uniform.

Throughout the mainland and Crete, but rare in the northern half of Greece. Not reported for any of the smaller islands. On bark at altitudes 900 - 1600 m. About two thirds of records 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 Europe, just extending into the southern part of central Europe. Also Asia (Saudi Arabia, Kazakhstan, Tajikistan, Pakistan), N. Africa (Morocco, Algeria), N. America (Arizona, California, Colorado), C. America (Mexico).

**Melinessa Essl.** (1978)

in: *Mycotaxon* 7(1): 46

Type: *M. stygia* (L.) Essl. Family: *Parmeliaceae*. Literature: Between them, Smith et al. (2009) and Clauzade & Roux (1985) treat all the species included in the key, though in many cases in *Cetraria, Melanelixia, Melanohalea* or
Parmelia, not Melanelia. Thell & Moberg (2011) is also helpful.

Thallus: foliose, to several cm diameter, brown, occasionally with a greenish tinge in the central part, not pruinose or (rarely) slightly white pruinose, usually mostly matt but margins of lobes sometimes shiny. Lower surface: white, brown or black, attached by rhizines. Lobes: to about 10 mm wide, usually ±adpressed, sometimes ascending at margins, 65 - 200 µm thick. Cortical hairs: present on lobes in some species, formed of a single hyphae. Isidia (or conical warts resembling isidia): present in some species; morphology various. Pseudocyphellae: present on apex of isidia, or absent. Rhizines: always present, white to black, simple. Soralia: absent in Peloponnesian species. Upper cortex: present, usually some shade of brown, rarely colourless, 8 - 12 (25) µm thick; anatomy not well observed, but hyphae in outer part oriented perpendicular to lobe surface, those in inner part oriented randomly (and ±anastomosed); K-, N-. Medulla: usually white, 20 -100 µm thick, of loosely interwoven and sometimes distinctly anastomosing hyphae; hyphae thin to, in some species, very broad, usually without visible septa, in some species clearly covered in angular crystals. Lower cortex: colourless to dark brown, 6 - 15 µm thick. Apothecia: sessile or shortly stalked, to several mm diameter, rounded, not pruinose. Disc: brown, often shiny. Exciple: poorly developed and not visible externally; in section about 25 µm wide, colourless. Thalline margin: present, brown, persistent; in section 110 - 150 µm broad; cortex 17 - 40 µm broad, sometimes with cortical hairs. Epitheciun: yellow-brown or brown, K-. Hymenium: colourless (sometimes with some epithelial pigment in upper part), 60 - 75 µm tall. Hypothecium: colourless, 40 -50 µm tall. Hamatheciun: of paraphyses. Paraphyses: simple, not or only weakly capitate. Asc: usually ±clavate, often with an ocular chamber clearly visible in water mounts, Lecanora type. Ascospores: colourless, simple, 8 per ascus, ellipsoid, fairly small (to 13 x 8 µm), with a distinct wall about 1 µm thick. Chemistry: medulla K- (except for orange patches of medulla in M. glabra), C- or C+ red, K- or KC+ red, P-, UV-. Photobiont: green, in a continuous layer 20 - 50 µm thick.

Differs from Parmelia in the presence of brown pigmentation in the upper and lower cortex. It is separated from other parmeliod genera with brown cortical pigmentation by the N- reaction of the upper cortex.

Two genera, Melanelixia and Melanohalea, have recently been segregated from Melanelia. Melanelixia comprises the glabratata group, species of which are usually, but not always, corticolous and which have a C+ red medulla. Melanohalea is the exasperata group, species of which are corticolous and have a C- medulla. The more narrowly circumscribed Melanelia that remains comprises the strictly saxicolous stygia group. This split appears to be soundly based, but for the moment, until it is certain that these new genera are of lasting value, I prefer to retain these groups in Melanelia s. lat.

With this broad circumscription, Melanelia has about 46 species. About 22 occur in Europe. In Greece, the genus is predominantly corticolous.

**Key to Melanelia main groups**

11 Isidia (or conical warts resembling isidia) and/or soralia present. **Group 1**

1 Neither isidia nor soralia present. **Group 2**

**Key to Melanelia group 1**: Isidia or soralia present.

111 Medulla instantly C+ bright red. (Note 1)

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. fulginosa**

11 Medulla C- or C+ pink, but KC+ pink or orange. On siliceous rock.

22 Medulla C+ pink. If present in Greece, then restricted to high altitude. (M. tominii)

2 Medulla C-. Not restricted to high altitude. **M. disjuncta**

1 Medulla C-, KC-. Usually on bark or wood.

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**

3 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 2), but more commonly
with a pseudocyphellae and then appearing dark brown. Lobes ±adpressed. Apothecia usually absent.

44 Upper surface red-brown or green-brown, not pruinose. On bark or wood. **M. elegantula**

4 Upper surface dark brown to almost black, often pruinose. On rock on montane regions. (M. infumata)

3 'Isidia' conical warts, 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) The reaction is unmistakeable but may be confined to the upper part of the medulla. So do not test where the thallus has been abraded, exposing the medulla, as the upper part of the medulla may then be missing.

(2) 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 pseudocyphellae. Examination under the stereo-microscope at x40 will usually clear up any confusion.

**Key to Melanelia group 2:** Isidia and soralia absent.

11 Upper surface of lobes with ridges or wrinkles, at least at centre of thallus. Medulla C- or C+ red. On bark.

22 Medulla C+ red, KC+ red. Common and widespread in Greece. **M. glabra**

2 Medulla C-, KC-. If present in Greece then rare and strictly montane. (M. olivacea) Greek reports doubtful.

1 Upper surface of lobes without ridges or wrinkles. Medulla C-. On bark or siliceous rock.

22 Thallus of many small, overlapping folioles. Lower surface pale. Apothecia usually absent. Medulla K-, P-, KC-.

Usually on bark. **M. laciniatula**


3 Pseudocyphellae laminal. Medulla KC-, and either K+ brown, P+ red, or K-, P-.

**Melanelia disjuncta** (Erichsen) Essl. (1978)


The earliest name at species rank is *Parmelia granulosa* Lyne (1932), but it is not legitimate, being a later homonym of *Parmelia granulosa* (Ehrh.) Mart. (1817).

Descriptions: Clauzade & Roux (1985) as *Parmelia disjuncta*, Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Rare and scattered, with no clear pattern. On siliceous rock at altitudes 30 - 1450 m.

Widely distributed in northern and central Europe, but rare south of the Alps. Also Asia (widespread), perhaps Africa (Kenya), N. America (widespread from Alaska to cooler parts of USA).

**Melanelia elegantula** (Zahlbr.) Essl. (1978)


_Collema exasperatum_ Ach. (1810) may be a synonym, and if so it is the earliest name for this lichen. However, Acharius's name can not be combined into _Melanelia_ because of the existing name _Melanelia exasperata_ (De Not.) Essl. (Nor could it be combined into _Melanohalea_).

Thallus: 5 - 7 cm diameter. Upper surface: brown, often shiny at lobe tips, not pruinose. Lower surface: pale brown, slightly darker brown at margin and there ±shiny, attached by rhizines. Lobes: 5 - 8 x 4 - 8 mm, 110 - 140 µm thick, tips incised, ±adpressed but sometimes slightly ascending at margins. Isidia: always abundant and sometimes obscuring central part of thallus, initially forming as small, conical papillae but 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 pseudocyphellae 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: 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; anatomy not well seen but apparently of hyphae oriented perpendicular to the lobe surface, 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.

This species can not be confused with other species with a C- medulla, provided that 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.

Widely distributed in Europe, except for the far north. Also Macaronesia, Asia (widespread), N. Africa (Morocco, N. America (widespread, mainly in the west, from southern Alaska to cooler parts of USA), C. America (Mexico), southern S. America (Argentina, Chile), Antarctica (S. Georgia).

Melanelia exasperata (De Not.) Essl. (1978)

The earliest name is Parmelia olivacea var. aspidota Ach. (1803), but at species rank priority of the epithet aspidota dates from 1872.

Thallus: to 7 cm diameter. Upper surface: brown, occasionally green-brown in shade, usually matt, occasionally shiny near tips of lobes, 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) and about 0.08 mm diameter, always with a white pseudocyphellae. 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 that is contiguous with the medulla but denser, without air gaps, and without any preferred hyphal orientation. Hairs: not visible externally but in section frequently seen projecting from upper cortex of lobe surfaces, erect, colourless, cylindrical, 6 - 10 x 2.5 µm, each hair apparently a single hypha. Rhizines: lower 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- (pigment fading slightly), N- (pigment sometimes developing a slight red-brown tinge). Medulla: white, of loosely interwoven hyphae that are oriented predominantly, but not exclusively, parallel to surface of lobes. Lower cortex: 9 - 12 µm thick, sharply delimited from medulla, brown, cellular; cells angular to almost square, about 5 µm across; brown pigment K- (pigment fading slightly), N- (pigment sometimes intensifying or developing a slight reddish tinge). Apothecia: usually present, sessile or shortly stalked, concave, 0.6 - 2.5 mm diameter, but not pruinose. Disc: brown, shiny when young, later becoming matt. Exciptle: not visible externally; in section 25 µm wide, colourless. Thalline exciple: present, persistent, with many isidia; in section 110 - 130 µm wide, cortex 17 - 30 µm wide. Epithecium: brown, K- (pigment unchanged), swelling markedly in K. Hymenium: colourless, sometimes brown in upper part, 60 µm tall. KI+ blue. Hypothecium: colourless, 40 µm tall. Paraphyses: simple, ±eclavate or weakly capitulate, 2 µm wide at base, 4 µm wide at tip, coherent. Asci: narrowly clavate, almost cylindrical when mature except at extreme base, with a distinct ocular chamber in water mounts (less distinct in K), 42 - 47 x 12 - 15 µm, Lecanora type. Ascospores: colourless, simple, 8 per ascus, 10 - 11 x 7 - 7.5 µm, usually ellipsoid, occasionally subglobose, ends rounded to subacute, with a distinct wall about 1 µm thick. Chemistry: medulla K-, P-, C-, KC-. 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.

This species can not be confused with other species with a C- medulla, provided that the isidia are examined carefully.

Throughout Greece, though absent from most of the smaller 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), eastern N. America (Saskatchewan, scattered in USA, mainly in the east). Reports for Australia are incorrect.

Melanelia exasperatula (Nyl.) Essl. (1978)
in: Mycotaxon 7(1): 47; Parmelia exasperatula Nyl. (1873) in: Flora 56: 299; Melanohalea exasperatula (Nyl.) O. Blanco et al.

The earliest name is Imbricaria olivacea f. papulosa Anzi (1868), but it does not have priority at species rank.

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 the lobe margins, brown, shiny, hollow, 0.35 - 0.55 x 0.15 - 0.25 mm; occasionally cylindrical or clavate, but more usually flattened in cross-section, occasionally almost squamule-like; sometimes erect but more usually decumbent; when decumbent without any preferred overall orientation, but adjacent isidia tend to have a similar
Brown, 20–25 and appear to be formed of a single hypha. Isidia: absent. Pseudocyphellae: absent. Rhizines: usually abundant, black, cortex of thalline exciple where they appear colourless, 15–28 µm thick, adpressed or with ascending margins; margins crenulate. Hairs: present, visible on surface of lobes when viewed at x32 in stereo-microscope and then appearing white, scarce in centre of thallus; only seen in section on the cortex of thalline exciple where they appear colourless, 15–28 µm long, 4–5 µm wide at base, tapering towards the tip, and appear to be formed of a single hypha. Isidia: absent. Pseudocyphellae: absent. Rhizines: usually abundant, black, except at tips which are often white, simple, 0.3–0.5 x 0.03 mm. Soralia: absent. Upper cortex: colourless to pale brown, 20–25 µm thick, not sharply delimited below, cellular; cells small, 2–5 µm diameter, angular and very

**Melanelia fuliginosa** (Fr. ex Duby) Essl. (1987)

in: Egan, in: Bryologist 90: 167; Parmelia olivacea (Fr. ex Duby) Nyl. (1830) in: Bot. Gall. 2: 602; Melanelia fuliginosa (Fr. ex Duby) O. Blanco et al.; Parmelia fuliginosa (Fr. ex Duby) Nyl.

Some authors have subsumed this species under *Melanelia glabratula* (or, sometimes, vice versa). However, the two species generally have a very 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 (in material seen to date), dark brown except at tips of lobes which have a greenish tinge, not pruinose. Lobes: 140–250 µm thick, not adpressed, usually slightly convex, elongate, to 5 x 1.5 mm, often dividing at the tips into rounded sublobes that may be concave to convex and are often shiny. Pseudocyphellae: absent. Soralia: absent. Isidia: abundant except at tips of lobes, laminal, dark brown to black, darker than thallus, not postular, not in clusters, cylindrical when mature (may be globose when young), 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, distinctly 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, distinctly 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 *Neofuscascia* (when saxicolous), but no species in that genus has the combination of a C+ strongly red medulla and very fine, simple, unclustered isidia.

According to published reports, this species is scattered on the mainland and the two large islands, though less common in the southern half of Greece, at altitudes 0–1700 m. However, most reports are from bark, and only a few (including my single collection) are from siliceous rock, but *M. fuliginosa* is usually saxicolous, at least in western Europe. Many of the corticolous reports may refer to *M. glabratula*. It would be worth examining extensive Greek collections to see whether *M. fuliginosa* and *M. glabratula* are as distinct here as they undoubtedly are in western Europe.

Most of Europe south of the arctic. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (scattered from Alaska to cooler parts of USA, but largely avoiding continental interior). However, some reports may refer to *M. glabratula*.

**Melanelia glabra** (Schaer.) Essl. (1978)

in: Mycotaxon 7(1): 47-48 (as glabratula owing to a printer's error, but as Esslinger cited the epithet correctly in the basionym, and as the combination was immediately followed by a combination for the real *Melanelia glabra*, his intention seems perfectly clear, and in my view the name was validly published in 1978. In case of doubt, it was validated by Esslinger in 1987, in Egan, in: Bryologist 90: 163.); Parmelia olivacea (Fr. ex Duby) corticola a. (= f.) glabra Schauer. (1840) in: Lich. Helv. Spic. 466; Melanelixia glabra (Schaer.) O. Blanco et al.; Parmelia glabra (Schaer.) Nyl.; Parmelia glabra l. imbricata (A. Massal.) Zahlbr.

Thallus: foliose, to 5 cm diameter. Upper surface: brown, sometimes with a green tinge in central part, usually shiny at lobe margins but elsewhere matt, not pruinose, distinctly wrinkled in central part but lobe margins smooth. Lower surface: black, brown only at extreme margin, attached by rhizines. Lobes: typically about 6 x 3–4 mm, 150–200 µm thick, adpressed or with ascending margins; margins crenulate. Hairs: present, visible on surface of lobes when viewed at x32 in stereo-microscope and then appearing white, scarce in centre of thallus; only seen in section on the cortex of thalline exciple where they appear colourless, 15–28 µm long, 4–5 µm wide at base, tapering towards the tip, and appear to be formed of a single hypha. Isidia: absent. Pseudocyphellae: absent. Rhizines: usually abundant, black, except at tips which are often white, simple, 0.3–0.5 x 0.03 mm. Soralia: absent. Upper cortex: colourless to pale brown, 20–25 µm thick, not sharply delimited below, cellular; cells small, 2–5 µm diameter, angular and very
or 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: colourless to brown, 6 - 40 µm thick, cellular; cells 2 - 7 µm diameter, angular, very irregular, the overall texture resembling a jigsaw puzzle; K- Apothecia: usually present, laminar, sessile to slightly stalked, rounded when young but often becoming distorted later, 2 - 4.5 mm diameter, not pruinose. Disc: brown, shiny, strongly concave when young and usually at least slightly concave even when mature. Exciple: poorly developed and not visible externally; in section about 25 µm wide, colourless. Thalline exciple: present, brown, thin but persistent, smooth, 110 - 150 µm thick in section; cortex 25 - 40 µm thick, lower part of loosely spaced, unoriented, anastomosing hyphae that merges gradually with the medulla, upper part of a denser network of hyphae that still appear to be anastomosing except near the tips. Epithecium: pale yellow-brown, K- (pigment persistent). Hypothecium: colourless, sometimes pale yellow-brown in upper part, 75 µm tall, KI- Hypothecium: colourless, 50 µm tall. Paraphyses: 3 µm wide, simple, not capitulate or moniliform, septa sometimes visible. This species is easily recognised by the absence of isidia or secondary lobules. Throughout Greece, except for many of the smaller islands. On bark of a wide range of trees (but only rarely on conifers) at altitudes 0 - 1600 m. Southern and central Europe. Absent from British Is and almost absent from the Nordic countries. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (Arizona, California, Idaho).

Melanelia glabrata (Lamy ex Nyl.) Essl. (1978)
in: Mycotaxon 7(1): 48; Parmelia glabrata Lamy ex Nyl. (1883) in: Flora 66:532; Melanelia fuliginosa subsp. glabrata (Lamy ex Nyl.) J. R. Laundon; Melanelia glabrata (Lamy ex Nyl.) Sandler & Arup; Parmelia fuliginosa var. laetevirens (Flot. ex Körb.) Nyl.
The earliest name is Imbricaria olivacea var. laetevirens Flot. (1850), but it does not have priority at the rank of species.
Thallus: 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 a greenish tinge, shiny at least at the margins, not pruinose. Lower surface: pale brown, smooth, attached by rhizines. Isidia: often abundant and sometimes almost obscuring thallus, brown to dark brown, usually darker than thallus; mostly laminar and on older parts of lobes, rarely marginal; initially simple, sometimes later becoming branched, rounded in cross-section, erect, 0.1 - 2 x 0.05 - 0.3 mm. Pseudocyphellae: absent. Rhizines: pale brown, sometimes white at tips or when immature, simple, 0.15 x 0.02 mm. Soralia: absent. Upper cortex: pale brown to brown, 8 - 15 µm thick, sharply delimited from algal layer, cellular in transverse section; cells small, 2.5 µm wide, rather square at least in outermost layer; K-, N-. Cortical hairs: not seen in the few thallus section examined. 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: brown, 6 - 7 µm thick, sharply delimited from medulla, cellular; cells square to angular, about 4 µm diameter. (The cellular structure can be seen in transverse section, but it is much clearer when a layer of cortex that has become detached from the medulla is viewed at right angles to the surface). Pycnidia: sometimes present, laminar, black, 0.02 - 0.04 mm diameter; in section: 100% immersed, 3globose or with a short neck, 120 µm tall x 110 µm wide, wall colourless to pale grey except at ostiole. Conidia: colourless, bacilliform, 5 - 8 x 1 µm. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K- (but orange patches, if present, K+ strongly violet), P-, C+ red, KC+ red, I-, UV-. Photobiont: green; cells globose, 8 - 12 µm diameter, in a spiral, sometimes slightly discontinuous, layer 25 - 30 µm thick. The C+ and KC+ reactions of the medulla are sometimes confined to the upper part of the medulla. Easily separated from other isidiate, corticolous species with a C+ medulla by the shiny upper surface. Widely distributed, but not reported from Crete. On bark of a wide range of species at altitudes 0 - 1500 m, but uncommon above 1000 m. There is a single report from wood. Throughout most of Europe. Also Macaronesia, western Asia (Turkey), N. Africa (Morocco), N. America (scattered from Alaska to cooler parts of USA), perhaps C. America. Reports for Australasia are incorrect. Confusion with M. fuliginosa has obscured the finer details of its distribution.
Melanelia laciniatula (Flaggy ex H. Olivier) Essl. (1978)
in: Mycotaxon 7(1): 48; Parmelia exasperatula var. laciniatula Flaggy ex H. Olivier (1894) in: Revue de Bot. 12: 69; Melanelixia laciniatula (Flaggy ex H. Olivier) O. Blanco et al.: Parmelia laciniatula (Flaggy ex H. Olivier) Zahlbr.

Thallus: foliose, to 4 cm diameter, 65 - 80 µm thick (measured at lobule, not primary lobe). Upper surface: brown, not pruinose, mostly matt but 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 adpressed, but soon obscured by secondary lobules. Lobules: abundant and soon obscuring the primary lobes, 0.5 - 1.5 mm wide, usually erect, laminal and marginal; laminal ones arising from small conical warts on surface of primary lobes, these 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 present in thin section, but only immature ones seen. Isidia: true isidia absent, but conical warts very similar to those of M. exasperata, present on primary lobes; however, in contrast to that species, 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 the apex of the conical warts. Rhizines: white to pale brown, 0.2 x 0.1 mm, simple, often with a blunt or slightly swollen tip (not tapered towards tip). Soralia: absent. Upper cortex: pale brown, 10 - 12 µm thick, N-.. Medulla: white, 20 µm thick, of loosely woven anastomosing hyphae; hyphae thin, about 1.5 µm wide, not encrusted with crystals. Lower cortex: colourless, 10 - 15 µm thick, 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; anatomy of inner part is clearly different, but structure not well seen.. Chemistry: medulla K-, C-, KC-, P-, UV-.

This species usually has abundant secondary lobules, making it easy to recognise.

Very scattered, with no clear pattern. On bark, usually of conifers, 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), perhaps N. America.

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 south of the Alps and Pyrenees. Also Asia (widespread), N. America (widespread).

Melanelia subargentifera (Nyl.) Essl. (1978)
in: Mycotaxon 7(1): 48; Parmelia subargentifera Nyl. (1875) in: Flora 58: 359; Melanelixia subargentifera (Nyl.) O. Blanco et al.

There are earlier names, but they do not have priority at the rank of species.

Descriptions: Clauzade & Roux (1985) as Parmelia subargentifera; Nash et al. (2002); Smith et al. (2009) as Melanelixia subargentifera; Thell & Moberg (2011) as Melanelixia subargentifera.

Known from a single site in Macedonia, where it occurred on bark at an altitude of 900 m.

Quite widely distributed in northern and central Europe, but very rare south of the Alps. Also Asia (widespread in cooler regions), perhaps Africa (Kenya), N. America (fairly widely distributed in southern Canada and cooler parts of USA), perhaps C. America.

Melanelia subaurifera (Nyl.) Essl. (1978)
in: Mycotaxon 7(1): 48; Parmelia subaurifera Nyl. (1873) in: Flora 56: 22; Melanelixia subaurifera (Nyl.) O. Blanco et al.

Descriptions: Clauzade & Roux (1985) as Parmelia subaurifera; Nash et al. (2002); Smith et al. (2009) as Melanelixia subaurifera; Thell & Moberg (2011) as Melanelixia subaurifera.

Fairly common in the northern half of Greece. On bark, occasionally on wood, at altitudes 0 - 1100 m.

Widely distributed in Europe, but absent from areas with a truly Mediterranean climate. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya), N. America (widespread), perhaps C. America.

Melaspilea Nyl. (1857)

Type: M. arthonioides (A. Massal.) Nyl. Family: Melaspilaceae. 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. It
needs a thorough revision. The best places to start are probably Clauzade & Roux (1985) and Smith et al. (2009).

As presently circumscribed, Melaspilea has about 70 species, but it is very heterogeneous. Some species are not lichenised. About 22 species have been reported for Europe.

The key is not very satisfactory at present, as I lack good descriptions for most of the species.

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, the exciple. Apothecia elongated. (M. poetarum)

2 Hypothecium pale. Apothecia elongated or rounded.

33 Apothecia ±elongate. (M. bagliettoana)

3 Apothecia ±round.

44 Apothecia in groups. M. oleae

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

Melaspilea graeca Szatala (1956)

Description: See the protologue.

Mt. Olympus, on calcareous rock at an altitude of 1800 m.

Known only from the type collection, which is reported as having 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 Melaspilea.

Melaspilea oleae J. Steiner (1894)

Description: See the protologue.

Known only from the type collection, from Patra in the NW Peloponnese, where it occurred on the bark of Olea close to sea level.

Steiner stated that the apothecia of this species 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 remains unclear for the moment.

Melaspilea proximella (Th. Fr.) Nyl. (1873)

The basionyn is usually cited as Arthonia proximella Nyl. (1861) in: Notis. Sällsk. Fauna Fl. Finn. Förh. 5: 269, but both Nylander's 1861 name and Fries's 1860 name appear to have been based on the same specimen, and so are probably homotypic. Although in 1861 Nylander did not refer to Fries, the 1861 name is probably best regarded as a presumed combination.

Melaspilea proximella var. graeca J. Steiner may be synonymous. The protologue, in Steiner (1898):171, makes it clear that this variety is close to var. proximella. I have not seen any other description of Steiner's taxon, and in the absence of a modern revision of the genus I am willing to regard the two varieties as synonymous. Var. graeca is only reported for Greece.

There are conflicting opinions in the literature as to whether Arthroprenia furfuracea A. Massal. (1856) is a synonym. If it is, Massalongo's epithet has priority.

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), perhaps N. America, perhaps S. America (Argentina), perhaps Australasia (Australia).
Melaspilea urceolata (Fr.) Almb. (1963)
in: Grummann, in: Cat. Lich. Germ. 20. (The name is not legitimate, being a later homonym of Melaspilea arthonioides var. hysteroides (A. Massal.) Zahlbr.)
Lecanactis urceolata Fr. (1825) in: Syst. Orb. Veg. 1: 288; Melaspilea arthonioides var. hysteroides (A. Massal.) Zahlbr.
Lecidea arthonioides Fée (1825), published a few months before Fries's name, may be synonymous but is not legitimate (later homonym).
Description: Clauzade & Roux (1985).
Athos Peninsula, on bark of Olea at an altitude of 50 m.
A rather uncommon species of central Europe and the northern parts of southern Europe. Absent from British Is, Baltic States and the Nordic countries. Also eastern Asia (China, Japan), N. America (scattered in USA), S. America (Brazil), but the status of many of these reports is unclear.

Merismatium Zopf (1898)
Type: M. lopadii (Anzi) Zopf. Family: Verrucariaceae. Literature: The best starting point is probably the key to all species in Roux, Gueidan & Navarro-Rosinés (2002).
About 13 species of lichenicolous fungi, of which 11 occur in Europe. Most are restricted to cold regions. Only one species is known for Greece, where it is rare.
11 Ascospores with a perispore at least initially. On saxicolous crustose lichens.
22 Length of ascospores generally exceeding 20 µm. M. deminutum
2 Length of ascospores generally less than 20 µm. (M. discrepans), (M. scamnoecum)
1 Ascospores without a perispore. On terricolous, muscicolous or corticolous lichens, not usually on saxicolous lichens. (M. decolorans), (M. heterophractum), (M. nigritellum), (M. peregrinum)

in: Roux, Gueidan & Navarro-Rosinés, in: Mycotaxon 84: 3; Polyblastia deminuta Arnold (1861) in: Flora 44: 264; (?) Strickeria dissidens (Arnold) J. Steiner
The combination Strickeria dissidens was made in Steiner (1898:185), based on Polyblastia dissidens Arnold. Steiner describes a Greek collection, which was parasitic on an endolithic calcareous lichen, quoted as Lecidea enteroleuca (probably Lecidella stigmatea). Steiner's description suggests to me that the species is close to M. deminutum, although the perithecial diameter of 0.1 - 0.2 mm quoted by Steiner is rather small for that species. I have not seen any other description of Strickeria dissidens, nor have I seen Arnold's protologue for Polyblastia dissidens. The only other reference to it that I have found is in the checklist for Germany, Scholz (2000), as Polyblastia dissidens.
Descriptions: Clauzade, Diederich & Roux (1989); Clauzade & Roux (1985) both as Polyblastia deminuta; Smith et al. (2009).
Northern half of mainland Greece at altitudes 1100 m and above. On limestone or parasitic on "Lecidea enteroleuca", which probably refers to Lecidella stigmatea.
Scattered, mainly in northern Europe and the Alps. I have not seen any reports for other continents.

Micarea Fr. (1825)
in: 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 most of them, including all that are likely to occur in Greece, are discussed in Smith et al. (2009).
Thallus crustose, of gonioyest 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 100 species, with about 68 in Europe. They usually occur on acidic substrata in cool, moist habitats, and so are uncommon in Greece, where only 6 species have been reported. More might be present in northern, and especially north west, Greece.
The key below may be unsatisfactory. Because the European distribution of many Micarea species is not well
known, I have may have omitted some that could occur in northern Greece. However, determination of *Micarea* collections is difficult and I do not with to complicate the key unnecessarily. If a Greek collection of *Micarea* does not key out, or keys out but does not seem to 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 Thalls with methoxymicareic or prasinic acid. *M. micrococca*
3 Thallus immersed or of green-grey to grey granular areoles. Thallus often 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. *M. 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.
Western half of Europe (British Isles, Benelux, Germany, Iberian Peninsula). The Greek report is disjunct.

**Micarea denigrata** (Fr.) Hedl. (1892)
Descriptions: Coppins (1983a); Nash et al. (2007); Smith et al. (2009).
Mt. Olympus, on wood at altitudes around 1000 m. The report for the Peloponnese in Abbott (2009) is incorrect; the material belonged to *M. misella*.
Widely distributed in Europe to as far north as the Arctic Circle, but south of the Alps uncommon and probably confined to upland areas. Also Macaronesia (Azores), Asia, (Turkey, Russia, perhaps Taiwan), N. Africa (Morocco), N. America (Alaska, Newfoundland, scattered in USA), 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 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 north of the Alps and south of the Nordic countries (though present in Baltic States). Also reliably reported for N. America (Arizona, California), Australasia (Tasmania, NZ). Reports for elsewhere (e.g. Taiwan, Brazil) are in need of confirmation.

**Micarea misella** (Nyl.) Hedl. (1892)
  The epithet *asserculorum* has often been used for this lichen, supposedly from *Lecidea asserculorum* Ach. (1810), but the application of Acharius's name is uncertain.

Thallus: crustose, grey to dark grey, thin, not continuous. Cortex: absent. Apothecia: abundant in the only Peloponnesian collection, sessile, convex, 0.15 - 0.3 (0.4) mm diameter, the larger ones often tuberculate, not pruinose. Disc: black. Proper exciple: not visible externally, absent or very poorly developed in section. Thalline margin: absent. 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 K+ blue. Ascospores: colourless, simple, ±ellipsoid, 8 per ascus, 6.5 - 10 x 3 - 3.5 µm. Chemistry: thallus C-, P-.
Photobiont: green, cells 6 - 10 µm diameter.
Crete and Peloponnese, on bark or wood at altitudes 250 - 1000 m. This is an inconspicuous species, and is probably more common in Greece than the few records suggest.
Widely distributed from the Alps to subarctic regions; rare but widely distributed south of the Alps, at least in the uplands. Also Asia (Kazakhstan, Russia, Bhutan, and perhaps Taiwan), N. Africa (Morocco), N. America (southern Canada, scattered in cooler parts of USA), S. America (Brazil).

**Micarea prasina** Fr. (1825)
in: Syst. Orb. Veg. 1: 256-257
  Thallus: crustose, of green, granular goniocysts 75 - 150 µm in 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. Exciple: absent. Thalline margin: absent. Epithecium: almost colourless. Hymenium: 35 µm tall, colourless. Hypothecium: 35 µm tall, colourless. Paraphyses: 1 µm wide. Ascospores: colourless, simple, ±ellipsoid, 8 per ascus, 8 - 10 x 4 µm. Pycnidia: externally visible as white dots, 0.1 mm diameter; in section: 100 µm tall x 75 µm wide. Conidia: 6 x 1 µm, sometimes slightly curved. Chemistry: thallus C-.
Photobiont: green, cells 6 - 10 µm diameter.
The apothecial pigments in *M. prasina* are said to react K+ purple. In the only Peloponnesian collection referred to *M. prasina*, apothecial sections had very little pigment, and I was not able to observe any K+ violet reaction.
Scattered, and the few records to date show no clear pattern. On bark of *Pinus* and *Platanus* at altitudes 10 - 900 m. Some of these reports might refer to *M. micrococca*.
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 many may refer to *M. micrococca*.

**Milospium D. Hawksw.** (1975)
Type: *M. graphideorum* (Nyl.) D. Hawksw. Family: anamorphic fungi - hyphomycetes. Literature: For *M. graphideorum*, see Clauzade, Diederich & Roux (1989). For *M. lacoizquetae*, see the original description, in Etayo &
Diederich (1996).

I know of four species in this genus of lichenicolous hyphomycetes, three of which occur in Europe. Only one has been reported for Greece.

11 Sporodochia blackish. On squamules of Cladonia. (M. lacoizquetae)
1 Sordaria blackish. On crustose lichens with photobiont Trentepohlia. **M. graphideorum**

*Millospium graphideorum* (Nyl.) D. Hawksw. (1975)

The earliest name may be *Contiocarpon olvaceum* DC. (1805), but the synonymy is not certain.

Description: Clauzade, Diederich & Roux (1989). Hawksworth (1979) has a diagram.

Kos and Rhodes, at altitudes 230 - 250 m. The only host determined to species was *Dirina ceratoniae*.

Throughout Europe to as far north as Wales, Ireland and southern Sweden. Also Macaronesia, Asia (Iran), Malesia (PNG), "Africa" (Ascension Is, St Helena), S. America (Colombia, Paraguay).

**Miriquidica Hertel & Rambold (1987)**


About 23 species, all saxicolous. About 20 are present in Europe, but most are strongly northern and unlikely to occur in Greece.

11 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).

Islands of the Aegean, including Crete, 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, but absent from regions with a truly Mediterranean climate. Also Asia (Russia, Mongolia, China, Japan).

**Miriquidica deusta** (Stenh.) Hertel & Rambold (1987)

Description: Clauzade & Roux (1989) as *Lecidea deustata*.

Islands of the Aegean, including Crete, on siliceous rock at altitudes 5 - 700 m. The occurrence 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).
Moelleropsis Gyeln. (1940)

in: Rabenhorst’s Kryptogamenflora, Ed. 2, 9(2,2): 257

Type: M. nebulosa (Hoffm.) Gyeln. Family: Pannariaceae. Literature: Smith et al. (2009) is as good a starting point as any.

Moelleropsis should probably be merged with Fuscopannaria, but the correct name for the combined genus depends on the result of a conservation proposal, so I retain traditional usage here. As presently delimited, Moelleropsis has only one species.

11 Distinct white prothallus present. On liverworts of the genus Frullania. (M. nebulosa subsp. frullaniae)
1 Prothallus black or absent. On various substrates. M. nebulosa subsp. nebulosa

Moelleropsis nebulosa (Hoffm.) Gyeln. (1940) subsp. nebulosa

Description: Ahti et al. (2007); Burgaz et al. (2010); Clauzade & Roux (1985) as Pannaria nebulosa; Nash et al. (2002); Smith et al. (2009).

The Greek reports are from a small area of Macedonia, where it occurred on soil at altitudes 50 - 1150 m. Throughout much of Europe. Also Macaronesia, central Asia (southern Siberia, Mongolia), Africa (Morocco, Transvaal), N. America (California).

Muellerella Hepp ex Müll. Arg. (1862)


Type: M. polyspora Hepp ex Müll. Arg. Family: Verrucariaceae. 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, 1-septate (in Greek species), 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.

Twelve described species of lichenicolous fungi, though two are poorly known and may not be good species. The genus is quite common in Greece.

11 Mature ascospores simple.
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 to ellipsoid, 5 - 14 x 5 - 7 μm. M. dilatata

11 Mature ascospores mostly 1-septate.
22 Perithecia (70) 100 - 120 (150) μm diameter. Periphyses to 15 μm long. Hymenium I+ blue. Ascii 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. Periphyses to 40 μm long. Hymenium I- or slightly I+ reddish. Ascii 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. Steiner does not mention any septation of the ascospores, but neither does he clearly state that the ascospores are simple. I suspect that this name will prove to be a synonym of M. erratica or M. pygmaea.

Mountains of northern Peloponnese, at subalpine levels, on Aspicilia trachytica (as Lecanora 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 warty.

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 Crete, at all altitudes. Reported hosts include species of Aspicilia, Caloplaca, Lecidea, Lecidella and Verrucaria.

Widely distributed in Europe. Also Asia (Turkey, widespread in Russia, Nepal), N. Africa (Algeria), N. America (widespread, but mainly in the west), C. America (Mexico), S. America (Chile), Australasia (NSW).

Muellerella lichenicola (Sommerf.) D. Hawksw. (1979)

Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004); Triebel (1989).

Crete, at altitudes 500 - 1600 m. Reported hosts are Caloplaca lactea and Catillaria detractula.

Widely distributed in Europe. Also Asia (Israel, Iran, Russia), Malesia (PNG), N. America (widespread), S. America (Chile, Colombia), Australasia (NZS).

Muellerella pygmaea (Körb.) D. Hawksw. (1979)

M. pygmaea and M. erratica are difficult to separate, and some collections included here might belong to the latter.

Perithecia: dark brown to black, 0.05 - 0.2 mm diameter, 50% 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: 1- (or almost). Paraphyses: simple, disappearing early. Ascii: 33 x 15 µm, subglobose. Ascospores: pale brown to brown, 1-septate, ellipsoid, not constricted at septum, ends rounded, 12 - 32 per ascus, (6) 7 - 10 x (3) 4 - 7 µm.

Ascospores are said to be slightly warted, but in practice this is hard to observe.

For comparison with *M. erratica*, see under that species.

Fairly common on the mainland and Crete, but not reported for any of the smaller islands. At altitudes 300 m and above, but rare below 650 m. On a very wide range of hosts, including species of: *Acarospora*, *Aspicilia*, *Caloplaca*, *Fulgensia*, *Lecanora*, *Lecidea*, *Rinodina* and *Tephroma*.

Throughout Europe. Also Asia (widespread in cool and temperate regions), N. Africa (Morocco), N. America (widespread, but rare in the east), perhaps S. America (Bolivia, Chile), Australasia (NZS), Antarctica (S. Georgia).


Descriptions: Nash et al. (2004); Triebel (1989), both as *Muellerella pygmaea var. ventosicola*.

Macedonia, at about 2000 m. Reported hosts are *Rhizocarpon distinctum* and *R. geographicum*.

Widely distributed in central and northern Europe, but rare south of the Alps and Pyrenees. Also Macaronesia, Asia (Iran, widespread in Russia), N. America (Arizona, Colorado, Louisiana), perhaps S. America (Bolivia).
Mycobilimbia Rehm (1889)


Type: M. obscurata (Sommerf.) Rehm (= M. tetramera). Family: Lecideaceae. 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. One of the species discussed below, as M. berengeriana, does not belong in Mycobibilimbia s. str., but as it has often been discussed under this genus, and its correct placement is uncertain, it is retained here for convenience. As the only species that I have seen probably does not belong to the genus proper, no description is provided.

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. (M. pilularis) Greek report doubtful.
1 Ascospores 3-septate.
22 Apothecia pale, without pigment in section. (M. carneoalbida)
2 Apothecia ±dark, with red-brown pigment in section. M. tetramera

Mycobilimbia berengeriana (A. Massal.) Hafellner & V. Wirth (1987)
The earliest name may be Biatora miscella Fr. (1831) [non Lecidea miscella Ach.], a name which is validly published and legitimate.

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. Excieple: brown, paler than disc, sometimes slightly shiny, becoming excluded; in section: colourless to pale brown in outer part, brown in inner part, hyphae developing distinct lumina towards exterior, lumina sometimes almost circular in outermost part. Thalline margin: absent. Epithecium: very pale yellow-brown, K-. Hymenium: 75 µm, colourless. Hypothecium: dark orange-brown in upper 50 µm, pale orange-brown in lower 150 µm, K-. Paraphyses: simple, apparently of two types; 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, 8 per ascus, 10 - 13 x 4 - 5 µm, sometimes ±moniserate, with a warded perispore. 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 it is probably confined to the uplands. However, more than one taxon may be involved, and the Mediterranean taxon may not be conspecific with that of northern Europe. Also Asia (Russia, Japan), N. America (widespread from Alaska to cooler parts of USA).

Mycobilimbia tetramera (De Not.) Vitik. et al. ex Hafellner & Türk (2001)

Descriptions: Nash et al. (2004); Smith et al. (2009).

Very scattered, in northern Greece. Overgrowing bryophytes or decaying vegetation, usually at altitudes above 1000 m, though there is a single report for an altitude of just 200 m.

There are reports from many parts of Europe. Also Asia (Iran, Russia, Tajikistan, Mongolia), N. Africa (Morocco), N. America (scattered from Alaska to northern USA), perhaps C. America.

Mycocalicium Vain. (1895)

in: need to investigate

Type: M. parietinum (Ach.) Vain. (= M. subtile). Family: Sphinctrinaceae. Literature: Tibell (1987) has good descriptions of all the European species, except for the recently described M. limonae, 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.

Many species are saprobic and not of interest to lichenologists. However the 13 or so species that occur on bark or wood, though not lichenised, 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 Stalk shining black; in section reddish in outer part. Apothecia 0.8 - 1.8 mm tall. Stalk 80 - 100 µm wide. Head 100 - 400 µm wide. (M. victoriae)  
2 Stalk brown to white; in section ±colourless everywhere. Apothecia to 0.4 mm tall. Stalk to 50 µm wide. Head 25 - 200 µm wide. (M. llimonae)  
1 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)  
Corfu, on wood of *Olea europaea* at an altitude of 20 m.  
A species of warm-temperate to subtropical regions. Very rare in Europe: only Greece, Ukraine and Russian Caucasus. Also Asia (Japan), Malesia (PNG), N. America (widespread in USA, but avoiding continental interior), C. America (CR, Guatemala, Mexico), S. America (Brazil, Venezuela), Australasia (widespread in temperate parts).

*Mycocalicium subtile* (Pers.) Szatala (1925)  
Descriptions: Ahti et al. (1999); Muñiz & Hladun (2011); Nash et al. (2007); Smith et al. (2009); Tibell (1987).  
Very scattered, with no clear pattern. On wood, less commonly bark, at altitudes 0 to about 2000 m.  
Widely distributed in Europe, but probably often overlooked. Also Macaronesia, Asia (scattered but widespread), Malesia (PNG), N. Africa (Morocco), N. America (widely distributed from Alaska southwards), C. America (Mexico), S. America (Brazil), Australasia (widespread).

**Myriospora Nägeli ex Uloth (1861)**  
in: *Flora* 44: 617  
Type: *M. smaragdula* (Wahlenb. ex Ach.) Nägeli ex Uloth. Family: *Acarosporaceae*. Literature: The species are treated in the standard Floras, usually under *Acarospora*.  
This is a recently resurrected segregate of *Acarospora*, for the "smaragdula group". It contains 9 species, 8 of which occur in Europe. Only one is likely to occur in Greece.

*Myriospora smaragdula* (Wahlenb. ex Ach.) Nägeli ex Uloth (1861)  
in: *Flora* 44: 618; *Endocarpon smaragdulum* Wahlenb. ex Ach. (1803) in: *Methodus* (Suppl.) 29-30; *Acarospora fuscata var. smaragdula* (Wahlenb. ex Ach.) Stein; *Acarospora smaragdula* (Wahlenb. ex Ach.) A. Massal.,  
Descriptions: Clauzade & Roux (1985); Roux (2007); Smith et al. (2009), all as *Acarospora smaragdula*.  
Crete and northern Peloponnese, on siliceous rock above 1500 m altitude. There are no recent records.  
Throughout Europe. Also Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread), C. America (Mexico), perhaps S. America (Argentina, Chile), Australasia (S. Australia).

**Nectriopsis Maire (1911)**  
in: *Annales Mycologici* 9(4): 323  
Type: *N. violacea* (Fr.) Maire, which is not lichenicolous. Family: *Bionectriaceae*. Literature: Information is very scattered. Hawksworth, Atienza & Coppins (2010) is helpful.  
About 60 species, of which about 18 are lichenicolous. There is only a single Greek record.

11 Two types of ascospores present in the same ascoma; large ones, 34 - 50 x 12 - 18 µm; small ones 8 - 17 x 3.5 - 7 µm. (N. parmeliae)  
1 Ascomata with only one type of ascospore.
22 Ascospores not more than 3 \( \mu \)m wide. (N. rubifaciens), (N. pertusariae)
2 Ascospores usually at least 5 \( \mu \)m wide.
33 Ascospores 9 - 12 \( \mu \)m long. On Lobaria and Peltigera. **N. lecanodes**
3 Most ascospores more than 12 \( \mu \)m long. On other hosts. (N. hirta), (N. indigens), (N. physisiiola)

**Nectriopsis lecanodes** (Ces.) Diederich & Schroers (1999)
in: Sérasiaux, Diederich, Brand & van den Boom, in: Lejeunia 162: 56; Nectria lecanodes Ces. (1863) in Rabenhorst, Klotzschii Herbarium Vivum Mycologicum en Nov. Ser. Sec. Cent. 6 no. 527
Description: Hawksworth, Atienza & Coppins (2010); Nash et al. (2004).
Epiros, on Lobaria scrobiculata at an altitude of 570 m.
Probably throughout Europe to as far north as southern Scandinavia. In the south probably restricted to the mountains. Also Macaronesia, Asia (Turkey, Russia, India), Malesia (PNG), N. America (widespread), Caribbean (DR), C. America (Mexico), S. America (Argentina).

**Neocatapyrenium** H. Harada (1993)
This recent 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. rhizinosum**
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)
Catapyrenium latzelii (Zahlbr.) Breuss
Descriptions: Breuss (1990) as Catapyrenium latzelii; Prieto et al. (2010); Roux (2005).
Kalimnos, on limestone and calcareous soil at an altitude of 80 m.
A rare species known only for Spain, Croatia, Serbia and Greece.

**Neocatapyrenium rhizinosum** (Müll. Arg.) Breuss (1996)
Catapyrenium rhizinosum (Müll. Arg.) Breuss; Dermatocarpon rhizinosum (Müll. Arg.) Zahlbr.; Placidium rhizinosum (Müll. Arg.) Szatala
Dodecanese Islands of the southern Aegean, and also Mt. Olympus. On calcareous soil at altitudes 0 - 2300 m.
In Europe, known only from Greece. Also western Asia (Turkey, Iraq, Iran, Uzbekistan, Tajikistan, Russia).

**Neofuscelia** Essl. (1978)
in: Mycotaxon 7(1): 49
Type: N. pulla (Ach.) Essl. Family: Parmeliaceae. Literature: The nearest thing to a monograph is Elix (1977b), but it places too much emphasis on chemistry. The treatment of Neofuscelia in Flora of Australia, Orchard & Gruganriov (1994), is good, but covers only a few of the European species. Clauzade & Roux (1985) (under Parmelia), and Smith et al. (2009) (under Xanthoparmelia) are helpful, but both have a broad concept of species in the N. pulla group and are of limited use if one wishes to apply the narrower species concepts favoured by some authors. For N. halei see Essling, Barbero & Llimona (1993), and for N. perrugata see Giordani et al. (2003) and Galun (1970):64. Giordani et al. (2003) give a key to the species present in Italy, but have only brief descriptions of the species themselves.
Thallus: foliose, heteromorous, to several cm diameter. Lobes: to a few mm wide, usually adpress ed, flat to moderately convex but not strongly convex, central part sometimes wrinkled, contorted, warted or cracked but marginal part usually smooth. Upper surface: brown to dark brown, often green-brown at margins and occasionally elsewhere,
usually matt except at the margins which are often shiny, rarely with a faint white pruina at the extreme tips of the lobes. Lower surface: dark brown to black (in Peloponnesian species), sometimes paler at the margin, smooth, attached by rhizines. Isidia: present in some species. Pseudocyphellae: absent. Rhizines: simple, dark brown to black when mature but often white, or at least white at the tips, when young. Soralia: absent. Upper cortex: present, to about 25 mm thick, orange-brown or brown, sometimes colourless in lower part, with a distinct cellular structure at least in the upper part (best seen when viewed perpendicular to the surface); K-, C+ blue-green, N+ blue-green giving way in some specimens to a permanent dull mauve. Medulla: white, of loosely interwoven hyphae that occupy at least half the thickness of the lobe; hyphae rather broad, 2.5 - 4 mm, usually without visible septa, in many species covered in small, colourless, angular crystals. Lower cortex: present, to about 25 mm thick, usually rather dark brown, distinctly cellular in outer part (best seen when viewed at right angles to surface); K-, C-, N-. Apothecia: sessile to slightly stalked, rounded, concave to flat (nearly always concave when young), large (to 5.5 mm diameter in some species), not pruinose. Disc: brown to dark brown, sometimes shiny when young. Excidium: poorly developed. Thalline margin: present, smooth, thin but persistent. Epithecium: orange-brown to brown, K- (but pigment dissolves). Hymenium: colourless, 35 - 50 mm tall. Hypothecium: of paraphyses. Paraphyses: not capitate, upper part sometimes slightly moniliform and with distinct septa, not branched, fairly broad (2.5 - 3.5 mm), coherent. Asci: Lecanora type. Ascospores: colourless, simple, ellipsoid, fairly small (10-11 x 5-6 mm in N. pulla), 8 per ascus, with a distinct wall about 1 mm thick. Conidiomata: pycnidia. Pycnidia: commonly present (but not seen in N. verruculifera), laminal, appearing externally as black dots about 0.05 mm diameter; in section 100% immersed, globose, 120 - 150 mm diameter, usually colourless (but recorded as pale brown in N. pulla except near ostiole which is usually brown. Conidia: colourless, straight, usually bifusiform, about 5 x 0.5 - 1 mm in most species. Chemistry: thallus always UV–; medulla with a complex and varied chemistry. Photobiont: green, in a continuous but sometimes slightly irregular layer; cells globose, usually in the range 8 - 12 mm diameter.

Differs from Parmelia in the presence of brown pigmentation in the upper and lower cortex. Separated from other Parmelioid genera with brown cortical pigmentation by the N+ blue-green (also C+ blue-green) reaction of the upper cortex.

Despite superficial appearances, Neofuscelia is not closely related to Melanelia. It is much closer to Xanthoparmelia, with which it shares: (1) the type of carbohydrate in the hyphal walls (Xanthoparmelia-type lichenin), (2) the shape of the conidia (normally bifusiform, rather than bacilliform or fusiform), (3) the absence of pseudocyphellae, (4) a complex chemistry and (5) a preference for siliceous substrates. It could be synonymised with Xanthoparmelia, as was done by Blanco et al. (2004), but the resulting Xanthoparmelia s. lat. is a very large genus that may well be subdivided in the future. One of the subdivisions would 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 would be called Neofuscelia. Neofuscelia in that sense probably does not include all the brown species presently placed in it, but it will include many of them, and I prefer to retain the name.

Over 130 species, and widely distributed in temperate regions. Its centre of diversity is in the Southern Hemisphere, especially South Africa. Up to about 17 species may be present in Europe, if one uses a narrow species concept. Species of Neofuscelia are normally saxicolous on siliceous rock.

Neofuscelia has a complex chemistry, thoroughly investigated by Esslinger (1977b), and many species have been recognised on the basis of small differences in medullary chemistry. In Europe, this affects mainly the group of taxa close to N. pulla. Sophisticated investigations can uncover many minor chemical differences between collections, but the biological basis of these differences is not understood. Using them uncritically to define species seems as unwise as the old practice of giving formal recognition to every trivial variation in morphology. My own impression is that some of these chemical races may be good taxa (though not necessarily meriting the rank of species), but I do not believe that all of them are.

I have encountered several difficulties when working with the non-isidiate Neofuscelia species, mainly because they are best separated by chemistry. To do this reliably requires the use of chromatography, but I have been limited to spot tests. As a result, any specimen with a dark lower surface whose diagnostic medullary substances are present only in low concentrations, or which react the same as those of N. pulla in spot tests, is likely to have been referred by me to N. pulla. Another problem is that species of Neofuscelia are restricted to a substrate that is not common in the Peloponnesse, so it is difficult to build up the representative collections needed for thorough study.

11 Isidia present.

22 Medulla KC+ permanent orange, red-orange or brown-orange, often after a fleeting +purple-pink reaction (Note 1).

33 Isidia cylindrical, simple to coralloid-branched. (N. loxodella)

3 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 Melanelia

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. On soil (?also on rock).
333 Thallus ±adpressed. Lobes narrow. Lower surface usually mostly pale. On soil (?)also on rock.

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-. N. pokornyi
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 Lower surface largely or entirely pale brown.
66 Divaricatic or stenosporic acids present. (N. luteonotata)
6 Divaricatic and stenosporic acids absent. N. pyrenaica
5 Lower surface dark brown to black, sometimes paler at margin.
66 Upper surface strongly maculate. Glomelliferic, glomelic and perlatolic acids as major compounds. N. delisei
6 Upper surface usually not maculate (lobe tips sometimes weakly maculate).
77 Centre of upper surface very rough and wrinkled because of densely aggregated warts or papillae, each
with a depression at the apex, rather resembling premature apothecia. A pycnidium is often present
within a wart. Divaricatic acid present as major compound. N. perrugata
7 Centre of upper surface smooth or irregular, but without such warts.
88 Stenosporic acid present as major compound. N. pulla
8 Divaricatic and stenosporic acids absent. N. pyrenaica, (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)
Fasc. 43, no. 1069; Parmelia attica (Leuckert, Poelt & B. Schwarz) Essl.; Xanthoparmelia attica (Leuckert, Poelt & B.
Schwarz) O. Blanco et al.

Thallus: foliose, 6 - 10 cm diameter, 150 mm thick. Lobes: 0.5 - 3 mm wide, usually f lat, adpressed, wr inkled and
contorted (and sometimes cracked) in older parts, at margins usually smooth or occasionally with a faint network of
ridges. Upper surface: dark brown, occasionally green-brown at margin, usually matt but sometimes shiny at extreme
tips of lobes, rarely slightly white pruinose at tips of lobes (last 0.5 mm). Lower surface: black, sometimes brown at
extreme margin (last 0.5 mm), smooth, attached by rhizines. Isidia: absent. Rhizines: simple, black except when very
young (then white), 0.3 x 0.05 mm. Upper cortex: 10 - 15 (35) µm thick, orange-brown to brown, K- (but pigment
dissolves); cellular at least in upper part (most clearly seen when viewed at right angles to surface), cells rounded to
subangular, 3 - 4 µm diameter; C+ blue-green, N+ fleeting blue-green > permanent mauve or dull violet. Medulla:
white, 80 - 175 µm thick, of loosely interwoven hyphae (hyphae sometimes more densely woven in lower part, giving a
two-part appearance to medulla); hyphae 2.5 µm wide. Lower cortex: 15 µm thick, dark brown, cellular (most clearly
seen when viewed at right angles to surface); 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. Exciple: poorly developed, not visible externally: in section 25 µm wide and appearing like a continuation of the
hymenium. Thalline margin: present, thin but persistent, smooth, about 0.1 mm wide when viewed externally, 60 -
100 µm in section. Epithecium: orange-brown, K- (but pigment dissolves). Hymenium: colourless, sometimes orange-
brown in upper part, 45 µm tall. Hypothecium: colourless, 50 µm tall. Paraphyses: not capitulate, sometimes slightly
moniliform and with visible septa in upper part, 2.5 µm wide at base, 3 - 3.5 µm wide near tip. Ascii: mature ones not seen. Ascospores: not seen. Pycnidia: usually present, laminal, appearing externally as black dots 0.05 mm diameter, 100% immersed; in section mostly colourless but brown or blue-green near ostiole, globose, 140 - 150 µm tall x 120 - 130 µm wide. Conidia: colourless, 5 - 10 x 0.5 - 1.5 µm, straight, usually bifusiform, occasionally appearing fusiform. Chemistry: thallus UV-; medulla K+ red-orange, orange or orange-brown (crystals of norstictic acid in thin section), C- in one specimen, the other C+ faint but persistent dull orange in the part of the medulla just below the cortex, KC in one specimen giving no further change to the colour obtained with K, in the other specimen there was an intense but fleeting +red reaction before reverting to the colour seen in K, P+ yellow > pale yellow-orange, UV+ shades of white. Photobiont: green, in a continuous layer 20 - 75 µm thick that is often irregular at its upper boundary; cells 8 - 12 (17) µm diameter.

The distinctive spot test reactions with K and P clearly separate this taxon from other species in this group.

There may be more than one taxon involved here. The medullary chemistry does not seem to be completely uniform, and in one Peloponnesian specimen conidia were recorded as 5 x 0.5 mm, in the other as 7 - 10 x 1.5 mm. One specimen was fertile, the other not. However, mixed collections are not uncommon in this genus, and might be a source of confusion. More collections are needed to clarify the situation.

Widely and fairly common in and around the Aegean, occasionally elsewhere but not very far away. 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)

in: Mycotaxon 7(1): 50; Parmelia olivacea (Nyl.) Duby (1830) in: Bot. Gall. 2: 602; Parmelia delisei (Duby) Nyl.: Parmelia pulla var. delisei (Duby) H. Magn.: Xanthoparmelia delisei (Duby) O. Blanco et al.


Rare and scattered around the Aegean, with no clear pattern, on rock at altitudes 250 - 1400 m.

Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), southern S. America (Argentina, Chile), Australasia (widespread in eastern half of Australia).

Neofuscelia glabrans (Nyl.) Essl. (1978)

in: Mycotaxon 7(1): 50; Parmelia glabrans Nyl. (1875) in: Flora 58: 15; Xanthoparmelia glabrans (Nyl.) O. Blanco et al.

Thallus: foliose, 3.5 cm diameter. Lobes: adpressed, ±wrinkled in central part of thallus. Upper surface brown, without any green tinge. Lower surface: brown at the margins (centre not seen), attached by rhizines. Isidia: absent. Rhizines: simple, brown (but the only ones seen were at the margin of the lower surface - those at the centre might be darker), 0.15 x 0.05 mm (but mature ones might be longer). Medulla: white. Apothecia: sessile to slightly stalked, concave, 0.7-1.6 mm diam. Pycnidia: laminal, black when viewed from above. Chemistry: thallus UV-; medulla K-, C-, KC+ faintly fleeting purple-pink > permanent dull mauve or dull brown-mauve, P-, UV+ blue-white (unambiguously blue-white). (There is no trace of any orange tint in the KC reaction of the medulla provided that the reagents are not permitted to come into contact with the cortex. If the reagents do come into contact with the cortex, it appears that some cortical pigment can sometimes be mobilised, giving confusing results.)

This species can be separated from the other non-isidiate Greek species of the genus by its UV+ blue-white medulla alone. Clauzade & Roux (1985) claim 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 this is not a reliable character. Many specimens in the pulla group display at least a faint green tinge on parts of the extreme margin if one looks closely enough, including some that certainly do not belong to N. glabrans. Some specimens that I have referred to N. pulla have a green-brown tinge over most of the upper surface, but lack the UV+ blue-white fluorescence characteristic of N. glabrans. Although it is possible that these might be specimens of N. glabrans that happen to have only a low concentration of alectoronic acid in the medulla, it seems more plausible to interpret the green tinge as an environmental effect related to the intensity of insolation.

Peloponnesian and Crete, on siliceous rock at altitudes 0 - 450 m.

Southern Europe, from Spain to Greece, though there is a doubtful report for Austria. Also Macaronesia (Canary Is), Asia (Syria, Mongolia), Africa (Morocco, Algeria, S. Africa), southern S. America (Argentina, Chile), Australasia (widespread in temperate parts), Antarctica (subantarctic Macquarie Is).

Neofuscelia loxodes (Nyl.) Essl. (1978)

in: Mycotaxon 7(1): 51; Parmelia loxodes Nyl. (1872) in: Flora 55: 426; Parmelia isidiota 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 of lobes often with a distinct network of ridges; the ridges often developing into cracks in the cortex later. Upper surface: brown, sometimes pale brown or green-brown in places, often shiny at lobe margins but matt elsewhere, sometimes slightly white pruinose at extreme tips (1 mm) of lobes. Lower surface: black in central parts, often pale brown to brown at margin, smooth, attached by rhizines. Rhizines: black, sometimes white to pale brown when young, simple, 0.4 - 0.7 x 0.05 mm. hairs: absent. Isidia: present, mainly in central part of the thallus; sometimes isolated, globose to subglobose, 0.15 - 0.25 mm diameter; but usually forming clusters 1 - 1.5 mm diameter; clusters sometimes abrading and leaving a white patch. Pseudocyphellae: absent, but 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 these structures are not true pseudocyphellae. 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; hyphae broad, about 3 µm wide, covered in small, colourless crystals about 0.5 - 1 µm diameter. Lower cortex: 12 µm thick, dark brown; appearing cellular in outer part, probably owing to closely packed (?)swollen tips of hyphae oriented perpendicular to surface; K-, N-. Apothecia: sometimes present but not abundant, sessile, concave, 0.35 - 1.5 mm diam, not pruinose. Disc: olive-brown, smooth, slightly shiny. Exiple: not visible externally; in section: 15 - 20 µm wide, pale orange-brown near surface, colourless elsewhere, outer part with overall cellular texture, cells rounded, 2 - 3 µm diameter. Thalline margin: present, often isidiate, thin, 0.05 mm wide, but persistent, same colour as disc; in section: 25 - 50 µm wide on sides of apothecia (thicker on lower surface). Epithecium: brown, K-, N-, some pigment dissolving 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 anastomosed hyphae on an overall horizontal trend; lower layer obscurely cellular with no preferred orientation. Paraphyses: simple, rather broad and stout, 3 µm wide, not capitate, septa clearly visible. Asci: 33 - 35 x 14 - 15 µm, clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 8.5 - 10 x 5 - 6 µm. Pycnidia: often present, laminal, appearing as black dots about 0.05 mm diameter; in section: globose, 100% immersed, 125 x 125 µm, colourless except for a brown patch near the ostiole. Conidia: colourless, 5 x 0.5 µm, bifusiform. Chemistry: thallus UV-; medulla K-, C-, KC+ or KC+; fruiting pink-purple or dull purple > permanent orange, P-, I- (or almost), UV+ white. Photobiont: green, in a continuous layer 25 µm thick; cells globose, 10 - 12 µm diameter.

For separation from N. verruculifera see under that species.

Scattered, with no clear pattern. On siliceous rock, or occasionally overgrowing bryophytes on siliceous rock, at altitudes 0 - 1450 m. Most reports are from close to the sea, but it can occur well inland.

Widely distributed in Europe to as far north as mid-Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Ethiopia), N. America (BC, widespread in western USA), perhaps S. America (Argentina).

**Neofusculia perrugata (Nyl.) Elix (2002)**

in: Australasian Lichenology 51: 8; Parmelia perrugata Nyl. (1885) in: Flora 68: 295-296; (?) Parmelia perrugata subsp. petimeningii Harm.; Parmelia prolixa var. perrugata (Nyl.) Harm.; Xanthoparmelia perrugata (Nyl.) O. Blanco et al.

The earliest name is Parmelia prolixa var. exasperans Nyl. (1875), but it does not have priority at the rank of species. Many authors, including Nimis (1993), Orchard & Grignonovic (1994), and recent checklists for some European regions regard N. perrugata as a synonym of N. pulla. If the material that I have seen in the Peloponnese is representative, then this view is difficult to accept.

Thallus: foliose, to 8 cm diameter, about 350 mm thick. Main lobes: 15 - 20 x 2 - 3 mm, repeatedly branched towards the tips, flat to slightly convex, not adpressed. Upper surface: brown to dark brown, sometimes with slight white maculation near lobe tips, strongly wrapt & wrinkled in older parts; warts 0.15-0.35 mm diam, with a distinct depression at the top, often containing a pycnidium. 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: appearing externally as black dots, 0.05 mm diameter; in section: globose, 100% immersed, 150 tall x 170 µm wide. Conidia: colourless, straight, bacilliform (not bifusiform even when examined at x1000), 5 x 1 µm. Chemistry: thallus UV-; medulla K-, C-, KC+ or KC- in some collections, P-, I-, UV+ faintly white by reflection (no blue tinge). Photobiont green, cells globose to subglobose, 9 - 13 µm diameter. Photobiont layer: 25 - 75 µm thick, ±continuous, often irregular especially on upper surface.

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)p64. Specimens referred by me to N. pulla have an upper
surface which varies from smooth to slightly or moderately wrinkled, but they never have anything remotely resembling these warts. If these warts are typical, then I can not understand why, in their key to Neofuscelia in Italy, Giordani et al. (2003) separate N. perrugata and N. pulla solely on the basis of medullary chemistry (divaricatic acid and stenoporic acid respectively). If my understanding of these two species is correct, then they are easy to separate on morphological grounds.

Widely distributed in the south and east of Greece (though not yet reported for Crete), but absent from the north and west. On siliceous rock at altitudes 10 - 1750 m, but commonest below 800 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), Australiasia (NSW).

**Neofuscelia pokornyi** (Körb.) Essl. (1978)

Description: Esslinger (1977b) as *Parmelia pokornyi.* Crete and Macedonia. On rock and soil at altitudes 1100 - 1300 m.

An infrequently recorded, but perhaps not rare, species of southern and central Europe; absent from British Is, Benelux, Baltic States and the Nordic countries. Also Asia (Turkey, Kazakhstan, southern Siberia).

**Neofuscelia pulla** (Ach.) Essl. (1978)

The earliest name is *Lichen pullus* Schreb. (1771), a later homonym of *Lichen pullus* Neck. (1768). Neck and Schreber cited the same Dillenian icon, but Neck's lichen was corticole whereas Schreber's was saxicole. Since Schreber did not cite Neck, matters are simplest if we assume that Schreber intended to describe a new species.

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 convex, 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 the margins and occasionally green-brown over most of the upper surface, mostly matt but sometimes shiny at 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, 0.2 - 0.5 (1.0) x 0.05 (0.1) mm; when mature they contain a ´core, amounting to about one-third of their total diameter, of colourless hyphae with a structure resembling that of the medulla, and contiguous with the medulla, surrounded by a sheath of dark brown hyphae structured like, and contiguous with, the lower cortex. Upper cortex: 10 - 25 µm thick, pale orange-brown, sometimes colourless in lower part; anatomy not well seen, but it appears to be weakly cellular, cells subrounded, 2 - 4 µm diameter; sometimes with numerous 'ghosts' of algal cells in lower part; C+ blue-green, N+ blue-green, both reactions sometimes faint and/or patchy. Medulla: white, of loosely interwoven hyphae, 75 - 200 µm thick; hyphae 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, at least, distinctly cellular (most clearly seen when cortex is viewed at right angles to the surface; less obvious in transverse section); cells about 3 mm diameter; structure of inner part less clear; 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 (?in shade), sometimes shiny when young. Excipla: poorly developed, even in section. Thalline margin: present, smooth, always very thin (0.1 mm when measured externally) but persistent; in section, 100 - 180 µm wide, of which cortex is 12 - 15 µm; cortex K+ blue. Epithecium: pale orange-brown to brown, K- (but pigment dissolves). Hymenium: colourless, 35 - 50 µm tall. Hypothecium: colourless to very pale brown, 50 - 55 µm tall. Paraphyses: simple, not capitate, upper part sometimes slightly moniliform and with distinct septa, 3.5 µm wide, coherent. Ascii: subcylindrical to clavate, 30 x 13 µm, Lecanora type. Ascospores: colourless, simple, ellipsoid, 10 - 11 x 5 - 6 µm, 8 per ascus, with a distinct wall about 1 µm thick. Pycnidia: often present, laminal, appearing externally as black dots 0.05 - 0.07 mm diameter; in section they are 100% immersed, globose, 150 x 150 µm, with a pale brown wall. Conidia: not seen in the only specimen in which pycnidia were studied in detail, though numerous pycnidia were sectioned. Chemistry: thallus UV-; medulla K-, usually C- (but one specimen reacted C- in some places but in others C+ faint fleeting pink > very faint but permanent dull brown), KC- or KC+ faint fleeting pink (the specimen with anomalous C reaction reacted KC+ faint fleeting pink > faint but permanent dull brown - this anomalous specimen might be N. delisei, but the initial +pink reaction is confusing). P-, UV usually + faint white or faint pale green-white (fluorescence never blue-white and never strong). Photobiont: green, in a continuous but rather irregular layer layer 35 - 100 µm thick; cells globose, 10 - 12 µm diameter.
Note: In a few specimens (and sometimes in specimens of other species in the *pulla* group) I have noted very small spots of intense UV+ blue (not blue-white) fluorescence. It is produced by both long-wave and short-wave UV. This fluorescence appears to come from the lichen itself, not from any contaminant, but the spots are very localised and the fluorescence is not characteristic of the medulla as a whole. I do not understand the origin of this fluorescence.

This species does not have many really distinctive characters of its own. In practice, one determines it by excluding the other possibilities.

Common throughout Greece, at altitudes 0 to about 1500 m. Almost always on siliceous rock, thought there is a single reliable report from calcareous rock. However, many of these reports, especially the older ones, might refer to other species in the *pulla* group.

Judging from published information, *N. pulla* is distributed throughout Europe, except for arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), S. America (Chile, perhaps Argentina), Australasia (widespread). Reports for N. America may be incorrect. However, some of these reports may be using the name *N. pulla* in a very broad sense.

**Neofuscelia pyrenaica** (Esssl.) Essl. (1978)


Description: Esslinger (1977b) as *Parmelia pyrenaica*.

Rhodes. No altitude or substrate information was published.

Spain, France, Greece and Cyprus. Also Africa (Morocco, Lesotho).

**N. verruculifera** (Nyl.) Essl. (1978)


The earliest name is *Parmelia prolixa* var. *subfuliginosa* Nyl. (1873), but it does not have priority at the rank of species.

Thallus: foliose, 3 cm diameter. Lobes: to 1 mm long, 0.1 - 1 mm wide, usually ± elongate, 160 - 190 mm thick (but only young lobe measured). Flat to slightly convex, not or only very weakly ridged, sometimes slightly overlapping, often adpressed; lobes often branched or at least with tips incised. Upper surface: brown, sometimes shiny at tips of lobes but matt elsewhere, sometimes very 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 a 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; C+ intensifying orange-brown. Medulla: white, of loosely interwoven hyphae, 60 - 100 mm thick; hyphae 2.5 mm wide, covered in colourless crystals, 0.5 - 1 mm across. Lower cortex: 15 - 25 mm thick, brown to dark brown, cellular at least in outer part; cells square, about 6 x 6 mm, probably tips of terminal hyphae; N-, K-. Apothece: uncommon (only one seen), 0.85 mm diameter, concave, not pruinose. Disc: brown. Exciple: not visible externally. Thalline margin: brown. 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 3.4 µm. Chemistry: thallus UV-; medulla K-, C+ faintly reddish brown; KC+ black; KC+ purple-pink > red (which fades slowly but does not quite disappear), P-, I-, UV+ white. Photobiont: green, in a continuous layer 25 - 50 mm thick; layer slightly irregular, with distinctly undulating upper and lower boundaries; cells globose to subglobose, 9 - 13 x 7 - 11 mm; if subglobose then long axis usually perpendicular to upper surface.

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.

Widely distributed in Europe, to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, widespread in E. Africa, S. Africa, perhaps Zimbabwe), N. America (BC, fairly widespread in western USA), C. America (Mexico)

**Nephroma Ach.** (1809)


Type: *N. polaris* (Ach.) Ach. (= *N. arcticum*). Family: *Nephromataceae*. Literature: James & White (1987) is the standard monograph for 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 30 species, of which 10 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 the Peloponnese in Abbott (2009) was the result of a data entry error.) On bark of *Abies cephalonica* at about 1500 m. This report seems rather doubtful to me, and may refer to *N. laevigatum*.

Throughout much of northern Europe (though not British Is), but in central Europe confined to the mountains. Rare in southern Europe, and confined to northern parts or the highest mountains. Also Asia (Russia, Mongolia, S. Korea, Japan), N. America (widespread from Alaska to cooler parts of USA).

**Nephroma helveticum** Ach. (1810)

in: 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 surprisingly low altitude for this northern species, and the reports is perhaps in need of confirmation.

Mainly in northern and oceanic parts of Europe. Absent from Iberian Peninsula, and the few reports for Italy are for the Alps. Only the very highest mountains of Greece would appear to be suitable for it. If the mainly tropical *N. tropicum* is regarded as synonymous then also Macaronesia, Asia (widespread, especially in the east), Malesia (PNG, Sabah), Africa (widespread in E. Africa, also Rwanda, S. Africa, Madagascar, Reunion Is), N. America (southern Canada, widespread in USA), C. America (CR, Mexico), S. America (Colombia, Ecuador, Venezuela), Australasia (eastern Australia, NZS), Pacific (Hawaii).

**Nephroma laevigatum** Ach. (1814)

in Syn. Meth. Lich. 242 as laevigata; *Nephroma lusitanicum* Schaer.; (?)*Nephroma lusitanicum* var. *sublusitanicum* (Gyeln.) Szatala; *Nephroma resupinatum* β (= var.) *laevigatum* (Ach.) Schaer.; (?)*Nephroma sublusitanicum* Gyeln.; *Nephromium laevigatum* (Ach.) Nyl.; *Nephromium lusitanicum* (Schaer.) Nyl.; (?) *Nephromium neolusitanicum* Gyeln. ex Räs.

The earliest name may be *Peltigera papyracea* Hoffm (1796), but the synonymy is not certain.

Thallus: foliose, sometimes to 10 cm diameter but more usually about 6 cm. Lobes: rounded, 6 - 8 mm wide, sometimes wrinkled or with fine folds, adpressed or ascending, 360 µm thick at centre line in transverse section, diminishing to about 100 µm thick at edges; margins ±smooth, slightly crenulate or slightly wavy. Upper surface: brown, sometimes pale brown or dark brown, rarely ±grey in shaded parts of lobes, matt; not tomentose. Lower surface: pale brown, usually ±smooth, sometimes with fine folds or striations, not tomentose. Cephalodia: absent. Isidia: absent, but laminal folioles sometimes present, marginal folioles rarely present in lobes regenerating after damage. Pseudocyphellae: absent. Rhizines: absent. Soralia: absent. Veins: absent. Upper cortex: 40 - 50 µm thick, colourless, of closely packed, ±vertical hyphae with distinct elongated to rounded lumina 3 - 8 s 2.5 - 5 µm wide, usually giving a cellular texture oveall, K-; a thin, colourless, structureless epicortex sometimes present. Medulla: pale yellow, yellow or orange (but appearing pale brown in section), 70 - 100 µm thick, of loosely interwoven hyphae; hyphae (2) 3 - 4 (5) µm wide, with rare septa visible in K. Lower cortex: 25 - 65 microns thick, colourless to pale brown, ±cellular, 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 the lobe, 1.5 - 2.5 mm diameter, usually slightly concave, not pruinose. Disc: brown, ±matt. Exciple: not visible externally; in section: poorly
developed, 10 - 20 µm wide, of ±vertical hyphae with small visible lumina, giving a weakly cellular texture. Thalline margin: present, very thin, persistent; in section: about 70 µm wide. Epithecium: pale brown, K-, often not clearly differentiated from hymenium. Hymenium: 50 µm tall, colourless in lower part, pale brown in upper part. Hypothecium: 90 µm tall, colourless in upper 50 µm, dark brown in lower part, without distinct structure. Paraphyses: simple, not capitulate, not moniliform, without visible septa, 1 - 1.5 µm wide. Ascii: clavate, 45 - 50 x 10 - 12 µm, wall KI+ blue, apex KI- or with a small indistinct region staining KI+ 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 +dark red reaction), in section diffusing a soluble pigment, C-, KC- (mauve colouration unchanged or slightly bleached), P-; thallus K-, C- (but cortex bleaches so blue-green colour of photobiont becomes visible), KC-, P-, UV- (or weakly and obscurely UV+, even in short-wave). Photobiont: blue-green, in a continuous, regular layer 40 - 75 µm thick; cells subglobose, 6 x 4 µm, not in chains.

In Peloponnesian collections that I have studied ascospores are 15 - 17 (20) µm long. This differs from the 17 - 20 µm length 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 distinct 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 (west coast from Alaska panhandle to central California, and small areas in SE Canada and NE USA). Reports for Australasia (Australia) are incorrect.

Nephroma parile (Ach.) Ach. (1810)

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.

Widely distributed throughout temperate and cool parts of Europe, but rare in arctic and in warm oceanic regions. Also Macaronesia, Asia (widespread), N. America (widespread from Alaska to cooler parts of USA), 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 the northern half of Greece. (Nineteenth century 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.

Widely distributed in boreal and arctic Europe. Further south confined to the mountains, but it does reach Portugal, Spain, Italy and Greece. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread from Alaska to cooler parts of USA), perhaps Pacific.

Nephroma tangeriense (Maheu & A. Gillet) Gattefossé & Werner (1931)

Descriptions: Burgaz & Martínez (2003); Clauzade & Roux (1989); Smith et al. (2009).

Epiros, 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. Also Macaronesia (Canary Is, Madeira), western Asia (Turkey), N. Africa (Morocco, Algeria, Tunisia).
Nesolechia A. Massal. (1855)

in: Symmicta 75. Often said to have been first published in 1856, in Misc. Lich. 43, but I accept the view of Doré et al. (2006: 425).

Type: N. oxyspora (Tul.) A. Massal. Family: Presently placed in Parmeliaceae, but as no other members of that family are even remotely lichenicolous, this clearly needs further study. 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 most of them do not belong here. There may be 4 or 5 species in the genus, 3 of which are present in Europe.

11 Epitheciurn 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 Epitheciurn dark green-blue. N. oxysporiza

Nesolechia oxyspora (Tul.) A. Massal. (1856)


Scattered in central latitudes of Greece, on Parmelia sulcata, Parmelina 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, but commoner in the west), C. America (Mexico), S. America (widespread), Australasia (scattered in Australia, NZS).

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.

Normandina Nyl. (1855)

Type: N. jungermanniae (Delise) Nyl. (= N. pulchella). Family: Verrucariaceae. Literature: Aptroot (1991a) purports to be a monograph, but is unsatisfactory. Smith et al. (2009) is better for the two European species.

Normandinna contains three species. Two occur in Europe but only one is likely to occur in Greece. It is rather oceanic, and consequently rare in Greece. As only one species is likely to be present in Greece, no key is provided.

Normandina pulchella (Borrer) Nyl. (1861)

My only collection is very scanty and I can not prepare a full description. To supplement the description here, see: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

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 the margins of the 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, on bark at altitudes 0 - 1600 m. Recorded from Abies cephalonica, Olea europaea, Platania orientalis and Quercus ilex. Most of those reports probably refer to bryophytes overgrowing the bark, which are its preferred substrate, though it can occur directly on bark.

Subcosmopolitan in regions that are not too dry or too cold. Widely distributed in Europe. Also Macaronesia (widespread), Asia (widespread), Malesia (widespread), Africa (widespread outside the humid tropics), N. America (widespread), perhaps Caribbean (Guadeloupe), C. America (CR, El Salvador, Guatemala, Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii).
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 (?) Bibliotheca Lichenologica 77) I prefer not to include it in this Flora.

Ochrolechia A. Massal. (1852)


Type: *O. tartarea* (L.) A. Massal. Family: Ochrolechiaceae. The genus is distinguished from *Pertusaria* mainly by having open apothecia, a character which does not seem to me to warrant separation at the rank of family. 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 a prominent, often robust thalline exciple and a brown, widely exposed disc. Epithecium: brown or grey-brown, K-, N-. Hypothecium: colourless (or almost). Paraphyses: very narrow, much branched and anastomosed, not capitate or moniliform. Ascii: with a KI+ blue wall, but apex KI- (or almost). Ascospores: colourless, simple, ellipsoid, 8 per ascus, medium sized to large. 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 are fairly large in most species. *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 60 species, of which about 25 are European. Although 15 species have been reported for Greece, only a few are commonly encountered; they generally occur on bark or non-calcareous rock.

11 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. Throughout Greece, *O. subviridis*

22 Isidia absent. True soredia present. Soralia C+ red. Medulla C-

33 Soralia not clearly delimited. On non-calcareous rock. (O. crozalsiana)

Soralia clearly delimited, at least at first. On various substrates.

44 Soralia UV+ orange, less than 0.5 mm diameter, concave. Thallus thin, not warty, K- or almost. *O. arborea*

4 Soralia UV+ white, often more than 0.5 mm diameter, concave or convex. Thallus well developed, fairly thick, warty or not.

55 Soralia often convex. Cortex C+ red (but sometimes overlain by a necrotic layer that is C-). *O. androgyna*

Soralia concave to flat, usually surrounded by a distinct upturned thalline rim. Cortex C+ yellow. See *Pertusaria dalmatica*

2 Isidia and soredia absent.

33 Thallus thin. On bryophytes. (O. grimmiae)

3 Thallus ±thick. On bark or rock.

44 On bark. *O. balcanica*

4 On non-calcareous rock.

55 Internal part of cortex C+ red (gyrophoric acid) but external part C+ yellow (variolaric acid). *O. aegae*

5 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 but 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 (if present) 170 - 300 µm long, usually 1 per ascus. Not restricted to bark of conifers or to the uplands. See **Pertusaria albescens**

2 Soredia absent. Variolaric acid present or absent. On various substrates.

33 Gyrophoric acid present in epithecium. Disc usually C- or C+ yellow, KC- or KC+ yellow. Thallus usually thin. 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 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. palescens by chromatography.

**Ochrolechia aegaea** Kukwa (2009)
in: *Graphis Scripta* 21(2): 43-44

Description: See the protologue.

Known from three islands in the Aegean. On siliceous rock at altitudes 20 - 800 m.

Known only from Greece and Turkey.

**Ochrolechia alboflavescens** (Wulf.) Zahlbr. (1927)
in: Cat. Lich. Univ. 4: 676; *Lichen alboflavescens* Wulf. (1791) in: Plantae rariores carinthiacae (in Jacquin, Collectanea Vol. 3) 111

I have several collections that probably belong here, but I have been unable to make an entirely certain determination. Sterile material collected without any marginal part of the thallus is best separated from *Pertusaria albescens* by demonstrating the presence of variolaric acid, but that is not easy to do with certainty using spot tests alone. My only fertile collection, which had just a single apothecium that lacked ascospores, appears to have a C+ red pruina, which is not typical for *O. alboflavescens*, though the epithecium is said to react C+ red. For the present, I prefer not to provide any description. For a published description see 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 (but not British Is), and probably restricted south of the Alps to upland areas. Also Asia (Syria, Russia, perhaps Mongolia). Reports for N. America are probably incorrect.

**Ochrolechia androgyna** (Hoffm.) Arnold (1885)

Thallus: crustose, to 6 cm diameter, white, not pruinose, continuous or with some cracks, often worted, 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, these sometimes coalescing later, a few small soralia not well-delimited; soredia coarse, 0.1 mm diameter. Cortex: true 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, irregular but slightly wavy.

The large robust thallus, greenish convex soralia reacting C+ distinctly red, and absence of apothecia are fairly distinctive. *Pertusaria dalmatica* has soralia that are excravate, at least when young.

Scattered throughout Greece, with no clear pattern. On bark or overgrowing bryophytes or decaying vegetation at
Ochrolechia arborea (Kreyer) Almb. (1952)

 Abbott (2009) referred two Peloponnesian collections here. One of them belongs to Pertusaria dalmatica. The other probably does belong to O. arborea but, given the difficulties in working with sterile, crustose lichens in a region with a poorly known lichen flora, I would like to see further collections before committing myself. Until the determination is certain, no description is provided. For modern, published descriptions, see Kukwa (2011b); Smith et al. (2009).

Scattered, with no clear pattern. On bark at altitudes 300 - 1300 m. Reported from bark of 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), N. America (fairly widespread), C. America (Mexico).

Ochrolechia balcanica Verseghy (1962)
in: Nova Hedwigia, Beihefte 1: 86; (?) Lecanora upsaliensis auct. graec.

Thallus: crustose, white to white-grey, to 10 cm diameter, usually warted, sometime slightly areolate, usually thick, (0.2) 0.5 - 1.5 mm, generally not pruinose. Prothallus: sometimes present, white, 0.5 mm wide. Isidia and soralia: absent. Cortex: a well-developed cortex seems to be absent, but a pseudocortex, with many crystals and little distinct structure, present, 50 - 120 µm thick, colourless to very pale brown; in section: K-, C+ red (reaction transient but not fleeting). Medulla: white. Apothecia: sessile, concave to flat, 0.9 - 4.5 mm diameter, not pruinose. Disc: usually orange-brown, sometimes pale orange or pink-orange, initially almost pustiform but soon becoming widely exposed. Exciplle: usually not visible externally; in section: 100 µm wide, colourless, hyphal, similar to hymenium but of denser tissue. Thalline margin: thick, 0.2 - 0.5 mm wide, persistent. Epithecium: brown to pale brown, K-, N-, pigment dissolving in K but not in N. Hymenium: 260 - 350 µm tall, colourless to very pale brown. Hypothecium: 80 µm, colourless to very pale brown. Paraphyses: much branched and anastomosed, very narrow (less than 1 µm wide in lower part), not capitulate or moniliform. Asci: 220 - 250 x 50 - 70 µm, clavate, with a prominent wall (at least when young) 5 - 10 µm thick, Ascospores: colourless, simple, subglobose to broadly ellipsoid, 8 per ascus, 47 - 77 x 31 - 47 µm, with a distinct wall 1 - 1.5 µm thick. Chemistry: in spot tests medulla K-, C-, KC-, P-, I-; thallus K+ very faintly yellow, C+ red or pink-red (reaction not permanent, but fading only slowly), P-, UV+ white. Photobiont: green, present below apothecia in a discontinuous layer (as in the thallus); cells globose, 9 - 12 µm diameter. Photobiont layer: 60 - 80 µm thick, fairly regular but discontinuous, cells in large clumps. Easily recognised as an Ochrolechia by the robust thallus and robust apothecia with a prominent thalline excieplle, and readily separated from other members of the genus by the C+ red reaction of the thallus (but not medulla), the absence of vegetative propagules, and the corticolous habit. O. pallescens, the other common corticolous species has a C-thallus and pruinose apothecia. Probably throughout Greece. Usually on bark, though there is a single report from rock. At altitudes 300 - 1500 m, but commonest at middle altitudes (600 - 1200 m). Reported from a wide range of species, but avoiding strongly acidic bark.

Southern Europe, from Iberian Peninsula to Cyprus and Ukraine (southern Crimea). Also western Asia (Mediterranean Turkey).

Ochrolechia microstictoides Räisänen (1936)

Descriptions: Kukwa (2011b); Smith et al. (2009); Tønsberg (1992a).

Scattered, with no really clear pattern though the few records to date are from the western half of the country. On bark or wood of conifers at altitudes 900 - 1600 m.

Widely distributed in Europe, but precise distribution is unclear as the name has often been synonymised with O. turneri. Also western Asia (Turkey, Ural Mts).

Ochrolechia pallescens (L.) A. Massal. (1853)
The name *Ochrolechia parella f. arborea* (DC.) Boistel is probably a synonym of *O. tartarea*, but the single Greek report under that name probably belongs elsewhere, and I have tentatively placed it here.

Thallus: crustose, usually smooth at margins, often coarsely warts in central parts, marginal parts 80 - 200 µm thick, much thicker at warts, to 5.5 cm diameter, without vegetative propagules. Cortex: 35 - 60 µm thick, pale brown in upper part, colourless in lower part; structure not apparent in water; in K formed of predominantly vertical, narrow, much branched hyphae intermixed with crystals and granules; K-, brown pigment dissolving in K. Apothecia: always present. Disc: strongly white pruinose, always strongly KC+ red, usually C+ red but reaction sometimes faint or ambiguous. Chemistry: medulla C-; thalline exciple 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.

Four of the eight Peloponnesian collections of *O. pallescens* reported by Abbott (2009) belong to *O. szatalaensis*.

Throughout Greece, but not especially common. Reported from all altitudes, though some upland reports may refer to *O. szatalaensis*. Usually on bark and recorded from a very wide range of trees and shrubs with no clear preference, though avoiding strongly nutrient-enriched bark. Only about a quarter of reports are from conifers. Occasionally on wood.

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 said to be incorrect, so those for Caribbean and C. America may also be unreliable.

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**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, K-, brown pigment partly dissolving in K, without distinct structure even in K; abundant crystals present. Medulla: white. Apothecia: subsessile to sessile, concave, 0.8 - 1.6 mm diameter. Disc: heavily white pruinose, pruina C- or rather faintly C+ red, but distinctly KC+ red. Exciple: not visible externally; in section: 50 - 100 µm wide, colourless, not differing much in appearance from hynumen. Thalline margin: prominent, persistent, 0.2 - 0.4 mm wide. Epithecium: brown to grey (grey appearance caused by crystals), K-, N-, brown pigment dissolving in K but not in 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 to 65 µm, clavate, side wall thick (5 µm) and prominent in developing asci, wall KI+ blue but no apical apparatus visible in KI. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 50 - 65 x 25 - 33 µm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C- or C+ faintly yellow, KC- yellow or orange yellow, P-, UV+ white with a 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, sightly irregular, sometimes discontinuous, cells tending to form large clumps.

The absence of vegetative propagules, C- thallus, C+ red apothecial pruina and the saxicolous habit make this species easy to recognise.

Probably throughout Greece, though at present there are no records from the western parts of the mainland. At altitudes 0 - 1100 m, but scarce above 800 m. Nearly always on siliceous rock. There are two reports from bark, one of them a modern report by an experienced lichenologist, but they may refer to *O. pallescens*, which has sometimes been regarded as a synonym of *O. parella*.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), Australasia (widespread), Antarctica (widespread in subantarctic islands and Antarctic Peninsula) Reports for N. and S. America are said to be incorrect. Reports for the Southern Hemisphere may refer to a different taxon.

**Ochrolechia subviridis** (Hoeg) Erichsen (1930)

Thallus: crustose, white, slightly warted, to several cm diameter, 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 tending 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 - 850 m, though half of all reports are from below 200 m. Reported from Castanea sativa, Olea europaea, Pinus halepensis and Quercus pubescens, with no obvious preference.

Widely distributed in Europe to as far north as southern Scandinavia. Also Asia (reliably reported for western Asia; reports for elsewhere may be incorrect), and North Africa (Tunisia). Reports for N. America are incorrect.

Ochrolechia szatalaensis Verseghy (1958)

The earliest name is Ochrolechia pallescens var. pseudotartarea Vain. (1903), but it does not have priority at species rank.

Thallus: crustose, grey, not pruinose, rather thin, 150 - 200 μm, sometimes reaching 250 μm in central parts, smooth, continuous, sometimes slightly warted, sometimes cracked or almost areolate, to 5.5 cm diameter, without vegetative propagules. Cortex: 25 - 50 μm thick, colourless, poorly striptured, not very compact and closer to a pseudocortex than a true cortex, K-. Medulla: white, of loosely interwoven hyphae. Apothecia: abundant, sessile, flat, 0.8 - 2 mm diameter. Disc: very pale brown to almost colourless, but usually obscured by white pruina, K-, C- or C+ faintly yellow or yellow-orange, KC- or KC+ more distinctly yellow or yellow-orange. Thalline margin: well developed, 0.15 - 0.25 mm wide, smooth, persistent; in section: 100 - 200 μm wide. Exciple: not visible externally; in section: 15 μm wide, colourless, of vertical hyphae, similar to hymenium but denser. Epithecium: brown to grey-brown, K-, N-, pigment soluble in K but not in N. Hymenium: 280 - 300 μm tall, colourless, Ki+ blue to red-blue. Hypothecium: 50 μm tall, colourless to very pale brown. Paraphyses: much branched and anastomosed, very thin (about 0.75 μm), sometimes with visible septa. Asci: 255 - 280 x 40 - 45 μm, cylindrical to narrowly clavate, wall distinct, 5 μm wide, Ki+ blue at least in inner part (outer part sometimes Ki-), apex faintly and obscurely Ki+ blue around a central Ki- region. Ascospores: colourless, simple, broadly ellipsoid, 8 per ascus, 52 - 75 x 30 - 36 μm. Chemistry: medulla K-, C-, KC-, P-, I-; thalline exciple K-, C- or C+ faintly yellow, KC- or KC+ faintly yellow-orange; thallus K-, C-, KC-, P-, UV+ white to pale green (long wave) or pale orange (short wave). Photobiont: green, cells globose, 8 - 12 μm diameter. Photobiont layer: 25 - 100 μm thick, sometimes discontinuous, sometimes irregular.

Throughout much of Greece, but not reported from the islands of the Aegean (except Crete). On bark or wood at altitudes 300 m and above, but most reports are from above 1000 m. Usually on conifers (about two thirds of reports), but also reported from Castanea sativa, Olea europaea, Quercus frainetto and Ulmus. Its ecology overlaps with that of O. pallescens, but O. szatalaensis is generally a more upland species and has more of a preference for conifers.

Widely distributed in Europe. Also Macaronesia, Asia (Turkey, Russia), Malesia (PNG), N. America (Alaska, Alberta, Washington, perhaps elsewhere), southern S. America (Argentina, Chile).

Ochrolechia tartarea (L.) A. Massal. (1852)
Lecanora tartarea (L.) Ach.; Ochrolechia tartarea var. grandinosa (Ach.) Arnold
Descriptions: Kukwa (2011b); Clauzade & Roux (1985); Smith et al. (2009). 
Aegean Islands, including Crete, and eastern half of the mainland. On bark and siliceous rock at altitudes 20 to about 2000 m, but most reports are from the zone 600 - 1400 m. Some of the reports, especially the older ones, may refer to O. balcanica or other species of the genus.

Widely distributed in the more oceanic parts of Europe, and in parts of the Mediterranean. Reports from regions with a more continental climate may refer to other species. Also Macaronesia, Asia (widespread), "Africa" (Ascension Is, St Helena), N. America (widely distributed, but scattered; pattern unclear), Australasia (Queensland, NZN), Antarctica (Signy Is). Reports for S. America are said to be incorrect. The status of other reports for the Southern Hemisphere is not clear to me.

Ochrolechia turneri (Sm.) Zopf (1896)
in: Hedwigia 35 :342; Lichen turneri Sm. (1801) in: Smith & Sowerby, English Botany 12, table 857; (?) Pertusaria lepaprioides auct. graec.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered, but never very far inland. On bark at altitudes 20 - 1400 m. Reported from: *Cupressus sempervirens, Olea europaea, Pinus nigra, Quercus frainetto* and *Q. ilex*. 
Widely distributed in Europe. Also Macaronesia, Asia (central and eastern Russia), N. America (Washington). Reports for Australia are said to be incorrect.

**Ochrolechia upsaliensis** (L.) A. Massal. (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)
Type: *O. vulgata* (Ach.) Ach. (1809) Family: *Opegraphaceae*. 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.

Thallus: crustose, usually thin, pale in colour. Apothecia: slightly to distinctly elongate, simple or branched. Disc black, slit-like to widely exposed. Exciple: black, carbonaceous, persistent; in section: dark brown to black, opaque, extending below hymenium or not. Thalline margin: absent. Epithecium: usually not clearly delimited from hymenium. Hymenium: colourless to very pale brown in lower part, sometimes a darker shade of brown in upper part. Hypothecium: often colourless, usually distinct from exciple when that extends below the hymenium, but generally rather thin (20 - 30 µm), colourless to pale brown. Paraphyses: usually thin, branched and anastomosed, not capitate. Asci: subglobose to clavate, usually appearing KI- but occasionally two small KI+ blue dots are visible near apex; these dots are clearly part of a ring in 3 dimensions (*Opegrapha* type). Ascospores: colourless, or becoming brown when mature in a few species, with 3 to many septa, I- in both Lugol's and Meltzer's reagents. Pycnidia and conidia: often present but rather variable - see the descriptions of individual species. Chemistry: reactions usually negative. Photobiont: Trentepohlia or (in parasitic species) absent.

The genus 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 about 300 species. They occur on most substrates; some are parasitic. In the Peloponnese *Opegrapha* is not rare, but nor is it especially common and I have encountered most species too infrequently to acquire a good understanding of them. The Greek species would benefit from a thorough revision based on more extensive collections than I possess.

Recent segregates include *Alyxoria* and *Zwackhia*, but for the present I retain traditional usage and keep all species in *Opegrapha*.

The poorly known *O. gyrocarpoides* and *O. mucosa* are not included in the key.

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. celtidicola**
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 Aspicilia on calcareous rock. Ascospores 16 - 22 x 6 - 8 µm, becoming brown when mature. **O. parasitica**
666 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.
55555 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. zwackhii**

5 Usually on Lecanora rupicola; perhaps also on Protoparmelia. Ascospores 21 - 29 x 7 - 9 µm. (O. 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. rufescens)

5 Ascospore wall narrow, not or only slightly thickening at septum.

66 Nearly all ascospores less than 20 µm long.

77 Ascis subglobose to broadly clavate. Ascospores 13 - 18 x 2.5 - 4 µm. Disc remaining slit-like. **O. atra**

7 Ascis 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. On bark.

99 Ascospores 3 - 4 -septate, 12 - 18 x 3 - 4 µm. Disc open. Apothecia usually not pruinose. **O. ochrocincta** Note 2.

9 Ascospores 3 - 5 -septate, 14 - 20 x 4 - 5.5 µm. Disc initially slit-like, opening later. Apothecia white pruinose. (O. xerica)

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. ochrocheila**. Note 2.

6 Ascospores 18 - 24 x 5 - 7 µm. **O. culmigena**

4 On rock

55 Ascospore wall moderately broad, thickening at septum. On non calcareous rock in shaded places.

Ascosporas 15 - 19 x 4 - 5 µm. (O. conferta)

5 Ascospores wall narrow, uniform or only slightly thickening at septum.

66 Ascospores nearly all less than 20 µm long.

77 Ascopetia white pruinose. Ascospores 14 - 18 x 3 - 5 µm. On siliceous rock. (O. demutata)

7 Ascopetia not pruinose. Ascospores 16 - 20 x 4 - 5 µm. On calcareous rock. **O. calcarea**

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. 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. 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. phaeophysciae)

444 On consolidated soil or sand. (O. areniseda)

44 On bark. **O. varia**

4 On rock.

55 Ascospores 4 - 5 -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, 25 - 33 µm long.

66 Ascospores 3.5 - 6 µm wide. See (Enterographa zonata)

6 Ascospores 5 - 8 µm wide, usually with an enlarged middle cell. (O. mougeotii)

3 Ascospores with 5 - 15 septa, fusiform to acicular, usually less than 4 µm wide; perispore absent or thin.

44 On bark.
55 Conidia curved (a few short, straight ones may also be present in O. vulgata).
66 Curved conidia more than 10 µm long.

77 Ascospores mostly 4 - 6-septate. Exciple below hymenium strongly carbonised. O. vulgata
7 Ascospores mostly 7 - 9 -septate. Exciple below hymenium weakly carbonised. (O. pauciexcipulata)
6 Conidia less than 8 µm long. O. niveoatra
5 Conidia straight. (O. prosodea), (O. vernicellifera), (O. viridis)
4 On non-calcareous rock. (O. cesareensis), (O. circumducta), (O. lathyrga)

1 Apothecia absent. Soralia usually abundant.
22 Soralia C+ red. O. gyrocarpa
2 Soralia C-. (O. corticola)

(1) In the case of endolithic species of Verrucaria the host might not be 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 species have an open disc, unlike the common O. atra.

Opegrapha atra Pers. (1794)
in: Ann Bot (Usteri) 7: 30; (?) Opegrapha atra f. cerasi (Pers.) Arnold; (?) Opegrapha atra var. opunticola J. Steiner

This species may not belong in Opegrapha s. str., and may be better placed in Arthonia. However, as Arthonia itself is likely to be subdivided eventually I prefer to use the traditional name here.

My only Peloponnesian collection is scanty, and most apothecia are over-mature and hollow, so the description is brief. A better description must await the collection of additional material. For published descriptions see: Smith et al. (2009); Torrente & Egea (1989).

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. Exciple: black, shiny, ±carbonaceous; in section: closed below.
Thalline exciple: absent. 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 recorded once on wood.

Throughout Europe, except for arctic regions. Also Macaronesia, western Asia (to as far east as Iran and Russia), Africa (widespread in N. Africa, present in S. Africa, perhaps Sao Tome - old report), N. America (Nova Scotia, scattered in USA), perhaps Caribbean (Bahamas, Bermuda), C. America (Mexico), S. America (Argentina, Brazil, Chile, Colombia), Australasia (SE Australia, both islands of NZ), Pacific (Hawaii). The name has probably been employed in a wide sense, and some older reports may be unreliable.

Opegrapha calcarea Turner ex Sm. (1807)
in: Smith & Sowerby, English Botany Vol. 25, tab. 1790; Opegrapha atra var. calcarea (Turner ex Sm.) Stizenb.;
Opegrapha chevallieri Leight.; Opegrapha decandollei (Stizenb.) H. Olivier; Opegrapha saxicola var. decandollei Stizenb.;
Opegrapha trifurcata Hepp ex Müll. Arg.

This species may not belong in Opegrapha s. str., and it was recently placed in Arthonia. However, as Arthonia itself is likely to be subdivided eventually I prefer to use the traditional name here.

Thallus: usually completely immersed, sometimes thinly superficial and white grey, usually in small patches of less than 1 cm square, but sometimes extending over many cm. 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. Exciple: black, carbonaceous; in section: black, opaque, closed below, K-.
Thalline margin: absent. Epithecium: poorly developed. Hymenium: 45 - 50 µm tall, colourless, KI+ blue.. Hypothecium: 60 - 80 µm tall, black, opaque, K-.. Paraphyses: much branches, 1 µm wide, not capitate.
Ascii: 30 - 50 x 15 - 21 µm, broadly clavate, sometimes subglobose, KI- or almost. Ascospores: colourless, 3 -septate, 8 per ascus, 15 - 20 x 6 - 7 µm, ends rounded, I-.
Photobiont: Trentepohlia.

The 3-septate ascospores, subglobose asci and calcareous substrate are distinctive.

Widely distributed throughout Greece but not especially common (at least in the Peloponnesse). On calcareous, or at least fairly base-rich, rock at all altitudes, but two-thirds of records are from below 500 m.

Widely distributed in southern and central Europe, reaching British Is and southern margin of the Nordic Countries. Also Macaronesia, Asia (Armenia, Taiwan), N. Africa (Morocco, Algeria), perhaps Caribbean (Bahamas).
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. macrolepis, Olea europaea and Quercus macrolepis, and on wood of Olea europaea.

Southern Europe from Portugal to Greece; also Russian Caucasus. Also N. Africa (Morroco, Algera, Tunisia, Egypt).

Opegrapha culmigena Lib. (1830)
in: [need to investigate]; Opegrapha herbarum Mont. nom. superfl.; Opegrapha turneri Leight.

The earliest name appears to be Opegrapha betulina Sm. (1811), but it is not legitimate, being a later homonym of O. betulina Pers. (1794).

I have a single collection that I have tentatively referred here, but as the material is scanty and the determination not completely certain, I do not provide any description. For published descriptions, see: 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. On bark of Ficus carica, Olea europaea, Phillyrea angustifolia and Platanus orientalis.

Widely distributed in warm to temperate parts of Europe with a mild climate. Absent from parts of eastern Europe with a strongly continental climate, and from all but the southern margin of the Nordic Countries. Also Macaronesia, Asia (Turkey, Iran, Russia, Taiwan), Africa (Morroco; St Helena), N. America (California, Washington), C. America (Mexico, Guatemala), perhaps S. America (Chile), Australasia (warm temperate Australia).

in: Bibl. Lich. 32: 146 (A 1985 combination by Clauzade & Roux was not validly published, as they did not cite the place of publication of the basionym.); Opegrapha rupestris β (= var.) dolomitica Arnold (1860) in: Flora 43: 78-79; Opegrapha saxicola f. dolomitica (Arnold) Arnold;

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 Sweden, and as far south as Sicily. I have not seen any reports for other continents.

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 (the easternmost part of) Crete. On calcareous rock at altitudes 0 - 200 m. Circum-Mediterranean. Portugal to Cyprus. Also western Asia (Turkey), N. Africa (Morroco, Algeria).

Opegrapha gyrocarpa Flot. (1825)
in: Flora 8(1): 345

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the southern Aegean, on siliceous rock at altitudes 5 - 300 m. Widely distributed in Europe as far north as mid Scandinavia. Also Macaronesia, Asia (Russia, Japan, Thailand), N. America (southern Canada, eastern USA).

Opegrapha gyrocarpoides Müll. Arg. (1884)
in: Rev. Mycol. 6: 19

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 lutulenta Nyl. (1855)

Descriptions: Clauzade & Roux (1985); Torrente & Egea (1989c).

Islands of the northern Aegean, on siliceous rock at altitudes 5 - 300 m.
A maritime-Mediterranean/Macaronesian species. Spain, France, Italy, and Greece. Also Macaronesia (Canary Is, Madeira), N. Africa (Morocco, Algeria).

**Opegrapha mougeotii A. Massal. (1853)**

in: 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, the summit of which is at 911 m. Fairly widely distributed in temperate parts of Europe with a mild climate, to as far north as southern Sweden. It avoids those parts of eastern Europe with a strongly continental climate. South of the Alps it is present, but uncommon, though its precise range is uncertain owing to confusion with other species. Also Macaronesia, N. Africa (Morocco, Algeria).

**Opegrapha mucosa Messner (1971)**

Description: See the protologue.

Known only from the type collection, which was from the island of Amorgos, on schist close to sea level. Messner's description suggests a lichen close to *O. lutulenta*.

**Opegrapha niveoatra** (Borrer) J. R. Laundon (1963)
in: *Lichenologist* 2(2): 138; *Verrucaria niveoatra* Borrer (1831) in: Hooker & Sowerby, English Botany, Suppl. 1, tab. 2637; *Opegrapha subsiderella* (Nyl.) Lamy

I have a single collection that probably belongs here, but as the material is scanty and the determination not completely certain, I do not provide any description. For published descriptions, see: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009); Torrente & Egea (1989c).

Very scattered, but 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 of *Olea europaea*.

Widely distributed in the western half of Europe, to as far north as southern Scandinavia, but avoiding the continental climate of the eastern half. Also Macaronesia, western Asia (Israel, Russia, perhaps China), N. Africa (Morocco, Algeria), N. America (California, Michigan), C. America (Mexico).

**Opegrapha ochrocheila** Nyl. (1865)
in: *Flora* 48: 212; *Opegrapha rubescens* Sandst.

Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009); Torrente & Egea (1989c).

Macedonia, and perhaps Amorgos. On bark or wood at altitudes 0 - 350 m.

Throughout the western half of Europe; very rare in the east. Also Macaronesia, Asia (Yemen, Armenia), perhaps Africa (Rwanda), western N. America (Alaska to California), C. America (Guatemala, Mexico).

**Opegrapha ochrocincta** Werner (1939)

Thallus: crustose, usually thinly superficial but in places ±immersed, pale grey to very pale brown, smooth and 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 that are usually oriented ±horizontally (i.e. parallel to surface), 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. Exciple: black, carbonaceous, persistent; in section: very dark brown to black, opaque, 30 - 70 µm wide, closed below. Thalline margin: absent. 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, 8 per ascus, 13 - 18 x 3 - 4 (5) µm, ends rounded, I-.

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, never very 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)
in: [need to investigate - available info is inconsistent]; Leciographa parasitica A. Massal. (1855) in: Symm. Lich. Nov. 66; Leciographa monspeliensis (Nyl.) Arnold

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. Excipla: black, carbonaceous; in section: 30 - 70 µm wide, black, opaque, not closed below, K-. Thalline margin: absent. 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 (though not very 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 a very small amount of brown pigment. Ascii: mature asci 50 - 67 x 16 - 20 µm, clavate (immature ones smaller and often globose), usually K1-, but two very small Ki+ blue dots are occasionally visible at the apex (Opegrapha type). Ascospores: brown when mature (colourless at first), 3-septate, 8 per ascus, 16 - 20 x 6 - 7 microns, I-. 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 asci are typical Opegrapha type.

The rather short lirellae, parasitic on Aspicilia on calcareous rock are distinctive.

Only definitely reported for Peloponnesse, but some reports of *O. rupestris* may belong here. At altitudes 20 - 800m, on species of Aspicilia on calcareous rock.

Distribution uncertain, owing to confusion with *O. rupestris*, but apparently a species of southern and central Europe.

**Opegrapha physciaria** (Nyl.) D. Hawksw. & Coppins (1992)

The earliest name is Phacopsis varia Tul. (1852), but the epithet is not available in Opegrapha owing to O. varia Pers. (1794).

Descriptions: Atienza (1992); Nash et al. (2007); Smith et al. (2009).

Corfu, close to sea level, on Xanthoria parietina.

Widely distributed 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 rufescens** Pers. (1794)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Torrente & Egea (1989c).

Rare in northern Greece. On bark of Platanus at altitudes 0 - 350 m.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (scattered in eastern half of USA), Australasia (eastern parts of Australia).

**Opegrapha rupestris** Pers. (1794)

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 slit-like, becoming exposed, but never widely exposed, in some older apothecia. Exciple: black, carbonaceous; in section: 25 µm wide, very dark brown to black, opaque, not closed below, K-. Thalline margin: absent. Epithecium: 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-. Ascii: 40 - 45 x 13 - 14 µm, clavate, with two very small Ki+ blue dots at the apex (Opegrapha type); in 3 dimensions the dots probably form a ring. Ascospores: colourless, 3-septate, 8 per ascus, 15 - 18 x 4 - 6 µm (excluding perispore), often with a prominent perispore to 1.5 µm wide. Photobiont: Trentepohlia cells are present near the apothecia and within the "thallus", though other kinds of algae appear to be present too.

The only collection that I have seen was not clearly associated with any host. No perithecium were present within the area covered by lirellae. It is not clear whether the poorly developed thallus was that of a host, or whether it belonged to the Opegrapha.

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 thallii of calcareous species of Aspicilia. 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 host, and the only material that I have seen was also not obviously associated with any host.

Distribution uncertain, owing to confusion with *O. parasitica*. There are reports for Europe to as far north as southern Scandinavia. Also Macaronesia (Azores), western Asia (Turkey, Syria, Israel, Russia), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America (Alaska, Newfoundland, Alabama), perhaps Caribbean (Bahamas), Australasia (NZS). Some reports may refer to *O. parasitica*.

**Opegrapha subelevata** Nyl. (1888)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Torrente & Egea (1989c).

Santorini, on calcareous rock at an altitude of 150 m. Commonest south of the Alps, but reported to as far north as SW England. Also Macaronesia, western Asia (Israel), Africa (widespread in N. Africa; Ascension Is, St Helena). Reports for Australasia (NZ) are incorrect.

**Opegrapha varia** Pers. (1794)
in: Ann. Bot. (Usteri) 7: 30-31; Alyxoria varia (Pers.) Ertz & Tehler; *Opegrapha diaphona* (Ach.) Ach.; *Opegrapha diaphona* var. tridens (Ach.) H. Olivier; *Opegrapha lichenoides* var. chlorina (Pers.) Redinger; *Opegrapha pulicaris* auct.; *Opegrapha rimalis* (Ach.) Fr.; *Opegrapha varia* var. *diaphora* (Ach.) G. Mey., nom. superfl.; *Opegrapha varia* var. *rimalis* (Ach.) Fr.

Material referred here may be heterogeneous. The description is based on a single collection (22-Mar-2000/64). The other collection is discussed below.

Thallus: crustose, white, thin, sometimes extending over several cm. Apothecia: sessile, 0.95 - 2 x 0.25 - 0.4 mm, often branched, not pruinose. Disc: black, usually widely exposed. Exciple: black, carbonaceous; in section: 20 - 70 µm wide, very dark brown to black, opaque, closed below. Thalline margin: absent. Epithecium: not well delimited from hymenium, brown. Hymenium: 80 µm tall, colourless to very pale brown. Paraphyses: 1.5 µm wide, branched. Ascospores: brown when mature, 5-septate, 8 per ascus, 25 - 30 x 7 - 8 µm, I-. Photobiont: Trentepohlia.

The other collection (26-Feb-2007/28) had smaller (0.2 - 0.7 x 0.15 - 0.25 mm), unbranched apothecia, with a slit like or narrowly exposed disc. It was associated with pycnidia containing conidia that were 8 - 10 x ¾ µm long, and usually curved. Conidia of *O. varia* are said to be about 3 - 5 x 1 µm. The long conidia match those of *O. vulgata* and *O. gyrocarpa*, but the material had broad ascospores, about 6 µm wide, sometimes with distinct perispore, and definitely does not belong to either of those species, both of which have narrow ascospores. Additional collections are needed to clarify the situation.

Any corticolous *Opegrapha* with broad, 3 - 5 -septate ascospores will key out here. Throughout lowland Greece. Usually on bark, occasionally on wood, at altitudes 0 - 900 m, but about half of all reports are from below 200 m. Reported from a wide range of phorophytes.

Widely distributed in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (Morocco, Algeria, Tunisia, Namibia), N. America (Saskatchewan, widespread in USA), perhaps Caribbean (Bahamas), S. America (widespread), Australasia (eastern Australia), Pacific (Fiji).

**Opegrapha variaeformis** Anzi (1862)

Descriptions: Clauzade & Roux (1985); Torrente & Egea (1989c).

Kos and eastern Crete, on rock at altitudes 10 - 200 m. Only central and southern Europe, and N. Africa (Morocco).

**Opegrapha vulgata** (Ach.) Ach. (1803)
in: Methodus 20-21; *Lichen vulgatus* Ach. in: 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, at altitudes 10 - 20 m. One record was from bark of *Cupressus*, the other (Amorgos) from schistose rock. As this species is usually corticolous, the report for Amorgos may be incorrect.

Widely distributed to as far north as southern Scandinavia. Also Macaronesia (widespread), Asia (widespread), Malesia (PNG), N. Africa (Morocco, Algeria), N. America (widespread in USA, mainly near the coast), perhaps Caribbean (Bahamas, Bermuda), C. America (Mexico), Australasia (Victoria), Pacific (New Caledonia - old report).
Opegrapha zwackhii (A. Massal. ex Zwackh) Källsten (1994)
in: Hafellner, Herzogia 10: 15; Leciographa zwackhii A. Massal. ex Zwackh (1862) in Flora 45(36): 571; Phacographa zwackhii (A. Massal. ex Zwackh) Hafellner
Enterographa zwackhii A. Massal. (1860) and Enterographa hutchinsiae var. zwackhii Zwackh (1862) are nomina nuda.
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)
in: Flora 41: 611-612
Three species, all of which occur in Europe. There are very few Greek records. Species of Pachyphiale occur on bark.
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)
Pachyphiale cornea auct.
The epithet cornea has been persistently misapplied to this species. As shown by Laundon (1984b), Lichen corneus With (1776) is a synonym of Umbilicaria cylindrica. Lichen corneus With. (1796), nom. illeg. is a synonym of Clustomum griffithii. Names derived from Withering’s 1796 name include Lecidea cornea Ach., Bacidia cornea (Ach.) Massal., Lecidea carneola var. cornea (Ach.) Ach., Gyalecta cornea (Ach.) Tuck., and Pachyphiale cornea (Ach.). Poetsch; these are all synonyms of Clustomum griffithii.
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 - 700 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 (NZ).

Pachyphiale ophiospora Lettau ex Vězda (1958)
Description: Clauzade & Roux (1985).
Macedonia at 800 m altitude. The substrate was not specified.
Very scattered, from southern Sweden to former Yugoslaavia, and now Greece. Also Asia (southern Siberia).
Although poorly known, it does appear to be a good taxon.

Pannaria Delise ex Bory (1828)
Type: P. rubiginosa (Ach.) Bory. Family: Pannariaceae. 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 70 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
Isidia and soralia absent. **P. rubiginosa**

**Pannaria conoplea** (Ach.) Bory (1828)


Descriptions: Ahti, Jörgensen et al. (2007); Burgaz, Llimona & Paz-Bermudez (2010); Smith et al. (2009).

Distribution and ecology in Greece rather uncertain, because earlier reports may refer to other species of Pannariaceae.

Throughout Europe, except for truly arctic regions. Also Macaronesia (widespread), Asia (widespread outside the tropics), Africa (widespread outside regions with a tropical or desert climate), N. Africa (widespread), C. America (Mexico, perhaps elsewhere). S. America (Chile, Colombia, Ecuador, Venezuela), Australasia (Victoria). A report for the Pacific (Hawaii) is probably incorrect.

**Pannaria rubiginosa** (Ach.) Bory (1828)


The earliest name is Lichen crenulatus With. (1776), but the epithet is not available in Pannaria, owing to Pannaria crenulata P. M. Jørg., an Australasian species. The name Lichen squamosus Hoffm. (1784) is also synonymous but is not legitimate, being a superfluous name for Lichen crenulatus With. as well as a later homonym of Lichen squamosus Scop.

Descriptions: Ahti, Jørgensen et al. (2007); Burgaz, Llimona & Paz-Bermudez (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 (widespread), Asia (widespread), Malesia (PNG, Sabah), Africa (widespread), N. America (scattered localities along east and west coasts), Caribbean (PR; perhaps also Bahamas and Guadeloupe), C. America (Mexico, Panama), S. America (widespread). Not in Australasia, and the status of reports for Pacific is unclear.

**Parabagliettoa Gueidan & Cl. Roux (2009)**

in: Gueidan et al., in: Taxon 58(1): 194-195


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.

11 Ascospores 8 - 10 x 6 - 7 µm. **P. disjuncta**

11 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 a 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)


Description: Krzewicka (2012); Smith et al. (2009) as Verrucaria cyanea.

Very scattered, on calcareous rock at altitudes 0 to about 2000 m. Widely distributed in Europe. Also N. Africa (Morocco, Algeria). However, some reports may be unreliable owing to confusion with other species.

**Parabagliettoa disjuncta** Arnold (1864)


Description: Clauzade & Roux (1985); Krzewicka (2012).

Mt. Olympus, on calcareous rock at altitudes 1700 - 2650 m.
Scattered, from Germany and Switzerland SE to Greece. I have not seen any reports for other continents.

**Parabagliettoa dufourii** (DC.) Gueidan & Cl. Roux (2009)
in: Gueidan et al., in: *Taxon* 58(1): 195; *Verrucaria dufourii* DC. (1805) in: Lamarck & De Candolle, Fl. Franç. Ed. 3, 2: 318; *Thelidium dufourii* (DC.) Servít (Greek reports as dufourei)
Description: 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.
Widely distributed in Europe. Also Asia (Turkey, Ural Mts), Australasia (Tasmania, NZS). However, some reports may be unreliable owing to confusion with other species.

**Parmelia** Ach. (1803)
in: Methodus 153. The name is conserved against *Lichen* L. (1753).
Type: *P. saxatilis* (L.) Ach. 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, heteromerous, to several cm. diameter. Upper surface: blue-grey in Peloponnesian species, occasionally brown near lobe tips; with white pseudocyphellae forming a reticular network when mature; soralia or isidia present in some species. Lower surface: black or brown, attached by rhizines. Ascomata: (not seen in Peloponnesian material) apothecia, with a brown disc and a thalline margin. Conidiomata: not seen, but said to be pycnidia. Chemistry: upper cortex K+ yellow. Photobiont: green. Ecology: on ± acid substrates.
Formerly a very large genus of about 1000 species, but it has been split into many smaller units over the last 40 years. As understood today, it contains about 40 species, distributed mainly in temperate to cold regions. The genus is best developed in eastern Asia and Australasia. Europe has about 10 species, of which only 3 are widely distributed. Species of *Parmelia* usually occur on bark and rock, but are occasionally found 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 Rhizines simple or dichotomously forked, never squarrose. Apothecia rare.
44 Upper surface and isidia pruinose. Isidia sometimes developing into lobules. **P. ernstiae**

1 Isidia absent. Soralia present.
22 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**

1 Soralia ± punctiform. Mature lobes often long, narrow, and strongly revolute. Rhizines simple or rarely forked. **P. submontana**

**Parmelia ernstiae** Feuerer & A. Thell (2002)
There are earlier names at the ranks of form and variety, but at species rank they do not have priority.
Parmelia omphalodes (L.) Ach. (1803)
in: Methodus 204; Lichen omphalodés L. (1753) in: Sp. Pl. 1143


Known from a single site in northern Macedonia, where it is occurred on granite at an altitude of 1600 m.

Throughout northern and central Europe; rare in the south and confined to the uplands. Also Asia (widespread), N. Africa (Morocco), N. America (widespread), perhaps S. America.

Parmelia saxatilis (L.) Ach. (1803)
in: Methodus 204-205; Lichen saxatilis L. (1753) in: Sp. Pl. 1142-1143; Imbricaria saxatilis (L.) Flot.; Parmelia saxatilis f. aizonii (Delise ex Duby) ined.; Parmelia saxatilis var. aizonii Delise ex Duby; Parmelia saxatilis b. (= f.) furfuracea Schaer.; Parmelia saxatilis var. furfuracea (Schaer.) Arnold; Parmelia saxatilis f. isidioidea Hillmann; Parmelia saxatilis a. (= f.) munda Schaer.; Parmelia saxatilis f. rubricosa J. Steiner.

Description: Thallus: 9 cm diameter. Upper surface blue-grey, occasionally brown near tips of lobes, smooth, not pruinose. Lower surface: yellow, sometimes brown at margin. Lobes 8 x 2 - 3 mm, 0.1 mm thick; broadening towards the ends and indented into 3-8 small, rounded lobules, often slightly ascending, tips of lobules often distinctly blunt or squareish. Isidia: laminal and marginal, blue-grey in lower part, brown to black above, usually simple but 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, simple or occasionally branched, 0.3 - 1.0 x 0.05 mm. Soralia: absent. Upper cortex: colourless in section, 10 -15 µm, poorly structured. Medulla: white, of loosely woven, randomly oriented hyphae that are rather broad. Chemistry: thallus K+ yellow; medulla C-, K+ red, P+ yellow. Photobiont: green.

Two of the Peloponnesian collections of Abbott (2009) belong to P. serra, 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. serra or to P. ernstiae. A recent collection tentatively referred here has a slight development of pruina on the upper surface, towards the lobe tips, but does not otherwise match P. ernstiae.

Distribution and ecology in Greece rather uncertain, owing to the possibility of confusion with other species. According to the reports, present 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. serra.

Cosmopolitan outside subtropical and tropical regions. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, S. Africa), N. America (widespread, avoiding only very dry or warm regions), S. America (widespread), Australasia (NZS only; reports for Australia are incorrect), Antarctica (widespread in subantarctic islands and Antarctic Peninsula).

in: Molina et al., in Lichenologist 36(1): 48-49

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 the thallus. Isidia: abundant, mostly laminal, some marginal, glBOSE when young, becoming cylindrical, 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 oriented mostly parallel to lower surface. Chemistry: medulla K+yellow > red, forming red crystals 0.5 - 2 µm diameter, C-, P+ yellow, I-; thallus UV- (but sometimes appearing +orange by reflection). 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 ridges are present on the surface of the lobes. Parmelia serrana does not have ridges, 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 Peloponnesian tentatively referred here have characters that overlap with P. saxatilis.) Collections from Macedonia were on siliceous rock.

Austria, Germany, Greece, Spain and Sweden; also Macaronesia (Tenerife).

Parmelia submontana Hale (1987)
in: Smithsonian Contr. Bot. 66: 44. (It is a nomen novum for Parmelia contorta Bory (1832) in: Fauché et al., Expédition scientifique du Morée 305-306.); Parmelia saxatilis var. contorta (Bory) Zahlbr.; Parmelia sulcata var. contorta (Bory) Nyl.; Parmelia sulcata var. contortoides (Zahlbr.) Szalata

The earliest name is Parmelia contorta Bory (1832), but it is an illegitimate later homonym of P. contorta (Hoffm.) Spreng. (1827). The next published name at species rank is Parmelia bohemica Nádv. (1951), but that is a later homonym of P. bohemica Gyeln. (1932), and is also not legitimate. Parmelia submontana Nádv. (1957), a nomen novum for P. bohemica Nádv. is not validly published according to Hale (1987).

It is arguably permissible to cite this species as P. submontana Nádv. ex Hale, but it seems inappropriate to do so because P. submontana Nádv. and P. submontana Hale are based on different types. The type of P. submontana Hale is that of P. contorta Bory, and is from Greece (Peloponnes, Taigetos Mountains). The type of P. submontana Nádv. is that of P. bohemica Gyeln., and is from the Czech Republic (Bohemia).

Description: Thallus not usually rosette forming, sometimes forming loose, subependent tufts. Upper surface 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 rolled downwards. Pseudocyphellae: frequent on upper surface, forming a conspicuous, white network; eroding to form soralia. Soralia: punctiform, white to blue-grey, mainly laminal but 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 but some marginal. Lower surface: black, brown at extreme margin. Rhizines: abundant, black, simple, rarely forked, 0.3 - 0.5 x 0.05 mm and appearing rather uniform in size; of ±parallel, conglutinated hyphae. Upper cortex: colourless in section, 10 μm thick, rather 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 that are rather broad (2.5 - 3 μm); hyphae sometimes tinged brown in lowest part of medulla. Lower cortex: brown in section, 15 - 25 μm thick, cellular; cells subrounded, 5 - 7 μm diameter; cortex K-, pigment (or most of it) not soluble in K. Chemistry: thallus K+ yellow, C-, P-, UV+ faintly orange; medulla K+ red, C-, P+ orange, I-; soralia K+ red, C-, P+ 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 elongated 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 entirely unlike those of other species of the genus.

Throughout Greece, but absent from most of the smaller islands. Commonest in the Peloponnesse, from where it was first described. Usually on bark, and recorded from a wide range of species, but with a strong preference (50% of all records) for Abies cephalonica. Occasionally on wood or siliceous rock. Recorded from 300 - 1800 m altitude, but most commonly encountered between 1000 and 1500 m. This is a very characteristic species of montane forests in the Peloponnesse.

Basically, but not strictly, circum-Mediterranean. In Europe commonest in the south. North of the Alps it is widely distributed, but probably not common. It appears to be spreading northwards, and was recently reported as new to British Is (Brightman, 1992b), and Denmark (Christensen, 1997). Also Macaronesia (Canary Is), western Asia (Turkey, Syria, southern Ural Mts), N. Africa (Morocco).

Parmelia sulcata Taylor (1836)
in: Mackay, Fl. Hibern. 2: 145; (?') Parmelia sulcata var. discreta (H. Olivier) Hillmann. (?') Parmelia sulcata f. rubescens (Harm.) de Lesd.

There are earlier names, but they do not have priority at the rank of species.

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 ± flatt (not distinctly downturned or upturned). Pseudocyphellae: abundant, white, long and narrow (0.05 - 0.1 mm wide), often merging and forming a conspicuous reticular 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). Medulla: white, of loosely woven hyphae that are predominantly horizontal in orientation; hyphae broad, 3 µm wide. Lower cortex: 20 µm thick, dark brown in section, K- (pigment not soluble). Chemistry: thallus K+ yellow, UV+ faintly orange; medulla K+ red, C-, P+ yellow-orange, I-. Soralia K+ red-orange. Photobiont: green, with large central chloroplast (trebouxioid); cells globose to subglobose, 8 - 14 µm diameter, forming a continuous regular 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.

Almost throughout Greece. Usually on bark, and recorded from a wide range of species. There are also a few records from wood and siliceous rock. At altitudes 0 - 1800 m. Cosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (throughout, except warmest parts of USA), C. America (Mexico), S. America (Argentina, Chile, Falkland Is, Peru), Australasia (SE Australia, widespread in NZ), Antarctica (S. Georgia).

**Parmeliella Müll. Arg. (1862)**


**Parmeliella triptophylla** (Ach.) Müll. Arg. (1862)


The earliest name may be *Lichen microphyllus* Schrad. (1794), but the epithet is not available in *Parmeliella* owing to *P. microphylla* (Ach.) Müll. Arg., a synonym of *Vahliella kecophaea*. *Stereoaulon corallinoides* Hoffm. (1796) is may also be synonymous, but the name has not been typified. (Hoffmann's name is not a synonym of *Lichen niger* Huds. as claimed by Jørgensen (1978: 73).)

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 very scattered on the mainland. On bark at altitudes 300 - 1400 m. Some reports, especially the older ones, may be unreliable since *Fuscopannaria mediterranea*, which is common in Greece, was only described in 1965 and the two species can be confused. There are no modern reports by an experienced lichenologist.

Widely distributed in Europe. Also Macaronesia, Asia (widespread), N. America (scattered, principally along northern parts of both coasts), C. America (Mexico), perhaps Australasia (Australia; reports for NZ are incorrect). Reports for S. Africa are incorrect.

**Parmelina Hale (1974)**

in: *Phytologia* 28(5): 481

*Type:* *P. tiliacea* (Hoffm.) Hale. *Family:* Parmeliaceae. Literature: Monographed by Hale (1976a), though about half of the taxa treated there have since been placed in other genera. The three common European species are treated in all the standard floras.


Differs from Parmelia most obviously in the absence of pseudocyphellae.

About 19 species. Six species occur in Europe, though one is a cryptic species. Species of Parmelina usually occur on bark, but are sometimes found on wood, rock or soil.

11 Isidia present.

22 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 the thalline margin. Lobes with distinct white maculae. On bark. If present in Greece, probably restricted to sites with an oceanic microclimate (Note 3). **P. carporrhizans**

2 Apothecia with, or more commonly without rhizines developing from the 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.

(3) I am not convinced that this species really is present in Greece. In my opinion most reports, perhaps all, refer to P. quercina.

**Parmelina carporrhizans** (Taylor) Hale (1974)


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 these authors, *P. carporrhizans* is a species of oceanic Europe and Macaronesia, and I would not expect it to occur in Greece. Most Greek reports are probably based on collections of *P. quercina* with rhizinate apothecia.

Descriptions: Poelt & Věžda (1977); Smith et al. (2009).

Reports are very scattered, with no clear pattern. On bark at altitudes 300 - 1200 m. However, most of these reports are probably unreliable.

Global distribution unclear, owing to confusion with *P. quercina*. Widely distributed southern and central Europe, reaching British Is but not the Nordic countries. Also Macaronesia, western Asia (Turkey), N. Africa (Algeria, Tunisia). Reports of *P. quercina* for N. America, C. America, and Australasia may also belong here.

**Parmelina pastillifera** (Harm.) Hale (1976)


Thallus: foliose, to 11 cm diameter, pale blue-grey, usually not pruinose, rarely with obscure white pruina near tips of lobes. 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 younger rhizines, before they darken). Cilia: present but not abundant, marginal, usually in axes 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 and usually resembling squashed spheres, sometimes with a 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 and 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: thallus K+ yellow, UV- (but sometimes appearing orange by reflection); medulla K-, C+ red, KC+ red, P-, I-. 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, though absent from many of the smaller islands, but not particularly common. Usually on bark, less common on rock (calcareous or siliceous) or wood. At altitudes 250 - 1750 m.

Throughout Europe except for the far north, but more of oceanic than P. tiliacea. Also western Asia (Turkey, Syria, Ural Mts, northern India), N. Africa (Morocco).


Parmelia tiliacea (Hoffm.) Ach.; Parmelia tiliacea var. scortea Duby

Lichen scortea Ach. (1799) is a superfluous name for Lichen lobatus J. F. Gmel. (1792). The epithet scortea was first used legitimately as Parmelia tiliacea var. scortea Duby, in Bot. Gall. 2: 601. 1830

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 but becoming cylindrical or slightly clavate, 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 (?epicotex) 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 surrounded to slightly elongated, 2.5 - 5 µm diameter. Medulla: white, about 90 µm thick; in section 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 surrounded, 2 - 3 µm diameter. Apothecia: uncommon, laminal, sessile, concave, 0.4 -1.5 mm diameter, not pruinose. Disc brown. Exciple: not visible externally; in section 30 - 80 µm wide, mostly colourless, orange-brown at surface, K-, orange-brown pigment not soluble in K. Thalline margin: 0.1 - 0.2 mm wide from above, smooth, persistent; in section 20 - 150 µm wide, thinnest on lower surface of apothecia; with abundant small crystals, mainly in cortex, soluble in K. Epithecium: very pale yellow-brown to pale brown, K-, pigment partly to entirely soluble in K, without crystals. Hymenium: colourless, 45 - 65 µm tall. Hypothecium: colourless, 60 - 100 µm tall, rather obscurely divided into an upper subhymenium and a lower hypothecium proper. Hamathecium: of paraphyses. Paraphyses: simple or sometimes branched, slightly clavate, broadening from about 1.5 µm at base to 3 µm at tip. Asc: 35 x 14 µm, clavate. Lecanora type. Ascospores: colourless, simple, ellipsoid, 7.5 - 11 x 5 µm, 8 per ascus, with Lecanora type wall. Chemistry: thallus K+ yellow, UV-; medulla K­, C+ persistent red, P­, I­. 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. pastilifera, see under that species. P. cryptotiliacea is said to have narrower ascospores than P. tiliacea, but in the fertile material that I have studied, ascospore widths fall in the zone of overlap between these two species. All Peloponese collections in the tiliacea complex, fertile or otherwise, are reported here as P. tiliacea.

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 on wood, bryophytes and soil. From sea level to at least 1700 m. The lichenicolous fungus Abrothallus buellianus has been reported once from this lichen.

Throughout Europe, except for the far north. Also Macaronesia, Asia (widespread), Africa (widespread north of the Sahara, also S. Africa, Madagascar). Reports for other regions may be unreliable.

Parmelinopsis Elix & Hale (1987)

in: Mycotaxon 29: 242


A genus of about 20 species, best developed in warm, humid regions. The few European species are distinctly oceanic, and there is only a single Greek record.

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)


Description: Nash et al. (2002); Smith et al. (2009).

Zakynthos, on bark of Cupressus sempervirens at an altitude of 30 m. The report, though surprising, 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.

Basically a species of the atlantic margin of Europe, though also present in Italy. Also Macaronesia, eastern Asia (widespread, but no further west than Kashmir), Malesia (PNG), Africa (widespread in E. Africa; also Madagascar,
Ascension Is, St Helena), N. America (scattered in southern USA), Caribbean (PR, perhaps St Lucia), C. America (CR, Guatemala, Mexico, Nicaragua), S. America (widespread), Australasia (eastern Australia, both islands of NZ), Pacific (Hawaii, Henderson Is).

**Parmeliopsis (Nyl.) Nyl. (1863)**


Type: *P. ambiguа* (Wulf.) Nyl. The type is conserved. Family: *Parmeliaceae*. 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. ambiguа*

1 Thallus pale grey (without usnic acid). *P. hyperoptа*

**Parmeliopsis ambiguа** (Hoffm.) Nyl. (1866)


The name *Lichen ambiguus* Wulf. (1791), sometimes cited as basionym, is not legitimate, being a later homonym of *L. ambiguus* Vill. (1789). The earliest name may be *Lichen diffusus* Weber (1778), but the name does not appear to have been typified, and there seems to be some uncertainty about whether it is synonymous with *P. ambiguа* or *P. hyperoptа*.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009); Thell & Moberg (2011).

Rare and very 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), N. America (widespread from Alaska to cooler parts of USA), C. America (Mexico), Australasia (SE Australia).

**Parmeliopsis hyperoptа** (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*, *Piceа* and *Pinus* at altitudes 700 - 1800 m. Much of Europe, but much more photophobic than *P. ambiguа* and very rare south of the Alps as a result. Also Asia (Kazakhstan, Russia, Mongolia Japan), N. America (widespread from Alaska to northern USA), C. America (Mexico), southern S. America (Argentina, Chile). Reports for Australasia are incorrect.

**Parmotrema A. Massal. (1860)**


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 here included in the key to *Parmotrema*.

At least 300 species, best developed in warm, moist regions. Only 17 species occur in Europe.

Because several species are rather poorly known in Europe, the key is quite extensive, even though there are very few Greek reports at present.

111 Isidia present. Soredia present or absent.

22 Upper surface with reticulate pattern of maculae and cracks. Rhizines simple or squarrose.

33 Some rhizines squarrose. (P. subsisidiosum)

3 Rhizines simple. (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. carneopruinatum)
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)
in: [need to investigate - don't know title of paper in Bull. Mens. Soc. Linn. de Lyon 21:]; *Lichen perlatus* Huds. (1762)
in: Fl. Angl. 448; *Imbricaria perlata* (Huds.) Flot.; *Parmelia perlata* (Huds.) Ach.; *Parmelia trichotera* Hue.

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, as I was not able to obtain a convincing reaction with K in spot tests and the reaction with P was very faint.

Fairly widespread, but scattered and not common. Usually fairly close to the coast. Usually on bark, sometimes overgrowing bryophytes on bark; reported once from rock. At altitudes 0 - 1000 m.

Subcosmopolitan. Widely distributed in Europe except for the far north, though with a preference for suboceanic regions. Also Macaronesia (widespread), Asia (widespread), Malesia (New Guinea), Africa (widespread), N. America (southern Canada, widespread in USA), perhaps Caribbean (Bahamas, Bermuda, Guadeloupe), C. America (Mexico), S. America (widespread), Australasia (eastern Australia, widespread in NZ), Pacific (widespread).

**Parmotrema reticulatum** (Taylor) M. Choisy (1952)
The earliest name is *Lobaria perlatula* var. *ciliata* DC. (1805), but it does not have priority at the rank of species.
Corfu and a few islands of the Cyclades. On bark or rock at altitudes 0 - 700 m.
Cosmopolitan wherever the climate is oceaneic and the temperature is not too cold. Widespread in Europe, but absent from the Nordic countries and regions with a cold continental climate such as Poland. Also Macaronesia (widespread), Asia (widespread, but no further west than Kazakhstan), Malesia (PNG, Sabah), Africa (widespread), N. America (Ontario, widespread in USA), Caribbean (PR), C. America (CR, Guatemala, Mexico), S. America (widespread), Australasia (widespread), Pacific (widespread), perhaps Antarctica (subantarctic St Paul Is - old report).

**Peccania** A. Massal. ex Arnold (1858)
in: *Flora* 41: 93. Arnold introduced the name as "Peccania Mass. in lit. 4. Decbr. 1856". He did not provide a description, but he cited "Corinophoros Mass. ... 1856" (as 'Corynophorus') in synonymy. Massalongo's description of *Corinophoros* provides the "previously and effectively published description" (Article 32.1) needed for valid publication of Arnold's *Peccania*. *Peccania* would be a superfluous name, except that it is conserved against *Corinophorus* A. Massal.
Type: *P. coralloides* (A. Massal.) A. Massal. 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 15 species, though some are poorly known and may eventually be reduced into synonymy. At least 6 species have been reported from Europe.

The poorly known *P. teretiuscula* is 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**

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 (Canary Is), SW Asia (Kuwait, Oman), northern Africa (Morocco, Socotra).

**Peccania coralloides** (A. Massal.) Arnold (1858) var. coralloides

in: *Flora* 41: 93; *Corinophoros coralloides* A. Massal. (1856) in: *Flora* 39: 213

The authors of the Vienna Code state in passing, on page 213, that the combination into *Peccania* was made in 1860 by Massalongo, in *Atti Imp. Reg. Ist. Veneto Sci. Lett. Arti, Ser. III* 5: 335. I disagree. In *Flora* 41: 93 Arnold introduced the name as "*P coralloides* Mass. l.c." immediately after citing the generic name *Corinophoros*. The "P" clearly means Peccania and the phrase "l.c." refers to the previously cited "*Flora* 1856 n. 14.", i.e. part 14 of volume 39 (the 1856 volume) of *Flora*. (Any ambiguity that "l.c." might be intended to refer only to a letter from Massalongo is removed on the following paragraph that discusses *Arnoldia*.) Part 14 of volume 39 of *Flora* contains, on page 213, Massalongo's description of *Corinophoros coralloides*. Taken together, this is amply sufficient for valid publication of the new combination.

Description: Clauzade & Roux (1985); Moreno & Egea (1992b).

Scattered in the southern Aegean and adjacent coasts of Crete. On limestone at altitudes 100 - 250 m.

Southern and central Europe (but, surprisingly, recently reported for Greenland). Also Asia (widespread as far east as Mongolia), northern Africa (Morocco, Algeria, Socotra), N. America (Arizona).

**Peccania coralloides** var. arenicola Hue (1897)

in: Patouillard, in: Cat. Raisonné 136-137

Description: See the protologue. Possibly just a trivial morph of *P. coralloides*.

SE Peloponnesse 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: The only description that I have found is the protologue. It is inadequate.

Crete, on calcareous rock at altitudes 0 - 900 m.

Known only from Crete and the Algerian type collection.
Peltigera Willd. (1787)

in: Fl. Berol. Prodr. 347. The name is conserved against Placodon P. Browne ex Adans. (1763)

Type: P. canina (L.) Willd. Family: Peltigeraceae. 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. Martínez (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 & Martínez (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 Martínez & Burgaz (1996).

Until the mid 1980s species in branch 1.2 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 in 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 structures: present in a few species. Rhizines: always present; size, colour and morphology rather variable. Soralia: present in a few species. Veins: present on lower surface in most species. Lower cortex: absent. Apothecia: always on the upper surface of the lobes, often on distinct extensions of the lobes. Ascospores: colourless, usually 3-septate. Chemistry: all spot test reactions said to be negative. Photobiont: primary photobiont blue-green in most species, but green in a few; the latter have cephalodia with a blue-green photobiont.

About 89 species, of which 29 occur in Europe; 15 are reliably recorded for Greece. Species of Peltigera are normally terricolous or overgrow terricolous or corticolous bryophytes, but sometimes grow directly on bark or on wood.

When determining collections of Peltigera it is often necessary to examine the rhizines and veins on the lower surface. Because of the terricolous habit, these features are often obscured by debris from the substrate. It is always advisable to clean carefully the lower surface, or at least a representative portion of it, under a binocular microscope, to remove adhering soil, bryophytes and decaying vegetation, before attempting to determine material.

1 Photobiont in lobes blue-green. P. aphthosa
2 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 just 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 warted everywhere. Rhizines usually separate. Veins on lower surface forming a distinct network.
3 Cephalodia smooth, at least in central part. Rhizines often confluent. Veins usually absent; if present then diffuse and not forming a distinct network. Lower surface of apothecia with discontinuous cortex. P. aphthosa
2 Soralia absent.
33 Upper surface tomentose, at least at lobe margins, matt. Notes 1, 2 and 3.
4 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 then 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.
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 4).
77 Rhizines with very fine, squarrose branches. Lobe margins downturned (Note 5). Note 6. P. membranacea
7 Rhizines unbranched, or with few branches, or rhizines 'unraveling' slightly towards the tip; not normally with squarrose branches (rarely, squarrose branches may be present on a few rhizines).
The species are difficult to separate. The key uses only characters that I have found to work fairly well with my collections. Use published monographs with caution, as they contain much contradictory information.

Rhizines and veins on the lower surface of lobes help separate these species, but they can be variable and it is advisable to examine several lobes so as not to be misled by an atypical one. Rhizines in this group are white or at most pale brown at the 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 the lobe margins. Rhizines in the central part of the thallus may have a different appearance, as contact with the substrate can cause their tips to branch or unravel extensively.

The following short-cuts may be helpful for this group:

*Isidia:* or similar (phyllidia, schizidia) occur only in *P. praetextata*. However, they must be distinguished from small margins flat to upturned (Note 5).

88 Thallus to 25 cm diameter. Lobes more than 1 cm wide, margins flat or slightly upturned. Veins white or pale at lobe margins (more than just the extreme margin), but dark brown in central part of thallus (Note 7). Rhizines dark in central parts of thallus. Probably confined to shady habitats in forests. **Note 6. *P. praetextata***

8 Thallus to 10 (15) cm diameter. Lobes less than 1 cm wide, margins upturned. Veins and rhizines various (Note 7). Not confined to forests.

99 Veins white or pale brown, not darkening much towards centre of thallus. Rhizines remaining white to pale brown and simple in centre of thallus. Thallus sometimes exceeding 10 cm diameter. **P. ponojensis**

9 Veins brownish except at the extreme margins of the 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 emerging together and so not forming a single cylinder), or strongly branched (Note 5).

77 Lobes 1 - 3 cm wide, margins often downturned (Note 5). Veins and rhizines near margins whitish. Apothecia often present. **P. canina**

7 Lobes to 1.5 cm wide, margins often upturned (Note 5). Veins and rhizines darkening not far from lobe margins. Apothecia present or absent.

88 Central part of lobes not tomentose, and 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.

44 4 Lower surface without veins. (P. elisabethae) Greek reports need confirmation.

44 Lower surface with pale veins (white, pale grey or pale brown).

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 central part of thallus).

55 Veins broad (typically 2 mm wide or more).

66 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. Interspaces between veins rounded. Apothecia red-brown.

Lobes 2 - 4 cm wide. Lobes not pruinose. (P. neopolydactyla)

7 Rhizines confluent, less than 5 mm long. Interspaces 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.

77 Veins dark brown to black almost to margins of lobes. Rhizines not arranged in concentric lines. Apothecia saddle shaped. (P. melanorrhiza)

7 Veins becoming pale at least at extreme margin of lobes. Rhizines arranged in concentric lines. Apothecia rounded. **P. horizontalis**
regenerating lobes that can occur in many species following injury. 

**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 apothecia are absent. Involute margins only occur in other species where they bear apothecia.

**Downturned (revolute) lobe margins:** occur in P. canina and P. membranacea.

**Dark veins or rhizines:** extending very close to the lobe margins occur in P. kristinssonii, P. monticola, and P. rufescens.

**Habitat.** P. praetextata is probably restricted to ±shaded habitats in montane forests.

**Substrate.** P. canina, P. membranacea, P. praetextata, P. rufescens and perhaps also P. kristinssonii occur on a wide range of substrates. P. monticola is probably restricted to fissures in strongly calcareous rocks in upland or montane regions. P. ponojensis is probably restricted to soil or rock fissures.

(4) 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. Because rhizines can be variable the only way to avoid confusion is to examine many of them, to determine what is typical for the specimen.

(5) Flat, upturned (involute), or downturned (revolute) lobe margins refers to sterile parts of lobes. Lobes may be very different where they bear apothecia.

(6) Rhizines of P. praetextata are very variable. Usually they lack squarrose branches, but some specimens that clearly belong to this species (because of their phyllidia) have a few squarrose rhizines. Similar specimens lacking phyllidia might be difficult to separate from P. membranacea, but that species is probably rare in Greece and restricted to the north.

(7) Much published information on the width of veins, on the extent to which they are raised, and on their branching pattern, is unreliable.

### Peltigera aphthosa (L.) Willd. (1787)

In: Fl. Berol. Prodr. 347; Lichen aphthosus L. (1753) in: 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’, so Linnaeus’s usage has generally been regarded as a correctable orthographic error.); Peltidea aphthosa (L.) Ach.

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Vitikainen (1994).

Scattered, on the northern half of the mainland. On rock at altitudes 20 - 1200 m.

Widely distributed in northern and central Europe; present, though not common, in the mountains of southern Europe. Also Asia (widespread), N. America (widespread from Alaska to cooler parts of USA). 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 when considered on a large scale, but extreme margin usually revolute. Upper surface: usually grey at the margins, sometimes with a brown tinge in central parts, matt, white tomentose at least near tips of lobes, sometimes everywhere; tomentum erect, usually not very dense. Lower surface: white, except for veins, attached by rhizines. Rhizines: abundant; rather variable, but most commonly fasciculate and strongly branched, a few may be unbranched and resemble those of typical P. praetextata, but 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 the lobe margin, raised (less strongly so in central part of lobes), pale brown, ±tomentose, 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 in this group. 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, but there are reports of it on bark or on rock. At altitudes 20 - 2300 m, but uncommon below 500 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (widespread), Africa (Morocco, Ethiopia, S. Africa), N. America (widespread, though reports for warmer parts of USA may be unreliable), S. America (widespread in cooler regions), probably Australasia (NZS; reports for Australia incorrect). Reports for C. America (Mexico), Antarctica are incorrect.
**Peltigera collina** (Ach.) Schrad. (1803)

The earliest name is *Lichen scutatus* Dicks. (1793), but it is not legitimate, being a later homonym of *L. scutatus* Wulf. (1791)

Thallus: foliose, to 6 cm diameter. Lobes: 15 - 23 x 5 - 9 mm, usually grey to blue-grey, sometimes brownish, not pruinose, smooth, matt, margins ascending and often rather wavy, about 200 µm thick, attached by rhizines. Lower surface: white in a broad zone at margins, brown towards cente 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, marginal on the lobes, 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 and 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 all other species of the genus by the marginal soralia. Could perhaps be confused with sorediate species of *Fuscopannaria*, but they are much smaller lichens.

Scattered, but mainly in the south-western half of Greece. Probably restricted to the most favourable, and perhaps least disturbed, localities in the 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 about 1600 m, rarely as low as 600 m.

Throughout Europe, but probably commonest in the Nordic countries, the British Is and the Alps; in the south restricted to the uplands. It requires a cool, suboceanic or oceanic climate, and seems intolerant of strongly continental conditions. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (widespread, mainly in the west, from Alaska to cooler parts of USA), C. America (CR, Mexico), southern S. America (widespread).

**Peltigera degenii** Gyeln. (1927)
in: *Magyar Bot. Lapok* 25: 253

There are earlier names at other ranks, but they do not have priority at the rank of species.

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.

Fairly common in central Europe and the Nordic countries. There are a few scattered records from some other parts of Europe, but almost absent from southern Europe. Also Macaronesia, Asia (widespread in cold regions), Africa, N. America (scattered from Alaska to cooler parts of USA).

**Peltigera horizontalis** (Huds.) Baumg. (1790)

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Clauzade & Roux (1985); Martínez (1999); Nash et al. (2004); Smith et al. (2009); Vitikainen (1994).

Scattered in the northern half of the mainland Greece. 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), Africa, N. America (widespread from Alaska to cooler parts of USA). Reports for Malesia, Australasia, Antarctica are incorrect.

**Peltigera kristinssonii** Vitik. (1985)

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Martínez (1999); Vitikainen (1994).

Macedonia at an altitude of about 1800 m. The substrate was not reported.

Most European localities are in the northern part of the Nordic countries and the Alps, but there are a few outliers in southern Scandinavia, the Pyrenees and elsewhere. Also Asia (Turkey, Georgia, Siberia, Mongolia), N. America (small areas in SE Alaska, BC and NW USA).

**Peltigera leucophlebia** (Nyl.) Gyeln. (1926)

The earliest name is *Peltigera aphthosa* var. *variolosa* A. Massal. (1856), but the epithet *variolosa* was not used at species rank until 1927 and does not have priority at that rank.

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 the highest mountains. Also Asia (widespread), N. America (widespread from Alaska to cooler parts of USA).

Peltigera membranacea (Ach.) Nyl. (1887)
in: [need to investigate - title of paper not known]; Peltidea canina P. (= var.) membranacea Ach. (1810) in: Lichenogr. Universalis 518

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. The report for Evia was from bark of Platanus orientalis.

Common in northern Europe and fairly common in central Europe, but few reports from the south. Also Macaronesia, Asia (widespread), perhaps Africa (S. Africa), N. America (widespread, mainly in the west, from Alaska to cooler parts of USA), S. America (Colombia, perhaps elsewhere), Australasia (NSW, widespread in NZ), Pacific (W. Samoa).

Peltigera monticola Vitik. (1994)
in: Acta Bot. Fenn. 152: 64-65

Descriptions: Ahti et al. (2007); Burgaz & Martínez (2003); Martínez (1999); Nash et al. (2004); Vitikainen (1994).

Scattered on the mainland at altitudes 0 - 1100 m. Commoner in the northern half of the country, but reliably reported for southern Peloponnese. According to Vitikainen, the Peloponnesian specimen was collected by Lindqvist in 1982 at an altitude of 1200 m, and it is clear from the itinerary in Lindqvist (1983) that this means Lindqvist's site 1B. Apart from a single report from sea level in Thessaly, which may be unreliable, all the others are at altitudes 600 m or above. 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 it seems clear that in southern Europe P. monticola prefers the uplands. Also Asia (Russia, Tajikistan), 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 the 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 coloured veins, attached by rhizines. Rhizines: fasciculate, branched, to 1.8 mm long, white when very young but soon becoming pale brown; dark brown to black in centre of lobes. Veins: broad and diffuse, to 3 mm wide, occupying much of the lower surface, mostly dark brown to black but paler near margins of lobes; most interstices distinctly elongate, but 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-. Photobiont: blue-green; cells globose, 6 - 8 µm diameter, not in chains, forming a continuous, regular layer 40 - 50 µm thick.

This species has no really clear-cut characters. The white pruina at the lobe tips is helpful, but may be scanty or absent. Careful attention to detail is the only reliable way to separate it from similar species.

Mainland Greece and perhaps Naxos. Probably commoner in the southern half of the country. Usually overgrowing bryophytes, occasionally directly on soil or bark, at altitudes 200 - 2100 m.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Algeria, Tunisia), N. America (widespread from Alaska to cold parts of USA), C. America (Mexico), S. America (Chile), Australasia (widespread in NZ), Antarctica (S. Georgia).

Peltigera polydactylon (Neck.) Hoffm. (1789)
in: Descr. Pl. Cl. Crypt. 1(1): 19; Lichen polydactylon Neck. (1771) in: Meth. Musc. 85 as polydactlion. (Changing the i into y, as was first done by Hoffmann, is a permissible correction of Necker's orthography to accord with standard transliteration of Greek into Latin characters. The word polydactylon is a perfectly good Greek noun, and it must be accepted as the epithet (Article 60.1). There is no justification for changing it to polydactyla, an adjective, as Acharius did.); Peltigera polydactyla auct. mult.; Peltigera polydactyla f. microcarpa auct.

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. Most of Europe. Uncommon in the south, but not as rare as the map in Vitikainen (1994) suggests: see maps for the Iberian Peninsula (Martínez 1999:135) and Italy (Nimis
Peltigera ponojensis Gyeln. (1931)
in: Mem. Soc. Fauna Fl. Fenn. 7: 143

The earliest name is Peltigera rufescens var. rhizinosa Gyeln. ex Erichsen (1928), but it does not have priority at species rank, where 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 seen any conservation proposal and the name is not listed as conserved in the present Code. The correct name for this species may be Peltigera plittii, but for now I follow current usage.

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; rather variable but most commonly separate and simple, sometimes unrolling at the tip; white to pale brown near lobe margins, brown in central parts of lobes; 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 but 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.

The rather small thallus diameter and lobe width help to separate this species from P. canina and P. praetextata. It also differs from P. canina in its rhizines, which are typically separate rather than confluent and not branched (though they may unpruine).

Very scattered on the mainland, on soil or overgrowing bryophytes on soil, at altitudes 800 - 2000 m.

Throughout Europe. Also Asia (Turkey, Russia, Tajikistan, Mongolia), N. America (widespread except in warmer parts of USA).

Peltigera praetextata (Flörke ex Sommerf.) Zopf (1909)

Thallus: foliose, to 22 cm diameter. Lobes: to about 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. Rhizines: true isidia absent but flattened phyllidia often present and sometimes abundant; they are usually in dense clusters on the lobe margins: often

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. Not reported from any of the islands except Evia.

Throughout Europe, though in the south it is an upland species. Also Macaronesia, Asia (widespread), Africa (Tunisia, widespread in E. Africa), N. America (widespread in cool and temperate regions), C. America (CR, Mexico), perhaps S. America (Bolivia, Venezuela), Australasia (NSW, NZS).

**Peltigera rufescens** (Weiss) Humb. (1793)

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. Throughout Europe, but uncommon in the south and confined to the uplands. Also Macaronesia, Asia (widespread), Africa (widespread in N. and E. Africa; reports for elsewhere doubtful), N. America (widespread except in warmest parts of USA), C. America (Mexico), S. America (widespread), Australasia (SE Australia, widespread in NZ), Pacific (Hawaii), Antarctica (subantarctic islands, Antarctic Peninsula).

**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 highest mountains of southern Europe. Also Asia (widespread in cool or cold regions), N. America (widespread from Alaska to cooler parts of USA).

**Peltula Nyl.** (1853)


About 46 species. In Europe there are about 12 species.

1 Soredia present. Thallus areolate, placodioid or squamulose.

22 Thallus areolate with a 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 discis. (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. rodriguesii)
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)

Islands of the Aegean, including Crete, and adjacent coast of the mainland. On siliceous rock at altitudes 25 - 600 m.
Subcosmopolitan in warm, dry regions. Essentially a species of southern and central Europe, though its range does extend into southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (mostly southern USA), C. America (Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Easter Is).

**Peltula obscurans** (Nyl.) Gyeln. (1935)

Known from a few islands of the Aegean, on rock at altitudes 50 - 350 m. It was not reported whether the collections belonged to var. obscurans or var. hassei.
Widely distributed in arid regions around the world. Southern Europe. Also Macaronesia (warmer parts), Asia (widespread), Malesia (PNG), Africa (widespread), N. America (SW USA), C. America (Mexico), S. America (widespread), Australasia (widespread in Australia).

**Peltula omphaliza** (Nyl. ex Eckfeldt) Wetmore (1970)

Kos and Paros, on siliceous rock at altitudes 20 - 250 m.
Widely distributed in arid regions around the world. Southern Europe. Also Macaronesia, Asia (Yemen, southern Siberia), Africa (Morocco, Algeria, Namibia), N. America (SW USA), C. America (Mexico), S. America (Ecuador), Australasia (widespread but scattered in Australia).

**Peridiothelia** D. Hawksw. (1985)
Three species of saprophytic fungi. They are not lichenised, but are sometimes encountered by lichenologists.

11 Ascospores 25 - 33 \(\mu\)m long. (P. grandiuscula)
1 Most ascospores less than 25 \(\mu\)m long.
22 Ascospores 17 - 21 x 7.5 - 9 \(\mu\)m. On bark of Tilia. (P. fuliguncta)
2 Ascospores 22 - 25 x 8.5 - 11 \(\mu\)m. On bark of Olea. **P. oleae**

**Peridiothelia oleae** (Körb.) D. Hawksw. (1985)
Description: Hawksworth (1985).
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 over several earlier names.

Type: *P. communis* DC. (= *P. pertusa* (Weigel) Tuck.). 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, usually white to some shade of grey, well-developed, usually fairly large (several cm diameter), and fairly thick, margin sometimes zoned or with a prothallus. Isidia and/or soralia present in some species. Apothecia almost entirely to partly immersed in thallus, never distinctly sessile. Disc: black, punctiform or ± widely exposed.

Thalline margin: apothecia always closely surrounded by thalline tissue, but most species lack a well-structured thalline exciple. Exciple: not usually visible externally; in section: thin, sometimes poorly developed, narrow, when well developed formed of hyphae parallel to hymenium. Epithecium: colourless, brown or grey, K+ violet in some species. Hymenium: colourless, usually tall. Hypothecium: often poorly developed. Paraphyses: fairly narrow (1 - 1.5 μm), much anastomosed, not capitate or moniliform. Asci: wall KI+ blue, usually rather uniformly, but some species have a more strongly staining region near the tip; no apical apparatus, opening by a slit. Ascospores: colourless, simple, ellipsoid, 1 - 8 per ascus, large to very large, often with a prominent wall which is multi-layered in some species. Pycnidia: 100% immersed. Conidia: colourless, bacilliform, 5 - 17 x 0.75 - 1 μm. Chemistry: complex and varied. Photobiont: green, trebouxiod.

As presently delimited, *Pertusaria* is not monophyletic, and its circumscription will eventually change.

Many species of *Pertusaria* 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 real need for a modern monograph that includes SE Europe. The number of good species is uncertain: estimates vary from 350 to 500. Most species occur on bark or rock.

It is often necessary to note the number of ascospores in an ascus when determining collections. Because ascospores are usually large in this genus, a conventional thin section may disrupt individual asci and release the ascospores. I have found it helpful, on occasion, to deliberately cut a thick section. Although no use for observing fine anatomical detail, such a section sometimes make it easier to count ascospores.

*P. graeca* Erichsen and *P. teneriffensis* Vain., which are reported for Greece, are not included in the keys as I have insufficient information.

**Key to Pertusaria main groups**

1 1 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. Ascospores 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. (*P. pseudocorallina*)
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.  (P. slesvicensis)
      4 On siliceous rock.  (P. melanochlora) Greek reports doubtful.
  3 Medulla P-.  **P. 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.  **P. corallina**
3 Thallus and medulla P-.  Usually on bark.
  44 Isidia small, granular, to 0.2 mm diameter.
    55 Isidia with central part darker than thallus. Isidia not showing much tendency to develop into soralia.
      Thallus ±white.  An undetermined collection (18-May-2006/L55) that seems distinct from P. albescens var. corallina.
    5 Isidia concolourous with thallus or (especially when developing into soralia) distinctly paler than thallus.
      Thallus pale grey.  **P. albescens var. corallina**
    4 Isidia at least 0.5 mm in longest dimension.
      55 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.  (P. 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.  **P. amara f. amara**
      4 Soralia with distinct thalline margin.  (P. szatalae)
    3 Soralia small, arising from small papillae.  (P. amara f. 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 a narrow base, usually remaining discrete. **P. 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. **P. 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 and 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.
        555 Soralia P+ red, but cortex and medulla P+ yellow. Apothecia usually present.  (P. multipuncta)
        555 Soralia P+ blue-grey, but medulla and cortex P-. Apothecia absent. **P. carneola**
        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. **P. ophthalmiza**
6 Few or no soralia associated with apothecia.
7 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
8 Soralia clearly delimited. P. albecens v. albescens
8 Soralia not clearly delimited. P. albecens v. corallina
4 On siliceous rock.
55 Thallus dark.
66 Thallus dark brown-grey. Soralia P+ red (reaction generally faint). P. mammosa
6 Thallus dark grey. Soralia P-. (P. ocellata) Greek report doubtful.
5 Thallus pale grey.
66 Thallus less than 1 mm thick, P+ distinctly red. P. aspergilla
6 Thallus more than 1 mm thick, P- or P+ slightly reddish (thallus, not medulla).
77 Medulla and soralia P+ red, KC-. P. 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 Pertusaria albecens 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.

11 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.
2 Disc punctiform. Ascospores 1 or 2 per ascus.
33 Ascospores 1 or 2 per ascus, 150 - 250 x 55 - 85 µm. (P. appennina)
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. P. 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 Asci 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. heterochaora
3 Fertile warts with narrow base. Ascospores wall 15 - 20 µm thick. (P. ficorum)
2 Ascospores wall 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 Asci 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

111 On mosses or soil. (P. octomela)
11 On bark or wood.

22 Disc eventually broadening when mature, not remaining punctiform. Ascospores 1, 2 or 8 per ascus.

33 Ascospores more than 120 \(\mu\)m long and more than 60 \(\mu\)m wide. **P. caesioalba** Note 1.

44 Ascospores usually 1 per ascus, more than 100 \(\mu\)m long and more than 60 \(\mu\)m wide. **P. caesioalba** Note 1.

55 Ascospores 65 - 95 \(\times\) 25 - 27 \(\mu\)m. **P. carmeli**

3 Ascospores 8 per ascus, 16 - 42 \(\mu\)m long. (P. carneopalida)

2 Disc remaining ± punctiform. Ascospores 2, 4 or 8 per ascus.

33 Ascospores less than 120 \(\mu\)m long. **P. pertusa**

1 On rock.

222 Asci with 8 ascospores. Ascospores less than 50 \(\mu\)m long. **P. chiodectonoides**

22 Asci with 2 (4) ascospores.

33 Ascospores 100 - 125 \(\times\) 50 \(\mu\)m. **P. pseudoparotica**

3 Ascospores more than 140 \(\mu\)m long. **P. pallidoflava**

34 Thallus pale yellow. **P. pallidoflava**

3 Thallus grey or green-grey. **P. pertusa**

44 Fertile warts with broad base. Ascospores 8 per ascus; ± uniseriate in ascus. **P. constricta**

4 Thallus pale yellow. **P. constricta**

5 Thallus P± orange (stictic acid). Ascospores 34 - 75 \(\times\) 20 - 35 \(\mu\)m. **P. alpina** Greek report doubtful.

5 Thallus P-. Ascospores 45 - 60 \(\times\) 25 - 30 \(\mu\)m. **P. werneriana**

4 Fertile warts ± globose, with narrow base. Ascospores (2) 4 - 8 per ascus; uniseriate or not. **P. werneriana**

55 Ascospores (4) 8 per ascus, 34 - 74 \(\times\) 20 - 32 \(\mu\)m; wall 2 - 3 \(\mu\)m thick. Probably restricted to upland or montane forests. **P. leioplaca**

1 On rock.

222 Asci with 8 ascospores. Ascospores less than 50 \(\mu\)m long. **P. chiodectonoides**

22 Asci with 2 (4) ascospores.

33 Ascospores 100 - 125 \(\times\) 50 \(\mu\)m. **P. pseudoparotica**

3 Ascospores more than 140 \(\mu\)m long. **P. pallidoflava**

44 Thallus pale yellow. **P. pallidoflava**

4 Thallus grey or green-grey. **P. pertusa**

2 Asci with 1 ascospore. Ascospores 180 - 200 \(\times\) 60 - 70 \(\mu\)m. **P. mammosa**

(1) P. paramerae, widely distributed around the Mediterranean but not yet recorded for Greece, would also key out here. It does not differ materially in morphology or ecology from P. caesioalba, and can only be reliably separated by chromatography. Both species have thiophaninic acid. P. paramerae also has planaic 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.

(2) P. australis is poorly known and its position in the key is based on my interpretation of the inadequate 19th century protologue. It is not entirely clear from the protologue whether the disc eventually broadens or not.

**Pertusaria albenscens** (Huds.) M. Choisy & Werner (1932) var. albenscens
in: Werner, **Cavanillesia** 5: 165 (Also in **Bull. Soc. Sci. Nat. Maroc** 12: 160); **Lichen albenscens** Huds. (1762) in: Fl. Angl. 444: **Pertusaria albenscens** var. globulifera (Turner) Poelt; **Pertusaria dacica** Erichsen; **Pertusaria discoidea** (Pers.) Malme; **Pertusaria discoidea** var. albidula 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 \(\mu\)m 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 \(\mu\)m thick, colourless, formed of hyphae parallel to surface. Medulla: white. Chemistry: thallus, medulla and soralia K-, C-, KC-, P-, UV- (but sometimes appearing spuriously UV+ white owing to reflection). Photobiont: green, cells globose, 8 - 12 \(\mu\)m diameter. Photobiont layer: 45 - 70 \(\mu\)m 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.

Few authors distinguish between varieties within this taxon, but most reports probably refer to var. *albescens*. *P. albescens* s. lat. is present throughout Europe, except for the truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, perhaps S. Africa), N. America (at least California), C. America (Mexico), S. America (Colombia, perhaps elsewhere).

**Pertusaria albescens var. corallina** (Zahlbr.) J. R. Laundon (1963)
in: *Lichenologist* 2(2): 143; *Pertusaria globulifera* var. *corallina* Zahlbr. (1902) in: [need to investigate]

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 to date). Cortex: 50 µm thick, mostly colourless, sometimes pale brown in upper part, formed of hyphae ± parallel to surface, K-. Medulla: white. Chemistry: all parts C-, K-, KC-, P: thallus UV- (or sometimes slightly +whiteish or +greenish, perhaps by reflection). Photobiont: green, cells globose, 9 - 12 µm diameter. Photobiont layer: regular and continuous (where there are no isidia), 30 - 50 µm thick.

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. An undetermined collection has more regular isidia with a central part that is distinctly darker than the thallus.

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).

**Pertusaria amara** (Ach.) Nyl. (1873)

The earliest name is *Lichen fagineus* L. (1753), but that name has been formally rejected. *Lichen orbiculatus* Schreb. (1771) is a superfluous name for *Lichen fagineus* L. and not legitimate. Acharius’s name is the earliest one available at the rank of species.

Thallus: crustose, pale-grey, not pruinose, usually warty, weakly areolate, to at least 7 cm diameter, 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 but soon becoming markedly convex, at first delimited but sometimes becoming 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 single Peloponnesian collection seen by me belonged to *f. amara*.

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, rare in the south. At all altitudes. Usually on bark (85% of records), and reported from: *Cupressus sempervirens*, *Fagus sylvatica*, *Olea europaea*, *Quercus frainetto*, *Quercus petraea* and *Quercus pubescens*, with no distinct preference. Occasionally on non-calcareous rock, and recorded once on wood.

Throughout Europe though, at least in Greece, it tends to avoid localities with a distinctly Mediterranean climate. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, S. Africa), N. America (widespread outside arctic regions and continental interior), C. America (Mexico), perhaps S. America.
Pertusaria amaurescens Nyl. (1874)
in: *Flora* 57: 311


Very rare in northern Greece, on siliceous rock.

Most reports are from southern Europe (Iberian Peninsula, Italy, Greece), but also known from British Is, Bulgaria and Czech Republic. Also Macaronesia (Canary Is), Asia (Sikkim, Hong Kong).

Pertusaria aspergilla (Ach.) J. R. Laundon (1992)

The epithets *dealbata* and *dealbescens* have been used for this lichen, but the type of *Lichen dealbatus* Ach. belongs to *Pertusaria corallina*, while *Pertusaria dealbescens* Erichsen is a superfluous name for *Pertusaria dealbata* (Ach.) Cribb., and thus also a synonym of *Pertusaria corallina*.


Rare and scattered, with no clear pattern. On bark or siliceous rock at altitudes 200 - 700 m.

Widely distributed north of the Alps, but rare in southern Europe. Also Macaronesia, Asia (Turkey, Russia, Mongolia, probably China), Africa (Algeria), S. America (Brazil, Colombia). Some reports from outside Europe are old and may be unreliable.

Pertusaria caesioalba auct., non (Le Prév. ex Duby) Nyl. (1855)

Synonyms: (?) *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 Phylctis 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. Nylander's name may be a synonym of *Aspicilia contorta*.

The correct name for the corticolous species may be *Pertusaria pruinosa* Kremp. (1868) in *Verhandl. k. k. zool.-bot. Ges. Wien* 18: 326. 1868, but I prefer not to take up that unfamiliar name until the matter has been studied by a specialist in this genus.

(Note, incidentally, 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, however, in that case Duby's name was legitimatized 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.)

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 to or oblique to surface; orientation of hyphae in lower half variable but often perpendicular to surface. Medulla: white. Apothecia: immersed to sub sessile in fertile warts, usually 1 per wart, flat, rather asciiolith in appearance; warts 0.5 - 1.5 mm diameter. Disc: black, widely exposed, slightly to moderately white pruinose. Exciple: not visible externally; in section: 50 - 60 µm wide, colourless to greyish, rather opaque. Thalline margin: basically absent; disc surrounded by remnants of thallus but there is no well-structured thalline margin.

Epithecium: grey to dark grey, K+ violet (sometimes also upper parts of hymenium). Hymenium: 200 - 300 µm tall, colourless. Hypothecium: poorly developed, colourless to very pale brown, to 50 µm tall. Paraphyses: 1 - 1.5 µm wide, anastomosed, not capitulate or moniliform. Asci: 175 x 65 µm, clavate, wall uniformly K+ blue. Ascospores: colourless, simple, ellipsoid, 1 per ascus, 150 - 190 x 50 - 80 µm; wall 10 - 15 µm thick, 2 layered, inner layer often with many fine concentric lines. Chemistry: medulla K-, C-, KC-, P-, 1; 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.

In all material seen by me to date the asci were 1-spored. According to some published descriptions they are sometimes 2-spored. It is not clear to me whether this taxon is conspecific with *P. ilicicola* Harm., which is said to have 2-spored asci, though some authors have synonymized them.

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.

Only known from a few sites in the northern Peloponnese. On bark and wood of conifers at altitudes 800 - 1400 m. Reported from *Abies cephalonica* and *Juniperus foetidissima*. This is a very distinctive taxon, and the absence of reports
for other parts of Greece is surprising.

Circum-Mediterranean/Macaronesian. Southern Europe, from Iberian Peninsula to Cyprus. Also Macaronesia, western Asia (Turkey, Israel), N. Africa (Morocco, Algeria, Tunisia).

**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. Substrate was not reported for either of the two records to date.

Known only from Greece and western Asia (Israel).

**Pertusaria chiodectonoides** Bagl. ex A. Massal. (1856)

in: Misc. Lich. 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 mountains. Also Macaronesia, Asia (Turkey, Russia, Kazakhstan), Africa (Morocco, S. Africa), N. America (California).

**Pertusaria coccodes** (Ach.) Nyl. (1858)


The earliest name is *Lepra obscura* Ehrh., but it is a nomen nudum.

Thallus: crustose, to several cm diameter, well delimited, white, pale grey or 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: a true cortex appears to be absent; layer above photobiont: 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- (though there is some reflection). 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, the presence of norstictic acid, 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 than *Pertusaria coccodes*.

Throughout Greece. On bark at altitudes 300 - 1300 m, but rare below 600 m. Present on a wide range of phorophytes, but usually avoiding strongly acidic bark and with a mild preference for *Quercus* (30% of records). The lichenicolous fungus *Cyphelium sessile* has been reported once from this host.

Throughout Europe to as far north as mid-Scandinavia. Also Macaronesia, Asia (scattered but widespread), C. America, S. America (Argentina), Antarctica (S. Shetland Is). Reports for Africa, North America said to be incorrect.

**Pertusaria constricta** Erichsen (1935)

in: Rabenhorst's Kryptogamen Flora, Ed. 2, 9(5.1): 343

Description: Clauzade & Roux (1989).

Evia, on bark of *Abies cephalonica* at an altitude of 700 m. Confirmation of the Greek report is desirable.

Most reports are for central Europe. Absent from British Is, Benelux, Baltic States and the Nordic Countries; there are no reports for France either, but this may be a case of under-recording. South of the Alps reliably reported for Sardinia. Also Asia (Turkey, Russia).

**Pertusaria corallina** (L.) Arnold (1861)


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Mountains of northern Greece, at altitudes 1400 m and above. The only substrate definitely mentioned 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, Japan),
Pertusaria coronata (Ach.) Th. Fr. (1871)

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, northern India).

Pertusaria dalmatica Erichsen (1936)
in: Rabenhorsts Kryptogamen Flora, Ed. 2, 9(5.1): 540; Ochrolechia dalmatica (Erichsen) Boqueras

This species was recently transferred to Ochrolechia, but I have not yet seen the evidence used to justify this transfer.

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 C+ persistent red, K-, 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.

Southern half of Greece, at altitudes 100 - 1400 m. On bark, often of conifers.

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). I have not seen any reports for other continents.

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.

Widely distributed in Europe to as far north as southern Scandinavia, but rather uncommon south of the Alps. Also Asia (widespread), "Africa" (Ascension Is).

Pertusaria flavida (DC.) J. R. Laundon (1963)
in: Lichenologist 2(2): 144; Variolaria flavida DC. (1815) in: Fl. Franç. Ed. 3, Tome 5: 177; Pertusaria lutescens (Hoffm.) Lamy; Pertusaria lutescens f. phragmaea (Ach.) Erichsen

The earliest name is Lichen lutescens Hoffm. (1784), but the epithet lutescens is not available in Pertusaria. The next name is Isidium phymatodes var. phragmaeum Ach. (1803), but Acharius's epithet was not used at species rank until 1826, and De Candolle's epithet has priority at that rank.

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, at altitudes 0 to over 1000 m. Recorded from Castanea, Fagus, Pinus heldreichii and Pyrus.

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). Reports for N. America are incorrect.

Pertusaria graeca Erichsen (1936)
in: Rabenhorsts Kryptogamen Flora, Ed. 2, 9(5.1): 624

Description: [No adequate description seen]

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 hemisphaerica (Flörke) Erichsen (1932)
in: Hedwigia 72: 85; Variolaria hemisphaerica Flörke (1815) in: Deutsche Lichenen Fasc. 2, pp6-7; (?) 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. Soralia: 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 rather variable: sometimes parallel to surface, sometimes distinctly perpendicular. Medulla: white. Chemistry: medulla C-, K-, KC-, P-, I-; soralia C+ red or pink-red, K-, P-, I-, UV+
green-white; thallus C-, K-, KC-, P-, UV-. Photobiont: green, cells ±globose, 8 - 11 µm diameter. Photobiont layer (away from soralia): regular, continuous, 20 - 30 µm thick.

The large, convex, white soralia reacting C+ red are distinctive. However, they are not always present in young material, which can easily be confused with Pertusaria dalmatica. In young material of P. hemisphaerica the soralia are less regularly excavate than in P. dalmatica, and though they may have a slightly upturned thatline rim it is less well developed and less persistent than in P. dalmatica; the soralia 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 bark of Abies cephalonica, Fagus sylvatica, Olea europaea, Phillyrea sp., Platanus orientalis and Quercus spp., with no distinct preference.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread, but only in western half), N. Africa (Morocco). Reports for N. America are said to be incorrect, so the status of reports for S. America must also be in some doubt.

Pertusaria heterochroa (Müll. Arg.) Erichsen (1936)

My only collection was scanty, so the description is incomplete. A better description must await further collections.


The 2-spored asci 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 - 100 m. Usually on bark, rarely on wood. Recorded from a wide range of phorophytes (but never conifers): Celtis occidentalis, Ficus carica, Olea europaea, Prunus cerasi and Robinia pseudacacia.

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).

Pertusaria huneckiana Feige & Lumbsch (1993)
in: Bibl. Lich. 53: 174

Thallus: crustose, pale green, not pruinose, coarsely warted, without vegetative propagules. Medulla: white. Apothecia: 0.4 mm thick, not pruinose. Disc: usually ±punctiform (in material seen by me; said to become open in mature apothecia). Epithecium: colourless to very pale brown. Hymenium: 350 - 400 µm tall, colourless, with abundant crystals in lower half. Hypothecium: not well developed, colourless. Paraphyses: 1 µm wide, anastomosed, not capitate or moniliform. Ascii: opening by a slit (no apical apparatus). Ascospores: colourless, simple, ellipsoid, 8 per ascus, 80 x 35 µm. Chemistry: medulla K+ yellow > orange (crystals of norstictic acid in section), 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.

Pertusaria hymenea (Ach.) Schaer. (1836)

Thallus: crustose, white-grey to pale green-grey, not pruinose, continuous but warty, 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, sometimes oriented ±parallel to surface, at other times (?incipient warts) perpendicular to surface. 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. Exciple: not visible externally; in section: 35 - 50 µm wide, colourless, of hyphae parallel to paraphyses. Thalline margin: thick, externally 0.3 - 0.5 mm wide, persistent; in section: 200 - 350 µm wide of which cortex 20 - 30 µm, large crystals present in medulla. Epithecium: brown to grey-brown, K+ purple (reaction sometimes patchy). Hymenium: 400 - 500 µm tall, colourless, KI+ blue. Hypothecium: 40 - 100 µm tall, colourless to very pale brown, sometimes with oil droplets. Paraphyses: 1 - 1.5 (2) µm wide, anastomosed, usually not capitate or moniliform, occasionally slightly capitately (apex to 3 µm). Ascii: 190 x 60 µm, ±clavate, a very narrow "ocular chamber" sometimes visible in water mounts (perhaps an incipient tear), wall KI+ blue. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 67 - 90 (130) x 32 - 40 µm; wall prominent, 4 - 7 µm at sides, usually not thickening much at tips but occasionally to 12 µm, formed of more than one layer (though this is not always apparent). Chemistry: medulla C-, K-, KC-, P-, I-; thallus C-, KC+, UV+, 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 apparently absent from the more continental parts of northern Greece. At altitudes 0 - 1200 m, but rare above 1000. 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. If reports to date are reliable, shows a clear preference for Olea europaea and Quercus spp. The lichenicolous fungi Dactylospora parasitica and Sphinctrina turbinata have been reported from this lichen. Dactylospora parellaria has also been reported, but Abbott (2009) suspected confusion with D. parasitica.

Throughout Europe to as far north s southern Scandinavia. Also Macaronesia, Asia (Turkey, Syria, Russia, perhaps Thailand), Africa (N. Africa; St Helena), N. America (scattered in USA), C. America (Mexico), S. America (Argentina, Brazil), Pacific (Hawaii). Some reports are old and may be unreliable. Reports for Australasia are incorrect.

**Pertusaria jurana** Erichsen (1936)

in: Feddes Rep. 41:100. However, sometimes ascribed to Erichsen's treatment of Pertusaria in Rabenhorts Kryptogamen Flora

Description: Clauzade & Roux (1985).

Western Crete, on bark at altitudes 900 - 1340 m.

Scattered in Europe: Poland, Slovenia, Switzerland, Italy (Liguria) and Greece. I have not seen any reports for other continents.

**Pertusaria lactea** (L.) Arnold (1872)


Thallus: crustose, grey-white, not pruinose, 8 x 3 cm (in only collection seen to date), cracked, thin in most places but occasionally to 250 µm thick. Soralia: frequent, discrete, white, distinctly paler than thallus, 0.4 - 0.5 mm diameter, usually distinctly convex with a narrow base. Cortex: probably absent; pseudocortex: 10 - 12 µm thick, colourless, poorly structured. Medulla: white. Chemistry: soralia C+ faintly red, KC+ strongly red, K-, P-, I-, UV-; thallus C-, KC+ red, K-, UV-. Photobiont: green (cells don't look much like Trebouxia), cells globose to slightly ellipsoid, 6 - 10 µm diameter. Photobiont layer, discontinuous, irregular, 30 - 60 µm thick.

Well characterised by the small, white (paler than thallus) convex soralia that are C+ red, and by the substrate. Only known from the northern Peloponnese, a few km from the sea, where it occurred on siliceous rock at an altitude of 700 m. The absence of other reports for Greece is surprising, as this species is quite widely distributed in Italy according to Nimis (1993).

Throughout Europe. Also Asia (Turkey, Russia, Kazakhstan, Japan), N. Africa (Morocco). A report for C. America (CR) seems doubtful to me.

**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 legitimatated 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 view, 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 Schaefer (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, but 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 Schaefer (1850: 229), where Lichen pertusus L. is mentioned directly.

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 a weakly zoned margin or a poorly developed prothallus, without vegetative propagules. Cortex: colourless; structure not well developed and rather variable, usually with distinct hyphae but orientation variable, occasionally developing a weak cellular texture. Medulla: white, poorly developed except at warts. Fertile warts: 0.5 - 2 mm diameter, ±hemispherical (i.e. with a narrow base), usually with a single apothecium (but contiguous warts may give the impression of several apothecia per wart). Disc: punctiform, black. Exciele: not visible externally and poorly developed in section: if discernible at all then to about 20 µm wide and differing from the hymenium only in that hyphae are more regularly parallel. Thalline margin: apothecia surrounded by thalline tissue, but no well-structured thalline exciple develops. Epithecium: colourless to brown, K-, pigment not soluble in K. Hymenium: 450 µm tall, colourless. Hypotheicum: poorly developed, colourless to very pale brown. Paraphyses: 1 µm wide, anastomosed, not moniliform, usually not capitate, apex occasionally slightly expanded to 2 µm diameter. Asci: 220 - 400 x 40 - 45 µm, ±cylindrical, wall KI+ blue, a broad apical region staining more intensely +blue. Ascospores: colourless, simple, ellipsoid, 4 - 8 per ascus, uniseriate, 57 - 100 (110) x 33 - 45 µm; wall prominent, 2 - 4 µm wide at sides of ascospores, 6 - 12 µm at ends. 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. Reported from a wide range of phorophytes, with no clear preferences. The lichen Catillaria nigroclavata was reported once from this lichen.

Subcosmopolitan. Throughout Europe, to as far north as the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa, Reunion Is), N. America (apparently widespread, though some old reports may be unreliable), Caribbean (Bermuda), C. America (Mexico, Nicaragua), S. America (widespread), Pacific (Hawaii, Marquesas, New Caledonia, Tahiti). Reports for Australia appear to be incorrect.

**Pertusaria leucosora Nyl. (1877)**

In: Flora 60: 223

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the southern afl of the Aegean (Chios, Crete and Kos). On siliceous rock at altitudes 500 - 800 m. Southern and central Europe, just reaching Britain Is. Also Asia (Turkey, Japan). There are reports for elsewhere (China, S. Africa) under names that may be synonyms.

**Pertusaria mammosa Harm. (1913)**

In: Lich. Fr. 5: 1141

Description: Clauzade & Roux (1985).

Chios, Kos and Samothraki, on siliceous rock at altitudes 200 - 700 m.

Known only from southern Europe (Iberian Peninsula to Greece), and Macaronesia (Canary Is).

**Pertusaria monogona Nyl. (1873)**


Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the Aegean, on siliceous rock at altitudes 15 - 670 m. Basically a species of southern Europe, but also present along the Atlantic margin to Brittany and the southern half of British Is. Also Macaronesia (Canary Is), Asia, N. Africa (Morocco).

**Pertusaria ophthalmiza (Nyl.) Nyl. (1865)**


Descriptions: Nash et al. (2009); Smith et al. (2009).

Chios and Ikaria, on bark. On Chios it was on bark of Acer sempervirens at an altitude of 880 m. The Greek reports are very disjunct, and I am hesitant to accept them.
Pertusaria pallidoflava Erichsen (1938)
in: Rev. Mycol. N. S. 3: 100-101
Description: See the protologue.

Lesvos, on siliceous rock.
Known only from the island of Lesvos. It is not clear whether the two reports in the literature refer to the same collection.

Pertusaria parotica Sipman (1999)
in: Sipman & Raus, in: Willdenovia 29: 274
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 formed of hyphae with long narrow lumina, but 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 (pruina C-), fairly widely exposed eventually. Exciple: present, over-arching the disc; in section: 50 - 80 µm wide, pale brown to pale green-brown. Thalline margin: absent (in material seen to date). Epithecium: dark grey. Hymenium: 250 µm tall, colourless, KI- or very weakly KI+ blue. Hypothecium: 40 µm tall, colourless. Paraphyses: 1 - 1.5 µm wide, often anastomosed, not capitulate or moniliform. Asci: 200 x 60 microns, ±cylindrical in upper part, wall uniformly KI+ blue. Ascospores: colourless, simple, ellipsoid, 2 per ascus, 75 - 160 x 40 - 70 µm. Pycnidia: not easily distinguishable externally from apothecia; in section: 100% immersed, U-shaped, 80 - 150 x 50 - 90 µm, mostly colourless but brown in outermost part; ostiole broad. Conidia: colourless, bacilliform, straight, 5 - 6 x 1 µm. Chemistry: medulla C-, K+ red, in section diffusing a yellow to red pigment into solution which forms flat, red, plate-like crystals 2 - 15 µm wide, P+ orange-yellow, I-, UV+ blue-white; thallus C-, KC-, K- or + yellow > red, P-, UV-. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: 25 - 70 µm thick, ±regular but sometimes discontinuous.

Provided that the reaction of the medulla with K 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)
in: Enum. N. Amer. Lich. 56; Lichen pertusus L. (1767) in: Mant. Pl. 131; Endocarpon pertusum (L.) Wahlenb.; Pertusaria chionaea (Ach.) DC.; Pertusaria communis DC.; Pertusaria meridionalis Zahlbr.; (?) Pertusaria laevigata f. meridionalis (Arnold) Arnold; (?) Pertusaria laevigata var. meridionalis Arnold; (?) Pertusaria leucostoma var. areolascens Erichsen; Pertusaria pertusa var. meridionalis (Zahlbr.) Szatala; (?) Pertusaria pertusa f. pisiformis Servit; Pertusaria pertusa var. polycarpa (Clemente) Zahlbr.; Pertusaria pertusa var. rupestris (DC.) Dalla Torre & Santh.; Pertusaria rupestris (DC.) Schae.; (?) Pertusaria rupestris var. deplanata Erichsen; (?) Pertusaria rupestris var. polystigma Erichsen; Porina pertusa Ach.

Jørgensen et al. (1994) claimed that the name Lichen pertusus L. is a superfluous name for Lichen verrucosus Huds. and so is illegitimate. That view was probably correct then, but it is not correct under the Melbourne Code, because Lindnaeus did not explicitly cite the name Lichen verrucosus.

The earliest name is Lichen verrucosus Huds. (1762). However, the epithet is not available in Pertusaria owing to Pertusaria verrucosa (Féé) Mont. (1843).

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), 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 a weak cellular texture. Medulla: white. Fertile warts: hemispherical (i.e. with a narrow base), 0.8 - 2.5 mm diameter, each with (1) 4 - 6 (15) apothecia. Disc: black, punctiform, not pruinose. Exciple: not visible externally; in section: poorly developed, to 20 µm
wide, scarcely distinguishable from hymenium. Thalline margin: apothecia surrounded by thalline tissue but no well-structured thalline exciple develops. Epithecium: colourless to brown, K-. Hymenium: 450 - 500 µm tall, colourless. Hypothecium: poorly developed, to 25 µm, very pale brown. Paraphyses: 1 - 1.5 µm wide, anastomosed, not capitate or moniliform. Ascospores: colourless, simple, z-ellipsoid, 2 per ascus (though this is difficult to observe), 170 - 225 x 42 - 60 µm; wall thick, 5 - 8 µm wide at sides, 10 - 12 µm at tips. 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 diameter, forming a continuous, regular layer 30 - 60 µm thick.

Easily recognised by the hemispherical warts each with several punctiform apothecial discs.

Throughout Greece, though usually not very far from the sea. At all altitudes. Usually on bark (rarely wood), sometimes on siliceous rock. Recorded from a wide range of phorophytes, with no clear preferences. The lichenicolous fungi Labrocarpon canariense and Sphinctrina turbinata have each been reported once from this lichen.

Throughout Europe to as far north as the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco; Ascension Is, St Helena; an old report for S. Africa may be unreliable). Reports for N. America are incorrect, so those for C. America may also be unreliable.

**Pertusaria pluripuncta** Nyl. (1883)

in: *Flora* 66: 532

- Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

- Crete. Not mapped, as the named locality 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 (Canary Is), N. Africa (Morocco, Algeria).

**Pertusaria pseudoparotica** Sipman (2002)

in: Sipman & Raus, in: *Willdenowia* 32: 381-382

- Description: See the protologue.

- Islands of the southern Aegean, on siliceous rock at altitudes 200 - 750 m.

- Known only from Greece.

**Pertusaria pseudotubulata** (Ach.) Duby (1830)


- Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

- Corfu, on bark of *Olea europaea* close to sea level. I have also tentatively referred here a single collection from the western Peloponnesse (on *Quercus coccifera*, close to sea level). Its ascospores do seem to display the characters expected for *P. pseudotubulata*, but few apothecia are really mature, and I can not rule out the possibility of confusion with immature material of *P. heterochroa*, a species which was also present at the same site.

- Southern and central Europe, ranging no further north than England. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread in USA), perhaps C. America (CR), S. America (Argentina, Colombia, Paraguay), Australia (warm-temperate E coast of Australia).

**Pertusaria rhodiensis** Erichsen (1938)


- Description: See the protologue.

- Islands of the southern Aegean, plus a disjunct report for northern Greece. At altitudes 0 - 1300 m. Usually on bark and reported from a wide range of phorophytes. There is a single report from wood of *Juniperus oxycedrus*.

- Known only from southern Italy (Basilicata) and Greece.

**Pertusaria rupicola** (Sommerf.) Harm. (1898)


- Thallus: crustose, to a few cm diameter, grey-green, not pruinose, thick (to 1 mm) and warty, without vegetative propagules. Cortex: 25 - 30 µm thick, mostly colourless, sometimes pale brown in outermost 5 - 10 µm, formed of hyphae with elongated, rather narrow lumina; orientation of hyphae rather variable. Medulla: white. Apothecia: 1 - 3 mm diameter, very contorted. Disc: widely exposed, black, not pruinose, central parts sometimes with remnants of what appears to be the original thalline covering of the apothecia. Exciple: not visible externally; in section: 25 - 30 µm wide, colourless, of hyphae eparallel to paraphyses. Thalline margin: prominent, thick, persistent; in section: 300 - 420 µm wide of which cortex 30 - 60 microns, structure of cortex as for thallus. 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 hyphal orientation less regular. Paraphyses: 1 µm wide, anastomosed, not capitiate or moniliform.

Ascosporae: colourless, simple, ellipsoid, several per ascus, 62 - 90 x 26 - 46 µm; wall 10 µm thick (in mature ascosporae), without distinct structure or ornamentation. Pycnidia: visible externally as concave depressions, often at the 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 about ¾ µm. Chemistry: medulla K+, C-, KC-, P-, I-; thallus C+ orange, K+ orange-yellow, P+. Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: regular, continuous, 50 - 70 µm thick.

The only Peloponnesian collection seen to date was over-mature, and some aspects of the description above may not be representative of more typical material. I was unable to observe any mature, undischarged asci, but it was apparent that asci contain more than one ascospore, which excludes P. pluripuncta.

Well characterised by the C+ orange thallus, the 8-spored asc and the substrate.

Islands of the Aegean and adjacent coasts of the mainland. Quite common within this region, but apparently entirely absent from other parts of Greece. On siliceous rock at altitudes 5 - 1100 m. The lichenicolous lichen Rhizocarpon epitaphium has been reported twice from this host.

Basically circum-Mediterranean/Macaronesian. Mostly southern Europe, though present around or just north of the Alps (Germany, Switzerland, Bulgaria). Also Macaronesia (Canary Is), N. Africa (Morocco). I am sceptical of a report for S. America (Chile).

Pertusaria servitiana Erichsen (1934)
in: 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 soralium 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 ±hemispherical warts 0.7 - 1.2 mm diameter, at first entirely covered by a thalline layer. Disc: open when mature, black, moderately white pruinose. Exciple: not visible externally; in section: colourless, 10 - 30 µm wide, of anastomosed hyphae, usually more net-like than paraphyses. Thalline exciple: present; in section: 50 - 100 µm wide. Epitheciun: brown, K-, pigment slightly soluble. Hymenium: 25 µm tall, colourless. Hypothecium: 25 µm tall, colourless of ±horizontal hyphae. Paraphyses: narrow, 0.75 - 1 µm in lower part, 1 - 1.5 µm at apex, not capitiate or moniliform, anastomosed, usually parallel and vertical, with some horizontal anastomoses, not usually forming an irregular net. Asci: 190 - 240 x 45 - 65 µm, ±clavate, wall uniformly KI+ blue. Ascosporae: colourless, simple, ellipsoid, 1 per ascus (in material seen by me; said to be more commonly 2), (80) 120 - 170 x (40) 47 - 55 µm, with a distinctive cellular wall. Chemistry: thallus K+ red (norstictic acid), C-, P+ orange-yellow, UV- or almost (a faint green tinge in long wave and a faint orange tinge in short wave UV); medulla K+ orange (reaction much weaker than cortex), C-, P+ pale yellow, I-; soralia K+ red, C-, P+ orange-yellow. 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, mainly in central Europe (Germany, Poland, Ukraine, Russia), but also Yugoslavia and Greece. Also Asia (Russia).

Pertusaria velata (Turner) Nyl. (1861)

Western and southern Europe. Absent from arctic regions and those parts of eastern Europe with a strongly continental climate. Also Macaronesia (Canary Is, Madeira), Asia (widespread), Africa (widespread outside deserts and humid tropics), N. America (widespread), Caribbean (Cuba, Guadeloupe, PR), C. America (CR, Mexico), S America (widespread), Australasia (widespread outside desert areas), and the Pacific (widespread).

Pertusaria werneriana Boqueras (2003)

Description: See the protologue.

Islands of the Aegean. On bark of *Acer sempervirens* or *Quercus coccifera* at altitudes 160 - 400 m.
Known only from Iberian Peninsula and Greece.

**Petractis Fr. (1845)**

in: *Summa Veg. Scand.* 1: 120

Type: *P. exanthematica* (Sm.) Fr. (= *P. clausa*). 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 that has very prominent radial cracks.
   Ascospores with a 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, radially cracked.
   Ascospores with or without a perispore.
22 Ascospores distinctly muriform. (P. thelotremella)
2 Ascospores basically septate; longitudinal septa rare.
33 Ascospores with perispore.
3 Ascospores without perispore.
44 Ascospores 3-septate, 15 - 25 µm long.
55 Ascospores with perispore. (P. nodispora)
5 Ascospores without perispore. (P. crozalsii)
4 Ascospores 5 - 9 -septate, 20 - 38 µm long. (P. hypoleuca)

**Petractis clausa** (Hoffm.) Krem. (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.
Widely distributed in Europe. Also Asia (Turkey, Russia, Japan), N. Africa (Algeria).

**Petractis leutkemuelleri** (Zahlbr.) Vězda (1965)


Thallus: crustose, thin, very pale brown. Apothecia: urceolate, 0.25 - 0.35 mm diam, remaining ± covered by thalline exciple. 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.
Only southern Europe, from Portugal to Greece, and N. Africa (Morocco).

**Phaeophyscia Moberg (1977)**


Thallus small foliose, to 2 cm diameter. Surface: usually some shade of grey, not pruinose. Lobes ±adpressed.

Diffsers 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 degree of nutrient-enrichment. Except for the common *P. orbicularis* the genus is not often encountered in Greece, although 8 species are reliably recorded.

Species of *Phaeophyscia* often grow in close proximity, and mixed gatherings can be a source of confusion. Note that several combinations in this genus were made in 1978, within a few weeks of each other, independently by Esslinger and by Moberg. Those of Esslinger have priority; see Esslinger (1980a, 1989b).

111 Soralia present.

22 Upper surface with fine hairs (x10), typically about 0.15 - 0.25 x 0.03 mm (Note 1).

33 Soralia lip shaped. Upper surface without maculae. Usually on bark. *P. hirsuta*

3 Soralia not lip shaped. Upper surface usually with maculae. Usually on rock. *P. cernohorskyi*

2 Upper surface without fine hairs.

33 Medulla orange-red to red, K+ purple, at least in lower part and at least in older parts of thallus. (P. endophoenicea), (P. rubropulchra)

3 Medulla white everywhere.

44 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. hispiduala) 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, and 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. poetii*

2 Medulla with orange-red pigment, K+ purple. Margin of apothecia without cilia. (P. endococcina)

(1) Hairs and rhizines are probably homologous, and are not sharply distinct, so there is scope for confusion. Some species have white rhizines that project beyond the lobe margins, and these can be confused with what are here termed hairs. However the rhizines arise from the lower surface or the extreme margin of the lobe, and most of them project downwards or outwards, few or none point upwards. Hairs arise from the extreme margin and the upper surface of the lobe, and they often point upwards. Hairs are white or colourless, never black.

*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.

Widely distributed in southern and central to as far north as Belgium, but absent from British Is, Baltic States and the Nordic countries. Also Macaronesia, Asia (Turkey, Mongolia), N. America (Saskatchewan, widespread in USA mainly in the east),

*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; brown pigment K-, not or only slightly soluble in K; cellular, cells subglobose or slightly elongated in direction perpendicular to surface, 6 - 8 µm diameter. 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. Exciple: present but not visible externally; in section: 15 µm wide, of hyphae ±parallel to paraphyses. Thalline margin: present, persistent, lower surface often with a corona of few to many white hairs; in section: 100 µm wide, of which cortex 30 µm. Epithecium: orange-brown, K-, pigment not soluble in K. Hypothecium: colourless, 90 µm. Paraphyses: 1.5 µm wide at base, 3 µm at apex, not or only slightly capitate, sometimes with visible septa especially in upper part. Ascii: narrowly clavate to ±cylindrical, 65 - 70 x 15 - 25 µm, 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 absence of isidia and soralia, and the white medulla, 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 most of the Peloponnesian sites where P. ciliata was found, P. orbicularis was also present and occurred on the same substrate.

Not rare 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 oce from this lichen. Throughout much of Europe, though absent from British Is. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (southern Canada, widespread in USA), C. America (Mexico), Australasia (SE Australia).

**Phaeophyscia hirsuta** (Mereschk.) Essl. (1978)

The only available collection is rather scanty, so the description is brief.

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 but 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., Quercus pubescens and Robinia pseudacacia.

Throughout southern and central Europe, but entirely absent from northern and NW Europe. Also Macaronesia, Asia (widespread), Africa (widespread outside deserts and the humid tropics), N. America (BC, fairly widespread in USA), C. America (Mexico), S. America (Argentina, Chile, Peru).

**Phaeophyscia insignis** (Mereschk.) Moberg (1978)

Descriptions: Clauzade & Roux (1985); Nash et al. (2004). 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 the Nordic Countries. Also N. America (scattered in USA) and C. America (Mexico).

**Phaeophyscia nigricans** (Flörke) Moberg (1977)

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009). Crete, on bark of Quercus macrolepis at an altitude of 370 m. Widely distributed in northern and central Europe, but rare south of the Alps. The Cretan report is surprising. Also Asia (widespread), N. America (southern Canada, widespread in cooler parts of western USA), 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 a 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 and usually abundant, usually dark grey but sometimes greenish (in shade? - greenish ones tending to become brown in herbarium), usually concave to flat but sometimes globose, usually marginal, occasionally laminal; at first delimited and ±circular or slightly elongated, 0.3 - 0.6 mm diameter, but later often spreading along lobe margins and becoming confluent. Upper cortex: present, not sharply delimited from photobiont layer, 20 - 25 µm thick, pale brown in outer 5 - 10 µm, colourless in lower part (brown pigment K-, partly dissolving in K), cellular; cells surrounded or slightly elongated in direction perpendicular to surface of lobe, 6 - 12 x 6 - 10 µm. 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 (brown pigment K-, not soluble in K), cellular; cells around 10 x 8 µm, with long axis perpendicular to surface of lobe. Apothecia: often absent, or very few or immature; when present: sessile, concave to flat, 0.4 - 0.7 mm diameter. Disc: dark brown to black, not pruinose. Exciple: present but 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. Thalline margin: present, smooth, persistent, without hairs, 0.1 mm wide; in section: 100 µm wide. Epithecium: orange-brown, K-, but pigment fading to pale brown in K. Hymenium: colourless, 75 µm. Hypothecium: colourless, 50 µm. Paraphyses: 1 - 1.5 µm wide at base, 2 - 2.5 µm wide at apex, sometimes with visible septa, not or only slightly capitate. Asci: clavate, 60 x 17 - 23 µm, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 20 x 10 - 12 µm, appearing Physcia type when mature, 8 per ascus. Pycnidia: usually absent (or perhaps just inconspicuous), appearing externally as brown dots; in section: the only one observed appeared multi-chambered (but might have been two pycnidia side by side), pyriform, 160 x 110 µm, mostly colourless, pale orange-brown near ostiole. Conidia: ellipsoid, 3 x 1.5 µm. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K-, C-, KC-, P-, soralia 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 strictly acidic, rarely saxicolous or overgrowing bryophytes. 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 (Morocco, Algeria, widespread in southern Africa), N. America (southern Canada, widespread in USA), perhaps Caribbean (Bahamas), S. America (Brazil, Paraguay), Australasia (widespread), Pacific (New Caledonia).

Phaeophyscia poeltii (Frey) Nimis (1993)

Description: Clauzade & Roux (1985).

Thessaly, at an altitude of 550 m. The substrate was not reported.

Widely distributed though not common in southern Europe, and also known from Switzerland and Bulgaria. Also Asia (Turkey, Syria, Tajikistan).

Phaeophyscia pusilloides (Zahlbr.) Essl. (1978)
in: Mycotaxon 7(2): 313; Physcia pusilloides Zahlbr. (1931) in: Cat. Lich. Univ. 7: 678

The earliest name is Physcia pusilla Mereschk. (1919), but it is not legitimate, being a later homonym of P. pusilla A. Massal. (1852).

Descriptions: Clauzade & Roux (1985); Esslinger (1978b); Nash et al. (2004).

Peloponnese, on bark of Quercus at an altitude of 400 m. Most records are from central Europe. It is entirely absent from northern and NW Europe. Present but rare south of the Alps. Also Macaronesia, Asia (Turkey, Russia), N. America (southern Canada, widespread in USA mainly in the east), C. America (Mexico).
Phaeophyscia sciastra (Ach.) Moberg (1977)

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Stereal 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, Algeria), N. America (widespread from Alaska to cooler parts of USA), C. America (Mexico), S. America (Argentina, Bolivia, Chile, Peru), Australasia (NZS).

Phaeospora Hepp ex Stein (1879)
in: Cohn, in: Jahresber. Schles. Ges. Vaterl. Kultur 2(2): 350. (The name was used in 1874 by Arnold in Flora 57: 455, but is not validly published there.)

Type: P. rimosicola (Mudd) Hepp ex Stein. Family: Verrucariaceae. Literature: Information is very scattered. Etayo & Sancho (2008) is good, but only discusses two species. Four of the five species included in the key are treated in Clauzade, Diederich & Roux (1989). For the fifth, P. verrucariae, see Alstrup & Hansen (2001).

About 15 species are presently placed in Phaeospora, though some probably belong elsewhere and some names may be synonyms. They are lichenicolous. The genus is not very well known.
11 Ascospores 11 - 16 µm long. (P. everniae), (P. fritzei), (P. lecanorae), (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. (P. fritzei), (P. verrucariae)

(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).
Peloponnesse, 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 Asia (Russia), N. America (BC).

Phlyctis (Wallr.) Flot. (1850)

Type P. agelaea (Ach.) Flot. Family: Phlyctidaceae. 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 25 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, 100 - 170 µm thick. Prothallus: said to be often present (not seen in the Peloponnesian collection, which did not include any thallus margin). Soralia: absent. Cortex: a true cortex is absent; the layer above the photobiont cells is 20 - 50 µm thick, mostly colourless, sometimes brown-grey in outermost 10 µm, without obvious structure (no discernible cells or hyphae), K-. Medulla: poorly developed. Apothecia: when immature totally immersed and globose, without any opening to the surface; mature apothecia immersed, flat, ±rounded, covered
by a dense white pruinum that makes them rather inconspicuous, pruinum not soluble in K. Disc: black but generally obscured by pruinum. Excipulum: not visible externally; in section: poorly developed, to 15 µm wide, colourless, distinguished from the hymenium mainly by the less hymeniform arrangement of the hyphae. Thalline margin: ± absent in mature apothecia; the photobiont layer runs uniformly up to the immersed apothecia but there is little or no development of a distinct excipulum. Epithecium: grey, sometimes with an irregular surface, K- (pigment not soluble in K), N-.

Hymenium: 160 µm tall, colourless, K1+ blue. Hypothecium: 15 - 20 µm tall, colourless. Paraphyses: sometimes branched especially in upper part, not capitulate or moniliform, 1.5 µm wide at base, 2.5 µm at apex. Ascii: 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 K1+ blue. Ascospores: colourless, muriform (formed 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 a distinct protruding point at one end (formed from a single cell), 2 per ascus, 50 - 72 x 27 - 30 µm. Chemistry: in spot tests thallus C-, K+ brown-orange to brown-red or dark red (no crystals), UV+ slightly white (just a reflection). Photobiont: green, cells globose to slightly ellipsoid, 10 - 15 x 10 µm, forming a ±continuous but irregular layer 50 - 150 µm thick.

The epithecium sometimes appears slightly violet in places in K, but as far as I can make out this is merely a result of trapped air; there is probably not any K+ violet pigment.

P. agelaea is said to contain norstictic acid, but the several thallus sections tested with K yielded no trace of crystals of norstictic acid, nor did they diffuse any yellow pigment into solution as is usual when norstictic acid is present.

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 large, muriform ascospores are unmistakable.

Scattered throughout Greece, but never in places very distant from the sea. On bark that is not strongly acidic, at altitudes 0 - 1000 m.

Widely distributed 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), N. America (New Brunswick, Ohio, Texas).

**Phlyctis argena** (Spreng.) Flot. (1850)


For the complex nomenclatural situation see Laundon (1970). Briefly, the name *Lichen farinosus* Hoffm. (1784) is of uncertain application. *Lichen argenus* Ach. (1799) is a superfluous name for *Lichen farinosus* Hoffm. and so is not legitimate. Any combination at species rank from *Lichen argenus* Ach. is also illegitimate, e.g. *Lecidea argena* Ach. (1803) in Methodus. Flörke (1807a) described a *Lecidea argena* that he appears to have regarded as distinct from *Lecidea argena* Ach., but Flörke's name is illegitimate, being a later homonym. When Sprengel (1827) introduced the name *Parmelia argena* he only cited "(Lecidea Flörk.)", so the name *Parmelia argena* Spreng. is legitimate and unrelated to *Lichen farinosus* Hoffm. When Flotow (1850) published the name *Phlyctis argena* he cited "Lecidea Ach. Meth. Flk. im Berl. Mag. 1807. p. 13 - Parmelia argena Wallr.". The discussion in Wallroth was of *Parmelia argena* Spreng., so Flotow included *Lecidea argena* Ach., *Lecidea argena* Flörke and *Parmelia argena* Spreng. within the scope of his name. His inclusion of *Lecidea argena* Ach, brings *Lichen farinosus* Hoffm. in scope too, and that made *Phlyctis argena* a superfluous name when published. However, it is not illegitimate now if we regard *Phlyctis argena* and *Lichen farinosus* Hoffm. as different species. Since the application of the name *Lichen farinosus* Hoffm. is uncertain, it is reasonable to do so.

Thallus: crustose, to 8 cm diameter, white to grey-white, superficial but thin (60 - 110 µm thick), usually not well delimited but sometimes bounded by a white prothallus 1 - 1.5 mm wide. Soralia: always abundant, not delimited, white, grey or with a slight greenish tinge when fresh, but developing a very pale pink-brown tinge in the herbarium; individual soredia coarse, 0.05 - 0.1 mm diameter, sometimes spreading over much of the 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 C-, K+ strongly yellow > red (abundant crystals of norstictic acid), P+ strongly yellow > orange, UV- (but sometimes appearing white or pale green by reflection). Photobiont: green (not Trentepohlia), cells globose, 10 - 16 µm diameter, sometimes forming clusters; photobiont layer discontinuous, about 25 µm thick.

*P. argena* is not always easy to separate with certainty from the two other normally sterile species with similar reactions that occur in Greece. *Buellia griseovirens* has delimited soralia. *Pertusaria coccodes* has globose, soft, easily eroded isidia that may resemble soredia. Individual soredia in *Phlyctis 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 *Phlyctis argena*, it is also usually more clearly delimited. *Pertusaria coccodes* is not recorded from conifers whereas *Phlyctis argena* often is.

Common throughout Greece at altitude 0 to about 1600 m, though in the Peloponnesse it is not found below 400 m. On bark of a wide range of trees, including some with acidic bark such as *Pinus*. Rarely on other substrates, though it has been recorded from wood of *Juniperus oxycedrus*, siliceous rock, and overgrowing bryophytes. The lichenicolous fungus Opegrapha zwackhi has been reported once from this host.
Physcia (Schreb.) Michx. (1803)


Type: P. tenella (Scop.) DC. Family: Physciaceae. 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. astrostriata 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, 1997), 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 (1997) 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: alway present, simple. Soralia: present in some species. Upper cortex: always cellular (paraplectenchymatous). Medulla: white; in section formed of loosely interwoven hyphae that are often distinctly broader than those of lower cortex. Lower cortex: usually consisting of hyphae oriented parallel to lobe surface in longitudinal section (but cellular in a few species, of which P. tribacia occurs in Greece). Apothecia: abundant in some species, usually laminal on the lobes and ±asessile. Disc: dark brown to black, sometimes slightly white pruinose. Exciple: not apparent externally; in section usually narrow, poorly developed, and formed of hyphae oriented ±parallel to paraphyses. Thalline margin: present, smooth, persistent. Epithecium: brown or orange-brown, K-, N- (pigment not soluble in either K or N). Hymenium: colourless. Hypothecium: colourless. Hamathecium: of paraphyses. Paraphyses: simple, occasionally sparingly branched in upper part, clavate, typically less than 2 µm wide at base, broadening to 3 or more µm wide at apex, not capitulate. Asci: narrowly clavate or almost cylindrical, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, Physcia type, 8 per ascus, typically between 15 and 25 µm long. Conidiomata: pycnidia. Pycnidia: laminal, forming black dots about 0.05 mm wide on the lobes; in section they are pyriform, 80 - 100% immersed, dark brown around ostiole and colourless to brown elsewhere. Conidia: colourless, simple, bacilliform, typically between 4 and 5 µm long and about 1 µm wide. Chemistry: thallus always 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, Trebouxia-like, usually forming a ±continuous, but sometimes irregular, layer.

About 100 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.

1 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. caesia
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. astrostriata), (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 of the 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 a yellow tinge in the herbarium. (P. aipoliae)
4 Thallus not, or scarcely, pruinose. Thallus not developing a yellow tinge in the herbarium. **P. aipolia**
3 Medull 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 altitude.
55 Thallus usually strongly pruinose (pruina crystalline); usually ±strongly adpressed. Apothecia sessile with thick margin. Underside with a pinkish tone. Lobes broad, to 3 mm wide (but usually less), distinctly widening at tips. Cortex K+ yellow reaction often faint. Maculation absent or, if present, weak and confined to centre of thallus. Usually on bark, less commonly on rock. Note 2. **P. biziana**
66 Apothecia frequent. Lobes (or similar) few or absent. **P. biziana var. biziana**
6 Apothecia few or absent. Lobes (or similar) abundant.
77 Lobules mostly arising from lobe margins, usually not erect, not constricted at point of attachment. **P. biziana var. leptophylla**
7 Lobules mostly arising from lobe margins, often erect or convex, often constricted at point of attachment (Note 3). **P. biziana var. phylidiata**
5 Thallus rarely pruinose; usually weakly adpressed. Apothecia shortly stalked. Underside without pinkish tone. Lobes narrow, 0.5 (1) mm wide. Cortex K+ yellow reaction usually distinct. Sometimes maculate. On bark or siliceous rock. Note 2.
66 Lobe margins ±smooth. Upper surface convex. Lower surface grey; centre not black. On bark **P. stellaris**
6 Lobe margins ±crenulate. Upper surface ±flat. Lower surface white at margin, but often black at centre. On rock. **P. albinea**

(1) Rhizines may extend a little beyond the lobe margins, but they originate from the lower surface, whereas cilia originate from the lobe edge. Cilia are much longer than rhizines, often more than 1 mm long, whereas rhizines rarely exceed 0.5 mm.
(2) Care is needed here, as P. biziana and P. stellaris are common, similar, variable, and may grow together. Strongly pruinose material belongs to P. biziana, but weakly pruinose or non-pruinose specimens are difficult because other characters overlap. For such specimens weigh all characters; in combination they are usually adequate.
(3) Technically, these "lobules" are phyllidia.

**Physcia ascendens** H. Olivier (1882)
in: Fl. Lich. Orne 1: 79. (The name has a conserved type.); **Physcia ascendens** Bitter; **Physcia ascendens f. echinata** Nådv.

Thallus: foliose, often forming irregular clusters 1 - 3 cm diameter. Lobes: to 5 x 1 mm, irregularly branched, not rosette-forming, distinctly ascending at tips, 160 - 210 µm thick; bearing convex structures, about 0.5 mm diameter, near the tips, within which the upper and lower surfaces of the lobe separate. Upper surface: grey, not pruinose, often white maculate. Lower surface: white, attached by rhizines. Cilia: always present at tips of lobes and sometimes along lobe margins, dark brown to black, sometimes white at base, simple, 0.35 - 1.6 x 0.05 - 0.07 mm. Rhizines: white to pale brown, resembling cilia but not extending beyond margins of lobes. Soralia: present, on the inside of the convex structures, which split when mature to reveal the soralia. Upper cortex: 15 - 50 µm thick, usually pale brown in upper part, colourless below, with a rather weak cellular structure; sometimes hyphal lumina are only very slightly swollen and cortex then appears to be formed of hyphae oriented predominantly perpendicular to surface; K- or almost (atranorin
Physcia aipolia (Ehrh. ex Humb.) Führn. (1839)

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 a 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 µm, with long axis perpendicular to surface; K- or almost in section (atranorin reaction faint), pigment soluble in K. Medulla: white, 80 - 170 µm thick, of loosely interwoven hyphae 4 - 5 µm wide. Lower cortex: 50 - 75 µm thick, usually colourless, occasionally pale brown at extreme surface, formed of narrow hyphae about 1.5 µm wide, K-. (Lower cortex comprises two layers; in inner layer, the hyphae are mostly parallel to surface in longitudinal section and few anastomoses are visible; in outer layer there are many more hyphae in other orientations, including some perpendicularly to surface, and many anastomoses; this outer layer is especially well developed above rhizines, but is present elsewhere.) Apothecia: usually present, sessile, rounded but sometimes becoming distorted by compression, to 2 mm diameter. Disc: black (rarely brown in shade), often slightly to strongly white pruinose. Exciple: not visible externally; in section 15 - 20 µm wide, of hyphae ±parallel to paraphyses, mostly colourless, outermost part orange-brown. Thalline margin: present, smooth, persistent 0.1 - 0.15 mm wide; in section 120 - 250 µm wide; cortex 40 - 90 m wide, formed of hyphae oriented perpendicular to surface, sometimes appearing weakly cellular. Epithecium: orange-brown, K- (becoming pure brown in K), N-. Hymenium: 90 µm tall, colourless. Hypothecium: 75 µm tall, colourless. Paraphyses: simple, clavate, 1 µm wide at base broadening to 3 µm at apex, not capitate, usually without visible septa (septa occasionally visible near apex), apex with a very thin layer of orange-brown pigment. Asci: ±cyllindrical or narrowly clavate, 65 x 18 - 22 µm, Lecanora type. Ascospores: brown, ellipsoid, 1-septate, Physcia type, 17 - 22 x 7.5 - 9 µm, 8 per ascus. Pycnidia: often present, laminal, black, 0.05 mm diameter; in section: pyriform with a long neck, 300 µm tall (of which neck accounts for about 135 µm), 200 m wide, multi- chambered when mature; wall pale brown in mid part, ±colourless at base, darker brown around ostiole; 80% immersed (emerging 60 - 80 µm above thallus surface). Conidia: colourless, bacilliform, 5 x 1 µm. Chemistry: thallus K+ yellow or orange-yellow, C-, KC-, P-, UV-; medulla K+ yellow, C-, KC-, P-, I-. Photobiont: green; cells globose, 10 - 12 µm diameter, trebouxoid, often in clusters 50 - 70 µm in diameter (clustering causing the maculation on upper surface). Photobiont layer: ±continuous but very irregular, 25 - 125 µm thick.

Physcia aipolia is a widespread species, found in regions with a cool to warm-temperate climate. It is most abundant in Europe and North America, but also occurs in Asia, Africa, and Australia. The thallus is foliose, usually less than 4 cm in diameter. Lobes are typically 1 - 5 mm wide, with a uniform grey upper surface that becomes white when wet. The lower surface is white to pale grey, attached by rhizines. The cortex is colourless and contains few anastomosing hyphae. The medulla is white and contains loose, interwoven hyphae. The thalline margin is smooth and persistent. The disc is black and contains no pigments. The hypothecium is orange-brown and the epithecium is colourless. The paraphyses are clavate, 1 µm wide at the base, and may extend beyond the margin of the lobes. The asci are ±cylindrical or narrowly clavate, measuring 65 x 18 - 22 µm. Ascospores are ellipsoid, 1-septate, and measure 17 - 22 x 7.5 - 9 µm. Pycnidia are often present, laminal, black, and measure 0.05 mm in diameter. Conidia are colourless, bacilliform, and measure 5 x 1 µm. The photobiont is green and consists of cells globose, 10 - 12 µm in diameter. Physcia aipolia is a common and widespread species in Europe, North America, and parts of Asia. It is also found in Macaronesia and Australia. It is particularly abundant in areas with a cool to warm-temperate climate and is often found on bark or rock.
Physcia albinea (Ach.) Nyl. (1872)
in: Flora 55: 426; Parmelia albinea Ach. (1810) in: Lichenogr. Universalis 491; Physcia caesia $\beta$ (= var.) albinea (Ach.) Th. Fr.; Physcia stellaris $\ast$ (= subsp.) albinea (Ach.) Nyl.


$P$. 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 $P$. albinea might prove to be merely a synonym of $P$. stellaris.

Scattered thinly throughout much of Greece, with no obvious pattern. Usually on rock, sometimes overgrowing bryophytes on rock. There are scattered reports from sea level to 2600 m; it is not clear that they all refer to the same taxon.

Almost restricted to southern Europe; rare north of the Alps, though reported as far north as Paris by Nylander. Also Macaronesia (Tenerife), Asia (widespread), N. Africa (Morocco) perhaps N. America (a few states of western USA; however at least some reports are incorrect).

Physcia biziana (A. Massal.) Zahlbr. (1901) var. biziana

Thallus: foliose, to several cm diameter. Lobes: 0.5 - 1 mm wide, often broadening at tips to 2 mm, usually ±adpressed, usually ±flat; lobules absent or few. Upper surface: grey to blue-grey, not maculate or 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 µm, long axis perpendicular to surface. Medulla: white. Lower cortex: of hyphae oriented parallel to surface in longitudinal section. Apothecia: always present, to 2 mm diameter, sessile, concave. Disc: dark brown to black, often white pruinose. Exciple: not visible externally; in section, poorly developed, 15 µm wide, formed of hyphae ±parallel to paraphyses or slightly radiating. Thalline margin: present, sometimes white pruinose, 0.1 - 0.15 mm wide, persistent; in section, 100 µm wide, of which cortex 12 - 35 µm (cortex becoming thinner towards top of apothecium); cortex cellular, differentiated into a colourless outer layer, 10 µm thick, and the rest which is a very pale brown. Epitheciun: brown, K- (becomes slightly paler in K but pigment persists). Hymenium: colourless, 60 - 80 µm tall. Hypothecium: colourless to very pale brown, to about 80 µm tall at centre of apothecium but less elsewhere. Paraphyses: about 2 µm wide at base, broadening to 3 - 4 µm wide at apex, not or only slightly capitate, mostly simple (sometimes sparingly branched in upper part), with a hemispherical cap of brown pigment. Asci: usually cylindrical or slightly clavate (but occasionally bulging in the middle), 62 - 65 x 15 - 18 µm. Ascospores: brown, 1-septate, ellipsoid, sometimes slightly curved, ±Physcia type, 15 - 21 x 7 - 10 µm, 8 per ascus. Pycnidia: often present, laminal, black, 0.05 - 0.07 mm diameter; in section: pyriform, 300 µm tall (of which neck is about 80 µm), 220 µm wide, usually 100% immersed, brown around ostiole but elsewhere ±colourless. Conidia: colourless, simple, bacilliform, 4 x 1 µm. Chemistry: thallus K+ yellow (reaction sometimes faint); medulla K-. Photobiont: green, cells globose, 8 - 10 µm diameter, forming a continuous layer.

This is a variable, and sometimes troublesome, species. Because of the pruina, it can be confused with Physconia, but its simple rhizines separate it from most species of that genus, and it has Physcia, rather than Physconia, type ascospores. Within Physcia, its normally dense, coarsely crystalline pruina is unusual and distinctive, but specimens with less pruina than usual can be confused with pruinose forms of $P$. stellaris, and it is then necessary to pay careful attention to all the characters in the key.

In this Flora I have accepted three varieties of this species, biziana, leptophylla and phyllidiata. However, their status needs further study, perhaps by molecular methods. It is not entirely clear that they merit formal taxonomic recognition.

Throughout Greece. Usually on bark (more than 90% of records), but it has been recorded from rock and wood. Recorded from a wide range of trees with neutral to basic bark. At altitudes 0 - 1300 m, but most records are from below 800 m.

Southern Europe and southern part of central Europe. Also Macaronesia (Tenerife), Asia (widespread), Africa (widespread outside deserts and the humid tropics), N. America (scattered in western Canada and western USA), C. America (Mexico), S. America (Galapagos Is; perhaps also Argentina, Chile, Bolivia), Australasia (NSW, Western Australia).

Physcia biziana var. leptophylla Vězda (1964)
in: Lich. Sel. Exs., fasc. 12, no. 298

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 Physcionia 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 Physcionia grisea subsp. lilacina usually has a 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 (recorded from Olea europaea, Pistacia terebinthus, Platanus orientalis and Quercus pubescens) and rock (calcareous rock and siliceous rock that is not too poor in bases).

Iberian Peninsula, Italy and Greece only.

Physcia biziana var. phylldiata Poelt & Vézda (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 apparently only known from Austria, Albania and Sardinia, but perhaps under-reported.

Physcia caesia (Hoffm.) Fürnrr. (1839)

Thallus: foliose, forming small circular patches to a few cm diameter. Lobes: 2.5 - 4.5 x 0.8 - 1 mm, frequently 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, and sometimes appearing laminal. Upper cortex: 20 - 55 µm thick, cellular; cells 9 - 10 x 6 - 9 µm, the long axis perpendicular to surface; diffusing a yellow pigment into solution in K (atranorin), N-

Medulla: white, 75 - 100 µm thick, cellular; cells 9 - 10 x 6 - 9 µm, the long axis perpendicular to surface; diffusing a yellow pigment into solution in K (atranorin), N-

Conidia: colourless, straight bacilliform, 4 - 5 x 3 µm, Chemistry: thallus K+ yellow to orange-yellow, C-, P-, UV-; medulla K+ yellow to orange-yellow, C-, P-, I-. Photobiont: green, cells globose, 8 - 11 µm diameter. Photobiont layer: continuous, 30 - 170 µm thick; lower surface ±regular but upper surface very irregular as clumps of algae rise above the general level; gaps between clumps probably correspond to the maculae on the 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 - 1700 m, though half of records are from below 500 m.

The distribution of var. caesia is not entirely clear, as the two varieties are not often distinguished. P. caesia s. lat. is cosmopolitan outside regions with a hot climate, and is present in much of Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (widespread except SE USA), C. America (Mexico), southern S. America (Argentina, Chile, Falkland Is), Australasia (Australia, widespread in NZ), Pacific (Hawaii), Antarctica (widespread).

Physcia caesia var. caesiella (de Lesd.) Clauzade & Cl. Roux (1985)

The earliest name is Physcia subalbinea Nyl. (1874). It is the correct name at the rank of species, but the epithet does not have priority at the rank of variety.

Description: Clauzade & Roux (1985).

The status of var. caesiella is not clear to me. I have not seen any Peloponnesian collections that unambiguously belong here. Peloponnesian material of var. caesia that I have seen has globose soralia that are both laminal and marginal, but a few marginal labriform soralia are occasionally also present suggesting that there may be forms intermediate between the two varieties. Some authors, including Moberg (1977), treat var. caesiella as a synonym of var. caesia, but Moberg examined mainly Scandinavian material and Nimis (1993) claims that in Mediterranean regions the two varieties are very distinct.

Aegean islands, including Crete, on siliceous rock at altitudes 250 - 670 m.
Physcia clementei (Sm.) Maas Geest. (1952)
in: Blumea 7(1): 226; Lichen clementei Sm. (1807) in: Smith & Sowerby, English Botany Vol. 25, table 1779 (as ‘clementi’)

A 1935 combination by Lyngb was not validly published, as the name was merely cited as a synonym. The epithet commemorates the Spanish botanist Clemente, and is correctly spelled clementei, not clementi or clementit.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009).

Corfu, on bark of Olea europaea at an altitude of 20 m.

Widely distributed in southern and central Europe. It reaches British Is, but not Baltic States or the Nordic countries. Also Macaronesia, Asia (Siberia, Nepal, Mongolia, China), Africa (Morocco, Egypt, S. Africa), N. America (very scattered in USA), C. America (Nicaragua), perhaps S. America (Peru), perhaps Australasia (Australia), Pacific (Hawaii).

Physcia dubia (Hoffm.) Lettau (1912)
in: Hedwigia 52(3–4): 254; Lobaria dubia Hoffm. (1796) in: Deutschlands Flora 2: 156; Physcia dubia var. teretiuscula (Ach.) Clauzade & Cl. Roux

The basionym is a nomen novum for Lichen diffusus Hoffm. (1784), an illegitimate later homonym of Lichen diffusus Weber (1778).

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 non-calcareous rock at altitudes 500 - 2200 m.

An arctic-alpine species that is widely distributed in northern and central Europe. There are many reports for southern Europe, but some are probably incorrect. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Kenya), N. America (widespread except in SE USA and continental interior), C. America (Guatemala, Mexico), southern S. America (Argentina, Chile), Australasia (NZS), Antarctica (widespread).

Physcia leptalea (Ach.) DC. (1805)

The earlier names Lichen hispidus Schreb. (1771) and Lichen semipinnatus J. F. Gmel. (1792) have both been formally rejected.

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 in some specimens attached 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 and 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. Sororia: absent. Upper cortex: 15 µm thick, very pale brown in section, of rounded cells, 4 - 7 x 4 - 5 µm; in section K+ yellow or appearing K- (atranorin sometimes difficult to demonstrate), pigment soluble in K. Medulla: white, 50 µm thick, of loosely interwoven hyphae 3 - 4 µm wide. Lower cortex: colourless, of narrow hyphae, about 1 µm wide, arranged parallel to surface 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. Exciple: poorly developed, not visible externally, in section about 10 µm wide. Thalline margin: present, smooth, persistent but thin, 0.05 - 0.1 mm wide; in section 80 - 150 µm wide; cortex 10 - 35 µm thick (thin where groups of algal cells push towards surface), of radiating hyphae with broad lumina and appearing cellular; cells rounded to slightly elongate, 5 - 10 µm wide in longest dimension. Epithecium: orange-brown, K- (though colour becomes more brown and less orange in K), N-.. Hymenium: colourless, 80 µm tall. Hypothecium: colourless, 50 µm tall, formed of a dense mass of tightly interwoven hyphae (individual hyphae not always visible) oriented predominantly horizontally. Paraphyses: simple, 1 - 1.5 µm, slightly capitulate (best seen in N), apex 2.5 µm wide with a very thin pigment layer on the top surface. Asci: clavate, 65 - 70 x 15 - 20 µm. 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

Widely distributed in Europe, though there are far fewer records than for var. caesia. Also Macaronesia, Asia (Turkey, southern Siberia, Pakistan), N. America (Colorado, Michigan, North Carolina).
common foliose species with cilia, is much larger. 

Common throughout Greece. Usually on bark (95% of records), but occasionally on wood or rock. Recorded from a wide range of trees and shrubs, with no strong preference. At altitudes 0 to about 2000 m, but scarce above 1500 m. The lichenicolous fungi *Heterocephalacria physciacearum* and *Polycoccum pulvinatum* have each been reported once form this species.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (BC, Saskatchewan, scattered in cool, humid parts of USA).

**Physcia mediterranea Nimis** (2016)

* in: Lichens of Italy 20; *Physcia scopulorum* (Lambinon & V4ezda) Poelt & Nimis, nom. illeg.

Description: No good description seen. 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.

A rather uncommon species that seems to be restricted to southern Europe, from Spain to Cyprus, and Macaronesia (Canary Is).

**Physcia stellaris** (L.) Nyl. (1853)

* in: *Botaniska Notiser* f. 1853: 155; *Lichen stellaris* L. (1753) in: *Sp. Pl.* 1144; *Parmelia stellaris* (L.) Ach.; (?) *Physcia stellaris* f. albogranulosa Mérat; *Physcia stellaris* var. radiata (Ach.) Lynge; *Physcia stellaris* var. rosulata (Ach.) Kremp.

The basionym was validly published in 1853, as Nylander's mention of "Fr." indicates that a previous effectively published description applies. He is referring to the discussion of *Parmelia stellaris* (L.) Ach. at Fries (1831: 82-83).

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 the 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 perpendicular to surface; K- or almost (atranorin reaction indistinct in section), 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 parallel to surface, K- Apothecia: usually present, to 2 mm diameter, sessile, ±concentric. Disc: black, usually not pruinose, rarely with a faint white pruina. Exciple: present but not visible externally and poorly developed in section, about 15 µm wide, formed of hyphae ±parallel to paraphyses. Thalline margin: present, persistent, usually smooth but sometimes becoming slightly crenulate in older apothecia; in section 100 µm wide, of which cortex is 25 - 50 µm. Epithecium: orange-brown to brown, K-, N- (pigment insoluble in both K and N). Hypotheicum: colourless, 65 µm tall, Ki+ blue. Hypothecium: colourless, 75 µm tall. Paraphyses: simple, 1 - 1.5 µm broad at base, widening to 2.5 µm at apex, not capitate. Ascii: ±cylindrical or narrowly clavate, 85 x 18 µm, 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: thallus K+ yellow, C-, KC- , P-, UV-; medulla K- , C-, KC- , P-, 1-. 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 do occur and can be confused with *P. biziana*, in which case it is essential to pay careful attention to all the characters in the key. Maculate morphs, which are quite common, resemble *P. aipolia*, but the medulla in that species reacts distinctly K+ yellow and the 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.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (widespread), N. America (southern Canada, widespread in USA), perhaps Caribbean (Bahamas, Bermuda), C. America (Mexico), S. America (widespread), Australasia (widespread in Australia; reports for NZ incorrect), Pacific (Easter Is).

**Physcia tenella** (Scop.) DC. (1805)

* in: Lamarck & de Candolle, Fl. Franç. Ed. 3, 2: 396; *Lichen tenellus* Scop. (1772) in: Fl. Carniol. Ed. 2, 2: 394. (The name has a conserved type.;) *Borrera tenella* (Scop.) Ach.; *Parmelia tenella* (Scop.) Ach.; *Physcia hispida* f. saxicola (Malbr.) Sántha; (?) *Physcia tenella* f. anaptychioides Nádv.; *Physcia tenella* var. astroioides (or astroioides) Nádv. Nádvornik introduced the name *Physcia tenella* var. astroioides with a description in French. Later in the same publication he
described *P. tenella var. atrooioides*, in Latin. One could argue that the former has no Latin diagnosis and so is invalid, and that the validly published epithet is *atrooioides*, or one might regard *astroioides* as a correctable error for *astroioides*.

The earliest name may be *Lichen ciliaris var. albidus* Weiss (1770), but it does not have priority at the rank of species.

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: white, 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 the lobe margins. Soralia: present, on lower surface of reflexed lobe tips. Upper cortex: present, 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 any strongly preferred orientation; hyphae broad, about 5 µm wide. Lower cortex: present, often not sharply delimited from the medulla but clearly differing in the width of the hyphae, about 75 µm thick; of narrow hyphae, about 1 µm wide, oriented predominantly but not exclusively ± parallel to lower surface in longitudinal section. Chemistry: cortex K+ yellow (reaction often faint); medulla K-. Photobiont: green. Photobiont layer: 30 - 45 µm thick, ± continuous, but upper and lower surfaces often rather irregular.

This species is usually easily recognised. However, poorly developed specimens may be difficult to separate from *P. adscendens*.

Throughout Greece at altitudes 0 - 1500, but less common than *P. adscendens*. Usually on bark, rarely on siliceous rock. Recorded from a wide range of phorophytes, with no clear preference, but avoiding strongly acidic bark.

Most of Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread from Alaska to cooler parts of USA), perhaps S. America (Argentina).

**Physcia tribacia** (Ach.) Nyl. (1874)


I have only seen one collection that belongs here, and it was too scanty to prepare a good description. For published descriptions see: 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. Scattered in southern and central parts Europe, reaching as far north as Scotland and Latvia but not the Nordic countries (an old report for Norway is probably incorrect). Also Macaronesia, Asia (widespread), Africa (widespread outside deserts and the humid tropics), N. America (BC, scattered in USA), C. America (Mexico, Guatemala), S. America (widespread), Australasia (widespread), Pacific (Henderson Is), perhaps Antarcitca.

**Physciella** Essl. (1986)


A small genus of 4 species, three of which occur in Europe. It is close to *Phaeophyscia*, and sometimes not distinguished from it. There is only a single Greek report.

11 Soredia present. Apothecia uncommon. **P. chloantha**

1 Soredia absent. Apothecia common. (P. nepalensis)

**Physciella chloantha** (Ach.) Essl. (1986)


Moberg


Known from a single site in western Epiros, on bark of Platanus orientalis at an altitude of 25 m. Throughout central and southern Europe, but absent from British Isles and the Nordic Countries. Also Macaronesia, Asia (widespread), Africa (Kenya, Lesotho, Namibia), N. America (southern Canada, widespread in USA), C. America (Mexico), S. America (Argentina, Peru).
**Physconia Poelt (1965)**

in: *Nova Hedwigia* 9: 30

Type: *P. pulverulacea* Moberg (= *P. distorta*) The type is conserved. Gunnerbeck & Moberg (1979) discuss the problem of typifying the genus. Family: *Physciaceae*. Literature: There is no monograph that covers southern Europe, which is unfortunate as the genus is well represented in this region and is a significant component of the lichen flora in some habitats. However, Atanassova & Mayrhofer (2012) is a good starting point. Clauzade & Roux (1985) do 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 almost 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 at least very limited development) of apical wall thickening in the ascospores, and the presence (in all but one species) of squarrose rather than simple rhizines. About 26 species, of which about 13 occur in Europe. It is well represented in Greece, and some species are widespread and common. However, *Physconia* can be quite 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 most of these are not recognised here. Most species of *Physconia* occur on substrates that are at least slightly base-rich.

11 Mature rhizines squarrose (with many short horizontal branches); white, brown or black. Lower surface black in rich. but most of these are not recognised here. Most species of rather confusing. In response to this variability, numerous infra-specific taxa have been recognised by some authors, widespread and common. However, *Physconia* can be quite 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 most of these are not recognised here. Most species of *Physconia* occur on substrates that are at least slightly base-rich.

<table>
<thead>
<tr>
<th>Soralia absent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Soralia present (Note 1).</td>
</tr>
<tr>
<td>3 Medulla white to yellow. Medulla K+ strongly yellow. Soralia K+ yellow. <em>P. enteroxantha</em></td>
</tr>
<tr>
<td>3 Medulla white. Medulla and soralia K-</td>
</tr>
<tr>
<td>4 Soredia mostly in soralia on the 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. <em>P. perisidiosa</em></td>
</tr>
<tr>
<td>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. <em>P. detersa</em></td>
</tr>
</tbody>
</table>

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 Usually overgrowing bryophytes or decaying vegetation (Note 4). *P. muscigena*

5 On rock (Note 4). (*P. petraea*)

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 5). *Care is required* as they commonly grow together. 66 Lower surface mostly pale, dark only in central parts. Hyphae in lowermost part of lobes parallel to surface, but over most of the 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 parallel to surface. *P. venusta*

6 Lower surface mostly dark, pale only near lobe margins (Note 6). Lower cortex well developed over most of lower surface, not restricted to the 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 perpendicular to surface (Note 7). 77 In transverse section, upper cortex with thick-walled hyphae (Note 8). 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 9).  

**P. distorta**

7 In transverse section, upper cortex with thin-walled cells (Notes 8 and 10). 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 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.  

22 Thallus isidia or soralia along lobe margins and sometimes on thalline margin. **P. grisea subsp. grisea**

2 Thallus without soralia.  

33 Central parts of thallus with many lobules. Apothecia usually absent. On various substrates. **P. grisea subsp. lillacina**

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) In **P. perisidiosa** the soralia may look more like rounded isidia than typical soralia.  

(2) The hairs are less than 0.1 mm long, almost colourless, and easily overlooked if few in number, so examine carefully at a magnification of at least x15. 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) I have insufficient information to separate **P. muscigena** and **P. petraea** on morphological grounds.  

(5) Most previously 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.  

(6) The white marginal zone may be quite broad in places, so it is advisable to examine several lobes.  

(7) This is a less reliable character than the nature of the lower surface and lower cortex. I have seen collections of **P. distorta** in which the outermost part of the upper cortex in transverse section consisted mainly of hyphae parallel to the surface.  

(8) In longitudinal section both species have a rather similar prosoplectenchymatous cortex.  

(9) If the lobes do not seem typical for **P. distorta**, search carefully for small hairs near the apices of the lobes. Physconia servitii will key out here if its hairs are overlooked, and in some collections they are easily overlooked.  

(10) 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)  
in: *Nova Hedwigia* 9: 30;  
*Physcia leucoleiptes f. argyphaeoides* (Harm.) Mereschk.; (?)*Physcia pulverulenta* (var. detersa) f. lacinulata J. Steiner.  

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Moberg (1977); Nash et al. (2002).  

Very scattered, on Crete and the mainland. On bark at altitudes 400 - 1200 m.  

Widely distributed in Europe, but rare in the south and confined to the mountains. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (widespread from Alaska southwards).  

**Physconia distorta**  
(With.) J. R. Laundon (1984)  
in: *Lichenologist* 16(3): 218;  
*Lobaria pulverulenta* var. allochroa (Schaer.) Hepp;  
*Lobaria pulverulenta* var. angustata (Hoffm.) Hepp;  
*Parmelia pulverulenta* auct.; (?)*Parmelia pulverulenta* 6 P. (= var.) alutaria Ach.;  
*Physcia pulverulenta* auct.; (?)*Physcia pulverulenta* f. alutaria (Ach.) Th. Fr.;  
*Physcia pulverulenta* f. angustata (Hoffm.) Leight.;  
*Physcia pulverulenta* var. angustata (Hoffm.) Nyl.;  
*Physcia pulverulenta* f. argyphae (Ach.) Cromb.;  
*Physcia pulverulenta* var. argyphae (Ach.) Nyl.;  
*Physcia pulverulenta* var. subvenusta Nyl.;  
*Physcia pulverulenta* var. superfusa Zahlbr.;  
*Physcia subvenusta* (Nyl.) Flagey; (?)*Physcia venusta* var. hybridra (Ach.) Parrique;  
*Physcia venusta* var. subvenusta (Nyl.) H. Olivier;  
*Physconia distorta* f. turgida (Schaer.) Nowak;  
*Physconia pulverulacea* Moberg;  
*Physconia pulverulenta* auct.;  
*Physconia venusta* var. subvenusta (Nyl.) H. Olivier  

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, and 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, unambiguously hyphal, never cellular; 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 (scleroplectenchyma). 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 pruinose. Disc: brown to dark brown (below pruina). Thalline margin: present, persistent, 0.1 - 0.2 mm wide, usually smooth and without lobules, lobules present occasionally; in section: 150 μm wide, cortex 50 μm. Exciple: not visible externally; in section: 25 - 35 μm wide, not sharply separated from medulla of thalline margin, mostly colourless, orange brown in at layer about 15 μm thick at surface, formed of hyphae ±parallel to paraphyses, or radiating in outward part, sometimes obscurely and finely cellular near surface.

Epithecium: orange-brown to brown, K-, some pigment dissolving in K. Hymenium: 130 - 150 μm tall, colourless. Hypothecium: 60 - 100 μm tall, colourless. Paraphyses: 1.5 - 2.5 μm wide, often branched, not capitate or moniliform. Asc: 100 x 30 μm, slightly clavate. Ascospores: brown (when mature), 1-septate, ellipsoid, 8 per ascus, 27 - 32 x 15 - 20 μm, sometimes slightly constricted at septum, ±Physcia type, septum inserted early. Pycnidia: fairly common, forming distinct convex bumps on upper surface of lobes, 0.2 mm diameter; in section: 60% immersed, colourless, 650 μm tall x 320 μm wide. Conidia: colourless, bacilliform, 5 x 1 μm. Chemistry: medulla K-, P-; thallus K-, UV-. Photobiont: green, cells globose, 8 - 12 μm diameter, sometimes forming clusters; photobiont layer 25 - 55 μm thick, sometimes discontinuous, sometimes irregular with uneven upper and lower margins.

Collections with strongly pruinose lobes, and collections with lobes that are not very elongated, should be checked against Parmelia farrea. 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, apparently with a preference for Abies and Quercus, though this may just reflect the ubiquity of those genera. The lichenicolous fungus Lichenochora weillii has been recorded once on this species. Some of the Peloponnesian reports in Abbott (2009) refer to P. thorstenii or P. venusta, and some of the 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). Said not to be present in the Americas (reports from N. America are said to refer to P. americana).

**Physconia enteroxantha** (Nyl.) Poelt (1966)
in: *Nova Hedwigia* 12: 125; *Physcia enteroxantha* Nyl. (1873) in: *Flora 56*: 196; *Physcia enteroxanthella* (Harm.) H. Olivier; *Physcia grisea f. alphiphona* (Ach.) Lyng

The earliest name is Parmelia farrea var. alphiphona Ach. (1810), but it does not have priority at the rank of species.

Descriptions: Ahti et al. (2002); Clauzade & Roux (1985); Moberg (1977); Nash et al. (2002); Smith et al. (2009).

Scattered, apparently with a preference for 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), N. Africa (Morocco), N. America (southern Canada, cooler parts of USA), C. America (Mexico). Reports for Australasia probably incorrect.

**Physconia grisea** (Lam.) Poelt (1965) subsp. grisea

in: *Nova Hedwigia* 9: 30; *Lichen griseus* Lam. (1792) in: *Encycl. 3*: 480; *Parmelia pulvulenta var. farrea* (Turner ex Ach.) ined.; *Physcia grisea* (Lam.) Zahlbr.: *Physcia pityrea* (Durieu & Mont.) Cronb., 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, though darker patches are occasionally present. Hairs: absent. Isidia: abundant, blue-grey to brown-grey, arising from lobe margins but eventually becoming coralloid and almost obscuring the thallus; also often present, and sometimes abundant, on thalline exciple. Lobules: absent. Rhizines: white, simple, 0.6 - 2 x 0.1 mm. Soralia: absent in material seen to date (though the isidia are small and almost resemble soralia), but said sometimes to develop from the isidia. Upper cortex: 37 - 60 μm thick, pale brown in outer 10 μm, colourless elsewhere, ±paraplectenchymatous; cells subangular, 5 - 6 μm wide, isodiametric or slightly elongated in direction perpendicular to surface of lobe. Lower cortex: of thin hyphae (prosoplectenchyma) oriented
parallel to long axis of lobe. Apothecia: 0.7 - 1.5 mm diameter, laminal, sessile, concave, strongly white pruinose.


The simple rhizines clearly distinguish this species from all others in Physconia. The presence of isidia or soralia easily distinguish this subspecies from the others. It could be confused with P. perisidiosa, but that is not normally fertile, and when fertile does not have isidia/soredia on the thalline exciple; it also differs in having a scleroplectenchymatous upper cortex.

Throughout Greece on ±basic bark, occasionally on rock. At altitudes 0 - 1500 m, but usually below 800 m.

Subsp. grisea is common in northern Europe, but becomes rarer in the south. It (or P. grisea s. lat.) is also reported for Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria). Reports for N. America are said to be incorrect, and those for Australasia may also be doubtful.

Physconia grisea subsp. algeriensis (Flagay) Poelt (1966)

Description: Clauzade & Roux (1985).

Naxos, on bark at altitudes 280 - 560 m.

Subsp. algeriensis is circum-Mediterranean. Southern Europe, from Spain to Cyprus, western Asia (Syria), N. Africa (Morocco).

Physconia grisea subsp. lilacina (Arnold) Poelt (1966)
in: Nova Hedwigia 12: 120; Parmelia pulverulenta var. lilacina Arnold (1863) in: Flora 46: 589


Differs from subsp. grisea in lacking vegetative propagules (unless the lobules may be assumed to serve that purpose) 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-. However, in that taxon the upper surface is grey or blue-grey everywhere, without any brown tinge. Also, it usually has a less dense pruina than Physconia grisea subsp. lilacina.

Very scattered in the southern half of Greece, never very far from the sea. On bark of Quercus pubescens, or overgrowing bryophytes on such bark, or on sandstone, at altitudes 110 - 490 m.

Subsp. lilacina is ±circum-Mediterranean: southern Europe from Spain to Greece, but also present in Hungary, and Asia (widespread close to the Mediterranean). I have not seen any reports for N. Africa, but would expect it to occur there.

Physconia muscigena (Ach.) Poelt (1965)

Descriptions: 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. Throughout northern Europe, reaching as far south as the Alps and a few of the highest mountains of southern Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Kenya, Tanzania), N. America (widespread from Alaska to cooler parts of western and central USA), C. America (Mexico), southern S. America (Argentina, Chile), Antarctica (widespread).

Physconia perisidiosa (Erichsen) Moberg (1977)

There are earlier names, but they do not have priority at the rank of species.

Thallus: foliose, to 5 cm diameter. Lobes: 0.5 - 1.5 mm wide, 200 - 220 µm thick near lobe tips, 290 - 330 µm thick in central parts; those in central part of thallus usually short, broad and ascending at margins and tips, and often with soredia; those at margin of thallus often long and narrow, with slightly down-turned tips, and usually without soredia. Upper surface: blue-grey to brown (marginal part of thallus often browner than centre), white pruinose at tips of lobes. Lower surface: white at margins, dark brown in centre; often slightly tomentose or irregular in marginal parts, where lower cortex absent. Isidia: absent, but soralia sometimes resemble clumps of small isidia. Rhizines: squarrose, black,
Physconia servitii (Nädv.) 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, but shorter and more rounded in others, 190 - 210 µm thick, flat to slightly concave, 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 at 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 the surface, but a thin surface layer, 10 - 15 µm thick, is sometimes present in which they are oriented mainly parallel to the surface (scleroplectenchyma of Moberg). Medulla: white; in section: 50 - 110 µm wide, that are oriented roughly parallel to surface of lobe in longitudinal section. Lower cortex: present, 20 - 40 µm thick, very dark brown, of thin hyphae oriented parallel to surface in longitudinal section (Moberg's proscleroplectenchyma) but details are hard to discern owing to the 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 a fairly thick white pruina. Exciple: not visible externally and not prominent in section, 50 µm wide, colourless except for a brown surface layer, formed of hyphae parallel to paraphyses. 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. Epitheicum: brown, K- (pigment not soluble in K). Hymenium: usually colourless, sometimes brown in upper part, 200 µm tall. Hypothecium: colourless, 50 - 75 µm tall. Paraphyses: 2 µm wide at base, 2.5 µm at apex, not capitate. Ascospores: brown, 1 -septate, 8 per ascus, ellipsoidal, 25 x 15 µm, ±Physconia type but sometimes with some apical wall thickening at some stages of development. Chemistry: thallus and medulla K-. Photobiont: green, of globose cells 8 - 12 µm diameter, forming a continuous layer (35) 70 - 120 µm thick, with an upper surface that is 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 the 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. In the Peloponnesse I have only one collection from above 900 m, and it differed noticeably from all other Peloponnesian material that I have seen. It had shorter and broader lobes, numerous lobules on the thallus that were rather wart-like, and it lacked apothecia. Additional collections are...
needed to assess the status of this morph.

Common south of the Alps, and there are a few records for the southern part of Central Europe. Also Macaronesia, Asia (Russian Far East, Mongolia), Africa (Morocco, Somalia).

*Physconia subpulverulenta* (Szatala) Poelt (1966)

in: *Nova Hedwigia* 12: 127; *Physcia subpulverulenta* Szatala (1941) in: *Borbasia* 3(8-10): 135-136

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 and sometimes everywhere. Lower surface: mostly black, sometimes with a 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 is 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 but pale brown in upper 10 - 15 µm (the pigmented layer is sometimes overlain by a colourless, structureless layer about 5 µm thick), the brown pigment K-, N- and not soluble in K or N; formed of robust hyphae oriented predominantly oblique or perpendicular to surface of lobe (Moberg’s scleroplectenchyma). Medulla: white to very pale yellow or very pale orange; in section: 75 - 100 µm thick, of rather densely interwoven hyphae that are oriented predominantly parallel to surface 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, and structure can not easily be discerned - the pigment, which reacts K-, N-, can not be bleached or dissolved using K, N, C or acetone; in marginal parts, where lower surface is pale the lower cortex is pale brown in outer half and colourless in inner half, formed of thin hyphae, 1 µm wide, oriented mostly parallel to surface of lobe in longitudinal section (Moberg’s prosoplectenchyma). Apothecia: usually present, sessile, slightly concave to flat, 1.2 - 4.2 mm diameter. Disc: dark brown, but usually obscured by white pruina. Exciple: not visible externally; in section: poorly developed, 25 µm wide, scarcely distinguishable from hymenium except for the absence of asci. Thalline margin: present, persistent, often white pruinose, sometimes with secondary lobules, 0.15 - 0.2 mm wide. Epithecium: brown, K-, N- (pigment not soluble in K or N). Hymenium: colourless, 125 µm tall, KI+ blue. Hypothecium: colourless, 70 µm tall. Paraphyses: 1.5 µm wide at base, to 2.5 µm wide at apex, sometimes slightly capitulate, occasionally anastomosed. Asc: clavate, 90 - 95 x 27 µm, Lecanora type. Ascospor: brown, 1-septate, ellipsoid, 24 - 26 x 12 - 15 µm, Physconia type, 8 per ascus. Pycnidia: sometimes present but inconspicuous when covered by pruina, laminal, 100% immersed; externally they are black, 0.1 mm diameter; in section: subglobose, 200 µm tall, 160 µm wide, mostly colourless but brown around ostiole. Conidia: colourless, bacilliform, 4 x 1 µm. Chemistry: thallus K-, medulla K+ yellow, yellow-orange, brown-orange or orange, the reaction usually strong and distinct but sometimes faint, especially where medulla is white. Photobiont: green; cells globose, 11 - 15 µm diameter, forming a continuous layer 30 - 70 µm thick with a regular lower surface; upper surface sometimes rather irregular, as clumps of cells arise above the general level.

The K+ reaction of the medulla usually makes this species easy to recognise, but specimens in which the reaction is faint can cause confusion.

Widespread and fairly common, but not recorded for the NW quadrant of Greece. Usually on neutral or slightly basic bark, with a preference for *Quercus*, especially *Q. pubescens*, sometimes overgrowing bryophytes on bark. At altitudes 200 - 1300 m. All Greek reports refer to var. *subpulverulenta*. The var. *atlantica* is known only from Madeira and Sardinia.

Southern Europe, from Spain to Cyprus. Also Macaronesia, Asia (Turkey, Israel, Russia, Mongolia).

*Physconia thorstenii* A. Crespo & Divakar (2007)

The description below is provisional. For fuller descriptions see the protologue or Atanassova & Mayrhofer (2012).

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 Europe, from Spain to Cyprus, but present further north too (Austria, Bulgaria). 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 exciple, 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 parallel to surface; 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 in which hyphae are oriented parallel to surface, but a compact cortex is not developed. Apothecia: common, sessile, slightly concave, 0.8 mm diameter. Thalline margin: present, persistent. Disc: often white pruinose. Exciple: not visible externally. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K-, C-, KC-, P-, I-. Photobiont green, cells globose to subglobose, trebouxioid, 9 - 12 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 sometimes also occur around the 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 aphrodites* have been recorded on this species.

Mostly southern Europe, though there are reports for Bulgaria and Ukraine. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America said to be incorrect.

Piccolia A. Massal. (1856)

in: Misc. Lich. 41

Type: [need to investigate - ? P. conspersa (Fée) Hafellner]. Family: *Acarosporaceae*. Literature: There is no monograph. For the only European species, see below.

Six species, all but one of which are tropical.

Piccolia ochrophora (Nyl.) Hafellner (2004)


Descriptions: Clauzade & Roux (1985) as *Biatorella ochrophora*; Hafellner (2004b); Smith et al. (2009).

Very scattered, with no clear pattern except that all reports are from sites not very far from the sea. On bark at altitudes 5 - 1200 m. Photophytes explicitly reported include *Abies cephalonica*, *Pistacia lentiscia* var. *chia*, *Platanus orientalis* 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 in southern USA), C. America (Mexico), S. America (Chile).

Placidiopsis Beltr. (1858)

in: Lich. Bassan. 212


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 Perithecial 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 Perithecial 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)

Descriptions: Breuss (1996b); Clauzade & Roux (1985) as *Placidiopsis grappae*; Nash et al. (2002); Nimis & Martellos (2004).

Islands of the southern Aegean, including Crete, and the adjacent mainland. On soil (usually calcareous) at altitudes 200 - 1000 m.

Southern Europe, occasionally ranging into central Europe as far north as Belgium. Also Asia (Syria, Israel, Mongolia), N. Africa (Morocco), N. America (at least California), C. America (Mexico).

**Placidiopsis custnani** (A. Massal.) Körb. (1863)
in: *Parerga Lichenol.* 305; *Placidium custnani* A. Massal. (1856) in: *Lotos* 6: 78

The epithet is sometimes written *custnanii*, but that is incorrect. It is derived from the name of a town, Custnano, not a person, so Massalongo's original spelling should be retained.

Thallus: squamulose, to 1.5 cm diameter (in material seen), grey (when fresh), 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. Perithecium: abundant, laminal, black; in section: 250 µm tall x 210 µm wide, 100% immersed, ±globose. Exciple: 30 µm wide, pale brown everywhere, formed of cells elongated parallel to wall of perithecium, 7 - 10 x 4 - 5 µm. Involucrellum: absent. Paraphyses: disappearing early. Periphyses: abundant in upper part of perithecium. Ascii: ±cylindrical. Ascospores: colourless, 1-septate (when mature), 8 per ascus, 18 x 5 µm. 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 soil, usually calcareous, at altitudes 100 - 900 m. Scattered from southern Europe to Finland: the pattern is hard to interpret. Also N. Africa (Morocco).

**Placidiopsis tenella** (Nyl.) Zahlbr. (1921)

Possibly a synonym of *P. cinerascens*.

Thallus: squamulose, grey to white-brown, usually not pruinose, to 2.5 cm diameter, without vegetative propagules. Squamules: 0.5 - 1.5 mm diameter, usually strongly adpressed, separated to contiguous but never overlapping, 200 - 300 µm thick. Lower surface: usually not visible, brown where visible. Perithecium: 1 - 3 per squamule, 0.1 mm diameter, brown to dark brown; in section: 75 - 100% immersed (when mature), 210 - 270 µm tall x 230 µm wide. Exciple: mostly colourless, brown in uppermost part only, cellular, cells 12 x 6 µm. Involucrellum: absent. Paraphyses: disappearing early. Ascii: 50 x 13 µm, ±cylindrical. Ascospores: colourless, 1-septate, usually ellipsoid, occasionally pyriform, 8 per ascus, 17 x 7 - 8 µm. Photobiont: green.

Easily recognised by the mostly pale exciple and the fairly large squamules.

Rare and scattered in the southern half of Greece. On soil at altitudes 0 - 500 m. Scattered from southern Europe to Finland: the pattern is hard to interpret. Also N. Africa (Morocco).

**Placidiopsis** A. Massal. (1855)
in: *Symm. Lich.* Nov. 75, where it is a nomen subnudum. The first proper description was by Beltramini in *Lich. Bassan.* 210-211. 1858.

Type: *P. michelii* A. Massal. Family: *Verrucariaceae*. Literature: The most convenient starting point for the southern European taxa is Prieto et al. (2010). Breuss (1990) treats many of the species, under *Catapyrenium*.

Thallus: squamulose, brown. Squamules: fairly large (more than 0.5 mm wide), usually ±adpressed. Upper cortex: thick (usually more than 30 µm), distinctly cellular. Perithecium: usually abundant, immersed, without an involucrellum. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 8 per ascus, medium sized (typically 12 - 18
microns long). Pycnidia: often present. Photobiont: green. Fairly easily recognised by the thallus of ±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 have sometimes been placed in *Clavascidium*, but that genus is not accepted by most lichenologists.

About 32 species, 16 in Europe, on a wide range of substrates. Many are reliably reported for Greece, but except for the widespread *P. squamulosum* they are known from few records.

11 Lower surface of squamules with rhizines.
22 Ascii clavate. Ascospores biseriate. (*P. umbrinum*)
2 Ascii cylindrical. Ascospores uniseriate. **P. lacinulatum** s. lat.
33 Ascospores 12 - 17 x 6 - 7.5 µm. Ascii 65 - 80 x 12 - 17 µm. **P. lacinulatum var. lacinulatum**
3 Ascospores 15 - 19 x 7.5 - 9.5 µm. Ascii 65 - 75 x 18 - 25 µm. (*P. lacinulatum var. latisporum*)
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.
55 Squamules medium brown to dark brown, 2 - 7 (10) mm wide, usually becoming thicker at margins. **P. lachneum**
5 Squamules pale brown to medium brown, 3 - 10 mm wide, becoming thinner 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. Rhizohyphae 4 - 6 µm wide. Medulla to 200 µm thick. **P. imbecillum**
66 Medulla 50 - 100 (130) µm thick. Ascospores 14 - 18 x 6 - 8 µm. Squamules 2 - 5 µm wide. **P. semafortorensense**
6 Medulla 100 - 200 µm thick. Ascospores 11 - 15 x 5 - 6 µm. Squamules 3 - 7 µm wide. **P. subrufescens**
5 Conidia oblong or ellipsoid, 1.5 - 2 µm wide. Rhizohyphae 5.5 - 7 µm wide. Medulla 100 - 300 µm thick. **P. rufescens**
3 Pycnidia laminal (or sometimes laminal and marginal in the same squamule in *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 globular cells.
55 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 oblong-ellipsoid, 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). Crete, on soil at an altitude of 1500 m.

Southern Europe, from Spain to Cyprus, and the southern part of central Europe (Hungary, Bulgaria). Also central Asia (Tajikistan).

**Placidium boccanum** (Servít) 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 tall, mostly colourless, outermost 10 - 15 µm often brown, cellular; cells isodiametric or slightly elongated perpendicular to surface, 8 - 15 µm wide. Lower cortex: present, not delimited from medulla, brown near surface, colourless in inner part; cellular; cells as in medulla. Medulla: white; in section of subrounded cells 8 - 14 µm wide. Perithecia: laminal, black, 0.1 mm diameter; in section: 100% immersed, 330 µm tall x 230 µm wide, ±pyriform. Exciple: brown near ostiole, colourless elsewhere. Involutrellum: absent. Asci: 60 - 80 x 17 - 20 µm, ±cylindrical to
narrowly clavate. Ascospores: colourless, simple, ellipsoid, 12 - 15 x 5 - 7 µm, sometimes \( \pm \)uniseriate. Photobiont: green, cells globose, 10 - 12 µm diameter, forming a continuous, regular layer 100 - 120 µm thick.

Similar to \( \textit{P. squamulosum} \), but saxicolous and with black-margined squamules.

Only known from a single site, in the Peloponnesse, where it occurred on limestone at an altitude of 1300 m.

There are rather few reports, but it appears to be a Mediterranean species that also occurs in mild parts of the Atlantic margin, as far north as SW England. Also western Asia (Turkey).

\textbf{Placidium imbecillum} (Breuss) Breuss (1996)


Chios and Crete, on soil or rock at altitudes 15 - 750 m. Abbott (2009) regarded this report as in need of confirmation, believing this species to be subalpine. However, Prieto et al. (2010) note that it also occurs in lowland localities in the Mediterranean, e.g. Bælearic Is, so these reports should be accepted.

Southern Europe, from Portugal to Greece, and the Alps. Also N. Africa (Morocco), perhaps N. America.

\textbf{Placidium lachneum} (Ach.) de Lesd. (1932)


\textbf{Descriptions:} Breuss (1990) as \textit{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 is usually a montane species. In Spain it occurs above 1200 m according to Prieto et al. (2010).

Throughout central and northern Europe except for truly arctic regions. Only scattered reports for southern Europe, where it is generally montane. Also Macaronesia, Asia (widespread), Malesia (PNG, Africa (Morocco, Ethiopia, Uganda), N. America (Canada, cooler parts of USA), S. America (Venezuela; reports for elsewhere appear to be incorrect). I am very sceptical of a report for Caribbean (Bahamas); reports for Australasia (NZ) are incorrect.

\textbf{Placidium lacinulatum} (Ach.) Breuss (1996)


The name \textit{Placidium rufescens} var. \textit{trapeziiforme} A. Massal. in Sched. Crit. 114 appears, at first sight, to be a superfluous name for \textit{Endocarpon pusillum} var. \textit{hedwigii} Schae., which is itself a superfluous name for \textit{Endocarpon pusillum} Hedw. However, on page 100 of that work Massalongo clearly indicated that he considered Hedwig's name to be a synonym of \textit{Placidium michelii}. (He referred to a Figure in Hedwig's work that Hedwig annotated as \textit{Endocarpon pusillum}, although Massalongo used the name \textit{Lichen pusillus} when referring to it.) Massalongo must therefore be regarded as excluding, by implication, the type of Hedwig's name from \textit{Placidium rufescens} var. \textit{trapeziiforme} A. Massal. Massalongo's name is thus the legitimate name of a new taxon.

The correct name for the present species is then \textit{Placidium trapeziiforme} (A. Massal.) J. Steiner (1894) in \textit{Denkschr. Akad. Wiss., Math.-Nat. Kl.} 61: 320 (as: 'tapeziiforme'). Acharius's epithet \textit{lacinulatum} was not used at species rank until 1990, as \textit{Catapyrenium lacinulatum} (Ach.) Breuss, in \textit{Stapfia} 23: 92, so Massalongo's epithet has priority at the rank of species. Steiner's combination may have been overlooked, and presumed to be a later homonym of \textit{P. trapeziiforme} (J. König) Arnold (1885), in \textit{Flora} 68: 64, but Arnold's name was merely cited in the synonymy of \textit{P. rufescens}, and is not validly published.

The name \textit{Placidium lacinulatum} is not very well established, and in this case it may be better to adopt the correct name, \textit{P. trapeziiforme}, than to resort to conservation.

\textbf{Descriptions:} Breuss (1990) as \textit{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 (only Porta Santo in Azores), Asia (Iran), Africa (Egypt, Socotra, perhaps Zimbabwe), N. America (southern Canada, widespread in USA), Caribbean (Bahamas, DR, PR), C. America (Mexico), Australasia (scattered in Australia). This pattern is difficult to interpret; perhaps many reports are incorrect, or more than one taxon is involved.

\textbf{Placidium pilosellum} (Breuss) Breuss (1996)


\textbf{Descriptions:} Breuss (1990) as \textit{Catapyrenium pilosellum}; Nash et al. (2002); Nimis & Martellos (2004); Prieto et al.
(2010); Smith et al. (2009).

Scattered, with no clear pattern, though all reports to date are from sites fairly close to the sea. On soil or limestone at altitudes 0 - 1300 m.

Widely distributed to as far north as southern Scandinavia. Also Macaronesia, Asia (Iran, perhaps elsewhere), N. Africa (Morocco, Algeria), N. America (western USA), C. America (Mexico), S. America (Argentina, perhaps elsewhere), Australasia (widespread in Australia).

Placidium rufescens (Ach.) A. Massal. (1856)
in: Sched. Crit. 114; Endocarpon rufescens Ach. (1810) in: Lichenogr. Universalis 304-305; Catapyrenium rufescens (Ach.) Breuss; Dermatocarpon rufescens (Ach.) Th. Fr.

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, except perhaps for the High Arctic. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria, perhaps Egypt), N. America (scattered in USA).

Placidium semaforonense (Breuss) Breuss (1996)

The earliest name is Endopyrenium hepaticum f. nigratum Mull. Arg. (1884), but the epithet has never been used at the rank of species.

Descriptions: Breuss (1990) as Catapyrenium semaforonense; Nimis & Martellos (2004); Prieto et al. (2010).

Kalimnos, on soil at an altitude of 100 m.

Southern Europe, from Portugal to Cyprus. Also Macaronesia (Tenerife), Asia (Jordan, Iran, Yemen, Afghanistan), Africa (Morocco, Socotra).

Placidium squamulosum (Ach.) Breuss (1996)

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: present, 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, (120) 300 - 700 µm tall x (115) 160 - 600 µm wide, pyriform. Exciple: continuous below, mostly colourless to pale brown, only dark brown to black near ostiole, 25 - 100 µm wide, formed of hyphae or very elongated cells parallel to walls (but in uppermost part extending upwards towards ostiole). Involucrellum: absent. Paraphyses: disappearing early, but hamatheicum often with branched or anastomosed pseudoparaphyses. Ascii: zygotrilocular. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 15 x 4 - 7 (9) µm, 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 µm wide) columns of algal cells.

This is the only common species of the genus in Greece, and can generally be recognised by its arhizinate lower surface, laminal pycnidia and terricolous habit. The rare P. boccanum is similar but occurs on calcareous rock. When pycnidia are absent it can not be separated from the rare P. fingens (not reported for Greece), and may be difficult to separate from some other species.

Throughout Greece, though commoner in the southern half of the country. At all altitudes. Usually on soil, especially calcareous soil. Occasionally overgrowing bryophytes on soil. There are a few old reports from rock but they may refer to other species.

Subcosmopolitan outside the humid tropics. Most of Europe except for truly arctic regions. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (southern Canada, fairly widespread in USA), Caribbean (Jamaica, Virgin Is), C. America (Mexico), S. America (Argentina, perhaps Chile and Bolivia), Australasia (widespread).

Placidium subrufescens (Breuss) Breuss (1996)
Descriptions: Breuss (1990) as *Catapyrenium subrufescens*; Prieto et al. (2010). Scattered, with no pattern. On limestone at altitudes 0 - 700 m. Described from Tenerife, and otherwise known only from Spain and Greece.

**Placidium tenellum** (Breuss) Breuss (1996)


Descriptions: Breuss (1990) as *Catapyrenium tenellum*; Nimis & Martellos (2004); Prieto et al. (2010). Islands of the southern Aegean, including Crete. On non-calcareous soil at altitudes 25 - 700 m. Southern Europe, from Portugal to Cyprus, and also southern Russia. Also Asia (Iran, Afghanistan, Mongolia), Africa (Morocco, Tunisia, Cape Province of S. Africa).

**Placocarpus Trevis.** (1860)
in: Conspr. Verruc. 19


As the genus has only one Greek species, see the description of *P. schaereri* below.

Diffsers from *Verrucaria* in having a much thicker thallus. Diffsers from the other subsquamulose genera in being initially parasitic on *Lecanora muralis*.

Four species, only one of which is European.

**Placocarpus schaereri** (Fr.) Breuss (1985)

Thallus: areolate to subsquamulose, pale grey, sometimes black at margins of areoles, strongly blue-white pruinose, to several cm diameter, 500 - 700 µm thick, without vegetative propagules. Areoles: contiguous but separated by deep cracks, often with an internal network of partial cracks, rounded to angular, flat to slightly convex, 0.5 - 4 mm wide. Cortex: 15 - 25 µm thick, usually brown, without distinct structure or sometimes obscurely cellular, K-, pigment not soluble in K. Medulla: white. Perithecia: black but often white pruinose around ostiole, 0.15 mm diameter; in section: 90 - 100% immersed, slightly pyriform but with a flat top, 500 µm tall x 430 µm wide. Exciple: colourless in lower part, dark brown in upper part, 20 - 25 µm wide in lower part, broadening to 40 µm in upper part; in section transverse to wall appearing hyphal, hyphae with elongated lumina; when viewed from outside perithecium (i.e. normal to wall) often appearing cellular. Involucrellum: absent. Paraphyses: disappearing early. Ascii: 75 x 32 µm, 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 ascii. Ascospores: colourless, simple, narrowly ellipsoid, 8 per ascus, 20 - 27 x 7 - 12 µm. Chemistry: thallus K-, C-, KC-, P-, UV-; medulla K-, C-, KC-, P-, I+ greyish (not blue). Photobiont: green, cells globose, 8 - 12 µm diameter. Photobiont layer: moderately regular, ±contiguous except at perithecia, 70 - 120 µm thick.

Fairly easily recognised, even when not parasitic, by the combination of thick, pale coloured, strongly pruinose, subsquamulose areoles, and the rather large ascospores. *Placopyrenium canellum* is similar but has smaller areoles, not exceeding 1 (2) mm diameter, and when young is parasitic on *Aspicilia calcarea*.

Scattered, with no clear pattern, at altitudes 0 - 1400 m. On limestone or parasitic on *Lecanora muralis* on calcareous rock.

Southern and central Europe, to as far north as Belgium. Also Asia (widespread as far east as Tajikistan and southern Siberia), Africa (Morocco, Algeria, Tunisia). Reports for N. America are incorrect.

**Placolecis Trevis.** (1857)

Type: *P. opaca* (Dufour) Hafellner. Trevisan included *Leccidea opaca* Dufour in the genus, even though he did not publish the combination *Placolecis opaca*. Family: *Catillariaceae*. Literature: The genus is rarely discussed in the literature. For the only species, see Clauzade & Roux (1985), or Wasser & Nevo (2005).
Differs from *Catillaria* in the placodioid growth form and the pigmented medulla.

### Placolecis opaca (Dufour) Hafellner (1984)


Thallus: placodioid, central parts sometimes warted, brown, sometimes dark brown at tips of marginal lobes, not pruinose, to 3 cm diameter, central parts to 450 µm thick (thicker when warted). 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 but sometimes paltmate near tips. Cortex: 20 - 35 µm tall, pale brown to brown in outer 7 - 10 µm, colourless in inner part, distinctly cellular; cells subranged, 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. Exciple: black, sometimes slightly shiny when young, persistent; in section: 60 - 80 µm wide, brown to dark brown in outer part, colourless to 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, that between hyphae (but not pigment within apical cell of hyphae) soluble in N. Thalline margin: usually absent. Epithecium: brown to dark brown, K-, N-, pigmented between paraphyses dissolving in N but not in K. Hymenium: 40 - 65 µm, colourless, KI blue. Photobiont: green, cells globose, 7 - 12 µm diameter, forming a continuous, regular layer 35 - 40 µm thick.

This very distinctive, but rather uncommon, species can not be confused with any other, even when sterile. Scattered, with no clear pattern. On calcareous rock at altitudes 0 - 1000 m, but rare above 600 m. Predominantly southern Europe, though it has been recorded as far north as Belgium. Also Macaronesia (Canary Is), Asia (scattered but widespread), Africa (Tunisia, Socotra).

### Placopyrenium Breuss (1987)


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.

Sixteen species, most of which are not very well known. They are saxicolous, but often lichenicolous when young. Eight species occur in Europe.

1 **Marginal lobes not elongate and divided.** On various substrates.

2 Most ascospores less than 20 µm long. Thallus areolate or aquamulose.

3 Squamules to 4 mm wide. Parasitic on Lecanora muralis when young. See *Placocarpus schaereri* **P. canellum**

4 Squamules to 1 (2) mm wide. Parasitic on Aspicilia calcarea when young. **P. fuscellum**

5 Squamules to 1 (2) mm wide. Parasitic on Aspicilia calcarea when young. **P. canellum**

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Sixteen species, most of which are not very well known. They are saxicolous, but often lichenicolous when young. Eight species occur in Europe.

1 **Marginal lobes not elongate and divided.** On various substrates.

2 **Mature ascospores mostly 1-septate.** **P. bucekii**

3 **Mature ascospore mostly 3-septate.** (P. bucekii var. triseptatum) **P. bucekii**

4 Most ascospores more then 20 µm long. Thallus areolate-subsquamulose.

3 Squamules to 1 (2) mm wide. Parasitic on Aspicilia calcarea when young. **P. canellum**

4 Squamules to 4 mm wide. Parasitic on Lecanora muralis when young. See *Placocarpus schaereri* **P. canellum**

5 Squamules to 1 (2) mm wide. Parasitic on Aspicilia calcarea when young. **P. canellum**

6 Squamules to 4 - 15 mm wide. On weakly or non-calcareous substrates. **P. trachyticum**
Placopyrenium bucekii (Nàdv. & Servít) Breuss (1987)
in: Nimis & Poelt, in: Studia Geobot. 7(1): 182; Dermatocarpon bucekii Nàdv. & Servít (1936) in: [need to investigate - title and page range of publication not known].

The earliest name is Placidium steineri Wettst. (1889). A conservation proposal has recently been made, to preserve current usage.


Greek reports do not indicate which variety was involved.

Rare and scattered in the southern half of Greece. On calcareous or siliceous rock at altitudes 250 - 600 m. (This usually a species of siliceous rock, and the single report from calcareous rock may be unreliable.) Only var. bucekii is reported for Greece.

Southern Europe, from Iberian Peninsula to Cyprus, and southernmost parts of central Europe. Also Macaronesia (Canary Is), Asia (Turkey, Israel, Iran, Armenia), and, surprisingly, S. America (Argentina).

Placopyrenium canellum (Nyl.) Gueidan & Cl. Roux (2007)

Descriptions: Krzewicka (2012); Roux (2007); Smith et al. (2009) as Verrucaria canella.

Islands of the southern Aegean, including Crete, and adjacent parts of the mainland. Usually parasitic on species of Aspicilia, especially A. calcarea, once reported directly on limestone, at altitudes 0 - 1000 m.

Widely distributed in Europe to as far north as southern Sweden. Said also to be present in N. America.


Descriptions: Krzewicka (2012); Roux (2007); Smith et al. (2009) as Verrucaria fuscella.

Scattered, rather thinly, throughout Greece. On calcareous rock (about half of records) or parasitic on lichens on calcareous rock, at altitudes 10 - 1400 m. Reported hosts are: Aspicilia calcarea, Caloplaca chalybaea, and Caloplaca variabilis.

Widely distributed in Europe to about the Arctic Circle. Also Macaronesia, Asia (widespread), Africa (Morocco; perhaps St Helena - determination tentative), N. America (widespread in Canada and USA), C. America (Mexico), Australasia (Australia). Reports for Pacific (Cook Is) are tentative and may refer to a different taxon.

Placopyrenium trachyticum (Hazsl.) Breuss (1987)

Thallus: subsquamulose to areolate, to several cm diameter, pale brown, distinctly grey pruinose, without vegetative propagules. Areoles: to 2 mm wide, to 800 μm thick, sometimes clearly attached by central stipe-like holdfast.


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 as far north as Belgium. Also Asia (Turkey, southern Siberia, Mongolia, Hong Kong).

Placynthiella Elenkin (1909)
in: [need to investigate - don't know title of paper in Izv. Imp. S.-Petersb. Bot. Sada 9:]


About 6 species, usually found 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. oligotropa)

(1) This is best tested in a squash preparation.


Lecidea fuliginea Ach. is a superfluous name for Lecidea icmalea Ach. However, the epithet fuliginea is legitimate at the ranks of subspecies and form (but not variety); its first legitimate use was as Biatora uliginosa f. fuliginea Fr. (1831)

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.

Three collections were cited for the Peloponnes in Abbott (2009). Of these, the one from the Methana Peninsula (71-06-A) is extremely scanty; it may belong to P. icmalea but the determination can not be confirmed. The one from the northern Peloponnes (52-81-A) certainly belongs to P. icmalea. The third collection is puzzling, as the thallus matches P. icmalea, but is closely associated with abundant small apothecia. P. icmalea is not normally fertile, let alone abundantly fertile, and the apothecia do not fit P. icmalea; externally they resemble some species of Micarea, but they do not key out in that genus. A description of these apothecia follows: Apothecia: sessile, convex, 0.2 - 0.25 mm diameter, not pruinose; in section all pigments K-, C-.

The small, brown isidia reacting C+ red are distinctive.

Scattered very thinly throughout Greece, on bark, rock or wood, at altitudes 500 - 1800 m. This is an inconspicuous species and may be more common, in upland regions, than the map suggests.

Almost throughout Europe, but uncommon south of the Alps and probably confined to the uplands. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa, N. America (southern Canada, widespread in cooler parts of USA), Caribbean (DR), C. America (Mexico), S. America (Bolivia, Colombia), Australasia (widespread in eastern half of Australia), Antarctica (fairly widespread).

Placynthiella uliginosa (Schrad.) Coppins & P. James (1984)
in: Lichenologist 16(3): 245; Lichen uliginosus Schrad. (1794) in: Spic. Fl. Germ. 88

Descriptions: Nash et al. (2004); Nimis & Martellos (2004); Smith et al. (2009).

NW Greece and Ikaria, on bark at altitudes around 800 m.

Widely distributed from the Alps northwards; rare south of the Alps. Also Macaronesia, Asia (widespread), N. America (widespread but avoiding continental interior), perhaps C. America (CR), S. America (widespread), Australasia (SE Australia, both islands of NZ).

Placynthium (Ach.) Gray (1821)


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 a 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 22 species, of which 19 occur in Europe; they usually occur on rock. Many of the European species are distinctly northern, and only 5 species have been reported for Greece; one of those is rather doubtful and two more are confined to Mt. Olympus. The genus has never been properly monographed, and there are unresolved taxonomic problems.

Sterile collections, which are quite common, can not be determined with certainty but most will belong to P. nigrum. The other species are rare in Greece.

Placynthium baumgartneri (Zahlbr.) Gyeln. (1939)
in: [need to investigate]; Pterygium baumgartneri Zahlbr. (1938) in: Degen, Flora Velebitica 3: 317; Collolechia caesia var. baumgartneri (Zahlbr.) Szatala, nom inval.

Description: Clauzade & Roux (1985).

Mt. Olympus, on calcareous rock at altitudes 1200 - 1600 m.

The only explicit reports of this species that I have seen are for Austria, Slovakia and Greece, though Clauzade & Roux (1985) seem to imply that it is widespread in Mediterranean parts of Europe. It is not mentioned in Nimis (1993). At present, it is not clear to me whether it is a good taxon or perhaps just a morph of P. garovagloii (A. Massal.) Malme.

Placynthium filiforme (Garov. ex Nyl.) M. Choisy (1951)

Description: Burgaz (2011); Clauzade & Roux (1985).

Mt. Olympus, on calcareous rock at about 1700 m altitude.

Central Europe, and upland areas south of the Alps. Absent from British Is, Benelux, Baltic States and the Nordic countries. Also central Asia (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, ±flattened squamules to 0.3 mm diameter. "Lobes": brown to dark brown, smooth, not pruinose; in section, they consist 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 the thallus; in section: formed of very broad (8 - 10 µm wide), colourless or pale blue hyphae with distinct septa; the hyphae are generally conglutinated and oriented parallel to
the substrate. 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. Exciple: black, smooth, usually persistent; in section: 50 - 100 µm wide, blue in a very thin layer near the surface but 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 the 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. Thalline margin: absent. Epithecium: usually blue, sometimes colourless, pale brown, pale green or green-black; K-, but blue colour becoming a little fainter and duller in K. Hymenium: 120 µm tall, usually colourless in lower half, upper half often with epiphtelial pigment, Ki+ blue. Subhymenium: 25 - 50 µm tall, sometimes poorly developed, colourless to pale brown, without a distinct cellular structure (but sometimes with a faint, fine cellular stricture on a scale of 2 - 3 µm). Hypothecium: 40 - 80 µm tall, usually purple-brown, but sometimes almost black (and opaque), sometimes brown or orange-brown (no purple tinge), usually with a very distinct cellular structure. Paraphyses: 1 - 2.5 µm wide at base, 3 - 5 µm at apex, with distinct septa, clavate, not capitiate, not or only slightly moniliform, sometimes branched. Asci: 37 - 50 x 11 - 12 µm, cylindrical to narrowly clavate, with a Ki+ strongly blue plug in the centre of the apical part and Ki+ faintly blue wall (Peltigera type). Ascospores: colourless, mostly 3-septate when mature but some 1- and 2-septate ascospores usually also present, 8 per ascus, (10) 14 - 20 x (4) 5 - 6 µm, ends rounded. Chemistry: thallus K- and 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 (?Scytomena).

One collection (18-May-2006/66) had more regular lobes than are normal for P. nigrum. The lobes had a tendency to radiate, but the material did not match any of the species with elongated marginal lobes in the key. Apothecial anatomy matched P. nigrum, except that the ascospores were rather small, 10 x 4 µm. Because the material was scanty, I have interpreted it - with some hesitation - as a morph of P. nigrum. It might belong elsewhere, but additional collections are needed to clarify its status.

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 diffracta and Toninia verrucarioides have been recorded from this species.

Subcosmopolitan outside the tropics. Almost throughout Europe. Also Asia (widespread), northern Africa (Morocco, Algeria, Socotra), N. America (widespread), C. America (CR, Mexico), southern S. America (Argentina, Chile), Australasia (SE Australia, both islands of NZ).

Placynthium subradiatum (Nyl.) Arnold (1884)

The only Peloponnesian collection had very few apothecia, none of which contained mature ascospores. The description below is incomplete as a result. A better description must await collection of additional material. For a published description see Smith et al. (2009).

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 the uppermost 5 - 8 µm develops a distinct cellular structure. Prothallus: absent. Apothecia: sessile, convex, 0.2 mm diam, not pruinose. Disc: black. Exciple: very poorly developed, scarcely distinguishable from hymenium. Thalline margin: present, 25 - 50 µm wide. Epithecium: blue to blue-black. Hymenium: 45 - 85 µm tall, mostly colourless, sometimes with faint traces of a purple-brown pigment, upper part sometimes with epiphtelial pigment. Hypothecium: 25 - 60 µm, colourless to pale brown, with a weak cellular structure on a scale of 2 - 5 µm. Paraphyses: 2 µm at base, 3 µm at apex, with visible septa, usually not capitiate or moniliform. Asci: 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 (Alberta, BC, scattered in USA), C. America (Mexico), perhaps Australasia (SE Australia; reports for NZ appear to be incorrect).

Placynthium tremniacum (A. Massal.) Jatta (1900)

The only Peloponnesian collection was scanty, so I can not yet write an adequate description. P. tremniacum appears to differ from P. nigrum only in possessing ascospores that are consistently 1-septate and slightly smaller than those of P. nigrum. In P. nigrum 1-septate ascospores are not uncommon, but 2- and 3-septate ascospores are always present too;
even with slightly immature ascospores it is generally clear that some will not be 1-septate when mature. For published descriptions see Ahlo et al. (2007); Burgaz (2011); Clauzade & Roux (1985); Smith et al. (2009). Some authors have regarded *P. tremniacum* as synonymous with *P. nigrum*.

Rhodes and Peloponnese. 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 (Canary Is), and Asia (Siberia, Tajikistan).

**Platismatia W. L. Culb. & C. F. Culb. (1968)**

in: *Contr. US Nat. Herb.* 34: 524

Type: *P. glauca* (L.) W. L. Culb. & C. F. Culb. Family: Parmeliaceae. Literature: The two 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.

Ten species, of which three occur in Europe, but only one is widespread. The European species occur on a wide range of acidic substrates.

**Platismatia glauca** (L.) W. L. Culb. & C. F. Culb. (1968)


Thallus: foliose, to 11 cm diameter. Lobes: to about 5 cm long; (4) 8 - 20 mm wide, 170 - 250 µm thick in central parts, thinner at margins; rounded to elongate in overall shape but margin may be rounded, crenulate or distinctly irregular and ragged, not adpressed, sometimes with narrow ridges forming a reticulate network. Upper surface: grey-green to grey, matt. Lower surface: white to black, colour sometimes varying greatly even within a single lobe, generally blacker towards point of attachment; sometimes with a reticulate network of low, rounded ridges at a scale of 0.2-0.3 mm; the hollows between these ridges are often paler in colour. Cilia: absent. Soralia: laminal and marginal on upper surface, laminal ones usually arising on the ridges; dark brown to black, sometimes grey in lower part; initially globose and 0.05 - 0.1 mm diameter but soon forming subcortalloid clusters 0.3 - 0.8 mm diameter; these clusters sometimes become confluent. Pseudocyphellae: absent, but small, white, punctiform maculae, 0.1 mm diam, occasionally present in early stage of development of ridges. Rhizines: occasionally present in younger parts of some lobes, but probably not very effective as attachment organs, simple, dark brown to black, 0.2 - 0.35 x 0.06 mm. Soralia: absent, but eroded isidia occasionally resemble soralia. Upper cortex: 20 - 35 µm thick, colourless to pale brown in section, formed of a network of narrow anastomosed hyphae in a gel (best seen in K), outermost hyphae usually perpendicular to surface, K-, N-, brown pigment soluble in K but not in N. Medulla: white, overlapping considerably with algal layer, 140 - 200 µm thick (including overlap); medullary hyphae 3 - 4 µm wide, oriented predominantly parallel to long axis of lobe. Lower cortex: 20 - 50 µm thick, otherwise like upper cortex. Apothecia: rare, laminal or at tips of lobes, shortly stalked, concave, 0.7 - 7.5 mm diameter, not pruinose. Disc: brown. Excipule: not visible externally and scarcely apparent in section. Thalline margin: present, smooth or slightly irregular, 0.1 - 0.2 mm wide, ±persistent but becoming very thin in mature apothecia; in section about 80 µm broad and not very distinct. Epithecium: orange-brown, K-, N-, pigment soluble in K but not in N. Hymenium: 30 µm thick, colourless below, orange-brown in upper part. Hypothecium: colourless, 45 µm thick, of anastomosing hyphae that are oriented predominantly parallel to the surface of the disc. Ascii: ±clavate, 25 x 10 µm. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 7 x 4 µm. Chemistry: medulla K-, C-, KC-, P-, IM- (Meltzer), UV-; thallus K+ yellow, C-, KC-, P-, UV-. Photobiont: green; cells globose, 10 - 12 µm diameter; photobiont layer continuous, 40 - 80 µm thick.

Peloponnesian material differ somewhat from that of NW and central Europe, and might merit formal taxonomic recognition, at an infra-specific rank, if the differences can be shown to have a genetic basis.

Could be confused with *Tuckermannopsis chlorophylla*, but that species has a lower surface which is uniformly pale, never black.

Apothecia are rarely present, and when present often lack ascospores and mature asci. This species must reproduce mainly vegetatively.

Throughout Greece. On acidic bark or wood, at altitudes 600 to at least 1700 m. A report from close to sea level seems doubtful to me.

Subcosmopolitan in cool and temperate regions. Throughout much of Europe, but in the south restricted to upland areas. Also Macaronesia, Asia (widespread), Africa (Morocco, widespread in E. Africa, S. Africa), N. America (widespread), southern S. America (Argentina, Chile, Falkland Is), Antarctica (S. Georgia). Reports for Australasia are incorrect.
Plectocarpon Fée (1825)

in: Essai Crypt. Écorc, 151
Type: *P. pseudosticta* (Fée) Fée. Family: *Lecanographaceae*. Literature: The genus was monographed by Ertz et al. (2005).

*Plectocarpon* contains 36 formally described species of lichenicolous fungi. Seven species have been reported from Europe. In case of difficulty, consult the key to all species in Ertz et al. (2005), on which the key below is based.

11 Ascospores (4) 5 -septate. On *Cladonia*. (P. cladoniae)
10 Ascospores 2 - 3 -septate. Not on *Cladonia*.
22 Ascomata not inducing clearly visible galls.
33 Ascomata flat or only slightly convex, not inducing galls. On *Lobaria linita*. (P. linitae)
3 Sterile stromatic tissue strongly convex, inducing galls under the ascomata that are only visible in section. On *Peltigera leucophlebia*. (P. peltigerae)
2 Ascomata inducing clearly visible galls that are distinctly constricted at the base, except when young.
33 Sterile stromatic tissue not carbonised. Ascomata red-brown. On *Lobaria scrobiculata*. (P. scrobiculatae)
3 Sterile stromatic tissue at least partly carbonised, black and opaque in all but very thin sections. Ascomata not red-brown. Not on *Lobaria scrobiculata*.
44 Sterile stromatic tissue and overmature ascospores dark olive-green, K+ intensifying green. Not on *Brodoa*.
55 Ascospores 13 - 19 x 3.5 - 4.5 µm, 2 (3) -septate when mature. On *Nephroma bellum*. (P. nephromum)
5 Ascospores 18 - 21.5 x 5.3 - 6.3 µm, 3-septate when mature. On *Lobaria pulmonaria*. **P. lichenum**
4 Sterile stromatic tissue pale to dark brown, sometimes K+ olivaceous but not K+ green. On *Brodoa intestiniformis*. (P. encausticum)

**Plectocarpon lichenum** (Sommerf.) D. Hawksw. (1984)
The earliest name is *Sticta pulmonacea* var. pulurocarpa Ach. (1810), but it does not have priority at the rank of species.

Descriptions: Clauzade, Diederich & Roux (1989); Ertz et al. (2005); Nash et al. (2007).

Epiros on *Lobaria scrobiculata* and Sterea Ellada on *Lobaria pulmonaria*.
Scattered throughout Europe, but in Mediterranean regions its host requirement will restrict it to upland regions. Also Macaronesia, Asia (Turkey, Russia, Japan), Africa (widespread), N. America (widespread), southern S. America (Chile). Reports for NZ are incorrect.

**Pleopsidium** Körb. (1855)
in: Syst. Lich. Germ. 113
Type: *P. flavum* (Bellardi) Körb. 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 nomenclatural situation is confused and needs to be clarified. The correct name appears to be *P. unicolor* (Ach.) ined., in which case conservation is desirable.

Very scattered, with no clear pattern. On siliceous rock at altitudes 300 m and above. This species is conspicuous and easily recognised, so the absence of records from intermediate regions is puzzling.

Widely distributed in northern and central Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (widespread), Malesia (Sabah), N. Africa (Morocco), N. America (Saskatchewan, scattered in cooler parts of
western USA), C. America (Mexico), S. America (Argentina, Brazil, Chile, Uruguay).

**Pleurosticta Petr. (1931)**


> Type: *P. lichenicola* Petr. (= *P. acetabulum*). Family: *Parmeliaceae*. Literature: The only widespread European 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 acetabulum* also differs from *Parmelia*.

Two species. Both occur in Europe, but one is endemic to the Alps and Carpathians.

**Pleurosticta acetabulum** (Neck.) Elix & Lumbsch (1988)


> Thallus: foliose, heteromorous, to 6 cm diameter. Lobes: 1.0 - 2.0 x 0.7 - 1.1 cm, without pseudocyphellae or vegetative propagules, ascending at the margins; margins wavy, 100 - 175 μm thick. Upper surface: green-brown to brown when dry, dark oily green when wet, sometimes shiny and/or smooth at lobe margins but matt and usually wrinkled in older parts of the thallus, very rarely slightly white pruinose at tips of lobes. Lower surface: black, but often white to pale brown at the margin, often with prominent, raised veins; attached by rhizines. Rhizines: black, sometimes white at the 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- (pigment dissolves), N+ purplish. Medulla: white, of loosely interwoven hyphae oriented ± parallel to long axis of lobes; medullary hyphae 3 - 5 μm broad. Lower cortex: 10 μm thick, brown, formed of hyphae perpendicular to surface, with swollen tips giving a zcellular structure (best seen in K); K-, some pigment soluble in K. Apothecia: usually present, sessile or shortly stalked on lobes, 1.5 - 6 mm diameter, concave, not pruinose. Disc: pale orange-brown to orange-brown, shiny. Exciple: poorly developed; not visible externally; in section 20 - 25 μm wide, colourless. 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. Epitheciun: usually pale yellow, but colour can vary from colourless to pale orange-brown; K- (but pigment dissolves), N-; sometimes overlain by a colourless, structureless layer 5 - 7 μm thick. Hymenium: colourless, sometimes pale yellow in upper part, 50 - 55 μm tall. Subhymenium: 25 μm tall, colourless, of 'horizontal' (i.e. perpendicular to paraphyses) hyphae. Hypothecium: colourless, 40 - 70 μm tall, of randomly oriented hyphae. Paraphyses: usually simple, very robust, 3 - 6 μm wide, with easily visible septa throughout, not (or scarcely) capitate or moniliform. Asci: (often immature) 50 - 55 x 17 - 26 μm, usually cylindrical initially, sometimes becoming clavate or even broadly clavate when mature, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 x 15 μm. Pycnidia: fairly common, appearing as black dots on the lobes, 0.06 - 0.07 mm diameter; in section globose, 210 x 200 μm (height x width), colourless everywhere except around ostiole, 100% immersed. Conidia: colourless, bacilliform, 5 - 6 x 1 μm. Chemistry: medulla C-, K+ strongly red (crystals of norstictic acid usually abundant in section), P+ orange (reaction sometimes faint), I- thallus UV-. Photobiont: green, forming a continuous layer 50 - 100 μm thick; present below apothecia and there forming a 2continuous layer 25 - 35 μm thick; cells globose, 10 - 15 μm diameter, almost entirely occupied by chloroplast.

This species cannot 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 trees, but with a mild preference for *Quercus* (about one third of records) and *Abies* (about one quarter of records). At altitudes 200 - 2000 m, but commonest between 600 and 1600 m.

Throughout much of Europe, but absent from the more oceanic parts. Also Asia (widespread as far east as southern Siberia, and perhaps to NW China), N. Africa (Morocco, Algeria, Tunisia). Reports from elsewhere are incorrect or doubtful.

**Polyblastia A. Massal. (1852)**


The genus is not well known. Many names have been referred to it, but the true number of species is uncertain. On present information, about 60 species occur in Europe, but many names are probably synonyms. Most species are northern or alpine, and there are few Greek records; many of those are doubtful. 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.

1 On soil. Mature ascospores colourless to dark brown. (*P. rouxiana*)

22 Ascospores distinctly muriform.

33 Ascospores more than 60 µm long, 1 or 2 per ascus. *P. helvetica*
3 Ascospores to 50 µm long, 8 per ascus.

44 Ascospores 35 - 50 µm long. Exciple black everywhere. Involute lum present. Perithecia immersed in pits in substrate. *P. albida*
4 Ascospores 25 - 35 µm long. Exciple colourless to pale brown in lower part. Involute lum present. Perithecia immersed or not, but not in well-developed pits. *P. cupularis*

2 Ascospores submuriform.

33 Ascospores 8 - 12 (18) µm long. (*P. plicata*) Greek report doubtful.
3 Ascospores at least 20 µm long.


**Polyblastia albida** Arnold (1858)
in: *Flora* 41: 551 (as '251' owing to a printer's error); *Polyblastia obsoleta* Arnold

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Mt. Olympus, on calcareous rock at altitudes 1000 - 2600 m.

Mostly central and northern Europe (to as far north as Svalbard); there are very few records for south of the Alps. Also western Asia (Syria, southern Siberia), N. Africa (Morocco), N. America (Alberta).

**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; there are very few records for south of the Alps. Also Asia (Russia, Tajikistan, China), N. America (widespread from Alaska to northernmost USA), Australasia (Victoria). Reports for hot countries are almost certainly incorrect.

**Polyblastia foveolata** Arnold (1887)
in: *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)
in: Bot. Tidsskr. 4: 104. Rostrup did not provide a description, but the citations lead back to an 1860 description by Th. Fries. (Often ascribed to Th. Fries in *Botaniska Notiser* 1865: 112, but not validly published there, as Fries did not definitely associate the epithet with the generic name.)

Descriptions: Clauzade & Roux (1985); Nimis & Martellos (2004); Smith et al. (2009).

Epiros, at an altitude of 1100 m. The substrate was not reported.

Widely distributed in central and northern Europe, to as far north as Svalbard, but I have not seen any confirmed reports for south of the Alps. Also Asia (southern Siberia).
**Polychidium (Ach.) Gray (1821)**


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)**


Thallus: small-fruticose, cushion-forming, dark-brown, much-branched, without vegetative propagules. Branches: erect, 2 - 3 x 0.07 - 0.1 mm. Cortex: present, pale brown, distinctly cellular; cells subrounded, 5 - 8 µm wide.

Apothecia: 0.1 mm diameter. Disc: brown. Thalline margin: present, dark brown. Photobiont: blue-green; cells globose, subglobose or slightly egg-shaped, 5 - 8 µm diameter, usually not in chains, occasionally forming short chains of 2 - 3 cells.

The small, dark brown, richly-branched, fruticose thallus, forming a cushion, is distinctive. Some species of *Leptogium* may appear small-fruticose, owing to isidia, marginal lacerations, or narrow elongated lobes, but closer examination will reveal some distinct lobes.

My only collection was rather scanty, and I was not able to prepare a full description. For published descriptions see: Ahti et al. (2007); Burgaz (2011); Clauzade & Roux (1985); Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009).

Rare and sattered on the mainland, usually overgrowing bryophytes on siliceous rock, but reported once from bark. At altitudes 500 - 1450 m. This is a small and inconspicuous species, so it may be more common than records suggest.

Widely distributed in the west of Europe, but in Mediterranean regions restricted to the mountains. Also Macaronesia, Asia (scattered but widespread), Malesia (PNG), N. Africa (Morocco, Algeria, Kenya), N. America (southern Canada, cooler parts of USA), perhaps C. America, Pacific (Hawaii).

**Polycoccum Saut. ex Körb. (1865)**

in: Parerga 470


About 47 species of lichenicolous fungi. About 33 have been reported for Europe.

11 Fungus modifying thallus of host, never present in ascoma of host. Ascii 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 Ascii with 4 - 6 ascospores. (P. clauzadei), (P. epizoharyi)

3 Ascii 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.

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 of host. Asci 4 or 8 spored.

22 Ascii with 4 ascospores. (P. crassum), (P. microsticticum), (P. peltigerae)

2 Ascii 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 Ascii almost cylindrical. On lichens on calcareous rock. (P. cartilaginosum)

6 Ascii cylindrical to clavate. On *Lepraria incana*. (P. anatolicum)

5 Perithecia partly emergent when mature. Hymenium I+ blue. Asci long but clavate. **P. marmoratum**

444 Ascospores 16 - 26 µm long. (P. decolorans), (P. evae), (P. squamarioides), (P. tinantii)
4 Ascospores less than 18 μm long. (P. arnoldii), (P. 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 kernerii 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 distribution in southern and central Europe. No further north than England, which is surprising since its usual host, Lecidea fuscoatra, is common in northern Europe. Also Macaronesia (Canary Is), N. America (Arizona).

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 of the Greek records refer to a fungus growing directly on limestone. The description of Microthelia marmorata in Swinscow (1966a) makes it clear this this organism often grows directly on rock, and can be lichenised with Trentepohlia. Hawksworth (1985)p155 remarks that is is primarily lichenicolous, but can take over the photobiont cells of its host and become facultatively lichenised. These characteristics are not typical of Polycoccus, and this species may not belong here.
   Most common in temperate regions of Europe, though also reported for Sweden. Reports for Spain are unconfirmed, and the only other reports that I have seen for southern Europe are those for Greece. Also Asia (Russia, Tajikistan, Mongolia).

Polycoccus pulvinatum (Eitner) R. Sant. (1993)
   Description: Hawksworth, Atienza & Coppins (2010).
   Epiros, on Physcia leptalea at an altitude of 900 m.
   Probably throughout Europe. Also Macaronesia, Asia (Turkey, Iran, Russia, India), Malesia (Malaysia), N. America (scattered), C. America (Mexico), S. America (Chile, Peru), Australasia (NZ).

Polysporina Vězda (1978)
   Type: P. simplex "(Davies)" Vězda. Family: Acarosporaceae. 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 12 species. Seven are known from Europe, but the genus is distinctly northern and is rare in southern Europe.

11 Parasitic on crustose lichens. P. subfuscescens
1 Not parasitic.
  22 On calcareous rock.
    33 Apothecia 0.5 - 2 mm diameter, sessile or only slightly immersed. P. cyclocarpa
    3 Apothecia 0.2 - 0.5 mm diameter, ± immersed.
      44 Disc of apothecia ± flat. Hymenium 80 - 120 μm tall. P. pusilla
      4 Disc of apothecia concave. Hymenium 50 - 60 μm tall. P. urceolata
  2 On non-calcareous rock.
    33 Ascospores 1 - 2 μm wide. P. simplex
    3 Ascospores 2 - 3 μm wide. P. subfuscescens
Polysporina cyclocarpa (Anzi) Vězda (1978)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Macedonia, on calcareous rock at altitudes 400 - 1800 m.
Widely distributed in central Europe. There are only a few reports for northern Europe (Scotland, Greenland), and hardly any from south of the Alps. Also Asia (Kazakhstan, Afghanistan, Pakistan; and rather implausibly Hong Kong), N. Africa (Morocco). Reports for N. America are incorrect.

Polysporina pusilla (Anzi) Nimis (1993)

Scattered in the northern half of the mainland. On limestone at altitudes 0 - 2650 m. The report for sea level (Thessaly:Lephokastron) seems very doubtful to me. All other Greek reports are from montane levels.

Polysporina simplex "(Davies)" Vězda (1978)
The earliest name, Lichen simplex Davies is, unfortunately a later homonym of Lichen simplex Roth (1788), and so 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 thus illegitimate. The correct name at present is Polysporina privigna (Ach.) ined. A conservation proposal to preserve present usage would probably succeed, but it will first be necessary to typify Davies's name or to locate an earlier lectotypification.
Abbott (2009) listed separately Polysporina simplex f. complicata (Cromb.) N. S. Golubk., for which there is a single Greek report, though he expressed uncertainty 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.

Descriptions Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).
Scattered, mostly around the Aegean. On rock, usually but not always siliceous, at altitudes 100 - 1100 m.
Widely distributed in northern and central Europe, and there are a few outlying records from southern Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Egypt), N. America (widespread), S. America (Argentina, Venezuela), Australasia (Western Australia, both islands of NZ).

Polysporina subfuscescens (Nyl.) Knudsen & Kocourk. (2008)
in: Mycotaxon 105: 151; Lecanora subfuscescens Nyl. (1873) in: Flora 56: 199. This was published in May 1873. Also published in Bull. Soc. Linn. Normandie Sér. II 6: 308. "1872", and often cited from there, but that was published in July 1873.

Chios, on siliceous rock at an altitude of 420 m.
Cold and temperate Europe. Rare in the south. Also Macaronesia (Gran Canaria), Asia (Kazakhstan), N. America (Arizona, California, New York).

Polysporina urceolata (Anzi) Brodo (1987)

Descriptions: Clauzade & Roux (1985); Kantvilas (198); 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 almost certainly incorrect. The other, for Sterea Ellada, was from limestone at about 2000 m.
Quite widely distributed in northern and central Europe, but there are very few reports from south of the Alps. Also Asia (Iran, Russia, Kazakhstan, Tajikistan), N. Africa (Morocco), N. America (Canada, scattered in western USA).
Porina Ach. (1809)


Type: *P. nucula* Ach. The type is conserved. Family: Porinaceae. 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 one of them. For the exception, *P. rechingeri*, consult the protologue.

Over 300 described species, predominantly in humid tropical and subtropical regions, though a few species range as far north as the Arctic Circle. Even in Europe, where over 30 species are known, it shows a marked preference for humid climates, and is best developed along the Atlantic margin of the continent. The genus is rare in Greece, although 7 species have been reported.

*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. mammilllosa)
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 Perithecium to 500 µm diameter. Involucrellum with much orange pigment. On damp, non-calcareous rock. (P. lectissima)
4 Perithecium to 300 µm diameter. Orange pigment, if present, confined to area near ostiole. On calcareous rock.
5 Thallus superficial. Perithecium not in pits. Perithecium 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 perithecium colourless. See *Strigula*
4 Perithecium 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 *Porina 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: ±colourless, with little structure. Perithecium: black, 0.15 - 0.2 mm diameter, 50% immersed; in section: ±globose, 130 - 180 x 140 - 210 µm (height x width). Involucrellum: present, dark brown, opaque, covering at least upper 60% of perithecium, sometimes separating from perithecium in lower part. Exciple: pale brown to brown, paler than involucrellum, of hyphae parallel to wall of perithecium. Paraphyses: simple, 1 µm wide. Ascii: 65
x 8 µm. Ascospores: colourless, 3-septate, 8 per ascus, 15 - 23 x 3 - 5 µm, sometimes slightly curved, ends rounded. 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 but usually fairly close to the sea. On bark at altitudes 0 - 1200 m, but uncommon above 800 m. Recorded from a wide range of phorophytes.

Widely distributed in Europe to as far north as southern Scandinavia, but avoiding areas with a distinctly continental climate. Also Macaronesia, Asia (widespread), N. Africa (Algeria, Morocco), N. America (very scattered in USA), Australasia (Queensland, Tasmania).

Porina byssophila (Körb. ex Hepp) Zahlbr. (1903)
in: [need to investigate] - need to investigate; dates for Engler-Prantl's work variously cited; Sagedia byssophila Körb. ex Hepp (1860) in: Flechtl. Eur. no. 695

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Corfu, on limestone at an altitude close to sea level.
Mediterranean/Atlantic. Western Europe to as far north as British Isles, and southern Europe. Also western Asia (Israel), Africa (Morocco).

Porina chlorotica (Ach.) Müll. Arg. (1884)

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. Excipule: pale brown, thin, K-. Involucrulum: 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.

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. In Europe, absent only from cold, continental parts of eastern Europe and truly arctic regions. Also Macaronesia, Asia (Russia, Hong Kong, Japan), Malesia (PNG), Africa (Morocco, Algeria, S. Africa; St Helena), N. America (temperate to cool regions on both coasts), C. America (Mexico), S. America (Brazil, JF), Australasia (widespread), Pacific (Hawaii), Antarctica (Macquarie Is).

Porina ginzbergeri Zahlbr. (1903)
in: 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.

Porina linearis (Leight.) Zahlbr. (1922)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered, with no clear pattern except that all localities are close to the sea. On calcareous rock at altitudes 5 - 1000 m.

Widely distributed in Europe to as far north as southern Scandinavia, but commonest in the south. Also western Asia (Israel), N. Africa (Morocco, Tunisia), perhaps N. America.

Porina oleriana (A. Massal.) Lettau (1912)
in: Hedwigia 52(3-4): 105; Sagedia oleriana A. Massal. (1855) in: Symm. Lich. Nov. 95. (Published in 1854 as a nomen nudum.)

Description: Clauzade & Roux (1985).
Naxos, on limestone at an unspecified altitude.
Only Iberian Peninsula, 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)

in: Syst. Lich. Germ. 221

Type: P. trullisata (Kremp.) Körb. (= P. zeoroides). 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 also helpful, but emphasises the species of NW Europe, most of which do not occur in Greece.

Thallus: crustose, usually some shade of grey, sometimes tinged orange or rust red in some species. Vegetative propagules: absent in species reliably reported for Greece. Apothecia: immersed to sessile, usually ± flat, only occasionally becoming strongly convex, sometimes pruinose. Disc: black. Exciple: black, thin to very broad, nearly always persistent, at least part strongly pigmented in section. Thalline margin: absent. Epithecium: usually olive or olive-grey, sometimes brown. Hypothecium: dark brown. Apothecial pigments: usually K- (or almost), N+ reddish. Paraphyses: rather slender (1 µm wide at base, 2 - 2.5 µm at apex), not capitate or moniliform, branched and anastomosed but usually only sparingly so. Asci: Porpidia type (apex with a narrow cylindrical tube reacting KI+ blue; the effect in section is of two vertical KI+ blue lines with a KI- region in between). Ascospores: colourless, simple, usually ± ellipsoid, 8 per ascus, medium sized (generally 12 - 22 µm long). Photobiont: green.

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 ecology (restricted strictly to siliceous rock).

About 38 species are presently referred to Porpidia, 26 of the European, but species concepts in this genus 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. I have rather few collections, and as a result have found it difficult to gain a good understanding of the genus in Greece. The descriptions below will certainly not encompass the full range of variation of these species.

111 Soredia present.

22 Medulla I+ blue or violet. Soralia often with a bluish tinge. P. tuberculosa
2 Medulla I-. Soralia white or grey, without a blue tinge. (P. rugosa) Greek reports need confirmation.

11 Soredia absent but isidia present. (P. nadvornikiana)
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 subimpressed (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 subimpressed.

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.
55 Apothecia mostly remaining immersed. Exciple 0.05 mm wide or less, ± level with disc. P. cinereoatra
5 Apothecia sessile. Exciple 0.1 mm wide or more, clearly raised above level of disc. (P. contraponenda)
4 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 those that become convex, it may become thin.
Porpidia alboacarulescens (Wulf.) Hertel & Knoph (1984)

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: subimmersed, 0.55 - 0.9 mm diameter, slightly concave to flat. Disc: black, white pruinose. 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. Thalline exciple: absent. Epithecium: brown to grey-brown, K- but some pigment dissolves. Hymenium: 100 µm tall, colourless. Hypothecium: dark brown, K- or K+ purple-brown intensifying. Paraphyses: 1 µm wide at base, 2 µm at apex, not capitulate or moniliform, almost simple (branching and anastomoses rare). Asci: 65 x 15 µm, Porpidia type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 15 - 17.5 (20) x 7.5 µm. Chemistry: medulla I-, K+; 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, though all sites are close to the sea. On siliceous rock at altitudes 0 - 470 m. Some reports are probably unreliable, as the site ecology does not seem suitable for this species. The only recent report is that of the author for the Peloponnese, from sandstone in a shaded woodland at an altitude of 470 m.

The European distribution of this species is unclear, as the name has been misapplied so much. There are reports for many other continents, but they are difficult to assess for the same reason. However, it is reliably reported for N. America.

Porpidia cinereoatra (Ach.) Hertel & Knoph (1984)
in: Hertel, in: Nova Hedwigia, Beihefte 79: 437; Lecidea cinereoatra Ach. (1810) in: Lichenogr. Universalis 167; Lecidea convexa (Fr.) Flagey

My only collection is scanty, so the description is incomplete.

Thallus: crustose, white, white pruinose, areolate, 1 cm diameter (in the single collection seen to date), 130 - 210 µm thick. Areoles: 0.5 - 1.3 mm wide. Medulla: white, I-. Apothecia: subimmersed, 0.4 - 1 mm diameter, flat, not pruinose. Disc: black. Exciple: persistent but thin, 0.03 - 0.05 mm wide, level with disc; in section: dark brown, almost opaque, K-, N- (or almost). Thalline margin: absent. Epithecium: olive-grey, N+ red. Hymenium: 75 µm tall, colourless. Subhymenium: 25 µm tall, colourless to very pale brown. Hypothecium: 200 µm tall, dark brown, opaque, N- (or almost). Paraphyses: 1 µm wide at base, 2.5 µm at apex, not capitulate or moniliform, very sparingly branched and anastomosed. Asci: 62 - 65 x 14 - 16 µm, clavate, Porpidia type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 17 - 18 x 7.5 µm. Chemistry: thallus UV-.

Well characterised by the immersed apothecia with a narrow exciple level that is ±level with the disc.

Scattered throughout Greece, usually not very far from the sea. On siliceous rock at altitudes 10 - 900 m. A record for Evia, from calcareous rock, may refer to some other species.

Widely distributed in Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (southern Canada, cooler parts of USA, mainly in the east), Australasia (widespread in Australia).

Porpidia crustulata (Ach.) Hertel & Knoph (1984)
The earliest name appears to be Patellaria albozonaria DC. (1805), so conservation may be required.
Descriptions: Clauzade & Roux (1985); Fryday (2005a); Nash et al. (2004); Smith et al. (2009).
Scattered, with no clear pattern. On siliceous rock at all altitudes.

Most of Europe. Also Macaronesia, Asia (widespread), Malesia (Java), Africa (Morocco, Algeria, S. Africa), N. America (widespread from Alaska to cooler parts of USA), S. America (Argentina, Chile, Venezuela), Australasia (eastern half of Australia, both islands of NZ), Antarctica (subantarctic islands).

in: Hertel, in: Nova Hedwigia, Beihefte 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. oxysta (Körb.) Stein; Lecidea macrocarpa a (= var.) platycarpa (Ach.) Th. Fr.; Lecidea phaea (Flot. ex Körb.) Nyl.; Lecidea platycarpa Ach.; Lecidea steriza (Ach.) Flot.; Lecidea steriza f. contigua (Vain.) Lyngse; (?) 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.
The earliest name is Lecidea confluens var. steriza Ach. (1803), but it does not have priority at the rank of species.
Thallus: crustose, to 8 cm diameter, grey-white, pale grey or pale brown-grey, superficial but thin, rarely exceeding 100 µm, sometimes cracked when well developed. Prothallus: sometimes present but 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 but sometime becoming convex in very old apothecia, 0.65 - 1.5 mm diameter, sometimes slightly white or grey pruinose. Disc: black. Exciple: black, persistent, usually very broad (0.1 - 0.2 mm) but sometimes becoming thin in old, and especially in convex, apothecia; in section: 75 - 250 µm wide, dark brown, 0.4 - 1.5 mm wide, colourless, obscurely cellular or without distinct structure. 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 but sometime becoming convex in very old apothecia, 0.65 - 1.5 mm diameter, sometimes slightly white or grey pruinose. Disc: black. Exciple: black, persistent, usually very broad (0.1 - 0.2 mm) but sometimes becoming thin in old, and especially in convex, apothecia; in section: 75 - 250 µm wide, dark brown, 0.4 - 1.5 mm wide, colourless, obscurely cellular or without distinct structure. 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 but sometime becoming convex in very old apothecia, 0.65 - 1.5 mm diameter, sometimes slightly white or grey pruinose. Disc: black. Exciple: black, persistent, usually very broad (0.1 - 0.2 mm) but sometimes becoming thin in old, and especially in convex, apothecia; in section: 75 - 250 µm wide, dark brown, 0.4 - 1.5 mm wide, colourless, obscurely cellular or without distinct structure. 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 but sometime becoming convex in very old apothecia, 0.65 - 1.5 mm diameter, sometimes slightly white or grey pruinose. Disc: black. Exciple: black, persistent, usually very broad (0.1 - 0.2 mm) but sometimes becoming thin in old, and especially in convex, apothecia; in section: 75 - 250 µm wide, dark brown, 0.4 - 1.5 mm wide, colourless, obscurely cellular or without distinct structure. 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 but sometime becoming convex in very old apothecia, 0.65 - 1.5 mm diameter, sometimes slightly white or grey pruinose. Disc: black. Exciple: black, persistent, usually very broad (0.1 - 0.2 mm) but sometimes becoming thin in old, and especially in convex, apothecia; in section: 75 - 250 µm wide, dark brown, 0.4 - 1.5 mm wide, colourless, obscurely cellular or without distinct structure.

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 a strongly continental climate; rare in the south. Also Macaronesia, Asia (Turkey, Hong Kong, Japan, Taiwan), N. America (New York), S. America (Brazil), Australasia (cool parts of NZ).

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 Asia (Turkey, Russia, Kazakhstan, Japan), N. America (widespread from Alaska to temperate USA), and S. America (Falkland Is).

Porpidinia Timdal (2010)
Type: P. tumidula (Sm.) Timdal. Family: Lecideaceae. Literature: The single species is described in all the standard floras, until recently as Toninia tumidula.
Porpidinia contains a single species that was, for many years, usually treated in Toninia, though it clearly does not belong there.

Porpidinia tumidula (Sm.) Timdal (2010)
in: Bibl. Lich. 104: 334; Lichen tumidulus Sm. (1791) in: Trans. Linn. Soc. 1: 82; Thalloidima tumidulum (Sm.) Szatala (as Thalloedema); Toninia tumidula (Sm.) Zahlbr.
The earliest name is Lichen candidus var. mezentieriformis Latourr. ex Vill. (1789), but it does not have priority at the rank of species.
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 - 750 m.
Southern and central Europe, just reaching England and southern Sweden. Also Macaronesia (CVI), western Asia
(Turkey), N. Africa (Morocco, Algeria), and surprisingly, Australasia (both islands of NZ).

**Protoblastenia (Zahlbr.) J. Steiner (1911)**


Differs from *Psora* in having a crustose rather than squamulose 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 are perhaps 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.

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 immersed in pits in the rock. *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 not immersed.
   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 thin. *P. calva* s. lat.
   66 Apothecia orange, dull orange, brown-orange or red-orange. Not restricted to alpine levels. *P. calva* var. *calva*
   6 Apothecia bright yellow-orange. Probably restricted to alpine levels. (P. calva var. *laeta*)
5 Thallus distinctly superficial. *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)**

in: Cat. Lich. Univ. 7: 1; *Lichen calvus* Dicks. (1790) in: Fasc. Pl. Crypt. Brit. 2: 18; *Biatora rupestris* f. *calva* (Dicks.) Hepp; *Lecanora rupestris* var. *calva* (Dicks.) Harm.; *Protoblastenia rupestris* var. *calva* (Dicks.) J. Steiner

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Fairly widely distributed in Greece, but not reported from the more inland areas. On calcareous rock at altitudes 0 - 1700 m, but usually below 1400 m.

Throughout Europe, except for the High Arctic. Also Asia (Syria, Israel, Russia, Tajikistan), N. Africa (Morocco, Tunisia), N. America (Alaska, scattered in Canada), Australasia (Tasmania).

**Protoblastenia cyclospora** (Hepp ex Körb.) Poelt (1975)


I have a single collection that may belong here, but would like to see additional material to exclude the possibility of confusion with juvenile material of other species. In the meantime, for descriptions see Clauzade & Roux (1985), or Smith et al. (2009).

Crete at altitudes 500 - 600 m, and perhaps Peloponnese at 1200 m, both on limestone. The Cretan report is from an unexpectedly low altitude for this species in a Mediterranean region, and Abbott (2009) accepted it only with some hesitation.

Nearly all European records are from latitudes between the Alps and southern Sweden. The Greek reports are the only ones that I have seen from south of the Alps, and they are very disjunct. Confirmation that this species really is present in Greece is desirable. Also Asia (Russia).
Protoblastenia incrustans (DC.) J. Steiner (1915)


My only collection was very scanty, and had only a very few apothecia (though there were many empty pits that had formerly contained apothecia). It was not studied in detail, to avoid destroying it entirely. A fuller description must await the collection of better developed material. For published descriptions see: Clauzade & Roux (1985) or Smith et al. (2009).

Clauzade 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 altitudes 100 - 2600 m.

Throughout Europe. Also Asia (Turkey, Russia, Tajikistan, China), N. Africa (Morocco), N. America (Newfoundland, Colorado), perhaps S. America (Bolivia).

Protoblastenia incrustans var. coniasis (A. Massal.) Nimis (1993)

Unfortunately, the epithet ochracea has priority at the rank of variety, if Biatora rupestris var. ochracea Anzi, in 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. I have not seen any reports for other continents.

Protoblastenia lilacina Poelt & Vězda (1970)
in: [need to investigate]

Thallus: crustose, inconspicuous, immersed or thinly superficial, cracked, white; sometimes bounded by a narrow black prothallus. Apothecia: sessile, convex, 0.4 - 0.8 mm diameter, not pruinose. Disc: orange-brown to brown-orange, sometimes with a slight red tinge. 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. Thalline margin: absent. 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 epithelial pigment in upper part. Hypothecium: 120 µm tall, ±colourless to pale orange-brown. Paraphyses: 1 - 1.5 µm wide at base, 1.5 - 2.5 µm at apex, very coherent, branched, with visible septa (all best seen in after using C to clear epithelial pigment). Asci: 45 x 15 µm, zclavate, apex Kl+ blue (details not well seen). Ascospores: colourless, simple, narrowly ellipsoid to almost fusiform, ends subrounded, 8 per ascus, 11 - 17 x 5 - 10 µm. 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.

Crete and Peloponnesse, on limestone at altitudes 60 - 1300 m.

Easily confused with Clauzadea monticola, and some of the Peloponnesian reports of that species in Abbott (2009) actually belong here. Separated from that species by the K+ purple or red-purple reaction of the epithelial granules, though that reaction may be faint and easily overlooked.

The only reports that I have seen are for British Is, Finland, Croatia and Greece. However, it may be overlooked rather than rare, as it can easily be confused with other species of the genus, especially the common P. calva.

Protoblastenia rupestris (Scop.) J. Steiner (1911)

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Widely distributed but uncommon; scattered with no clear pattern. On calcareous rock at altitudes 30 - 2300 m.

Throughout Europe. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread from Alaska to cooler parts of USA), C. America (Guatemala), Australasias (Tasmania, both islands of NZ).
Protoblastenia siebenhaariana var. alpina (Arnold) Clauzade & Cl. Roux (1985)

Description: Clauzade & Roux (1975).
Mt. Olympus, on calcareous rock at an altitude of 2300 m.
Known only from southern Germany, Austria and Greece.

Protopannaria (Gyeln.) P. M. Jørg. & S. Ekman (2000)

Type: P. pezizoides (Weber) P. M. Jørg. & S. Ekman. Family: Pannariaceae. Literature: Jørgensen in Ahti et al. (2007), and Smith et al. (2009) treat the only species.
The genus has 7 species, but 6 of them have a very narrow distribution. Only a single species 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).
Mt. Olympus, on bark of Pinus heldreichii at altitudes 1700 -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 from Alaska to cool parts of USA), perhaps S. America.

Protoparmelia M. Choisy (1929)

Although lower totals are usually quoted, Protoparmelia contains about 27 described species that have not, so far as I am aware, been referred elsewhere or synonymised. About 16 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 lack a good description of the rather poorly known species P. nitens. It may just be an extreme morph within P. montagnei.
Protoparmelia atriseda (Fr.) 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.

Widely distributed in central and northern Europe, but rare south of the Alps. Also Asia (Russia, perhaps Taiwan), N. America (Arizona, Colorado), perhaps C. America.

Protoparmelia badia (Hoffm.) Hafellner (1984)

Lichen badius Pers. (1794) is homotypic, but Persoon's name is a later homonym, and thus illegitimate.

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Scattered, with no clear pattern. On siliceous rock at altitudes 0 - 2500 m. Some older reports may refer to P. montagnei.

Almost throughout Europe, though according to Nimis (1993) in the south it is restricted to the mountains. Also Macaronesia, Asia (widespread), Malesia (PNG), perhaps Africa (S. Africa), N. America (widespread in the western half, scattered in the east), C. America (Mexico), S. America (Colombia; perhaps elsewhere), Australasia (SE Australia, NZS), Antarctica (S. Orkney Is). A report for Caribbean (Bahamas) seems doubtful to me.

Protoparmelia montagnei (Fr.) Poelt & Nimis (1987)
in: Studia Geobot. 7(1): 188; Parmelia montagnei Fr. (1831) in: Lichenogr. Eur. Reform. 107; Lecanora montagnei (Fr.) Schaer.; Lecanora psarophana Nyl.; (? ) Lecanora psarophana var. pallida (Wedd.) Harm.; (? ) Lecanora psarophana f. subvirens J. Steiner; (? ) Protoparmelia picea auct. graec., non (Dicks.) Hafellner; Protoparmelia psarophana (Nyl.) Sancho & A. Crespo

Thallus: crustose, to 7 cm diameter, to 0.5 mm thick, pale brown to brown, sometimes white pruinose especially at margins of areoles, most commonly of ±flat areoles 0.2 - 0.7 mm across, but areoles may become convex and warty, or even subquamulose 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-; overlain by a colourless, structureless layer 5 - 15 µm thick that swells markedly in K to 30 - 70 µm. Medulla: white. Apothecia: always present, subimpressed when young, sessile when mature, 0.4 - 1.5 mm diam, flat, usually not pruinose but sometimes with a slight white pruina on exciple. Disc: dark brown, shiny; when over-mature often becoming black and matt. Exciple: not visible externally; in section: 40 - 60 µm wide, colourless in inner part, orange-brown in outer part, basically formed of radiating hyphae but these may have fairly broad lamina resulting in a weakly cellular appearance. Thalline margin: present, persistent but becoming very thin. Epithecium: brown to orange-brown, K-, pigment partly dissolving 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. Asci: 52 x 15 µm, narrowly clavate, Lecanora type. Ascospores: colourless, simple but occasionally appearing sparsely 1-septate, usually oblong with rounded ends, occasionally ellipsoid or dacyriform, 8 per ascus, 7 - 12 x 2.5 - 3.5 µm, with a thin but distinct wall. Pycnidia: often present, appearing externally as black dots, 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 about 0.75 µm. Chemistry: the outer part of the thallus seems to lack lichen substances (C-, K-, KC-, P-, UV-); the medulla always reacts K- but otherwise has a variable chemistry and several chemotypes are present. The following sets of 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 layer 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 it is reported for British Is, Bulgaria and Ukraine. Also Macaronesia (Canary Is), western Asia (Turkey, Syria, Iran), N. Africa (Morocco, Algeria).

Protoparmelia olivascens (Nyl.) Llimona [date not known]

Descriptions: Clauzade & Roux (1985); Poelt & Vézda (1977), both as Lecanora olivascens.

Crete, close to sea level. The substrate was not reported. The presence of this species in Greece is in need of confirmation.
Only Iberian Peninsula, France, Bulgaria, Greece, and Macaronesia (Tenerife).

**Protoparmelia psarophana var. reagens (J. Steiner) Sipman (1999)**
in: *Willdenowia* 29: 278; *Lecanora psarophana var. reagens* J. Steiner (1931) in: [need to investigate]

*Protoparmelia psarophana var. psarophana* is now considered to be a synonym of *Protoparmelia montagnei*. The status of var. *reagens* is not clear to me, mainly because I lack a good description of this taxon. 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.

Description: I have not found a good description of this taxon in the literature.

Islands of the Aegean, including Crete. On siliceous rock at altitudes 0 - 700 m. Apparently only known from Greece.

**Pseudephebe M. Choisy (1930)**


Two species, one of which is strongly northern and unlikely to occur in Greece.

**Pseudephebe pubescens** (L.) M. Choisy (1930)
in: [need to investigate]; *Lichen pubescens* L. (1753) in: Sp. Pl. 1155

Description: Clauzade & Roux (1985); Nast et al. (2002); Smith et al. (2009); Thell & Moberg (2011).

Known from a single site in northern Macedonia, where it occurred on granite rock at an altitude of about 1800 m. Throughout northern and central Europe, but rare south of the Alps and Pyrenees where it is confined to high mountains. Also Macaronesia (Madeira), Asia (widespread), N. America (widespread in cool regions), C. America (Mexico), S. America (Argentina, Bolivia, Chile, Peru), Australasia (widespread in cool regions), Antarctica (subantarctic islands, Antarctic Peninsula)

**Pseudevernia Zopf (1903)**

Type: *P. furfuracea* (L.) Zopf. Family: Parmeliaceae. Literature: The only European species is treated in all the standard Floras.

Differs from *Parmelia* in the subfruticose 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 lignicolous, 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**


Thallus: foliose, but often appearing ±fruticose as lobes are attached to substrate only at one end; forming irregularly circular thallus 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; lobes 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 but soon becoming 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, same same colour as upper surface of lobes but 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. Exciple: poorly developed, not visible externally; in section: not well delimited from hymenium or thalline exciple, brown, 25 µm wide. Thalline margin: present, thin, persistent, sometimes slightly crenulate or irregular. Epithecium: very 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 epithelial pigment, K+ slightly blueish. 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 is lacking. Paraphyses: 1 µm wide at base, 2.5 µm at apex, moniliform, often with visible septa, mostly simple, sometimes branched and occasionally anomastomosed. Asci: 25 - 30 x 13 µm, broadly clavate, Lecanora type. Ascospores: colourless, simple, globose, 8 per ascus, 5.5 - 6 x 5 - 6 µm (?immature). Photobiont: often present on upper surface of young lobes, but not very common, laminal, black, 0.05 - 0.08 mm diameter. Chemistry: thallus K+ yellow, C-, KC- (or sometimes intensifying yellow), P-, UV+ faintly orange; medulla K-, C-, KC usually +pink or brown-pink, P-, I-, UV+ faintly blue-white. Photobiont: green, cells globose, 10 - 14 µm diameter, wall often I+ slightly reddish. Photobiont layer: discontinuous and irregular; when present, 20 - 55 µm thick.

Smith et al. (2009) say that the medulla reacts KC-, but in Peloponnesian material the medulla usually reacts unambiguously, though sometimes faintly, positive in some shade of pink. The reaction is transient. A sorediate morph has been mentioned in the literature, but does not appear to have been reported for Greece. It is said not to be a distinct taxon.

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 is almost certainly due to under-recording. Usually on acidic bark (96% of records), sometimes on wood of Juniperus oxycedrus, rarely on rock. With a strong preference for conifers, though it does occur on other species. 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 lichen.

Many authors do not distinguish the two varieties, so the distribution of var. furfuracea is not entirely clear. P. furfuracea s. lat. is widely distributed in Europe, though in the south it is confined to upland regions. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Mauretania, widespread in E. Africa). Not present in N. America, which casts doubt on reports for C. and S. America.

**Pseudevernia furfuracea var. ceratea (Ach.) D. Hawksw. (1969)**

In: Lichenologist 4(2): 162; Parmelia furfuracea var. ceratea Ach. (1803) in: 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) Szatrala; Pseudevernia furfuracea var. olivetorina (Zopf) Zopf

Note that if this taxon were treated at the rank of form, 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 with a different medullary chemistry (C+ red). The two varieties also have the same ecology. The C+ reaction of the medulla is always clear and unambiguous, and var. ceratea can not be confused with var. furfuracea.

Many authors regard 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 how the frequency of the two varieties varies 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 of the two chemotypes in the north and the less common in the south. My own view is that the two chemotypes probably form a single, freely interbreeding, population, with the relative frequency of one or a few genes (or alleles) being influenced by environmental factors. On this view, var. ceratea does not merit formal recognition. I maintain it here for the practical reason that something with a name will get recorded, so we will more easily gather information on the relative frequency of the two chemotypes, whereas something without a name will be ignored.

Distribution, substrate and altitude range approximately as for var. furfuracea, but 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). Reports for S. America are incorrect.
Psora Hoffm. (1796)

in: Deutschl. Fl. 2: 161. The name is conserved against Psora Hill (1762) and Psora Hoffm. (1789).

Type: *P. decipiens* (Hedw.) Hoffm. Family: Psoraceae. Literature: Monographed by Schneider in *Bibl. Lich.* 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 my 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.

About 32 species, on soil and rock especially in dry regions. About 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 a white margin. Medulla K-. **P. decipiens**

2 Squamules brown or green-brown, without a pink tinge, usually without a red tinge (except sometimes in *P. globifera*), with or without a 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, ±entire. 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 sometimes orange-brown, but 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):581, claims that it is not. However, since that date it has been included in the checklists for the Iberian Peninsula (Llimona & Hladun, 2001), and Macaronesia (Hafellner, 1995). It was recently reported for Crete by Christensen & Svane (2007). In the careful discussion of the Sonoran species of *Psora* by Timdal in Nash et al. (2002), the distribution cited does not include Europe. Greek reports might refer to *P. vallesiaca*, which has similar spot test reactions. The matter needs to be clarified.

Elsewhere, reliably reported for Africa (S. Africa), N. America (SW USA), C. America (Mexico), Australasia (several states of Australia, NZS). Reports for Asia (Mongolia, China) may be incorrect, as Timdal in Nash et al. (2002) does not mention Asia.

Psora decipiens (Hedw.) Hoffm. (1794)

in: *Descr. Pl. Cr. Crypt. 2(2-4):* 63-64; *Lichen decipiens* Hedw. (1789) in: *Descr. Micr.-Anal. Musc. Frond.* 2:7. (The name was also published the same year by Ehrhart, in *Beiträge zur Naturkunde* 4:46. I do not know which was published first.); *Biatora decipiens* (Hedw.) Fr.; *Lecidea decipiens* (Hedw.) Ach.; *Lecidea decipiens var. albomarginata* (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. albomarginata Müll. Arg.; Psora decipiens f. dealbata A. Massal.; Psora decipiens var. galactina (Zahlbr.) ined.

Acharius (1799: 96) considered Lichen stellatus Relhan (1785), in Fl. cantab. 430, to be synonymous. It would have priority. However, Relhan's name does not appear to have been typified, and authentic material probably no longer exists, so the synonymy can not be confirmed.

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 of these reports may refer to P. vallesiaca.

Abbott's Peloponnesian collections cited in Abbott (2009) have been re-examined and all were found to contain abundant norstictic acid. The colour of the thallus varies from brown to orange brown to (in a single collection, pink-brown). At present it is not clear to me whether they belong in P. decipiens or P. vallesiaca, but for the present I have tentatively referred 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), 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. South of the Alps very rare and confined to high mountains. Also Asia (Russia, Kazakhstan, Mongolia), N. America (widespread), C. America (Mexico), perhaps Australasia.

Psora gresinonis de Lesd. (1930)


Possibly present on Santorini and Crete, but there are no confirmed modern records. Published reports are from soil at altitudes 0 - 100 m.

Only Mediterranean Europe, from Iberian Peninsula to Greece.

Psora pseudoruscellii Timdal (1987)
in: Bryologist 89(4): 269-271

Description: Nash et al. (2002).

Crete, overgrowing saxicolous bryophytes at altitudes 700 - 1100 m.

Present in Mediterranean Europe according to Timdal in Nash et al. (2002), though the only explicit reports that I have seen are those for Greece. Also N. America (fairly widespread in USA), C. America (Mexico).

Psora testacea Hoffm. (1790)

My only Peloponnesian collection is rather scanty and lacks mature asci. The description is incomplete as a result.

Thallus: squamulose, to 2 cm diameter. Squamules: grey to very pale brown, usually heavily white pruinose, 2 - 4 mm diameter, contiguous and 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, K- (in section). Lower cortex: absent, but below the medulla is a distinct, pale brown layer 40 - 200 µm thick; it is too loosely organised to be called a cortex. Apothecia: 1 - 1.8 mm diameter, strongly convex, often occurring in clusters, not pruinose. Disc: brown-red to dull red, K+ purple. Exciple: excluded very early, generally not apparent externally, rather poorly developed in section. Thalline margin: absent. 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 colourless in lower half, usually with much epiblastic pigment in upper half. Hypothecium: ±colourless. Ascospores: colourless, simple, ellipsoid, 13 x 5 µm. Chemistry: in spot tests, medulla K-. Photobiont: green, cells globose, 10 - 15 µm diameter, forming a continuous, regular layer 50 - 70 µm thick.

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.

Probably commonest in southern Europe, but present to as far north as southern Sweden, though absent from British Is. Also Asia (widespread), N. Africa (Morocco, Algeria, Mauretania). Reports for N. America said to be incorrect, and I am sceptical of a report for S. America (Argentina).

Psora vallesiaca (Schaer.) Timdal (1984)

As discussed above under P. decipiens, many Peloponnesian collections are difficult to place. The description below should be used with caution, as some of the material on which it is based may eventually prove to belong to P. decipiens.

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 the 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-nrown 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. Exciple: excluded early. Thalline margin: absent in mature apothecia; sometimes obscurely present on lower surface of young apothecia. Epithecium: brown to dark brown, K-, (? K+ in one collection) little changed in K. Hymenium: 70 - 75 µm tall, colourless to pale brown or pale red-brown. Hypothecium: colourless to pale brown. Paraphyses: coherent, ±moniliiform. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 12 x 5 - 7 µm. Chemistry: cortex K- (in section); 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 roughly as far north as the Arctic Circle. Also Macaronesia (Canary Is), Asia (widespread), Africa (Morocco, Egypt, S. Africa), N. America (arctic Canada).

Psoroma Ach. ex Michx. (1803)
in: Fl. Bor.-Amer. 2: 321. (The name was originally introduced, as Lichen tribus Psoroma Ach. in Lichenogr. Svec. Prodr. 91. However, the rank of tribe is to be used for a taxon intermediate between family and genus, not for a subdivision of a genus, so Acharius's name is not validly published.)


About 32 species, 3 of which occur in Europe. Two of these are distinctly northern and will not be present 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.

Widely distributed in northern and central Europe, but very rare south of the Alps. Also Macaronesia, Asia (Iran, Kazakhstan, Russia, Mongolia), Malesia (PNG), N. America (widespread from Alaska to cooler parts of USA, but avoiding continental interior), C. America (Mexico), S. America (widespread), Australasia (SE Australia, both islands of NZ), Antarctica (widespread).

Psrotichia A. Massal. (1855)
in: Framm. Lich. 15

Peninsula and would probably be helpful in Greece. A basic starting point is Clauzade & Roux (1985).

At least 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 ±globose. (P. frustulosa) Greek report doubtful.
2 Ascospores distinctly ellipsoid.
33 Thallus almost continuous, not pruinose.
   44 Ascospores 6 - 7 µm long. (P. incrustans)
   4 Ascospores 8 - 14 µm long. *P. montinii*
33 Thallus of ±dispersed granules, not pruinose. *P. numidella* s. lat.
   44 Epitheciun colourless. (P. numidella var. numidella)
   4 Epitheciun blue-green *P. numidella var. flageyana*
3 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.) Forssell (1885)
   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 probably does not belong to *Psorotichia* either, but its correct position is not clear at present.
   Rare and very scattered, but 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), C. America (Mexico).

*Psorotichia numidella var. flageyana* J. Steiner (1898)
   Description: Nash et al. (2007).
   Peloponnese, on limestone at an altitude of 20 m.
   Known only from Greece, N. Africa and Mexico. Var. numidella is not reported for Greece, but might occur here.

*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 (scattered in USA), C. America (Mexico), Antarctica (S. Georgia, though this may be a different taxon).

*Psorotichia vermiculata* (Nyl.) Forssell (1885)
in: Beitr. Gloeolich. 73: Collemopsis vermiculata Nyl. (1881) in: Flora 64: 529
   Description: Clauzade & Roux (1985).
   Crete, on limestone close to sea level.
   Known only from Iberian Peninsula, Greece and Syria.
Pterygiopsis Vain. (1890)

in: Acta Soc. Fauna Fl. Fenn. 7(1): 238

Type: *P. atra* Vain. Family: Lichinaceae. Literature: There is no comprehensive 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 known 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.
Scattered in southern and central Europe. Also SW Asia (Yemen), N. Africa (Morocco).

Punctelia Krog (1982)

in: 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 36 species, of which about 8 occur in Europe. Species that are likely to occur in Greece have soredia and lack corticate isidia or isidia-like structures.

11 Lower surface black. *(P. borreri)*, *(P. stictica)*
1 Lower surface white to pale brown.
22 Upper surface wrinkled or ridged. *(P. perretilculata)*
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 the lobe surface. *(P. jeckeri)*

Punctelia subrudecta (Nyl.) Krog (1982)

in: Nordic J. Bot. 2: 291; *Parmelia subrudecta* Nyl. (1886) in: Flora 69: 320; *Parmelia borreri var. subrudecta* (Nyl.) Cl. Roux

The earliest name appears to be *Lichen dubius* Wulf. (1790), and the correct name may be *Punctelia dubia* (Wulf.) ined. Wulfen’s name may have been overlooked because *Parmelia dubia* (Wulf.) Schaer. is not legitimate (later homonym).


Rare and scattered in northern Greece, on bark at altitudes 0 - 160 m. Recorded from *Prunus persica*, *Platanus orientalis*, *Quercus coccifera* and *Robinia pseudacacia*.

Subcosmopolitan. Widely distributed in Europe Also Macaronesia, Asia (widespread), Africa (N. Africa, widespread in E. Africa, S. Africa, Madagascar), Australasia (widespread), Pacific (Hawaii), Antarctica (St. Paul Island). Its status in N. America is unclear: the America taxon may be distinct. Reports for C. and S. America are also uncertain as a result.
**Pycnora Hafellner (2001)**

in: Hafellner & Türk, in *Stapfia* 76: 157-158  
Type: *P. xanthococca* (Sommerf.) Hafellner. Family: Pycnoraceae. 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** (Nyl.) Hafellner (2001)  
in: Hafellner & Türk, in *Stapfia* 76: 158; *Lecidea praestabilis* Nyl. (1874) in: *Flora* 57: 13; *Lecidea xanthococca* var. *praestabilis* (Nyl.) Vain.  
Description: Nash et al. (2002) as *Hypocenomyce praestabilis*.  
Mt. Olympus, on wood at an altitude of 1800 m.  
Widely distributed in central Europe, ranging as far north as southern Norway, but rare south of the Alps. Also Asia (Russia), N. America (scattered in USA). C. America (Mexico).

**Pyrenopsis** (Nyl.) Nyl. (1858)

Type: *P. fuscatula* Nyl. (=? *P. subareolata*). The type is conserved. Family: Lichinaceae. 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. In the absence of a modern monograph, it is impossible to estimate the number of species. About 19 have been 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.  

**Pyrenopsis subareolata** Nyl. (1861)  
The nomenclature need to be investigated, as the 1861 name is a nomen nudum. The correct name may be *Pyrenopsis fuscatula*Nyl. (1858), but the synonymy is not certain.  
Description: Ahti et al. (2007); Smith et al. (2009).  
Paros, on siliceous rock (granite) at an altitude of 25 m.  
Scattered in NW Europe (Greenland to Germany). The Greek report is the only one from south of the Alps, and is very disjunct. I have not seen any reports for other continents.

**Pyrenula Ach. (1814)**

Type: *P. nitida* (Weigel) Ach. The type is conserved. Family: Pyrenulaceae. Literature: Smith et al. (2009) treat all the species that are likely to occur in southern Europe, except for *P. pyrenuloides*. For that, see Nash et al. (2002).  
About 200 species, mostly corticolous, best developed in tropical regions. About 15 species occur in Europe, but most reports are from humid western regions and the genus is poorly represented in Greece.

11 Involucrellum distinctly extended laterally, separated from exciple. Exciple not continuous below perithecial cavity. (P. coryli)  
1 Involucrellum not, or only slightly, extended laterally; not separated from exciple. Exciple continuous below perithecial cavity.  
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.

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.

44 Ascospores 3-septate, 25 - 35 µm long.

55 Perithecia 0.2 - 0.3 mm diameter. P. chlorospila

5 Perithecia more than 0.4 mm diameter.

66 Ostiole central. Ascospores 27 - 33 x 10 - 13 µm. (P. macrospora) Greek report doubtful.

6 Ostiole displaced to one side. Ascospores 20 - 25 x 8 - 10 µm. (P. acutispora)

4 Ascospores muriform, 50 - 70 µm long. (P. pyrenuloides)

Pyrenula chlorospila Arnold (1887)

in: Flora 70: 155; Verrucaria chlorospila Nyl.

Verrucaria chlorospila Nyl. (1886) in Flora 69: 464 is homotypic but not legitimate, being a later homonym of V. chlorospila Nyl. (1879). There are numerous earlier names. All but one are either at infra-specific ranks or illegitimate. The only earlier legitimate name at the rank of species is for a lichen collected in New Zealand, and the synonymy must, I think, be regarded as uncertain.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Widely distributed in Mediterranean regions with a humid or at least subhumid climate, and in suboceanic parts of western Europe, but very rare in other parts of Europe. Also Asia (Syria, Iran, southern Siberia).

Pyrenula nitida (Weigel) Ach. (1814)


The name Lichen alveolatus Scop. (1772) may be synonymous. It is not known whether it was published before or after Weigel's name.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Rare and scattered in northern Greece. On bark at altitudes up to 1500 m.

Widely distributed in Europe, but rare south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, Sao Tome, S. Africa, Reunion Is), perhaps Australasia (Australia), Pacific (New Caledonia, Tahiti). Reports for N. America are incorrect, so those for Caribbean, C. & S. America are probably also doubtful.

Pyrenula nitidella (Flörke) Müll. Arg. (1885)

in: Bot. Jahrb. 6: 414; Verrucaria nitida (= indefinite rank) nitidella Flörke (1815) in: Deutsche Lichenen no. 10; Pyrenula nitidula var. nitidella (Flörke ) Schær.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in NW Greece. On bark at altitudes 20 - 400 m.

Quite widely distributed in Europe. Also Asia (southern Siberia), Africa (Morocco, S. Africa, Reunion Is), 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)


Type: P. quernea (Dicks.) Körb. Family: Lecanoraceae. Literature: Monographed by Hafellner in Herzogia 9: 725-747. 1993 [not seen]. Poelt & Vězda (1977) discuss, rather briefly, the three species included in the key below, but under Protoblastenia.

As presently delimited Pyrrhospora contains 9 species, 4 of which occur in Europe. Three are reported for Greece, but all are rare. The limits of the genus have fluctuated considerably in recent years, with species moving both in and out, and further changes may occur.

11 Apothecia bright red.

22 Soredia present. P. lusitanica

2 Soredia absent. P. cinnabarina

1 Apothecia brown-red or black-red.

22 Thallus ± entirely granular sorediate. P. quernea
2 Soralia absent. See (Ramboldia russula)

**Pyrrhospora cinnabarina** (Sommerv.) M. Choisy (1950)

Descriptions: Clauzade & Roux (1985), Poelt & Vězdá (1977), both as *Protoblastenia cinnabarina*.

Epithecium, at an altitude of 700 m, on bark.

Widely distributed in the western half of Europe from the Alps and Pyrenees to beyond the Arctic Circle, but avoiding those parts of eastern Europe with a distinctly continental climate. Very rare, in southern Europe. Also Asia (northern Russia, Mongolia, Yunnan), N. America (Alaska to NW USA), S. America (Venezuela, perhaps Argentina).

**Pyrrhospora lusitanica** (Räsänen) Hafellner (1992)

Description: Poelt & Vězdá (1977) as *Protoblastenia lusitanica*.

Mediterranean/Macaronesian. Spain to Greece. Also Macaronesia (Madeira, Canary Is, but not the much cooler Azores).

**Pyrrhospora quernea** (Dicks.) Körb. (1855)

Thallus: crustose, entirely sorediate, forming small patches to 2 cm diameter, often bounded by a black prothallus, 0.2 mm wide. Soralia: green. Apothecia: sessile, soon becoming convex, 0.55 - 0.6 mm diameter, not pruinose. Disc: brown. Proper exciple: not visible externally; in section: poorly developed and not clearly distinct from hymenium, of radiating hyphae. Thalline margin: absent. Epithecium: orange-brown, K+ purple (reaction fleeting), pigment soluble in K. Hymenium: 50 µm tall, colourless. Hypothecium: pale orange-brown, K+ bright red in places. Paraphyses: 1.5 µm wide at base, not capitate. Asc: 37 x 20 µm, subglobose to broadly clavate. Ascospores: colourless, simple but often with 2 distinct locules, ellipsoid, 8 per ascus, 12 x 7 µm. Chemistry: soralia K-, C+ orange, P-. Photobiont: green.

This is a distinctive species that is unlikely to be confused with any other.

Very scattered, with no clear pattern except that most records are from near the sea. Usually on bark, occasionally on wood, at altitudes 0 - 1280 m, though most reports are from below 400 m. Reported from a fairly wide range of phorophytes, with no strong preference, but, judging from the rather few reports, it avoids strongly basic bark.

Widely distributed in the western half of Europe to as far north as southern Scandinavia. In the east, restricted to regions with a mild climate, such as the Mediterranean coast. Also Macaronesia. Asia (Turkey, Syria, Pacific coast), N. Africa (Morocco), N. America (mild regions along both coasts, rarely elsewhere), C. America (Mexico).

**Ramalina Ach.** (1809)
in: *Luyken, Tent. Hist. Lich.* 95

Type: *R. farinacea* (L.) Ach. The type is conserved. Family: *Ramalinaceae*. 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, even though she treats only the 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: sometimes present on soralia, but independent isidia absent. Apothecia: usually slightly stalked, fairly large (typically 0.5 - 5 mm diameter). Disc: pale green, green-brown or brown, white pruinose in some species. Exciple: not visible externally, usually rather poorly developed in section. Thalline exciple: present, usually fairly thin; in section with a prominent cortex formed of anastomosed hyphae. 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 a 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 (never strongly) capitate. Asc: rather small (to about 50 x 15 µm), usually clavate, Bacidia type. Ascospores: colourless, 1-septate, ellipsoid, straight or curved, 8 per ascus, fairly small (to about 20 µm long). Chemistry: medulla I-; other reactions various, but many species reacting entirely negatively in spot tests. Photobiont: green, trebouxoid.

Detailed anatomical investigations of the thallus, and to a lesser degree the apothecia, are handicapped in this genus by the difficulty of cutting good thin sections.
Asci in *Ramalina* are said to be Bacidia type. In practice, it is usually very difficult to distinguish between Biatora type and Bacidia type asci, especially when asci are rather small, as they are in *Ramalina*. In the descriptions of individual species in this genus, when I describe asci as “Bacidia type” this should be understood only as meaning that my own observations indicate that they have 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.

Over 200 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 other Greek species are known from very few records.

Many 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., also reported for Greece, is included, but as one of a group of species that needs revision; they are not keyed out to individual species. The key also does not properly include *R. euxini*, not reported for Greece but present in Bulgaria, as the only published description, in the protologue in *Folia. Geobot. Phytotax.* 14(2): 205-206. 1979, is inadequate for this genus, in which many species exhibit much morphological plasticity.

**Key to Ramalina main groups**

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Thallus pendent, of many thin branches, like Alectoria.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Thallus erect or pendent, not resembling Alectoria.</td>
<td></td>
</tr>
<tr>
<td>22 Soralia and/or isidia present. Group 2.</td>
<td></td>
</tr>
<tr>
<td>33 Apothecia only at branch tips. Group 3.</td>
<td></td>
</tr>
<tr>
<td>3 Apothecia not restricted to branch tips. Group 4.</td>
<td></td>
</tr>
</tbody>
</table>

(1) If apothecia are absent, and the material is clearly not juvenile, consider *Evernia divaricata*.

**Key to Ramalina group 1**: Branches thin, like Alectoria.

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Thallus with a yellowish tinge. Medulla K+ yellow &gt; reddish, P+ orange or red. Soralia absent. Pseudocyphellae common, elongate. (R. arabum)</th>
</tr>
</thead>
</table>

**Key to Ramalina group 2**: Branches not very thin; vegetative propagules present.

<table>
<thead>
<tr>
<th>Group 2</th>
<th>Soralia forming on inside surfaces of the lobes. Branches becoming hollow and splitting open.</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Soralia formed on inside of inflated structure at apex of branches.</td>
<td></td>
</tr>
<tr>
<td>2 Soralia not confined to apex of branches; apex not inflated.</td>
<td></td>
</tr>
<tr>
<td>1 Soralia forming on outer surface of the lobes. Branches solid or hollow, but not normally splitting open.</td>
<td></td>
</tr>
<tr>
<td>22 Main branches perforated with small holes. Main branches to 1 (2) mm wide, dividing into many fine branches; thallus sometimes appearing almost coralloid as a result. (R. roesleri)</td>
<td></td>
</tr>
<tr>
<td>2 Main branches without (or almost without) holes, more than 1 mm wide in some species, divided or not; thallus not coralloid.</td>
<td></td>
</tr>
<tr>
<td>33 True soralia absent, but corticate granules resembling soralia often present. Granules and apothecia marginal and laminal. Branches to 6 cm long.</td>
<td></td>
</tr>
<tr>
<td>44 True soralia often present. Soralia and apothecia mostly near the apices. Branches to 2 cm long.</td>
<td></td>
</tr>
<tr>
<td>4 True soralia often present. Soralia and apothecia mostly near the apices. Branches to 2 cm long.</td>
<td></td>
</tr>
<tr>
<td>55 Soralia agglomerate, sometimes capitately.</td>
<td></td>
</tr>
<tr>
<td>56 Main branches finely divided into small branchlets, with very small terminal soralia.</td>
<td></td>
</tr>
<tr>
<td>56 Main branches not finely divided into small branchlets. Soralia larger.</td>
<td></td>
</tr>
<tr>
<td>5 Soralia labiform.</td>
<td></td>
</tr>
<tr>
<td>6 Main branches without longitudinal ridges. Thallus erect or pendent. On bark or rock.</td>
<td></td>
</tr>
</tbody>
</table>

57 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. laceria** 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 and P reactions various.
   77 Soredia granular, usually concentrated at branch tips. Soralia K-, P-. On rock. (R. intermedia)
   7 Soredia farinose, not concentrated at branch tips. Soralia K+ or K-, P+ yellow to orange or P-. On bark or rock.

88 Holdfast simple. On bark, not forming extensive swarms. **R. farinacea**

Note 2.

8 Holdfast spreading. On rock, usually forming extensive swarms. **R. subfarinacea**

6 Soralia irregularly round or long, becoming confluent. Medulla and soralia 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. hycana)

(1) In R. polymorpha the 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. laceria and R. pollinaria are variable species and many of their characters overlap. However the branches in R. laceria are matt whereas those in R. pollinaria are shiny.

**Key to Ramalina group 3**: Branches not very thin; vegetative propagules absent; apothecia only at tips of branches.

11 Branches very hollow and swollen.
   22 Thallus K+ red, P+ orange. (R. subpusilla)
   2 Thallus K-, P-.

   33 Pseudocyphellae absent. On bark. **R. pusilla**
   3 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 4**: 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 and 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. subgenicularata**

3 Branches not channeled (but surface may be ridged). Ascospores straight or curved. 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. implicens**

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, even 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.

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**Ramalina breviuscula** (Nyl.) Nyl. (1872)


Description: Clauzade & Roux (1985).

Peloponnesse and islands of the southern Aegean, including Crete. On siliceous rock at altitudes 25 - 1000 m. Basically a species of southern Europe, from Iberian Peninsula to Cyprus, though also present in Bulgaria. Also western Asia (Turkey).

**Ramalina calicaris** (L.) Fr. (1824)


*Ramalina calicaris var. canaliculata* Boiss., nom. superf1.; (?) *Ramalina calicaris var. sorediosa* Sambo; (?) *Ramalina graeca* Müll. Arg.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Throughout Greece. On bark at altitudes 25 to about 1800 m. Reported from a wide range of phorophytes, with no marked preference. Most of the reports are old, and many may refer to *R. fraxinea var. calicariformis*.

Throughout Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Egypt, perhaps S. Africa), N. America (Alberta, widespread in USA mainly in the eastern half), perhaps C. America (Mexico), perhaps Pacific (Fiji, Hawaii, New Caledonia, Tahiti). Reports for S. America, Australasia aid to be incorrect.

**Ramalina canariensis** J. Steiner (1904)


Easily recognised when the 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, mostly in sites with a maritime climate, and never far from the sea. Usually on bark, occasionally on siliceous rock, at altitudes 0 - 780 m, but more than half of records are from below 200 m. Reported from a wide range of basic and acidic barked phorophytes, with no obvious preference.

Widely distributed in those parts of Europe with a warm, or at least mild, maritime climate. It reaches British Is, but
is absent from Baltic States and very rare in the Nordic Countries. Absent from large parts of eastern Europe. Also Macaronesia, western Asia (Turkey, Syria), Africa (Morocco, S. Africa), N. America (California), C. America (Mexico), perhaps S. America (Chile), Australasia (widespread).

**Ramalina capitata (Ach.) Nyl. (1872) var. capitata**

If the name *Lichen tinctorius* Weber is synonymous, as some have suggested, then the correct name for this taxon is *Ramalina tinctoria* (Weber) D. Dietr.

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.

Widely distributed in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), perhaps Africa (Morocco, perhaps Ethiopia - old report), perhaps N. America (Arkansas).

**Ramalina capitata var. digitellata (Nyl.) Nimis (1993)**
in: The lichens of Italy 597; *Ramalina digitellata* Nyl. (1880) in: *Flora* 63: 10

Description: Nimis (1993):602 (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 Spain to Cyprus, and perhaps 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 Spain to Greece, and western Asia (Turkey).

**Ramalina carpatica Körb. (1870)**

Description: Ş enkardeşler & Calba (2011)

Rare in northern Greece, on siliceous rock at altitudes around 1600 m. Except for the two Greek records, all reports of *R. carpatica* are from central Europe, from Germany to Ukraine. There are no reports for other continents.

**Ramalina clementeana Llimona & Werner (1975)**
in: *Acta Phytotax. Barcinon.* 16: 9; *Ramalina cribrosa* f. fastigiata (De Not.) Szatala

There are earlier names, but not at the rank of species.

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.

Only southern Europe, from Spain to Greece, and 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 Croatia and Greece. Reports for Macaronesia are incorrect.
Ramalina elegans (Bagl. & Car.) Stützenb. (1891)  


**Description:** Clauzade & Roux (1985).

Very scattered, with no clear pattern. The report for Rhodes is disjunct and may be unreliable. On bark at altitudes 400 - 1100 m. Phorophytes were not indicated.

A rather uncommon, or perhaps just rarely recognised, species with its centre of distribution in central Europe. Range extends north into southern Scandinavia, but absent from British Is. Southwards it extends into the Balkans and at least northern Greece, but probably absent from regions with truly Mediterranean vegetation. I have not seen any reports for other continents.

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**Ramalina farinacea** (L.) Ach. (1810)  


**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-, KC-, P+ orange, UV-. Photobiont: green; cells globose, 9 - 13 μm diameter, with large central chloroplast, 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.

Common throughout Greece at altitudes 0 - 1650 m. Usually on bark (94% of records), but occasionally on wood or siliceous rock. Recorded from a wide range of phorophytes with no clear preferences, but generally avoiding strongly basic bark.

Throughout Europe except for truly arctic regions. Also Macaronesia (widespread), Asia (widespread), Africa (Morocco, Algeria, Tunisia, Socotra, perhaps S. Africa), N. America (widespread), Caribbean (Cuba; perhaps also Bahamas and Guadeloupe), C. America (Mexico), perhaps Pacific (Hawaii, Tahiti, W. Samoa). Reports for S. America, Australasia said to be incorrect.

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**Ramalina fastigiata** (Pers.) Ach. (1810)  


**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 channeled. Soralia: absent. Cortex: 25 - 80 μm thick, colourless or almost, formed of thin anastomosed hyphae, usually in two layers; lower layer usually 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. 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. Thalline margin: thin but persistent; in section: 60 μm wide of which cortex 40 μm; cortex of anastomosed hyphae oriented predominantly perpendicular to surface. 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, apex 2 - 4 µm, sometimes slightly capitate, occasionally slightly moniliform. Asci: 45 - 50 x 12 - 15 µm, clavate to almost cylindrical, Bacidia type. Ascospores: colourless, 1-septate, basically ellipsoid but often curved, 8 per ascus, 12.5 - 14 x 5 - 8 µm. 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 the hyphae are predominantly horizontal, may be difficult to recognise in some sections. However, it will be clearly seen in a longitudinal section taken at the extreme margin of a branch, i.e. a very shallow section. Note that 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 channeled branches, but that character may be less helpful in doubtful cases as the basal parts of branches in *R. fastigiata* are sometimes slightly channelled.

Throughout Greece. Common at altitudes 0 - 1500 m; there is also a single report from over 2000 m. Usually on bark (95% of records), occasionally on rock. With a clear preference for *Quercus* (about half of corticolous records for which the phorophyte was reported) but also reported from a wide range of other species. The lichenicolous fungus *Tremella numalinae* has been reported once from this lichen.

Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Socotra; a very old report for Cape Province in S. Africa may not be reliable), S. America (Chile, perhaps Argentina). Reports for N. America, Australasia said to be incorrect.

**Ramalina fraxinea** (L.) Ach. (1810) var. *fraxinea*


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 channelled. Pseudocryptphallae: present on both surface of branches but often inconspicuous, 0.3 - 0.6 x 0.05 - 0.1 (0.2) mm. Sororia: 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. Exciple: not visible externally; in section: poorly developed, to 15 µm wide. Thalline margin: present, usually thin, often becoming excluded in convex apothecia; in section: to 200 µm wide, cortex 20 - 40 µm, of Anastomosed hyphae. 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, 8 per ascus, 12 - 14 x 5 µm. Chemistry: medulla I-; thallus K-, C-, KC-, P-, UV- Photobiont: green, cells globose, 9 - 17 µm diameter.

Well developed material of this species can not be confused with any other.

Throughout Greece. On bark at all altitudes, though scarce below 400 m. Reported from a wide range of phorophytes, with no clear preference.

*R. fraxinea* s. lat. is present throughout Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), N. Africa (Morocco, Algeria, perhaps Cape Province of S. Africa - old report), Malesia (Java), N. America (widespread but scattered in temperate regions), perhaps C. America (Mexico - old report), perhaps S. America (Argentina, Ecuador, Venezuela - but I have not seen modern, confirmed reports), perhaps Pacific (Hawaii). Reports for Australasia are incorrect.

**Ramalina fraxinea** var. *calicariformis* Nyl. (1870)


Like var. *fraxinea*, but with narrower branches (0.5 - 1 mm wide in lower parts, to 2 mm in upper parts) that are distinctly channelled, 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 Europe, from Iberian Peninsula to Greece, though also present in Austria. Also Macaronesia (19th century report for Tenerife), Asia (Syria, NW China), N. America (California - old report).
Ramalina implectens Nyl. (1870)
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 the Balearic Is to Greece, but it does not occur in or north of the Alps and Pyrenees. Also Macaronesia (Azores, Canary Is), western Asia (Turkey), N. Africa (Morocco).

Ramalina lacera (With.) J. R. Laundon (1984)
The description is based on a single, rather scanty collection, and is brief. For fuller descriptions see: Clauzade & Roux (1985) as R. duriae; Nash et al. (2004); Smith et al. (2009).
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. Usually on bark (two thirds of reports), sometimes on calcareous or siliceous rock. Reported phorophytes include: Juniperus oxycedrus subsp. macrocarpa, Lycium schweinfurthii, Olea europaea, and Paliurus sp.
Widely distributed in western Europe to as far north as British Is and Denmark. In eastern Europe restricted to areas with a maritime climate: Crimea and the eastern Mediterranean. Also Macaronesia, Asia (widespread, but no further east than Oman), Africa (widespread in N. Africa; also S. Africa; St Helena), N. America (California), C. America (Mexico), S. America (Chile).

Ramalina lusitanica H. Magn. (1956)
in: Botaniska Notiser 109: 149
Description: Clauzade & Roux (1985).
Apparently reported for Corfu in the same university thesis as R. implectens. No further information available.
Strictly Mediterranean. Iberian Peninsula to Greece; also N. Africa (Morocco). Reports for Macaronesia are incorrect.

Ramalina nuda J. Steiner (1900)
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)
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 (Canary Is), 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 Europe, from Iberian Peninsula to Greece, just extending into the more southerly parts of Central Europe (Switzerland, Romania). Also N. Africa (Algeria).

Ramalina pollinaria (Westr.) Ach. (1810)
Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Scattered rather thinly throughout Greece, with no clear pattern. At altitudes 0 - 1800 m. On bark (about two-thirds of reports) or calcareous or siliceous rock. Reported phorophytes include: Cupressus sempervirens, Fagus sylvatica (which it may prefer, though there are too few records to be really sure), Pinus halepensis and Platanus orientalis.

Throughout Europe except for truly arctic regions. Also Macaronesia (reliably reported only for CVI), Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread), Caribbean (Trinidad), C. America (Mexico), S. America (Chile, Peru, perhaps Venezuela), Australasia (NZS), perhaps Pacific (Hawaii).

Ramalina polymorpha (Lilj.) Ach. (1810)

The earliest name may be Lichen polymorphus Ach. (1797), but it is not legitimate, being a later homonym of Lichen polymorphus With. (1776)

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Islands of the Aegean, including Crete, on siliceous rock at altitudes 20 - 1400 m.

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), Africa (Morocco, widespread in E. Africa; also Tristan Da Cunha), N. America (Saskatchewan, New Mexico), perhaps S. America (Argentina). Reports for Australasia are incorrect.

Ramalina pontica Vězda (1975)
in: [need to investigate - bibliographical details incomplete]

Description: [none seen]

Chios, on siliceous rock at altitudes 490 - 670 m.

Romania, Ukraine and Greece. Also western Asia (Turkey).

Ramalina pusilla Duby (1830)
in: Bot. Gall. 2: 614. (Authorship is not "Le Prev. ex Duby" as commonly cited. Le Prevost merely collected the material named by Duby.).


Corfu, and islands of the southern Aegean, at altitudes 0 - 300 m. Usually on bark, but reported once from wood.

On a wide range of phorophytes, with no clear preference.

Mediterranean Europe, from Portugal to Cyprus, and Macaronesia (widespread). There are old reports for Asia, Malesia, N. & S. Africa, Caribbean, but they 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 calcareous rock, and reported once from bark.

Southern Europe, from Spain to Greece (just extending beyond those limits into Bulgaria), and Macaronesia (widespread).

Ramalina scoriseda Zahlbr. (1914)
in: Annales Mycol. 12(3): 342-343

Description: none seen.

Samothraki, on rock. No altitude was reported.

Only Croatia, Ukraine and Greece.

Ramalina sinensis Jatta (1902)

There are earlier names, but not at the rank of species.


Macedonia, at altitudes 350 - 900 m. No substrate was reported.

Widely distributed north of the Alps, to as far as southern Scandinavia. Very rare south of the Alps. Also Asia (widespread), N. Africa (Morocco), N. America (widespread in southern Canada and cooler parts of USA), C. America (Mexico).
Ramalina subfarinacea (Nyl. ex Cromb.) 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.

Ramalina subgeniculata Nyl. (1870)
I have seen two collections, though one was scanty and the determination was tentative, but in this difficult group I prefer to wait until I have examined more material before attempting a description. For a published description see Groner & La Greca (1997:445).
Very scattered in the southern two thirds of Greece, never very far from the sea. On bark at altitudes 0 - 1000 m. Reported from Cupressus sempervirens, Quercus cocifera and Q. pubescens.
Perhaps circum-Mediterranean/Macaronesian. Southern Europe, from Iberian Peninsula to Greece. Also Macaronesia (widespread), western Asia (Turkey), N. Africa (Morocco, Algeria). There are reports for eastern Asia (China, Taiwan), but they are so disjunct that I wonder whether a different species may be involved.

Ramalina thrausta (Ach.) Nyl. (1870)
The name Usnea dichotoma Hoffm. (1796) may be the earliest name, but the synonymy is not certain.
Description: Clauzade & Roux (1985).
Macedonia, on bark of Picea abies at an altitude of about 1400 m.
Mostly northern and central Europe. Rare in the south, from Portugal to Greece and the Caucasus. Also Macaronesia (Azores, Canary Is), Asia (Turkey, Iran, Russia, Mongolia), N. America (widespread).

Rhizocarpon Ramond ex DC. (1805)
Type: R. geographicum (L.) DC. Family: Rhizocarpaceae. 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 his work is now dated and some of his concepts have not been accepted by later workers. Runemark saw rather little material from SE Europe, and so 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) give a good and reliable treatment of those species occurring in the British Is, while Timdal & Holtan-Hartwig (1988) provide a key to the species then known from Scandinavia. Elsewhere in Europe, these can usefully be supplemented by material from Clauzade & Roux (1985) and Nash et al. (2004).
Thallus: crustose, green, brown or white, often with a distinct dark-coloured hypothallus or prothallus. Vegetative propagules: absent in most species. Apothecia: black, without a thalline exciple. Paraphyses: much branched and often anastomosed. Ascospores muriform, 3-septate or 1-septate, medium sized to fairly large, pale grey to dark brown when mature, often with a visible perispore.
Some 1-septate species could be confused with Buellia. The two genera have different asus types, but an easier way to separate them is by paraphyses: simple in Buellia and distinctly anastomosed in Rhizocarpon.
As presently circumscribed, the genus is not monophyletic, and its boundaries are likely to change eventually.
About 140 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.

**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. superficiale) 
3 Medulla K- or K+ yellow, I+ blue. (R. effiguratum) Greek reports doubtful.
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.
22 Medulla I- or faintly I+ blue. Upper part of epithecium with many black granules. Ascospores 14 - 32 x 7 - 16 µm. Parasitic when young. **R. viridiatrum** Note 1.
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. eupetraeoides**
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. macrosorum**
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) Several 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 it might be advisable to 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. radioatrum**) 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. obscuratum** and **R. reductum**
   3 Not parasitic. **R. geminatum**
      33 Asci with 2 ascospores. **R. geminatum**
      3 Asci with 1 ascospore. **R. disporum**

**Rhizocarpon disporum** (Nägeli ex Hepp) Müll. Arg. (1879)
in: *Rev. Mycol.* 1: 170; *Lecidea dispora* Nägeli ex Hepp (1853) in: Die Flechten Europa's no. 28

The earliest name may be *Rhizocarpon confervoides* DC., but the application of that name is disputed. Descriptions: Clauzade & Roux (1985); Nash et al. (2004). There is a single report for Macedonia, at an altitude of 200 m. The substrate was not stated.

Widely distributed in northern and central Europe, but rare south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread from Alaska to cooler parts of USA), C. America (Mexico), S. America (Argentina, Bolivia, Chile), Australasia (SE Australia, NZS), Antarctica (widespread).
**Rhizocarpon distinctum** Th. Fr. (1874)
in: Lichenogr. Scand. 625­627; *Rhizocarpon ambiguum* sensu Zahlbr., non (Ach.) Zahlbr.; *Rhizocarpon atroalbum* sensu Arnold, non (L.) Arnold, nec (Nyl.) Zahlbr.; *Rhizocarpon distinctum* f. *olympicum* (J. Steiner) J. Steiner

Thallus: crustose, areolate, grey to brown­grey, not pruinose, 1 - 2 cm diam (in material seen by me; 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. Epithecium: ± 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, forming a continuous, ± regular layer 80 μm thick.

Scattered throughout Greece, on siliceous rock at altitudes 0 - 2000 m. Throughout Europe. Also Asia (Turkey, Kazakhstan, Russia, India), N. Africa (Morocco), N. America (scattered in Canada and cooler parts of USA), southern S. America (Chile, perhaps Argentina), Australasia (Victoria, cooler parts of NZ), Antarctica (Antarctic Peninsula).

**Rhizocarpon epispilum** (Nyl.) Zahlbr. (1926)
in: Cat. Lich. Univ. 4: 333; *Lecidea epispila* Nyl. (1873) in: Flora 56: 73. Also in Bull. Soc. Linn. Normandie, sér. II, 6: 292, but that was probably published later; *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 European and Macaronesia (Canary Is). Its range extends north to the Pyrenees and to just beyond the Alps (southern Germany).

**Rhizocarpon eupetraeoides** (Nyl.) Blomb. & Forssell (1880)
in: [need to investigate]; *Lecidea eupetraeoides* Nyl. (1875) in: Flora 58: 12

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Known from a single site i Macedonia, where it occurred on serpentine at an altitude of 1550 m. Widely distributed in northern Europe; very rare further south. Also Asia (Russia, Japan), N. America (scattered in cold parts).

**Rhizocarpon ferax** H. Magn. (1948)
in: Botaniska Notiser 1948: 405

Description: Clauzade & Roux (1985).

Known from a single site in Macedonia, where it occurred on serpentine at an altitude of 2170 m. Widely spread in northern Europe, becoming much rarer southwards. Also Asia (Russia, Tajikistan, northern India), N. America (at least Quebec).

**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. Reported only from Germany, Austria, Italy and Greece.

**Rhizocarpon geminatum** Körb. (1855)

There are earlier names but they are either formally rejected, not legitimate or at different ranks.

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 to date. Cortex: 25 μm thick, not sharply delimited from algal layer, colourless to grey or brown, formed 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 the 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. Proper exciple: black, thin but persistent; in section: 50 - 100 μm wide, dark brown. Thalline margin: absent. Epithectum: brown to purple-brown, K+ red-purple, N-. Hymenium: 110 - 150 μm tall, colourless. Hypothecium: dark brown, opaque. Paraphyses: 1.5 μm wide, often with visible septa throughout, anastomosed. Ascospores: brown when mature but long remaining colourless or pale grey, muriform, ellipsoid to tadpole shaped, 2 per ascus, 35 - 55 x 20 - 28 μm; perispore sometimes visible, 1.5 - 2 μm wide. Chemistry: thallus UV-; medulla K-, P-. 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

Widely distributed in central and northern Europe. Uncommon south of the Alps and restricted to the mountains. Also Macaronesia, Asia (widespread), N. America (widespread from Alaska to cooler parts of USA), S. America (Argentina, Bolivia), Australasia (NZS), Antarctica (Antarctic Peninsula and adjacent subantarctic islands).

**Rhizocarpon geographicum (L.) DC. (1805) subsp. geographicum**


Thallus: crustose, to 6 cm diameter (in material examined in the 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 the areoles, black; a black, marginal prothallus sometimes also present. Cortex: 25 - 30 μm tall, without distinct structure, mostly colourless but sometimes grey in uppermost 5 μm, with abundant small crystals that are not soluble in K. Medulla: white, formed of hyphae oriented perpendicular to surface, I+ blue. Apothecia: usually arising between the 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. Exciple: black, thin but persistent, usually slightly raised above level of disc; in section: 30 - 40 μm wide, pale brown to dark brown. Thalline margin: absent, but in some collections areoles can almost, or even entirely, surround an apothecium giving the impression of a thalline exciple. Epithectum: brown, sometimes with a faint red or purple tinge in water, K+ faintly but distinctly purplish, at least in places; sometimes overlain by a colourless, structureless layer 1 - 5 μm thick. Hymenium: 140 - 300 μm tall, colourless to brown. Hypothecium: dark brown, opaque. Paraphyses: 1.5 μm wide, with visible septa throughout, anastomosed, sometimes slightly capitulate, apex 2.5 - 3 μm, apical cell often with a thin, internal, crescent shaped cap of brown pigment that is not soluble in K. Ascospores: usually brown to dark brown, occasionally grey, muriform, 8 per ascus, ±ellipsoid, 35 - 42 x 13 - 20 μm, with 5 - 11 cells; a broad perispore, 5 - 7 μm wide, is sometimes visible. 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 fungi *Endococcus macrosorus*, *Endococcus perpusillus*, *Lecidea halacsyi*, *Muellerella ventosicola*, and *Rhymbocarpus geographicus* have been reported from *R. geographicum* s. lat.

Cosmopolitan outside tropical regions. Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (PNG, Sabah), Africa (widespread in N. Africa; also S. Africa, Reunion Is), N. America (widespread but continental interior or SE USA), C. America (CR, Mexico), S. America (widespread), Australasia (widespread in temperate parts), Pacific (Hawaii), Antarctica (widespread).

**Rhizocarpon geographicum subsp. diabasicum (Räisänen) Poelt & Vězda (1980)**


The earliest name is *Lecidea geographica* var. *alpestris* Hepp (1857), but it does not have priority at the rank of species.

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 a black prothallus, 0.1 - 0.5 mm wide, sometimes present. Cortex: 25 μm thick, pale brown, without distinct structure, with abundant crystals that are not soluble in K. Medulla: white, I+ blue or purple, formed of vertical hyphae. Apothecia: between the 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. Exciple: thin and sometimes inconspicuous but always present, black, persistent, usually raised above level of disc; in section: 15 - 50 µm wide, dark brown, opaque, sometimes faintly K+ purplish. Thalline margin: absent. Epithecium: brown, generally not well delimited from hymenium, K+ faintly purplish; often overlain by a 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, with visible septa throughout, anastomosed, only rarely slightly capitate or moniliform, apex to 4 µm but usually less. Ascii: 110 x 32 µm, ±eclavate. Ascospores: brown, muriform, 8 per ascus, ellipsoid, 18 - 38 x 12 - 20 µm, with 8 - 16 cells; a perispore is sometimes visible. 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.

Scattered throughout the cooler parts of Europe, Asia and North America. There is also a report from high altitude in N. Africa (Morocco).

**Rhizocarpon geographicum subsp. tinei** (Tornab.) Clauzade & Cl. Roux (1985)

At the rank of subspecies, the name *Rhizocarpon geographicum* subsp. *transatlanticum* Räsinen (1941) has priority if the synonymy is confirmed.


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.

Widely distributed in Europe, but commonest in the south. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Morocco, Algeria, Tunisia), N. America (scattered in USA), S. America (Falkland Is), Australasia (widespread in Australia), Antarctica (subantarctic Heard Is, Antarctic Peninsula).

**Rhizocarpon hochstetteri** (Körb.) Vain. (1922)

There are earlier names but they do not have priority at the rank of species.

**Descriptions:** There is a comprehensive discussion in Fryday (2002). See also Clauzade & Roux (1985); Smith et al. (2009).

Sterea Ellada, at an altitude of about 2150 m. The substrate was not reported. Throughout Europe, though rare south of the Alps and probably confined to high mountains. Also Macaronesia (only Azores), Asia (Russia, Mongolia, Japan), N. America (widespread from Alaska to cooler parts of USA), Australasia (NZS).

**Rhizocarpon lecanorinum** Anders (1923)

The nomenclature is not straightforward. The earliest name is *Lecidea atrovirens* var. *lecanora* Flörke (1819). *Rhizocarpon geographicum* var. *lecanorum* Flörke 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. lecanorum* Anders is legitimate. Lyne combined Flörke'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* (Flörke) Lyne is a superfluous name and not legitimate.

**Descriptions:** Clauzade & Roux (1985); Runemark (1956a); Smith et al. (2009).

Rare and scattered, with no clear pattern. On siliceous rock at all altitudes.

Widely distributed in Europe south of arctic regions. Also Macaronesia, Asia (widespread), Africa (S. Africa), N. America (widespread from Alaska to cool pars of USA), S. America (Colombia), Australasia (both islands of NZ).
Rhizocarpon macrosporum Rässén (1943)
in: Feddes Rep. 52(2): 139

Descriptive: 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 south of arctic regions, though not British Is. Also Asia (widespread as far east as southern Siberia and Himalayas), N. Africa (Morocco), N. America (southern Canada, cooler parts of USA).

Rhizocarpon obscuratum (Ach.) A. Massal. (1852)

Descriptive: Nash et al. (2004). The description in Purvis et al. (1992) refers to a different species. The name has often been misapplied; for a full discussion see Fryday (2000). Acharius's collections of Lecidea petraea var. obscurata include several different species, but the name has not yet been typified and its application is uncertain. The status of Greek reports is unclear, but some may refer to R. reductum.

Scattered, in the southern half of Greece, on siliceous rock at altitudes 0 - 2200 m. Owing to the confusion surrounding this name, some of these reports may be unreliable. The lichenicolous fungus Phaeospora rimosicola has been recorded once from this lichen.

Distribution rather uncertain, owing to confusion with other species. Probably widespread in Europe, except for the High Arctic. Also reported for Macaronesia, Asia (widespread), Africa (Morocco, S. Africa), N. America (cold to temperate regions along both coasts; only extending some way inland where the climate is moderated by the Great Lakes), C. America (CR, Mexico), S. America (Bolivia, Falkland Is), Australasia (SE Australia), Antarctica (Antarctic Peninsula, subantarctic Macquarie Is).

Rhizocarpon petraeum (Wulf.) A. Massal. (1852)

Lichen concentricus Davies (1794) is a superfluous name for Lichen petraeus Wulf., and most subsequent concentricus names are also superfluous.

As I have only a single, very scanty collection of this species, the description is brief.

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. Exciple: with crystals. Thalline exciple: absent. Epitheciun: 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 that was not the case in my only Greek collection.

Scattered, with no clear pattern. On siliceous rock at altitudes 100 to more than 1500 m.

Widely distributed in Europe to about as far north as the Arctic Circle. Also Macaronesia, Asia (Turkey, Russia, India), N. America (widespread from Alaska to cooler parts of USA), S. America (Colombia), Australasia (Tasmania, widespread in NZ).

Rhizocarpon polycarpum (Hepp) Th. Fr. (1874)

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 from Alaska to cooler parts of USA), perhaps S. America (Argentina), Australasia (Western Australia, NZS), Antarctica (widespread, but not continental Antarctica).

Rhizocarpon reductum Th. Fr. (1874)
in: Lichenogr. Scand. 633-634

Description: Smith et al. (2009).

Only definitely reported from the islands of Chios and Samothraki, where it occurred on siliceous rock at altitudes 420 - 440 m. However, some reports of R. obscuratum may belong here.
Throughout northern and central Europe, but very rare south of the Alps. Also Asia (widespread), Africa (N. Africa, S. Africa), N. America (widespread), S. America (widespread), and Australasia (Victoria, cooler parts of NZ).

**Rhizocarpon richardii** (Lamy ex Nyl.) Zahlbr. (1926)
in: Cat. Lich. Univ. 4: 341; *Lecidea richardii* Lamy ex Nyl. (1875) in: *Flora* 58: 446 as 'richardi'

Description: Smith et al. (2009).
Chios, on siliceous rock at altitudes 250 - 670 m.

Widepsread in cold and temperate Europe, rare in the south. Not reported from other continents.

**Rhizocarpon sublucidum** Räsänen (1947)

If the name *Rhizocarpon saanaense* Räsänen really is synonymous, as suggested by Timdal & Holtan-Hartwig (1988: 53), it would be the correct name for this lichen, as it dates from 1942. However, those authors specifically stated that they had not seen type material of either name.. There are also earlier names at infra-specific ranks, but they do not have priority at the rank of species.

Descriptions: Clauzade & Roux (1985); Runemark (1956a).
Peloponnesse, at high altitude.

Much of Europe, though absent from British Is. but not a common species. It may be most common in the Alps. Also Asia (widespread), Africa (Morocco, Ethiopia), N. America (scattered in USA).

**Rhizocarpon umbilicatum** (Ramond) Flagey (1894)
in: [need to investigate]; *Lecidea umbilicata* Ramond (1827) in: *Mém. Acad. Roy. Sci. Inst. Fr. 6*: 128; *Buellia epipolia var. calcarea* (Fr.) Servit; *Diplotomma epipolium var. calcareum* (Fr.) Flagey; *Lecidea calcarea α (= var.) weissii* Schä., nom. superfl.; *Rhizocarpon umbilicatum f. pseudospeireum* (Th. Fr.) Szatala

The earliest legitimate name at species rank may be synonymous is *Patellaria calcarea* Hoffm. (1801), but the synonymy is disputed.

As I have only a single, very scantly collection, the description is brief.


Scattered throughout Greece, but not common. On calcareous rock at altitudes 150 - 2600 m. Most records are from above 1000 m.

Widely distributed in Europe, but absent from the High Arctic. Also Macaronesia, Asia (Turkey, Russia, Mongolia), N. Africa (Morocco), N. America (very 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, on siliceous rock at altitudes 30 - 700 m.

Widely distributed in middle latitudes of Europe, but rare north of mid-Scandinavia and south of the Alps. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Natal), N. America (Arizona, California), S. America (Bolivia, Chile, Colombia), Australasia (Victoria, both islands of NZ).

**Rhizoplaca Zopf** (1905)


About 19 species, 6 of which occur in Europe.

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) Greeek report doubtful.

3 Thallus usually clearly umbilicate. Lower surface usually at least partly green to blue-black, without rhizinose strands. **R. chrysoleuca**

**Rhizoplaca chrysroleuca** (Sm.) Zopf (1905)

The name *Lichen rubinus* Lam. (1779) in: Fl. Franç. (mêth. anal.) 77 would have priority if the synonymy were confirmed, but Lamarck's name does not appear to have been typified.

Descriptions: Clauzade & Roux (1985); Nash et al. (2002).

Known from two sites in Epiros, on calcareous and serpentine rock at altitudes 2100 - 2150 m.

Widely distributed in cooler parts of Europe, but very rare south of the Alps. Also Asia (widespread), N. America (widespread), C. America (Mexico), and perhaps elsewhere.

**Rhizoplaca melanophthalma** (DC.) Leuckert & Poelt (1977)

Descriptions: Clauzade & Roux (1985); Nash et al. (2002).

Known from two sites in Epiros, on calcareous and serpentine rock at altitudes 2100 - 2150 m.

Widely distributed in cooler parts of Europe, but very rare south of the Alps. Also Asia (widespread), Africa (Morocco, Ethiopia, Kenya), N. America (widespread), C. America (Mexico), S. America (Argentina, Venezuela), Antarctica (widespread).

**Rhymbocarpus Zopf** (1896)
in: *Hedwigia* 35: 357


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 µm diameter, sometimes appearing perithecioid. Margin not or scarcely apparent.

22 Ascospores 11 - 12 x 4 - 5 µm. On Rhizocarpon. **R. geographici**

2 Ascospores 8 - 10.5 x 3 - 4 µm.

33 Lower part of exciple brown. On Roccella. (R. roccellae)

3 Lower part of exciple colourless or green. On Dirina ceratoniae. (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 Pertusaria or Lepraria.

33 On Pertusaria. (R. pertusariae)

3 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 various hosts.

33 Ascospores 10 - 15 x 2 - 3.5 µm. On Pertusaria. (R. pertusariae)

3 Ascospores 7 - 11 x 2 - 3 µm. Not on Pertusaria.

44 Disc pruinose. On Buellia griseovirens. (R. aggregatus)

4 Disc not pruinose. On Lepraria. (R. neglectus)

**Rhymbocarpus geographici** (J. Steiner) Vouaux (1913)
Descriptions: Clauzade, Diederich & Roux (1989) as *Phacopsis geographici*; Diederich & Etayo (2000). Attica and eastern Peloponnesse, at altitudes 20 - 1100 m. Always on *Rhizocarpon geographicum*. Sweden, Italy and Greece. Also Asia (Turkey, Russia), S. America (Chile).

**Rimularia Nyl. (1868)**

in: Flora 51: 346


About 38 species, 13 of which have been reported for 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. *R. furvella*

2 Thallus pale brown. Ascospores 7 - 14 x 5 - 7 µm. On *Lecanora rupicola* s. lat. *R. insularis*

1 Not parasitic. Ascospores 16 - 28 x 8 - 14 µm. (R. gibbosa) Greek reports need confirmation.


Scattered in Macedonia, at altitudes 200 - 1860 m. Reported hosts are *Lecidea fuscoatra* and *Rhizocarpon geographicum*.

Widely distributed in northern and central Europe but rare south of the Alps. Also western Asia (Syria), Malesia (Sabah), N. America (Nova Scotia, Colorado).

**Rimularia insularis** (Nyl.) Rambold & Hertel (1985) in Hertel, in: sched. ad. Lecideaceae Exsiccatae, Fasc. 8, no. 159; *Lecidea insularis* Nyl. (1852) in: Botaniska Notiser 1852: 177; *Biatora intumescens* (Flörke ex Flot.) Hepp; *Lecidea intumescens* (Flörke ex Flot.) Nyl.

The earliest name is *Lecidea petraea var. intumescens* Flörke ex Flot. (1828), but it does not have priority at the rank of species.

Sometimes treated as *Lambiella insularis* (Nyl.) T. Sprib., but the small genus *Lambiella* has not yet been well characterised, so I prefer to treat this species in *Rimularia* for the present.


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 a northern species in Europe; in the south it is quite widespread but sporadic. Also Macaronesia, Asia (Turkey, Syria, Iran, Russia), N. America (scattered, mainly in the west, from Alaska to cool parts of USA), C. America (Mexico), S. America (Chile), Australasia (SE Australia, NZS).

**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 hyphae perpendicular to surface, sometimes with a distinct apical cell. Medulla: usually white, always I-. Apothecia: immersed to sessile, flat to moderately convex (rarely strongly convex), small to medium sized (rarely exceeding 1.5 mm diameter), pruinose in a few species. Disc: usually black, sometimes brown. 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. Thalline margin: well developed in most species. 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 a broader apical cell that often has an internal brown pigment cap. Asci: Lecanora type. Ascospores: brown, usually 1-septate, ±ellipsoid, usually 8 per ascus, lumina of various shapes. Pycnidia: not seen in most species; usually entirely immersed and not visible externally (so encountered only by chance), pyriform. Conidia: colourless,
ellipsoid, small. Chemistry: most reactions negative; atranorin and/or pannarin present in some species. Photobiont: green, trebouxioid.

*Rinodina* is a large genus, with about 300 species worldwide and over 100 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 attention over the last few 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 these substances are present can be challenging for those without facilities for chromatography. Some of the ascospores 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 rather 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 complete certainty. Corticolous collections tend to be the most difficult to determine.

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. It is not used as a character in the key below, but is characteristic of some species and its presence should be noted.

**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). **Bischofii** 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 a thick outer wall, and lumina thus appearing double-walled. **Tunicata** type.  
4 Ascospores without a 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 maturity.  
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 here. First, the brown band may be faint, and can be overlooked. Second, 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

**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) When the thallus is dark coloured or thin, atranorin is difficult to demonstrate by spot tests. Some authors recommend doing a normal test and soaking up the liquid on filter paper (or similar) to observe any colour, but I have never had any success with this method. I prefer to 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 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.

(2) Usually the thallus or medulla reacts C+ or KC+, but in some collections of *R. sicula* the reaction may be restricted to the exciple and hypothecium.

### 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 Ascii 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 8 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. turfaceoides)
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 the 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 Mischoblastia type, 19 - 26 x 10 - 13 µm. (R. euskadiensis)
22 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 Pachysporaria 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.

111 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 Physconia 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
33 Ascospores 12 - 14 x 5 - 7 µm. Thallus white-grey to grey. R. pyrina
3 Ascospores more than 14 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 Apothecia 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)
2 Ascospores Milvina or Physcia type (septum inserted early). Thallus pale or dark.
33 Ascospores Milvina type (or tending towards Physcia type), 13 - 15 x 7 - 8 µm. Thallus dark grey, forming small patches, often on twigs. Apothecia immersed or subimmersed. 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. Other characters various.
44 Ascospores (16) 18 - 23 (26) x (8.5) 10 - 12 (14) µm, strongly wartyed even when young, torus not or poorly developed. Apothecial cortex of round, large thin-walled cells, 5 - 8 (10) µm diameter. R. albana
4 Ascospores smaller, smooth when young, with a well-developed torus. Apothecial cortex different.
55 Thallus usually delimited by brown or black prothallus. Thallus grey to grey-brown, without a red tinge. Apothecia submersed to adnate, (0.3) 0.5 - 0.8 (1.0) mm diameter. Ascospores (14) 17 - 21 (23) x (7) 8 - 10.5 µm. Epithecium yellow-brown. R. plana
5 Prothallus absent (except sometimes in R. laevigata when thallus adjoins other species). Ascospores smaller.
66 Cortex of thalline margin thick, 50 - 70 µm wide. Thallus very thin, mainly of pale brown to brown dispersed areoles. Apothecia submersse to sessile, 0.4 - 0.8 mm diameter. Ascospores 16 - 20 x 7 - 9 µm. (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 (atranorin)
   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 a thalline margin (algae present in section. **R. beccariana var. beccariana**
         3 Apothecia with a false thalline margin (margin may appear thalline, but 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**
         3 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**
         33 Ascospores 19 - 23 x 10 - 12 µm. Probably restricted to the uplands. **R. oxydata**
      3 Ascospores 24 - 27 x 12 - 14 µm. (R. destituta)

**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 (when seen in greater thickness). **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**

1 Ascospores not as above; without a double wall or brown bands.

222 Ascospores Physconia or Dubyana type.

2222 Ascospores Bischoffii type. On base-rich siliceous rock; never on strongly acidic rock. See Group 4D1 key.

222 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 Apothecia 0.5 - 1 mm diameter. Probably restricted to high altitudes. **R. rinodinoides**

4 Apothecia 0.2 - 0.5 mm diameter. Probably a species of low altitudes. (R. cana)

3 Apothecial margin with many algal cells, clearly lecanorine.

44 Areoles usually arising from a 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**

22 Ascospores Mischoblastia to Pachysporaria type.

333 Apothecia immersed, and remaining so. Ascospores 22 - 31 x 11 - 17 µm. Thallus thin, cracked to areolate. (R. fimбриata)

33 Apothecia immersed at first, later becoming sessile or sessile. Ascospores 20 - 32 x 11 - 19 µm. Thallus thick, cracked to areolate. **R. teichophila**


2 Ascospores Dirinaria type, 13 - 16 x 7 - 10 µm. Thallus thin, grey. Apothecia sessile. **R. gennarii**

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**Rinodina alba** Metzler ex Arnold (1872)

* in: 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. Widely distributed in southern Europe, from Spain to Greece. Also Macaronesia (Canary Is, Madeira), N. Africa (Morocco).

**Rinodina albana** (A. Massal.) A. Massal. (1852)

Description: Giralt (2001, 2010).
Macedonia, at an altitude of 200 m. The substrate was not reported.
Southern and central Europe. Absent from British Is, Baltic States, the Nordic Countries and the most continental parts of eastern Europe. Also Macaronesia, Asia (southern Siberia).

**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, but not present north of the Alps or Pyrenees. Also Macaronesia (Acores, Canary Is), N. Africa (Morocco, Tunisia).

**Rinodina archaea** (Ach.) Arnold (1881)


The thin brown thallus (most usually visible in the colour contrast between the thalline exciple and the black disc) is fairly distinctive. The large, Physcionia 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 (65% of reports) or bark. Reported from wood of *Juniperus* and *Pinus*, and bark of *Abies* and *Pruinus*.

Widely distributed in Europe but rare south of the Alps. Also Macaronesia, Asia (Iran, Russia, Kazakhstan, Mongolia), Africa (Morocco), N. America (throughout western half, though rare in arctic regions), 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 Peloponnese, on siliceous rock at an altitude of 600 m. Not recorded since the 19th century.

Widely distributed in the western half of Europe, as far north as southern Scandinavia. It Italy it is rare, and one would like to see confirmation of its presence in Greece, 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)

The earliest name is *Lichen atrocinereus* Dicks. (1793), which is a later homonym of *Lichen atrocinereus* Vill. (1789). Villars published the epithet as “atro cinereus”, but his name is to be regarded as being in Linnaean binomial form (Article 23.1) and is validly published. As shown by Laundon (1986: 176) the first legitimate name for this lichen is *Lecidea atrocinerea* Hook.; the name *Parmelia atrocinerea* Fr. (1831) is an obligate synonym of *Lecanora cooerita* (Ach.) Ach., an entirely different lichen (perhaps a synonym of *Lecania nylanderiana*). When Körb made the combination into *Rinodina* he cited in synonymy *Parmelia atrocinerea* Fr., but explicitly excluded the type of that name.

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.

Widely distributed 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)
in: *N. Giorn. Bot. Ital.* 3: 239; *Rinodina fragososa var. fumosa* (Wedd.) H. Olivier; *Rinodina subglaucescens* (Nyl.) Sheard


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 the herbarium), not pruinose, forming small patches to about 2 cm diameter; very variable: usually cracked, but 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 sub sessile, flat, 0.3 - 0.55 mm diameter. Disc: black, not pruinose. Exicle: almost absent, scarcely distinguishable from hymenium. Thalline margin: present, persistent, often slightly crenulate, sometimes slightly white pruinose; in section: 60 µm wide. 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, 8 per ascus, 20 - 21 x 10 - 11 µm. Bischoffii type with prominent brown band and unambiguously Physconia type lumina. 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, ±continuous but rather irregular, as cells tend to form large clumps.

Both the abundance and the size of the hymenial oil droplets vary considerably, but some are always present. Could only be confused with R. guzzinii, 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 lichen.

Throughout Europe. Also Asia (widespread as far east as Mongolia and Inner Mongolia), N. Africa (Morocco, Algeria), N. America (widespread), S. America (Argentina), Australasia (widespread).

Rinodina boleana Giralt & H. Mayrhofer (1991)
in: Mycotaxon 40: 435-439
Description: Giralt (2001, 2010).
Naxos, on bark at an altitude of 5 m.
Spain, Italy, Croatia and Greece. Also southern Africa (Namibia - as R. cf boleana, so perhaps different species), Australasia (both islands of NZ).

Rinodina calcarea (Arnold) Arnold (1880)
in: Verh. k. k. zool.-bot. Ges. Wien 29: 362; Rinodina caesiella B (= var.) calcarea Arnold (1860) in: Flora 43: 69; (?) Rinodina calcarea var. graeca J. Steiner; Rinodina calcarea var. melanocarpa J. Steiner; (?) Rinodina calcarea var. nummullitica 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.
Widely distributed in southern European, with a few records to as far north as southern Scandinavia, but not British Is. Also Asia (widespread as far east as Tajikistan; perhaps present in China), N. Africa (Morocco, Algeria). The few reports for N. America appear to be 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 higher occasionally. The only phorophytes definitely reported were Olea, Pinus and Prunus.
Southern and central Europe. Absent from British Is, Baltic States and the Nordic Countries; does not appear to have been reported even for France. Also Macaronesia, Asia (Turkey, Georgia, southern Siberia, Taiwan), Africa (Morocco, S. Africa), N. America (widely distributed in western half, but absent from arctic regions), Australasia (NZS).
Rinodina colobina (Ach.) Th. Fr. (1871)

My only collection is far too scanty for thorough study, so the description is incomplete. For published descriptions see: Ahti et al. (2002), Giralt (2001, 2010) or Sheard (2010). The description under this name in Purvis et al. 1992 refers to a different species.


Hairs on the thalline exciple are not mentioned in any of the published descriptions 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 not a conspicuous species. On bark of deciduous trees at altitudes 0 - 1000 m. Reported from Olea europaea, Platanus orientalis, Prunus dulcis and Pyrus communis, with no clear preference.

Widely distributed 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, but absent from arctic regions).

Rinodina confragosa (Ach.) Körb. (1855)
in: Syst. Lich. Germ. 125; Parmelia confragosa Ach. (1803) in: Methodus (Suppl.) 33-34; Rinodina samothrakiana Szatala

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 20 - 1100 m.

Throughout Europe except for truly arctic regions. Also Macaronesia, Asia (Turkey, Armenia, Russia, Mongolia), Africa (Morocco, Cape Province of S. Africa), N. America (SW Canada, western USA), C. America (Mexico), perhaps S. America (Argentina; perhaps Paraguay - old report), Australasia (Victoria).

Rinodina conradii Körb. (1855)
in: Syst. Lich. Germ. 123

Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Nimis & Martellos (2004); Smith et al. (2009).

Macedonia, on terricolous bryophytes and decaying vegetation at an altitude of 1300 m.

Throughout Europe, though rare in the south and restricted to the mountains. Also Macaronesia (Tenerife), Asia (widespread), Malesia (PNG), N. America (widespread in western half), S. America (widespread), Australasia (Tasmania and perhaps elsewhere in Australia, both islands of NZ).

in: J. Hattori Bot. Lab. 55: 402

Description: See the protologue.

Crete, Lefkada and Corfu, at altitudes 100 - 1000 m. The substrate was not reported.

Eastern Mediterranean: Italy, Croatia, Greece (and, extending into the Black Sea, Ukraine); Asia (Syria), N. Africa (Tunisia).

Rinodina dalmatica Zahlbr. (1901)
in: Öst. Bot. Z. 51(9): 348

Description: Giralt (2001, 2010).

Scattered, but never very far from the sea. On bark at altitudes 20 - 450 m. Reported from Juniperus phoenicea, Olea, and Pinus spp.

Only southern Europe, from Portugal to Cyprus.

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. Exciple: dark brown, becoming almost excluded; in section: 25 - 50 µm wide, colourless in inner part, dark brown in outer part, of parallel hyphae that sometimes have narrow, elongated lumina. Thalline margin: absent. 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 capitate, 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, 8 per ascus, 14 - 17.5 x 8 - 10 (11) µm, Physconia type.

Chemistry: thallus K-, C-. Photobiont: green.

Could only be confused with *R. immersa*, but that has slightly larger, Bischoffii type ascospores.

Throughout Greece. On calcareous rock at all altitudes.

Southern and central Europe, with occasional records to as far north as southern Sweden, but not British Is. Also Asia (widespread as far east as Tajikistan), N. Africa (Morocco, Algeria, Tunisia, Egypt).

**Rinodina excrescens** Vain. (1928)

Description: Giralt (2010); Giralt, Mayrhofer & Obermayer (1994).

Western Crete, on wood of *Castanea sativa* at an altitude of 500 m.

In Europe, known only for Spain, Austria, Croatia, and Greece. Also Asia (western Siberia), N. America (mostly around the Great Lakes in Canada and USA).

**Rinodina exigua** (Ach.) Gray (1821)

The nomenclatural situation is complicated, and I have not fully untangled it. Briefly, *Lichen exiguis* Ach. (1799) is an illegitimate later homonym, and *Parmelia exigua* Ach. (1803) is also illegitimate because Acharius included the name *Lichen pinicola* Ach. (1799) within its scope. Conservation may be required to preserve current usage.

My only collection is rather scanty, and a complete description will have to await the collection of additional material.

Thallus: crustose, white, very thin, to a maximum of 100 µm thickness. Apothecia: subimmersed to subsessile, flat, 0.2 - 0.45 mm diameter, not pruinose. Disc: black. 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. Thalline margin: not usually apparent externally, present in section (though rather weakly); cortex 12 µm thick, I-. 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, 8 per ascus, 16 - 18 x 9 - 10 µm, Physcia to Milvina type. 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. The author's Peloponnesian collection was from wood of *Abies cephalonica* at an altitude of 1400 m, which is consistent with the expected ecology of this species.

Widely distributed in Europe to about the Arctic Circle. Also Asia (widespread), Africa (Morocco, Algeria, Egypt, S. Africa), N. America (reliably reported for California; reports for elsewhere doubtful), perhaps S. America (Argentina), Australasia (NZN). Reports for Macaronesia are incorrect.

**Rinodina freyi** H. Magn. (1947)

Description: Sheard (2010). Considered a synonym of *R. septentrionalis* by Giralt (2001) but Sheard regards the two as distinct.

Scattered, with no clear patterns, on bark at altitudes 160 - 780 m.

Probably widely distributed in at least cool and temperate Europe, though distribution uncertain owing to confusion with other species. May be rarer in the south. Also N. America (widespread).

**Rinodina furfuracea** H. Magn. (1947)
in: *Acta Horti Gothob.* 17: 236

Description: Giralt (2001, 2010).

Corfu, at an altitude of about 20 m. No substrate was reported.

Only southern Europe, from Portugal to Greece.
Rinodina gennarii Bagl. (1861)
in: Comment. Soc. Crittogam. Ital. 1(1): 17; Rinodina cinerascens J. Steiner; Rinodina demissa auct.; Rinodina subexigua (Nyl.) H. Olivier

The earliest name is Lecanora atra var. accumulata Ach. (1810), but it does not have priority at the rank of species. 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 entirely clear. If it were synonymous, the epithel demissa would have priority.

Thallus: crustose, grey-brown, not pruinose, warty, to a few cm diameter, 180 - 300 µm thick. Cortex: 10 - 15 µm thick, colourless except for a 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. 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. Thalline margin: thin, 0.05 mm wide, persistent but sometimes discontinuous in older apothecia; in section: 70 - 80 µm wide. Epitheciun: brown, K-, P-. Hymenium: 80 - 100 µm tall, colourless, K+ blue. Hypothecium: 60 - 125 µm tall, colourless. Paraphyses: usually simple, occasionally branched close to apex, sometimes with visible septa, 1.5 - 2 µm wide in lower part, capitate, sometimes slightly moniliform, apical cell 4 - 5 µm with internal brown pigment cap. Asci: 60 x 17 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid but sometimes constricted at septum (in water; swollen at septum in K), 8 per ascus. 12.5 - 15 x 9 - 10 µm, Dirinaria type, torus absent. Pycnidia: entirely immersed (not visible externally), pyriform, 100 µm tall, 75 µm wide. Chemistry: medulla K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 7.5 - 13 µm diameter. Photobiont layer: continuous, ±regular, 60 - 75 µm thick.

Unlikely to be confused with any other species, provided that the ascospore 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 (as understood here) is 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 (scattered in cool to temperate regions of both coasts), C. America (Mexico), perhaps S. America (Chile), Australasia (NZ), Antarctica (subantarctic 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 a black margin (and then sides brown in thin section). Cortex: 30 - 40 µm thick, colourless, formed of hyphae perpendicular to surface with ±broad lumina giving a (rather obscure) cellular texture, K-. Medulla: white. Apothecia: subimmerscd (in thallus) to sessile, flat to slightly convex, 0.5 - 0.7 mm diameter, not pruinose. Disc: black. Exciple: not visible externally; in section: 10 - 20 µm wide, brown at surface, colourless elsewhere, formed of hyphae with narrow, elongated lumina. Thalline margin: present, sometimes becoming excluded; in section: 50 - 75 µm wide. Epitheciun: brown to orange-brown, K-, most pigment not soluble in K. Hymenium: 100 - 125 µm tall, colourless, without oil droplets, K+ 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. Ascii: 50 - 55 x 15 - 16 microns, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid to occasionally slightly tadpole-shaped, 8 per ascus, 17 - 20 x 7 - 11 microns, ±Bischoffi type (brown band often faint; lumina as in Physconia or Milvina type). Chemistry: medulla K-, C-, 1-; 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 the two Peloponnesian collections seen, ascospores had the unambiguously Physconia type lumina expected for this species. In the other (10-Dec-2005/L131 from close to sea level near Methana) the lumina were unambiguously ±Milvina type. More collections are need to assess whether two taxa are involved.

Provided the ascospores type is correctly determined, this species could only be confused with R. bischoffi.

However, that species has abundant oil droplets in the hymenium and/or hypothecium.

Scattered throughout Greece, with no clear pattern. On calcareous or base-rich siliceous rock at all altitudes. Scattered, with no clear pattern. At all altitudes from 100 m to alpine levels. On calcareous and siliceous rock. The reported distribution and ecological data seems chaotic and suggests that some of the reports may be incorrect.

Southern Europe, from Spain to Cyprus (and also southern Russia). Also Asia (widespread as far east as Tajikistan.
and Afghanistan), N. Africa (Morocco, Algeria, Tunisia), N. America (scattered in montane 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. Exciple: 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. Thalline margin: absent. Epithecium: orange-brown to brown, K-. Hymenium: 70 - 110 microns tall, mostly colourless but upper part sometimes with some epithelial 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. Asci: 70 - 75 x 20 - 22 µm, clavate. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, (13) 16 - 22 x 9 - 12 µm, Bischoffii type. Pycnidia: rare. Conidia: colourless, bacilliform, 4 x 1 µm. Chemistry: all reactions negative (but this is generally hard to observe 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 am not willing to accept this view in the absence of detailed investigations. 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 *Lecanora rupicola*. 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.

Basically a species of southern Europe and the Alps, though there are scattered reports to as far north as Norway. Also Macaronesia, Asia (Turkey), N. America (BC, Arizona), S. America (Chile), Australasia (SE Australia, NZS).

**Rinodina kalbii** Giralt & Matzer (1994)

in: *Lichenologist 26(4): 328-330*

Description: Giralt (2001).

Chios, on bark at altitudes 10 - 690 m. Southern Europe, from Portugal to Greece. Also Macaronesia.

**Rinodina lecanorina** (A. Massal.) A. Massal. (1854)


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.

My only collection is too scanty to prepare a good description. In the meantime, see Ahti et al. (2002) or Giralt (2001, 2010).

Easily recognised by the Bicincta type ascospores and the well developed thallus.

Scattered throughout Greece, but commoner in the southern half of the country. On calcareous rock at all altitudes.

Widely distributed in southern and central Europe, with few reports from further north to southern Sweden, but absent from the British Is. Also Asia (widespread as far east as Tajikistan), N. Africa (Morocco, Algeria, Tunisia). Reports for N. America, Australasia are incorrect.
Rinodina luridata (Körb.) H. Mayrhofer, Scheid. & Sheard (1990)
in: Bibliotheca Lichenologica 38: 346; Buellia luridata Körb. (1860) in: Parerga Lichenol. 188
Southern Europe and the southern part of central Europe, with a very few scattered records further north to mid Scandinavia, but not British Is. Also western Asia (Turkey, Iraq), N. Africa (Morocco), N. America (scattered in western USA), Australasia (eastern Australia, both islands of NZ).

Rinodina luridescens (Anzi) Arnold (1872)
Islands of the Aegean, including Crete, and adjacent coasts of the mainland. On siliceous rock at altitudes 0 - 700 m.
Widely distributed along the Atlantic margin of Europe, from Portugal to mid Norway, and present, though not common, throughout much of Mediterranean Europe. Also N. Africa (Tunisia). I am sceptical of a report for Pacific (Hawaii).

Rinodina milvina (Wahlenb. ex Ach.) Th. Fr. (1860)
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, well-developed below the areoles but not visible externally. 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 hyphae perpendicular to surface, 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. Exciple: not visible externally; in section: poorly developed, 10 µm wide, scarcely distinguishable from hymenium. Thalline margin: fairly thick, persistent; in section: 15 - 100 µm wide, cortex to 20 µm but not very distinct. Epithecium: brown, K-, P-, pigment not soluble in K. Hymenium: 90 - 100 µm tall, colourless, Ki+ blue. Hypothecium: 90 - 1000 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, 8 per ascus, 17.5 - 21 x 10 - 12.5 µm, Milvina type, sometimes tending towards Pachysporaria type when mature, torus present. Pycnidia: frequent (in the single collection seen), 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 siliceous rock. There are reports from altitudes of 200 - 2150 m, but low altitude reports seem rather doubtful to me.
Throughout Europe. Also Asia (widespread), N. Africa (Algeria), N. America (scattered in western USA; reports for elsewhere may be unreliable). 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. macroura at altitudes 0 - 500 m.
In Europe, known only from the south, from Portugal to Greece. Also western Asia (Syria).

Rinodina obnascens (Nyl.) H. Olivier (1903)
in: [need to investigate - I don't have title of paper and page range]; Lecanora obnascens Nyl. (1886) in: Flora 69: 462
Description: Giralt (2001, 2010); Sheard (2010).
Islands of the Aegean, including Crete, never far from the sea, at altitudes 10 - 670 m. All reports give the substrate as siliceous rock, and it is not clear whether a parasitic habit has been overlooked. According to Giralt (2001) this species is always parasitic, on Aspicilia species.
Southern Europe, with scattered occurrences in western Europe to as far north as Sweden. Also Macaronesia, central Asia (Tajikistan, Mongolia), N. America (western USA).

Rinodina occulta (Körb.) Sheard (1967)
in: Lichenologist 3(3): 349; Buellia occulta Körb. (1860) in: Parerga Lichenol. 186-187; Rinodina attica H. Mayrhofer & Poelt; Rinodina tegulicola (Nyl.) J. Steiner
There are earlier names, but it is not clear whether any of them are at the rank of species.

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.

Widely distributed in Europe except for truly arctic regions, but uncommon in the south. (In Greece it appears to be restricted to the uplands, but in Italy it is sometimes coastal according to Nimis, 1993). Also Asia (Georgia, southern Siberia), Malesia (PNG), Australasia (SE Australia), Antarctica (S. Shetland Is).

Rinodina oleae Bagl. (1857)

Description: Giralt (2001, 2010); Sheard (2010).

Widely distributed in the Aegean and adjacent parts of the mainland, never very far from the sea, at altitudes 0 - 680 m. About 60% of reports are from below 200 m. On bark (over 80% of reports) or siliceous rock. The reports from siliceous rock were made by modern authors who consider *R. gennarii* to be synonymous. Reports from bark are from a wide range of phorophytes, with no marked preference but avoiding very acidic bark.

Southern Europe (Portugal to Greece) and the Atlantic margin (Portugal to England and Netherlands, with a disjunct occurrence in southern Sweden). Also Macaronesia (CVI), western Asia (Turkey, Syria), Africa (Morocco, S. Africa), N. America (widespread in western USA), S. America (at least JF), Australasia (widespread). Some reports might refer to *R. gennarii*.

Rinodina olivaceobrunnea C. W. Dodge & G. E. Baker (1938)

The earliest name is *Rinodina archaea f. minuta* Arnold (1887), but it does not have priority at the rank of species.


Sterea Ellada, at about 1850 m altitude. The substrate was not reported.

Throughout Europe, but very rare south of the Alps and restricted to the highest mountains. Also Asia (Russia, Tajikistan), perhaps Africa, N. America (widespread in western half), S. America (Chile), Australasia (NZS), Antarctica (widespread).

Rinodina orculata Poelt & M. Steiner

Reported for Greece in Muggia et al. (2018), but the report is both very disjunct and an unusually low altitude for this species. I am not willing to accept *R. orculata* as a Greek species without stronger evidence.

Rinodina oxydata (A. Massal.) A. Massal. (1854)

Descriptions: Ahti et al. (2002); Giralt (2001, 2010); Sheard (2010); Smith et al. (2009).

Crete, on an unspecified substrate at an altitude of 970 m. Abbott (2009) placed reports of *Rinodina discolor* here, on the authority of Sheard (1967: 353), but the name is an obligate synonym of *R. lecanorina*.

Widely distributed in Europe to as far north as mid Scandinavia. Also Macaronesia, Asia (widespread), Malesia (Java, PNG), Africa (Morocco, Zambia, Zimbabwe; St Helena), N. America (SE Canada, widespread in USA except Rocky Mts), C. America (Mexico), perhaps S. America (Argentina), Australasia (widespread in Australia, including Norfolk Is).

Rinodina plana H. Magn. (1947)
in: Acta Horti Gothob. 17: 298

Thallus: crustose, pale grey or pale green-grey, usually very thin (60 - 70 µm), cracked (when well developed), forming small patches about 1 cm diameter, sometimes delimited by a black prothallus, 0.1 mm wide. Apothecia: subimmersed at first, later subsessile, 0.3 - 0.65 mm diameter, flat, not pruinose. Disc: dark brown to black. Exciple: not visible externally; in section: 15 - 25 µm wide, colourless except at surface, hyphal. Thalline margin: present, usually persistent; in section: 50 - 70 µm wide. Epithecium: brown to orange-brown, K+. A little (not all) pigment dissolving 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 capitulate, apical cell with internal brown pigment cap. Asci: 55 - 80 x 18 - 28 µm, clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, (15) 17 - 23 x (6) 7.5 - 10 µm, Physcia type. Chemistry: thallus K-.

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. Recorded from *Ceratonia siliqua*, *Fraxinus ornus*, *Pistacia terebinthus*, *Platanus orientalis*, *Pyrus spinosa* and *Quercus coccifera*.
Basically circum-Mediterranean/Macaronesian. Portugal to Greece, and ranging a little outside the Mediterranean Basin to Switzerland and Austria). Also Macaronesia (Canary Is), Asia (Syria).

**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. Exciple: sometimes visible externally as a thin ring concolourous with disc but slightly raised; in section: to 25 µm wide when well developed but sometimes scarcely apparent, colourless except at surface, of hyphae parallel to paraphyses. Thalline margin: present, ±persistent but sometimes becoming thin or discontinuous; in section: 65 µm wide of which cortex 25 µm. Epithecium: brown to dark brown, K- (pigment not dissolving), P+ orange. Hymenium: 100 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, 8 per ascus, 16 - 17 x (6) 9 - 10 µm, Dirinaria type (though this is apparent only in *very* early stages of development, and not always then). 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 rather rare species of strongly maritime sites in southern Greece. On bark at altitudes 20 - 350 m. Reported from *Quercus coccifera* and *Vitex agnus-castus.*

Circum-Mediterranean/Macaronesian. Portugal to Greece. Also Macaronesia (Tenerife), Asia (Israel), N. Africa (Morocco, Tunisia).

**Rinodina pyrina** (Ach.) Arnold (1881)

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. Proper exciple: rarely visible externally in a few of the largest apothecia as a thin ring concolourous with the disc; in section: 10 - 25 µm wide, colourless except at surface, of hyphae that often develop distinct lumina in their upper parts. Thalline exciple: present, persistent; in section: 30 - 70 µm wide of which cortex 15 - 30 µm; cortex I-.


According to Giralt (2001), in material from the Iberian Peninsula, the algal cells in the thalline exciple are unusually large, but I have never observed this in Greek collections.

The small Physconia type ascospores and the thin, pale grey thallus are fairly distinctive.

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.I America (Mexico), 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: 20 - 25 µm thick, brown in upper part, colourless below, formed of hyphae perpendicular to surface, apical cell distinct with internal brown pigment cap. K-, internal pigment not soluble in K. Medulla: white in upper part, pale orange-brown below (? affected by substrate in only collection seen). Apothecia: subimmersed to subsessile, slightly to distinctly convex, 0.4 - 1.2 mm diameter, not pruinose. Disc: black, matt. 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. Thalline margin: weakly developed in some young apothecia, otherwise ± absent both externally and in section. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 75 µm tall, colourless, Ki+ blue. Hypothecium: 75 µm tall, colourless
in upper part, pale orange-brown below. Paraphyses: simple, 1 - 1.5 \( \mu m \) wide at base, 3 - 5 \( \mu m \) 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. Ascii: 48 - 50 x 19 - 20 \( \mu m \), narrowly clavate to almost cylindrical, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, occasionally slightly curved, 8 per ascus, 14 - 16 x 7.5 - 10 \( \mu m \), Milvina type, torus absent. Chemistry: medulla K-, C-, KC-, P-, I-; thallus K-, C-, KC-, P-, UV-. Photobiont: green, cells globose, 10 - 13 \( \mu m \) diameter, forming a continuous, regular layer 50 - 75 \( \mu m \) thick.

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 central and northern Europe, though absent from British Is. Uncommon south of the Alps, and restricted to the mountains. Also Macaronesia, Asia (Turkey - early reports unreliable, but reliably reported recently; also mountains of northern India), N. America (California).

**Rinodina roscida** (Sommerf.) Arnold (1887)


Descriptions: Ahti et al. (2002); Nimis & Martellos (2004); Sheard (2010).

Mt. Olympus, on soil at 2600 m altitude.

Widely distributed from Svalbard to the Alps, but almost absent further south. The report for Mt. Olympus appears to be the only one from south of the Alps. Also Asia (Russia, Tibet, Mongolia), N. America (widespread in western half, from Alaska to cold parts of USA).

**Rinodina santorinensis** J. Steiner (1919)


Description: Giralt (2001, 2010).

Islands of the Aegean, on siliceous rock at altitudes 5 - 750 m.

Circum-Mediterranean/Macaronesian. Portugal to Greece. Also Macaronesia (Canary Is), N. Africa (Morocco).

The var. *olivieri*, not reported for Greece, is restricted to the western Mediterranean and Canary Is.

**Rinodina septentrionalis** Malme (1913)


The earliest name is *Lecanora laevigata* f. *dispersella* Vain. (1881). The epithet *dispersella* has priority at the ranks of form and variety, but not species.

I have several Peloponnesian collections that may belong here, but the determinations are not certain as I cannot conclusively exclude other species (*R. freyi* and/or *R. plana*), so no description is provided. For published descriptions see: Ahti et al. (2002); Giralt (2001, 2010); Sheard (2010).

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, predominantly of conifers.

Widely distributed in northern and central Europe, though absent from British Is, but very rare south of the Alps. Low altitude reports for Greece may be incorrect, but the report from 1300 m in Macedonia seems plausible. Also Asia (widespread in Russia), N. America (widespread in western half, from Alaska to montane USA), Australasia (NZS).

**Rinodina sicula** H. Mayrhofer & Poelt (1979)

in: *Bibl. Lich.* 12: 143

Description: Clauzade & Roux (1985); Giralt (2001, 2010); Smith et al. (2009).

Chios and Samothraki, on siliceous rock at altitudes 130 - 600 m.

Scattered in temperate and mediterranean Europe, extending as far north as Denmark and southern Sweden.

Endemic to Europe.

**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 \( \mu m \). Prothallus: often present at margin of thallus and between areoles, black, diffuse. Cortex: 15 - 25 \( \mu m \) thick, colourless to pale brown, without distinct structure or in places obscurely cellular. Medulla: poorly developed. Apothecia: subimmersed to sessile, flat, 0.25 - 0.45 (0.6) \( \mu m \) diameter, not pruinose. Disc: dark brown to black. Proper exciple: not visible externally; in section: poorly developed, 10 \( \mu m \) wide, colourless except at surface, of hyphae ± parallel to paraphyses. Thalline margin: present, persistent; in section: 60 - 100
µm wide, cortex often poorly developed or almost absent, when well developed to 35 µm wide, of paraphlextenchyma, 1.-E皮cthecium: orange-brown to brown, K-, most pigment not dissolving in K. Hymenium: 50 - 80 (100) µm tall, colourless, K+ 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. Ascii: 50 x 13 - 14 μm, narrowly clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid, 8 per ascus, (10) 12 - 16 x 6 - 8.5 (10) µm, Milvina to Physconia type. 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 present as low as 400 m. Reports from close to sea level are probably erroneous. Nearly always on bark, though there is a single report from wood. On a wide range of phorophytes, though with a mild preference for Quercus (35% of records). A pioneer species, often occurring on young twigs, especially at internodes.

Throughout Europe, except for truly arctic regions. Also Macaronesia, Asia (widespread), perhaps Africa (S. Africa), perhaps S. America (Argentina), perhaps Pacific (Hawaii; also an old report for New Caledonia). Reports for N. America are incorrect, which makes me sceptical of unconfirmed reports from far outside Eurasia.

**Rinodina teichophila** (Nyl.) Arnold (1863)
Description: Ahti et al. (2002); Giralt (2001, 2010); Smith et al. (2009).
Very scattered, with no clear pattern. On siliceous rock at altitudes 200 - 550 m
Widely distributed in Europe as far north as southern Scandinavia, though rare in the most continental parts of eastern Europe. Also Macaronesia (only Azores), Asia (widespread), N. Africa (Morocco). Reports for Australasia (NZ) are incorrect.

**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 hyphae perpendicular to surface, giving a weak cellular texture (best seen in K), K+ yellow (reaction faint and not always observable), N-. Medulla: white. Apothecia: immersed when young, later becoming subimpressed to subsessile, flat to slightly convex, 0.25 - 0.6 mm diameter, not pruinose. Disc: black. Exciple: not visible externally, poorly developed in section. Thalline margin: present, persistent. Epithecium: brown, K-, pigment not soluble in K. Hymenium: 75 µm tall, basically colourless but upper half sometimes with epithelial pigment, K+ 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. Ascii: 60 x 17 - 20 µm, narrowly clavate to clavate, Lecanora type. Ascospores: brown, 1-septate, ellipsoid in water but swelling at septum in K, 8 per ascus, 16 - 20 x 8 - 11 µm, Mischoblastia type. Chemistry: medulla I-; thallus K+ faintly yellow (probably atranorin in low concentration), C-, KC-, P-, UV+ very faintly 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.
Widespread in southern Europe, from Portugal to Cyprus. It is present north of the Alps (Hungary, Romania, and perhaps elsewhere), but many reports from north of the Alps are incorrect. Also Macaronesia, Asia (Turkey, Armenia), N. Africa (Morocco).

**Rinodina tunicata** H. Mayrhofer & Poelt (1979)
Description: Giralt (2001, 2010).
Crete, and the east coast of Greece. 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)

in: Hoppea 37: 91


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 and 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**

Rinodinella controversa (A. Massal.) H. Mayrhofer & Poelt (1978)


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, of radiating hyphae with elongated to broad lumina. Thalline margin: well developed, but becoming almost excluded in many mature apothecia; in section: 50 - 120 µm thick, formed of rather coarse cells about 7 µm wide. Epithecium: brown to dark brown, K-. Hymenium: 55 - 80 µm tall, basically colourless but upper part may have some epithelial pigment, sometimes with oil droplets, KI+ blue. Hypothecium: 50 - 1110 µm tall, colourless, sometimes with oil droplets. Paraphyses: simple, 1 µm wide at base, apical cell 3 - 5 µm with a 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 but often slightly constricted at septum, 8 per ascus, 10 - 15 x 5 - 7 µm, without wall thickenings; septum very thin (1 µm or less). Pycnidia: 100% immersed, 150 µm tall, 80 µm wide, colourless. Conidia: bacilliform to narrowly ellipsoid, 3 x about ¾ 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 is a distinctive species that is unlikely to be confused with any other. Common in the southern half of Greece (though not reported for the islands of the Aegean, except Crete), scattered in the north. On calcareous rock at all altitudes, but 70% of reports are from below 400 m. Scattered, mainly in the southern half of Greece. On calcareous rock at altitudes 0 - 1300 m, but commonest below 400 m.

Southern Europe and southern part of central Europe; absent from British Is and the Nordic countries. Also western Asia (Turkey, Syria, Russia, Iran), N. Africa (Morocco, Algeria).

Rinodinella dubyanoides (Hepp) H. Mayrhofer & Poelt (1978)


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)


Type: *R. fuciformis* (L.) DC. Family: Roccellaceae. Literature: Tehler et al. (2004) monographed the European (and Macaronesian) species, and is the best starting point. Clauzade & Roux (1985) do cover all the widespread European species, but their information is dated and potentially misleading.

Description: As only one species is present in Greece, see the description of *R. phycopsis* below.

About 31 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 to foveate. (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)
in: Lichenogr. Universalis 440; Parmelia phycopsis Ach. (1804) in Arch. syst. Naturges. 1(1): 110; Roccella fucoides Vain.; Roccella fucoides var. corticola Sambo; Roccella fucoides var. farinosa Delise ex Sambo

The earliest name is Lichen fucoides Dicks. (1790), but it is not legitimate, being a later homonym of L. fucoides Neck.

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 a basal holdfast from which several branches emerge. Holdfast: ± circular, about 5 mm diameter, externally same colour as the branches but internally with an 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 the branches but not at the tip. Cortex: 25 - 50 µm thick, of hyphae oriented perpendicular to surface of thallus; hyphae clearly septate; tips of hyphae 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 by no means exclusively ± longitudinally; hyphae 2.5 - 3 µm wide, without visible septa. Pycnidia: what may be pycnidia are present as dark brown or black dots, 0.2 mm wide, on the tips of some branches. Unfortunately, they are difficult to section, and squash preparations yielded neither convincing evidence of the expected anatomy for a pycnidium nor conidia. Chemistry: K- (or possibly very faintly + yellow), thallus C+ red (colour persistent but fading to orange-red), KC+ red, P-; medulla K- (in both white and orange-yellow parts), C-, KC- (but sometimes appearing sparsely +red if the K mobilises the substances in the cortex), P-; soralia usually K+ very pale red, sometimes K-, C-, KC red fading to pale red (this is a true KC+ reaction and not due to diffusion of cortical pigments), P-. Photobiont: Trentepohlia, present in a layer apparently 0 - 50 µm thick.

This species can not be confused with any other.

Common in the southern Aegean, rather scarce elsewhere. Always coastal. Most commonly found on rock (calcareous or siliceous) but not rare on bark or wood. At altitudes 0 - 400 m, rarely higher. The lichenicolous fungus Lecanographa grumulosa has been recorded once on this lichen.

In many coastal areas to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread on warm coasts), Africa (widespread). Not present in N. America, so reports for Caribbean, S. America are probably incorrect. A report for Pacific (New Caledonia), seems too disjunct to be plausible.

Roccellographa J. Steiner (1902)

Type: R. cretacea J. Steiner. Family: Roccellographaceae. Literature: For R. circumscripta see any of the standard Floras; until recently it was treated as Peterjamesia circumscripta or Sclerephyton circumscriptum.

The genus has three species, two of which occur in Europe. One of those is strongly oceanic and confined to the west; it will not occur in Greece.

Roccellographa circumscripta (Leight.) Ertz & Tehler (2011)

The earliest name is Verrucaria circumscripta Taylor (1836), but it is not legitimate, being a later homonym of V. circumscripta Chaub. (1821). The epithet was legitimated by Leighton.


Santorini, and probably Crete, on siliceous rock at an altitude of 200 m.

Common throughout southern Europe, and ranging as far north as Scotland and southern Scandinavia. Also Macaronesia, Africa (Morocco, Tunisia; St Helena), perhaps N America, perhaps Caribbean, C. America (Mexico), perhaps S. America, Australasia (Lord Howe Is, NSW).
**Romjularia Timdal (2007)**

The genus has only one species.

**Romjularia lurida (Ach.) Timdal (2007)**

in: Nash et al., in: Lich. Sonoran Desert 3: 288; *Lecidea lurida* Ach. (1803) in: Methodus 77; *Biatora lurida* (Ach.) Stenh.; *Lecidea lurida f. pallescens* Grognot; *Mycothecium luridum* (Ach.) Hafellner & Türk; *Psora lurida* (Ach.) DC.  
The earliest name is *Lichen luridus* Sw. (1784), but it is illegitimate because of the earlier *L. luridus* With. (1776).  
Thallus: squamulose, to 5 cm diameter, sometimes forming small clumps, without vegetative propagules. 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, but 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 hyphae oriented parallel to surface, lower layer appearing cellular, cells with long axis perpendicular to surface; cortex mostly colourless, sometimes pale brown to brown near surface or at interface between two layers; cortex sometimes overlain by a 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 the squamules, sessile, flat to slightly convex, 0.3 - 1.5 mm diameter, not pruinose. Disc: usually black, sometimes very red-brown. 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 but overall appearance often rather cellular as hyphae have prominent large lumina. Thalline margin: absent. 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 a 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 the base, and resembling the hyphae of the exciple, those in mature apothecia narrower at the base and of more normal appearance. Ascii: 70 x 15 µm, ±cylindrical to narrowly clavate, Porpidia type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 16 x 5 - 9 µm. 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 epithecium reacts K+ red or purple.  
Fairly common throughout Greece. On calcareous soil or, less commonly, calcareous rock. Occasionally overgrowing bryophytes on those substrates. At altitudes 0 - 2800 m.  
Throughout Europe. Also Macaronesia, western Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (scattered in Canada and cold parts of USA), C. America (Mexico). A report for Pacific (Marquesas) seems doubtful to me.

**Rosellinula R. Sant. (1986)**

in: Eriksson & Hawksworth, in: [need to investigate - need title of publication]  
Type: *R. haplospora* (Th. Fr. & Almq.) R. Sant. Family: of uncertain position in *Dothideomycetes*. Literature:  
There is no monograph. Clauzade, Diederich & Roux (1989) remains the best starting point.  
As I have seen only one species of the genus in Greece, see the description of *R. haplospora* below.  
A genus of four species, three of which are European. Only one species is likely to occur in Greece.

**Rosellinula haplospora (Th. Fr. & Almq.) R. Sant. (1986)**

in: [need to investigate - need title of publication]; *Endococcus haplospora* Th. Fr. & Almq. (1867) in: Fries, Botaniska Notiser 1867: 109-110  
Perithecia: entirely immersed in thallus of host, resembling apothecia (so easily overlooked); in section 470 µm tall x

Unlikely to be confused with any other species. In the common genus Muellerella the paraphyses disappear early. Peloponnese, on Aspicilia cupreoglauca at an altitude of 1750 m.

Scattered in Europe, mainly in the west. Also Asia (Turkey, southern Siberia).

**Sagedia Ach. (1809)**

The name is not in current use, as Aspicilia has been conserved against it.

**Sagedia pyrenophora var. arenaria Hepp (1853)**

in: Flecht. Eur. no. 98

Included in Abbott (2009) as a name of uncertain application. The name has been combined into other genera, including Arthopyrenia, Spermatodum 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)**

in: Geneac. Lich. 11

Type: *S. protuberans* (Ach.) A. Massal. Family: Sagiolechiaceae. Literature: There is no monograph. For the only Greek species, see below.

Five species, 3 of which occur in Europe. Only one is likely to occur in Greece.

**Sagiolechia protuberans (Ach.) A. Massal. (1854)**


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 mountains. Also Asia (widespread in Russia), N. America (Yukon, Washington).

**Sarcogyne Flot. (1851)**

in: *Bot. Zeitung* 9: 753, 759. The 1851 name is supposedly conserved against Sarcogyne Flot. (1850) in *Botanische Zeitung* 8: 382, but it was introduced with the remark “ad. int” and so is a provisional name and thus not validly published. The matter will probably need to be the subject of a new conservation proposal.

Type: listed in the Code as *S. corrugata* Flot., but that is a provisional name and not validly published. An invalid name does not fall within the scope of the Code, and can not be the type of any generic name. The matter will probably need to be the subject of a new conservation proposal. Family: Acalarosporaceae. Literature: The only species likely to occur in southern Europe are discussed in Smith et al. (2009) and in 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. Asci: cylindrical to clavate, wall distinctly thickened at apex, apex KI-.

Ascospores: colourless, ellipsoid, many per ascus, about 5 µm long. Photobiont: chlorococcoid (not Trebouxia).

The genus is poorly known, even in Europe. There are probably about 30 species worldwide. About 14 species (and numerous infra-specific taxa) have been reported from Europe, but some will probably prove to be synonymous. Most species of Sarcogyne occur in cold regions, and only a few are likely to be found in southern Europe. They usually occur on rock.
11 Exciple carbonised, at least outer black in section (inner part may be paler). Apothecia not pruinose. On siliceous rock.
22 Hypothecium brown to dark brown. Apothecia 1 - 3 mm diameter. Exciple at first thick, and irregularly cracked or want; eventually excluded. If present in Greece, probably restricted to high mountains. (S. clavus)
2 Hypothecium colourless or pale brown. Apothecia 0.3 - 1 mm diameter. Exciple thin, sometimes slightly crenulate but not cracked or wanting; persistent. Widely distributed, not restricted to high mountains. *S. hypophæa*

1 Exciple not carbonised, dark brown to colourless in section. Apothecia pruinose or not. On calcareous or siliceous rock.
22 Ascospores larger than 6 x 2.5 µm.
33 Ascospores 6 x 11 - 5 - 7 µm. On calcareous rock. (S. magnispora)
3 Ascospores 7 - 10 x 3 - 3.5 µm. On calcareous or neutral rock. (S. algerica)
2 Ascospores not exceeding 6 x 2.5 µm.
33 On calcareous rock. Apothecia often pruinose. Ascospores 3 - 5 x 1.5 - 2 µm. *S. regularis*
3 On siliceous rock. Apothecia not pruinose. Ascospores 4 - 6 x 1 - 2.5 µm. *S. similis*

*Sarcogyne hypophæa* (Nyl.) Arnold (1870)
in: *Flora 53: 47; Lecanora hypophæa* Nyl. (1870) in: *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; structure not well seen but apparently 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. Exciple: black, shiny, thin, smooth to wavy, only becoming distinctly irregular in large old apothecia, eventually almost excluded; in section: with an outer part that is ±black and a colourless inner part, inner part hyphal (structure of outermost part obscured by pigment); K- (pigment not dissolving). Thalline margin: absent. Epithecium: orange-brown to dark brown, K- (pigment not dissolving). Hymenium: 100 - 125 µm tall, colourless, KI+ blue. Hypothecium: colourless to pale brown, 100 µm tall, rather obscurely divided into an upper 60 - 70 µm that could be called a subhymenium, and a lower hypothecium proper. Paraphyses: simple, sometimes with visible septa, sometimes slightly moniliform, sometimes capitate, 1 µm wide at base, 2 - 3 µm at apex. Asci: 90 x 25 µm, elavate, apical part with a thick wall (to 10 µm), apical part KI-. Ascospores: colourless, simple, many per ascus (at least 100), ellipsoid, 5 x 2.5 µm. Chemistry: in spot tests thallus C-; reaction with K not clear but in section diffuses a 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.

The only Peloponnesian collection certainly belongs in *Sarcogyne*, but it does not agree well with published descriptions of *S. privigna*; the thallus is better developed than expected, some of the apothecia are larger than expected, and the hymenium is taller than expected. The substrate and lack of apothecial pruina excludes *S. regularis*. It is unlikely to be *S. clavus*, as that is a distinctly northern species that would not be expected to occur in the submediterranean zone. Additional collections are required to clarify the status of the Peloponnesian collection.

Scattered in the southern half of Greece, on siliceous rock at altitudes 600 - 1100 m.

Widely distributed in Europe, though in the south confined to the uplands. Also Asia (widespread), N. Africa (Morocco, Tunisia), N. America (Alberta, fairly widespread in USA), C. America (Mexico), Australasia (Western Australia), Pacific (Hawaii), Antartic (continental Antarctica and Antartic Peninsula only).

*Sarcogyne regularis* Körb. (1855)
in: *Syst. Lich. Germ. 267; Biotorella pruinosa* (Schae.) Mudd; (?) *Biotorella pruinosa f. nuda* (Nyl. ex Lamy) H. Olivier; *Sarcogyne pruinosa* (Schae.) 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. The earliest legitimate name at the rank of species may be *Sarcogyne pruinosa* (Schae.) A. Massal. (1854), and it has priority if the synonymy is confirmed.

Many infra-specific taxa are accepted by some authors within *S. regularis*, but until some proper taxonomic work has been done on this complex I prefer not to recognise them.

Thallus: immersed. Apothecia: subimmersed in substrate, ±flat, 0.5 - 0.6 mm diameter, slightly white pruinose. Disc: black. 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-. Thalline margin: absent. Epithecium: orange-brown, K- but the orange tinge disappears in K and
remaining pigment is brown. Hymenium: 110 µm tall, colourless, KI+ blue. Hypothecium: 35 µm tall, colourless. Hymenium: 110 µm tall, colourless, KI+ blue. Hypothecium: 35 µm tall, colourless. Paraphyses: simple, often with visible septa, not capitate, 1 µm wide in lower part, 1.5 µm at apex. Asci: 40 - 75 x 12 - 15 µm, cylindrical to clavate, wall at apex thickened (to 5 µm), apex KI-. Ascospores: colourless, simple, many per ascus (at least 100), narrowly ellipsoid, 5 x 1.5 - 2 µm. Photobiont: green.

Macroscopically, *S. regularis* could be confused with several other limestone taxa with black, lecideine apothecia. Microscopically, the genus is easily recognised, and the calcareous substrate and pruinose apothecia easily distinguish *S. regularis* from other species of Sarcogyne.

Throughout Greece, though not very common. On calcareous rock at altitudes 0 - 2600 m. Quite widely distributed in Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Egypt, S. Africa), 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 in USA.

**Sarcopyrenia Nyl. (1858)**

According to Smith et al. (2009) *Sarcopyrenia gibba* (Nyl.) Nyl. is present in Greece. No further information is given, and no reference is stated.

**Schaereria Körb. (1855)**

in: *Syst. Lich. Germ.* 232. (*Schaereria* Th. Fr. was proposed for conservation against *Schaereria* Körb., but the proposal was not accepted.)

Type: *S. lugubris* Falkenstein (= *S. cinereorufa*). The type is conserved. Family: *Schaereriaceae*. Literature: Kantvilas (1999) has a key to all known species.

About 11 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 not known which epithet has priority. I am following 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.

Common in northern parts of Europe, but south of the Alps almost restricted to the mountains. Also Macaronesia (only Azores), Asia (Russia, Kazakhstan, Nepal), Africa (S. Africa), N. America (widespread from Alaska to cold parts of USA), S. America (Colombia), Australasia (temperate Australia, NZS), Antarctica (subantarctic islands).

**Schismatomma Flot. & Körb. ex A. Massal. (1852)**


Type: *S. pericleum* (Ach.) Zwackh (= *S. graphidioides*). Family: *Roccellaceae*. Literature: Torrente & Egea (1989c) is a good starting point, but is by no means complete. Information on the species not discussed there is rather scattered.


I have seen too little material to give a comprehensive description of the genus. See the species descriptions below for some further details.

About 39 names at species rank are presently referred to *Schismatomma*, but some of these may belong elsewhere or
do not denote good species. A modern revision of the genus, and its limits, would be helpful. About 9 good species appear to be present in Europe. All species require a ± humid climate, and in Greece are uncommon and almost always coastal.

11 Soralia present. Apothecia rare or absent. **S. decolorans**

1 Soralia absent. Apothecia usually frequent.

22 Hypothecium colourless or almost. Most ascospores less than 24 µm long, 3 - 5 µm wide. **S. dirinellum**

2 Hypothecium pale brown to brown. Most ascospores more than 24 µm long, width various.

33 Apothecia not rounded (irregular or elongate or branched). Ascospores 2 - 3 µm wide. **S. graphidioides**

3 Apothecia rounded. Ascospores more than 2.5 µm wide.

44 Ascospores 2.5 - 4 µm wide. If present in Greece, then probably restricted to upland sites. (S. periculum)

4 Ascospores 5 - 6 µm wide. Rare morphs of **S. decolorans**

**Schismatomma decolorans** (Turner & Borrer ex Sm.) Clauzade & Vězda (1965)


Thallus: crustose, white, pale grey-white or pale pink-brown, forming small patches to 1.5 cm diameter (in material seen to date), older parts slightly cracked, younger parts continuous, thin (150 - 220 µm in section). 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 tall, mostly colourless, sometimes grey in outermost 15 µm. Medulla: poorly developed. Apothecia: usually absent, only a single apothecium seen (material now in E). Epitheciun: black. Hymenium: 55 µm tall, colourless. Hypothecium: brown. Ascospores: colourless, 3-septate when mature (though all but one seen were immature), 35 - 45 x 3.5 - 5 µm, often curved. Chemistry: thallus and soralia C-, K-, KC-, P-, UV-. Photobiont: Trentepohlia.

The name **S. albocinctum** has been used in the past for the rare fertile morph. Recently transferred to the genus **Dendrographa**, as **D. decolorans** (Turner & Borrer ex Sm.) Ertz & Tehler.

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.

Western half of Europe, to as far north as British Is and southern Sweden. Almost absent from eastern Europe. Also Macaronesia, western Asia (Syria, Iran, Yemen), N. America (Michigan, perhaps elsewhere).

**Schismatomma dirinellum** (Nyl.) Zahlbr. (1923)

in: Cat. Lich. Univ. 2: 555; **Platygrapha dirinella** Nyl. (1856) in: Mém. Soc. Imp. Sci. Nat. Cherbourg 4: 95 and 104; (?) **Lecanora picconiana** var. microcarpa Bagl.; **Schismatomma picconianum** (Bagl.) J. Steiner; (?) **Schismatomma picconianum** var. microcarpum (Bagl.) J. Steiner

Some authors have regard **S. dirinellum** and **S. picconianum** as distinct, the former being said to be parasitic on **Dirina ceratoniae** and the latter corticolous. Tehler (1994: 33) regarded the names as synonyms, but apparently now treat them as distinct, under the names **Diromma dirinellum** and **Ocelloma picconianum**. The matter needs to be clarified.

Thallus: crustose, pale grey, forming small patches to 1 cm diameter, thin (80 - 90 µm in section). Soralia: absent. Cortex: colourless. Medulla: poorly developed. Apothecia: sessile, z/flat, 0.3 - 0.5 mm diam, sometimes slightly white pruinose. Disc: black. Exciple: sometimes visible externally as a dark brown to black ring; in section: 20 - 40 µm wide, pale brown to dark brown, structure obscured by pigment and abundant crystals. K-, 1+ red-brown, a little pigment dissolving in K; crystals: colourless, angular, 2 - 14 x 2 - 6 µm, not soluble in K. "Thalline" margin: present, persistent, sometimes without algal cells. Epitheciun: dark brown, K-, a little pigment dissolving in K. Hymenium: 60 - 100 µm tall, mostly colourless, upper part sometimes with some epitheciunal pigment, 1+ red-brown, KI+ rather faintly blue. Hypothecium: 20 - 25 µm tall, colourless, upper part 1+ blue > red-brown, reaction less intense than hymenium. Paraphyses: rather sparingly branched and anastomosed (many paraphyses are simple), 1 µm wide at base, 1 - 1.5 (2.5) µm at apex, not capitunate. Asci: 45 - 50 x 15 - 20 µm, clavate, Opegrapha type (usually appearing KI-, but two small KI+ blue dots occasionally visible at apex). Ascospores: colourless, usually 3-septate when mature, 8 per ascus, 20 - 25 (30) x 3 - 4 (5) µm, sometimes slightly curved. Pycnidia: common, visible externally as low warts with a black dot, 0.05 mm wide at centre; in section: 100% immersed, 110 µm tall, 100 µm wide, brown around ostiole but colourless elsewhere. Conidia: colourless, straight, 2.5 - 4 x 1 - 1.5 µm. Chemistry: thallus C-. Photobiont: Trentepohlia.

Easily distinguished from other species of the genus by the absence of soralia and the pale hypothecium. The genus itself can be recognised fairly easily by the combination of Trentepohlia photobiont, apothecia with a thalline exciple,
septate ascospores and negative spot test reactions.

Scattered, in sites close to the sea. At altitudes 0 - 700 m, though more than half of all records are from below 200 m. Usually on bark, sometimes on wood. Reported from bark of many different phorophytes.

Circum-Mediterranean/Macaronesian. Portugal, Spain, Italy, and Greece. Also Macaronesia, western Asia (Lebanon, Israel), N. Africa (Morocco, Algeria, Tunisia).

Schismatomma graphidioides (Leight.) Zahlbr. (1919)

The nomenclature needs to be untangled. For a start, the supposed basionym is a provisional name and thus not validly published. The earliest validation of the epithet that I have seen dates from 1912. Also, the name Lecanactis ricasolii A. Massal., which dates from 1852, may be synonymous, in which case the correct name would be Schismatomma ricasolii (A. Massal.) Egea & Torrente. There are several other epithets published before 1912.

Description: Cluzade & Roux (1985); Smith et al. (2009).

Athos Peninsula, on bark at an altitude of 1200 m.

Widely distributed in Europe to as far north as British Is and southern Scandinavia. Also Macaronesia, western Asia (Turkey, Israel, Russia, Mongolia), N. Africa (Morocco), N. America (scattered in USA). Reports for S. America are incorrect. The status of reports for Pacific is not clear to me.

Sclerococcum Fr. (? 1819)
in: [need to investigate. The description in Syst. Orb. Veg., 1:173. 1825 is sufficient for valid publication, but Fries appears to refer there to an earlier work when he cites "Fries Nov. Fl. Suec. V"]

Type: S. sphaerale (Ach.) Fr. Family: anamorphic fungi - hyphomycetes. Literature: Information is very scattered, and there is no unified, up-to-date treatment. Etayo & Calatayud (1998) give a key to the species with black sporodochia in Spain.

About 16 species of lichenicolous (or, in one case, probably lichenised) hyphomycetes. Many of them have been described in recent years, and our knowledge of the genus is probably still very incomplete. Fourteen species have been reported for Europe, but there is only a single Greek record.

111 Conidia mostly simple. (S. cladoniae), (S. simplex)
11 Conidia mostly 1-septate. (S. acarosporae), (S. montagnei) (S. parmeliae)
1 Conidia irregularly shaped, with 2 - 14 cells.
222 Sporodochia dark red-brown. (S. epithytorum)
22 Sporodochia grey or grey-mauve. (S. griseosporodochium), (S. normandinae)
2 Sporodochia ±black.
33 Wall of conidia smooth.
44 Sporodochia 60 - 180 µm diameter. Conidia with 2 - 14 (20) cells. Conidia with irregular, well-delimited darker regions due to an unevenly thickened cell wall. S. serusiauxii

4 Sporodochia 170 - 500 µm diameter. Conidia with 2 - 6 (9) cells. Conidia without well-delimited darker regions. (S. sphaerale)
3 Wall of conidia ornamented. (S. leuckertii), (S. tephromelarum)

Sclerococcum serusiauxii Boqueras & Diederich (1993)
in: 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.

Only Austria, Spain, Corsica, Slovenia and Greece.

Scoliciosporum A. Massal. (1852)

Type: S. holomelaenum (Flörke) A. Massal. (= S. umbrinum). Family: Scoliciosporaceae. Literature: There is no monograph and information is scattered. Between them, Cluzade & Roux (1985) and Smith et al. (2009) treat all the
species known for Greece.
As I have seen only one species, see the description of S. umbrinum below.

About 15 species, of which 9 occur in Europe. The genus is poorly represented in Mediterranean regions, and only 4 species occur in Greece, where they are uncommon. They are also inconspicuous and easily overlooked.

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 Ascospores strongly curved, spirally twisted in ascus.
44 Apothecia 0.1 - 0.3 mm diameter, dark brown. Ascospores 14 - 20 x 1 - 2 μm. S. perpusillum
4 Apothecia 0.3 - 0.8 mm diameter, pale brown to dark grey or blackish. Ascospores 20 - 40 x 2 - 3 μm. S. umbrinum
3 Ascospores straight or slightly curved.
44 Ascospores 3 - 9 -septate, 20 - 40 μm long. S. chlorococcum
4 Ascospores 3-septate, 15 - 22 μm long. (S. gallurae)

Scoliciosporum chlorococcum (Graewe ex Stenh.) Vězda (1978)

Ikaria and Thessaly, close to sea level, on bark. The only phorophyte explicitly mentioned is Arbutus unedo, an unusual substrate for lichens.
Widely distributed in Europe to as far north as the Arctic Circle, but uncommon in southern Europe. Also Asia (widespread), N. America (widespread).

Scoliciosporum perpusillum J. Lahm ex Körb. (1861)
in: Parerga Lichenol. 241-242; Scoliciosporum umbrinum var. corticicola (often as 'corticola') (Anzi) Clauzade & Cl. Roux

Description: Clauzade & Roux (1985).
Scattered, with no clear pattern. On bark at altitudes 600 - 1200 m.
Widely distributed in middle latitudes of Europe. It reaches southern Sweden, but not British Is. Rare in southern Europe. Also Asia (south of Siberia).

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.
Widely distributed in central Europe. Northward, it reaches the southern parts of British Is and the Nordic Countries. South of the Alps it is very rare. Also N. America (California), C. America (CR).

Scoliciosporum umbrinum (Ach.) Lorka (1869)

The earliest name is Lecidea synothea Ach. (1808), but it has been formally rejected.
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: poorly developed; layer above photobiont cells 0 - 20 μm thick, colourless to pale brown, without distinct structure. - 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. Exciple: brown, thin, excluded early; in section: 50 - 60 μm wide, mostly colourless, sometimes pale brown at outer margin, of narrow, well-separated, anastomosed hyphae. Thalline margin: absent. Epithecium: almost colourless or brown, dull green, blue, blue-green, green-blue or green-black, K- N+ intensifying blue, slowly changing to 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, 8 per ascus, 20 - 25 x 2 - 3 µm, one end often broader than the other. Chemistry: 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. This is a rather inconspicuous species, and it may be more common than the few records suggest.

Throughout Europe. Also Macaronesia, Asia (widespread), Africa (Socotra), N. America (southern Canada, widespread in USA), C. America (Guatemala), Australasia (SE Australia, both islands of NZ).
Solenopsora A. Massal. (1855)

in: Framm. Lich. 20

Type: S. requienii A. Massal. (= S. holophaea). 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). Guttové et al. (2014) has brief, but good descriptions of all European species.

Thallus placodioid 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 exciple at least when young. Epithecium: colourless to brown; pigment K-, N-, dissolving in K but not in N. Paraphyses: simple. Ascii: Catillaria type. Ascospores: colourless, 1-septate with a thin septum, a few becoming 3-septate, narrowly ellipsoid to almost acicular, sometimes lower part, not capitate or moniliform. Asci: 35 - 40 x 11 - 12 µm, narrowly clavate, Catillaria type. Ascospores: colourless, 1-septate with a thin septum, a few becoming 3-septate, narrowly ellipsoid to almost acicular, sometimes obscurely so, becoming elongated. Epithecium: brown to brown-grey, K-, N-, pigment not soluble in K or N. Hymenium: 50 - 90 µm tall, colourless, K+ blue. Hypothecium: 75 - 150 µm tall, colourless. Paraphyses: 1 µm wide in lower part, not capitate or moniliform. Asci: 35 - 40 x 11 - 12 µm, narrowly clavate, Catillaria type. Ascospores: colourless, 1-septate with a thin septum, a few becoming 3-septate, narrowly ellipsoid to almost acicular, sometimes

Differs from Catillaria in having a placodioid to squamulose, rather than strictly crustose, growth form and in possessing a thalline exciple at young apex. Thallus placodioid or crustose. Vegetative propagules absent. Rhizines present.

About 18 species occurring on rock or soil. Eight 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 of lichenological investigations in this region mean that the genus is not especially well known. It is well represented in Greece, but is restricted, or almost restricted, to localities not far from the sea.

The key is based on that in Guttové et al. (2014). Keys in earlier publications are apt to be misleading.

1 1 Thallus foliose or distinctly squamulose. Vegetative propagules absent. Rhizines present.

2 2 Thallus foliose, red brown to green-brown, not pruinose, shiny. Upper cortex ±hyphal. Apothecia dark red-brown to black, sometimes becoming strongly convex. On slightly nutrient enriched siliceous substrates. S. holophaea

1 1 Thallus placodioid or crustose. Vegetative propagules present or absent. Rhizines absent.

2 2 Thallus placodioid.

3 3 On calcareous rock. Thallus grey-green, tips of marginal lobes white pruinose. Disc dark, blue-white pruinose. In shaded situations. S. liparina

3 3 On calcareous rock. S. olivacea s. lat.

4 4 Thallus forming continuous, irregular patches, not rosettes. Often with blastidia or granular soralia. S. grisea

4 4 Thallus forming rosettes or (when central parts decay) concentric radiating circles or arcs.

5 5 Thallus blue-grey to grey, white pruinose. Lobes wavy or folded. Central part of thallus often decayed. In sheltered situations. S. cesatii

5 5 Thallus white, pruinose. Lobes flat, adpressed to substrate. Central part of thallus persistent. In sheltered or open situations. S. candidans

2 2 Thallus crustose or with small granular squamules.

3 3 On calcareous rock. S. olivacea subsp. olbiensis

4 4 Soralia absent. Apothecia commonly present. S. olivacea subsp. olivacea

4 4 Soralia present. Apothecia usually absent. S. olivacea subsp. olbiensis

3 3 On siliceous rock. S. vulturiniensis

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. Medulla: white, of rather broad hyphae, 3 - 4 µm wide, without visible septa, with a few external crystals; hyphae oriented predominantly horizontally (i.e. parallel to substrate) 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. Exciple: pale brown 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 reacting as for epithecium. Thalline margin: present, sometimes obscurely so, becoming elongated. Epithecium: brown to brown-grey, K-, N-, pigment not soluble in K or N. Hymenium: 50 - 90 µm tall, colourless, K+ blue. Hypothecium: 75 - 150 µm tall, colourless. Paraphyses: 1 µm wide in lower part, not capitate or moniliform. Asci: 35 - 40 x 11 - 12 µm, narrowly clavate, Catillaria type. Ascospores: colourless, 1-septate with a thin septum, a few becoming 3-septate, narrowly ellipsoid to almost acicular, sometimes
Slightly curved, 8 per ascus, 12.5 - 16 x 3 - 5 μm. 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.

Scattered in coastal areas, on calcareous rock. Usually at altitudes below 800 m, occasionally higher.

Widely distributed in southern Europe, and occasional further north to Scotland. Absent from Baltic States and Nordic countries. Also western Asia (Turkey, Israel), N. Africa (Morocco, Algeria, Tunisia), perhaps N. America (California Utah), Australasia (NSW).

Solenopsora cesatii (A. Massal.) Zahlbr. (1919)


Islands of the Aegean, including Crete. (There is also a single anomalous, but probably reliable, report for Meteora, in Thessaly.) On calcareous rock or, less commonly, calcareous soil, at altitudes 0 - 900 m.

Mostly southern Europe; there are very few reports for north of the Alps, though it is known for Ukraine. Also Macaronesia (Canary Is), western Asia (Turkey, Jordan).

Solenopsora grisea (Bagl.) Kotlov (2004)

Description: Clauzade & Roux (1985) as Solenopsora cesatii var. grisea; Guttová et al. (2014).

Islands of the southern Aegean, on calcareous rock and soil at altitudes 50 - 700 m.

Southern Europe, Macaronesia (Canary Is), western Asia (Israel, Jordan).

Solenopsora holophaea (Mont.) Samp. (1921)

Thallus: squamulose. Squamules: 0.5 - 1.5 mm wide, adpressed when young, sometimes ascending at margins when mature, occasionally overlapping, brown (dark green when wet), not pruinose. Soralia: absent. Medulla: white.


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 corticolous (Waynea) or have darker apothecia (darker brown to black).

Scattered and uncommon, on the Aegean islands and adjacent coast of the mainland. On soil or rock near the coast at altitudes 0 - 450 m.

Spain to Greece, and along the Atlantic margin to SW Norway. Also Macaronesia, N. Africa (Morocco), N. America, S. America (Argentina), Australasia (NSW).

Solenopsora liparina (Nyl.) Zahlbr. (1919)

Descriptions: Clauzade & Roux (1985) as Solenopsom cesatii f. liparina; Guttová et al. (2014); Smith et al. (2009). Scattered, with no clear pattern, but never very far inland, on calcareous rock at altitudes 50 - 350 m.

France, Italy and Greece, with a disjunct locality 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.

S. marina is known from Croatia, Montenegro and Greece only.
Solenopsora olivacea (Fr.) H. Kilias (1981) subsp. olivacea
in: Herzogia 5(3-4): 399; Biatora olivacea Fr. (1825) in: Syst. Orb. Veg. 1: 285; Biatora ungeri Hepp; Catillaria olivacea (Fr.) Zahlbr.; Placodiella olivacea (Fr.) Szatala; (?) Placodiella olivacea var. stampaliana Szatala; Ricasolia olivacea (Fr.) Bagl.

Early names that may be synonymous include Parmelia liparia var. olivacea Clemente (1807) and Patellaria olivacea Pers. (1810), but they can not now be combined into Solenopsora.

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 surrounded cells to 4 µm wide, to ±hyphal with hyphae predominantly parallel to surface; pigment K-, N-, dissolving 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. Exciple: pale pink-brown to brown, paler than disc (when disc not pruinose); in section: 20 - 30 µm wide, colourless in inner part, colourless to brown in outer part, usually of radiating hyphae, but in some collections developing a cellular texture. Thalline margin: present at least in section, but excluded early. Epithecium: colourless to pale brown or pale orange-brown, not well delimited from hymenium, K-, N-, pigment dissolving 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, clavate, not (or scarcely) capitate, apex 4 µm wide. Asci: 35 x 8 µm, narrowly clavate, ±Catillaria type but apex sometimes with a small KI- central region that does not reach to top of ascus. Ascospores: colourless, 1-septate with a thin septum, ±hyphal with hyphae predominantly parallel to surface; pigment K-, N-, dissolving in K but not in N. Medulla: white. Apothecia: often abundant, sessile, flat, 0.3 - 0.55 µm thick.

Widely distributed and fairly common in southern Greece, less common in the north of the country. Never far from the sea. On calcareous rock at altitudes 0 - 900 m, but about half of all records are from below 200 m. Mediterranean/Macaronesian. Iberian Peninsula to Cyprus; there are probably no reliable reports for north of the Alps and Pyrenees. Also Macaronesia (Canary Is), western Asia (Turkey, Syria), N. Africa (Morocco).

Solenopsora olivacea subsp. obiensiis (Nyl.) Clauzade & Cl. Roux (1982)
in: [need to investigate]; Lecanora obiensiis Nyl. (1876) in: Flora 59: 306; Placodiella olivacea var. sorediifera (Zahlbr.) Szatala; Description: Clauzade & Roux (1985); Guttova et al. (2014).

Macedonia, on calcareous rock at altitudes up to 1000 m. Never very far from the sea.

Only Italy and Greece.

Solenopsora vulturiensis A. Massal. (1856)
in: Lotos 6: 75

Descriptions: Clauzade & Roux (1985, 1989); Guttova et al. (2014); Smith et al. (2009).

Islands of the Aegean, including Crete, at altitudes 0 - 450 m. Apparently rather indifferent as to substrate, and reported from rock (calcareous and siliceous), non-calcareous soil, and bark of Junipers phoenicea.

Mediterranean Europe and the Atlantic coast to as far north as Norway. Also Macaronesia, western Asia (Turkey), Australasia (scattered in Australia).

Solorina Ach. (1808)

Type: S. crocea (L.) Ach. Family: Peltigeraeae. 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 & Martinez (2003).

About 9 species. About 6 occur in Europe, though the precise number depends on whether one regards certain taxa as species or at a lower rank. Most species are terricolous, or occur on rock near the ground, and they usually occur in cool to arctic regions.

The laminal apothecia clearly distinguish Solorina from Peltigera, in which the apothecia are always marginal.

11 Asci with (1) 2 ascospores. Thallus less than 1 cm diameter. S. bispora s. lat.
22 Ascospores about 90 x 40 µm. S. bispora subsp. bispora
2 Ascospores about 110 x 45 - 60 µm. **S. bispora subsp. macrospora**

1 Ascii 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 of the reports might refer to subsp. *macrospora*). On soil, less often rock, at altitudes 1250 - 2600 m.
- Widespread in northern and central Europe, but south of the Alps restricted to the highest mountains. Also Asia (widespread), N. America (scattered from Alaska to cold parts of USA). Some reports might refer to subsp. *macrospora*.

**Solorina bispora subsp. macrospora** (Harm.) Burgaz & Martínez (1998)

- **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.
- A rarely reported taxon of central Europe and the Alps, with a very few records from the highest mountains of southern Europe. I have not seen any reports from other continents.

**Solorina saccata** (L.) Ach. (1808)

- **Descriptions:** B. & A. (1808: 228); *Lichen saccatus* L. (1755) in: Fl. Sv. Ed. 2, 419
- The description below is brief and incomplete, as it is based on field notes plus more detailed observations on just two small fragments of lichen, which was all that I considered it appropriate to collect. A better description must await the discovery of this species at additional sites.
- Fertile specimens of *Solorina* can not be confused with any other genus, and this species is the only one likely to occur in southern Greece.
- Very scattered on the mainland. Usually on calcareous soil, sometimes on calcareous rock, at altitudes 700 - 1800 m. The Peloponnesian collection from the base of a limestone outcrop at 900 m 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 about a small patch of rock, and a careful search of the surrounding area failed to 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 at a rather low altitude. It is very unlikely that the few thalli seen at this site are a viable population, and they are presumably a temporary colony sourced from some larger population elsewhere. However, I do not know where this parent population might be located. The situation is reminiscent of the very disjunct find of *S. saccata* near Peterborough in England, described in Gilbert (2000: 149).
- Throughout Europe, but rather rare in the south. Also Macaronesia (Madeira), Asia (widespread), Africa (Morocco, S. Africa), N. America (widespread from Alaska to cooler parts of USA).

**Sphaerellothecium** Zopf (1897)

- **Type:** *S. araneosum* (Rehm ex Arnold) Zopf. Family: *Mycosphaerellaceae*. Literature: Two recent papers, which I have not seen, are noted in *British Lichen Soc. Bull.* 77:47. Elsewhere, information is very scattered, but Nash et al. (2004) is a good starting point. Other publications with some useful information include: Alstrup & Hawksworth (1990:28-30 (under *Echinothecium glabrum*, which is a synonym of *S. araneosum*), Etayo & Diederich (1998), Hansen & Alstrup (1995), Hawksworth (1994), Ihlen (1998) and Triebel (1989).
About 23 species of lichenicolous fungi, 16 of which occur Europe. The genus is rare in Greece.

11 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 and host various.
    5555 On Physcia.  (S. aipolium)
    5555 On Placidium.  (S. breussii)
    55 On Aspicilia, Lecanora and Ochrolechia.  (S. araneosum)
    5 On Cladonia.  (S. cladoniae)
  2 Ascospores brown.
    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)
  1 Ascomata growing mainly in ascomata of host. On corticolous Lecanora.  (S. propinquellum)

*Sphaerellothecium abditum* Triebel (1989)
in: *Bibl. Lich.* 35: 72-76
Description: See the protologue, or Nash et al. (2004).
Macedonia, at about 2000 m altitude on *Lecidea atrobrunnea*. (Not mapped, as the precise locality has not been identified.)
Cold parts of Europe (Norway, Sweden, France, Austria and Greece), Asia (Russia, Nepal), N. America (Alberta, mountains of western USA).

*Sphinctrina* Fr. (1825) : Fr.
Type: *S. turbinata* (Pers.) De Not.  Family: *Sphinctrinaceae*. Literature: Löfgren & Tibell (1979) monograph the European species. There are more recent treatments of most of these species in Ahti et al. (1999), Muñiz & Hladun (2011) and Smith et al. (2009).
A distinctive genus of stalked, mazediate, lichenicolous fungi. Worldwide there may be around 15 species. Six occur in Europe; all are rare. The hosts of European species are crustose lichens, most commonly species of *Pertusaria*.

11 Ascospores almond-shaped.  (S. tubaeformis)
1 Ascospores ±globose to ellipsoid.
  22 Ascospores 4 - 6.5 µm long.
    33 Apothecia K+ purplish.  **S. turbinata**
    3 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 irregularly ridged ornamentation. Exciple colourless to pale brown in section, not very hard.  (S. paramerae)

*Sphinctrina leucopoda* Nyl. (1859)
in: *Flora* 42: 44-45. (The 1859 description is very brief, but unless formally rejected as a nomen subnudum under Article 32.4 it must be accepted.)
Descriptions: Ahti 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 (Russia, Japan), N. America (scattered in USA), C. America (Mexico), S. America (Peru), Australasia (Tasmania), Pacific (Hawaii).
Sphinctrina turbinata  (Pers. : Fr.) De Not. (1846)

Descriptions: Ahti et al. (1999); Clauzade & Roux (1985); Clauzade, Diederich & Roux (1989); Muñiz & Hladun (2011); Nash et al. (2004); Smith et al. (2009).

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 is difficult to assess. This would be an unexpected host, but the material was determined by Julius Steiner, usually a reliable worker.

Widely distributed in Europe, but in the south restricted to the mountains. Also Macaronesia, Asia (Turkey, Syria, Russia, Japan), Africa (Morocco, Algeria, Libya, S. Africa), N. America (scattered from Alaska southwards, but avoiding hottest parts of USA), Australasia (Tasmania), Pacific (Hawaii).

Spilonema Bornet (1856)

Type: S. paradoxum Bornet. Family: Coccocarpiaceae. Literature: The two European species are discussed in all the standard floras

About 4 species worldwide, though the non-European ones are rather poorly known. Two species 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, but probably absent from truly Mediterranean regions and from the High Arctic. Also Macaronesia, North Africa (Morocco), North America (Alabama, Massachusetts), South America (widespread), Australasia (Western Australia).

Sporastatia A. Massal. (1854)
in: Geneac. Lich. 9

Type: S. testudinea (Ach.) A. Massal. Family: Sporastatiaceae. Literature: There is no monograph, but the two European species are treated in all the standard Floras.

A small genus of 4 species, three 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)

The earliest name is Lecidea morio γ (= var.) cinerea Schae. (1833), but it does not have priority at the rank of species.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).

Scattered in northern Greece, on siliceous rock. Reported altitudes 1860 - 2500 m, but on Samothraki at lower altitude.

Widely distributed in northern and central Europe, but I have not seen any confirmed reports for south of the Alps. Also Asia (Turkey, Russia), N. America (scattered from Alaska to cold parts of USA), Antarctica (subantarctic islands).
**Sporastatia testudinea** (Ach.) A. Massal. (1854)
The correct name may be *Sporostatia morio* (DC.) Körb.
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, but 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)
Type: *S. gypsacea* (Sm.) Poelt. Family: *Stereocaulaceae*. 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 that occur in 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, but excluded early in some species. Exciple: inconspicuous but often visible externally as a thin rim slightly differentiated from disc. Epithecium: brown, K-, pigment dissolving in K. Hymenium: generally less than 100 \( \mu \)m tall, basically colourless though upper part sometimes with epithecial pigment. Paraphyses: simple, slightly clavate, not capitate. Asci: narrowly clavate, Bacidia or Lecanora type. Ascospores: colourless, simple, ellipsoid to narrowly ellipsoid, 8 per ascus, medium sized (10 - 20 \( \mu \)m long). Chemistry: medulla P+ yellow in some species; other reactions usually negative. Photobiont: green, trebouxioid.

*Squamarina* has been a problematic genus ever since it was described. Poelt regarded it as a segregate from *Lecanora*, characterised by a squamulose, rather than crustose or placoidioid, thallus, but, like many genera defined by a single, simple morphological criterion, in that sense it is artificial and probably polyphyletic. Some species may indeed belong in *Lecanoraceae*, but the type species has an ascus of *Bacidia* type, and is unlikely to be 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, preferably in English, is desirable.

As presently delimited, *Squamarina* has about 21 species worldwide, and about 15 in Europe. They generally occur on soil and rock, usually calcareous, in warm, dry places. The genus is well represented in Greece, and one species, *S. cartilaginea*, is ubiquitous. The Mediterranean appears to be a centre of diversity for this genus.

Some species of *Squamarina* can be confused with members of the *Lecanora muralis* aggregate, but most members of that aggregate 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 (length 2 - 8 times width). 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 (length 1.5 - 3 times width). Medulla P+ yellow. Thallus pruinose or not. 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 (not or only slightly overlapping) convex squamules. 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, not strictly montane. **S. periculosa**
3 Squamules discrete or not; if discrete then not markedly convex. Thalline margin sometimes present in young apothecia, but usually becoming excluded later.
44 Ascospores 14 - 20 \( \mu \)m long, with subrounded to pointed ends. Squamules foliose, often overlapping. Medulla
P+ yellow. On rock. **S. oleosa**

4 Ascospores 10 - 15 µm, with rounded ends. Squamules various. Medulla P+ yellow, P+ red or P-. On rock or soil.

55 Thallus of discrete (not or only slightly overlapping) squamules, sometimes concave, sometimes with a white, upturned margin (Note 1). Thalline margin thin, excluded very early. Medulla P+ yellow. **S. gypsacea**

5 Thallus of ±folioid, often overlapping squamules (Note 1). Thalline margin fairly well developed in young apothecia, often pruinose, often excluded later. **S. cartilaginea** s. lat.

666 Medulla P+ red. **S. cartilaginea f. iberica**

66 Medulla P+ yellow. **S. cartilaginea f. cartilaginea**

6 Medulla P-. **S. cartilaginea f. pseudocrassa**

(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, James & Coppins, in: Lichenologist 12(1): 107; **Lichen cartilagineus** With. (1776) in: Bot. Arr. Veg. Gr. Brit. 708; **Lecanora cartilaginea** auct. græc., non Ach.; **Lecanora crassa** Ach.; **Lecanora crassa** f. caespitosa (Schaer.) J. Steiner; **Lecanora crassa** b. (= var.) caespitosa (Schaer.) Rabenh.; **Lecanora crassa** f. dealbata (A. Massal.) Hepp; **Lecanora crassa** var. dealbata (A. Massal.) J. Steiner; **Lecanora crassa** b. (= f.) dufouri (Fr.) Schaer.; **Lecanora crassa** var. imbricata (A. Massal.) Hepp; **Placodium crassum** Link; **Placodium crassum** var. cetrarioides (A. Massal.) Müll. Arg.; **Placodium crassum** var. dufouri (Fr.) Müll. Arg. (sometimes as 'dufoirei'); **Psoroma crassum** f. caespitosum (Schaer.) Arnold; **Psoroma crassum** f. dealbatum A. Massal.; **Squamaria crassa** DC.; **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** β (= var.) melaloma (Ach.) Duby; **Squamarina crassa** Poelt

**Lichen crassus** Huds. (1778) is a superfluous name for **Lichen cartilagineus** With., and all subsequent *crassus* names are illegitimate. **Lichen caespitosus** Vill. (1789) is a later homonym, but the epithet was legitimated as **Parmelia crassa** var. caespitosa (Ach.) Schaer. (1840).

Thallus: squamulose, forming irregular patches to many cm diameter. Squamules: pale green to dark green (becoming brown in herbarium), 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, entirely immersed to sessile, slightly concave to slightly convex, 0.8 - 3 mm diameter. Disc: orange-brown to brown, not pruinose. Exciple: 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 that develop small rounded lumina in outer part. Thalline margin: often present in young apothecia, sometimes white pruinose, usually becoming excluded eventually but persisting on lower surface of apothecia. Epitheciurn: orange-brown to brown, K-, pigment soluble in K. Hymenium: 60 - 90 µm tall, colourless in lower part, upper half usually with epithelial pigment, KI+ blue. Hypothecium: 100 - 150 µm thick, colourless, of pointedly 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. Ascii: 50 - 55 x 8 - 10 µm, cylindrical, apex KI+ blue. Ascospores: colourless, simple, narrowly ellipsoid, 8 per ascus, 9 - 13 x 4 - 6 µm. Chemistry: K-, C-, KC-, medulla P+ yellow (reaction always strong and distinct), I-; thallus K-, C-, KC-, UV-, (P test misleading as reaction of medulla usually shows through). Photobiont: green, cells globose, 8 - 15 µm diameter. Photobiont layer: continuous, regular, 50 - 80 µm thick.

The ascus apex is difficult to study because the asci are narrow. 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. However, 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 **Clypeococcum psoromatis** (= **C. epicrassum**) and **Lichenostigma rouxi** have been reported from this lichen.

Widely distributed in Europe to as far north as southern Scandinavia, but commonest in the south. Also Macaronesia, Asia (widespread), Africa (widespread in N. Africa; also Mauretania, S. Africa), N. America (Saskatchewan, Nebraska), perhaps S. America (Argentina).
**Squamarina cartilaginea f. iberica** (Mattick) Clauzade & Cl. Roux (1985)


Description: Clauzade & Roux (1985); Nimis & Martellos (2004).

Crète, at an altitude of 1100 m. The substrate was not reported.

Circum-Mediterranean. Italy and Greece (and, presumably, judging from the epithet, Iberian Peninsula, though I have not seen any reports). Also western Asia (Israel), N. Africa (Tunisia).

**Squamarina cartilaginea f. pseudocrassa** (Mattick) ined.

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. pseudocrassa* Mattick (1940) in: *Ber. Deutsch. Bot. Ges.* 58: 351

Differ from var. *cartilaginea* only in having a medulla that reacts P- (rather than P+ yellow).

Only reported from a few sites in the Peloponessse, 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.

Mediterranean/Macaronesian. Italy and Greece. Also Macaronesia (Tenerife), western Asia (Israel), N. Africa (Tunisia, Egypt).

**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. 60% of reports are from below 200 m.

Mainly southern Europe, with a few reports for central Europe. Also Macaronesia (Canary Is), Asia (widespread as far east as Tajikistan), N. Africa (Morocco).

**Squamarina gypsacea** (Sm.) Poelt (1958)


The earliest name is *Lichen fragilis* Scop. (1772), but it is not legitimate, being a later homonym of *L. fragilis* L. (1753). The epithet *fragilis* does not appear to have been used legitimately until the 20th century.

Thallus: squamulose, to several cm diameter, green when fresh, becoming brown in herbarium, 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 a prominent white margin where medulla visible, ±sodiametric or slightly broader than long, 2 - 3.5 x 2 - 5 mm, not radiating, 300 - 500 µm thick; lower surface white to black. Medulla: white. Apothecia: sessile to very shortly stalked, flat to slightly convex, 1 - 1.5 mm diameter, sometimes slightly white pruinose. Disc: pale brown. Exciple: inconspicuous but usually visible as a thin ring slightly darker than disc and sometimes slightly raised; in section: 100 µm wide, pale brown, most pigment soluble in K leaving a very pale yellow-brown residue, K-, KI-, formed of overlapping hyphae on an overall ±radial trend, sometimes with small but distinct elongated lumina in outer part. Thalline margin: ±absent. Epithecium: brown. Hymenium: 70 - 85 µm tall, colourless, KI+ blue. Hypothecium: colourless, KI-. Paraphyses: sparingly branched, 1 µm wide at base, 1.5 - 2.5 µm at apex, clavate, not usually capitate, often with visible septa. Ascii: 60 x 11 µm, narrowly clavate, usually ±Bacidia type but a few mature ones unambiguously ±Lecanora type. Ascospores: colourless, simple, narrowly ellipsoid, 8 per ascus, 10 - 13 x 4 - 5 µm, ends rounded. Chemistry: medulla P+ yellow, I-.. Photobiont: green; cells globose, 10 - 13 µm diameter.

Unlikely to be confused with any species except *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.

Widely distributed in Europe to as far north as southern Scandinavia, though not British Is or Baltic States. Commonest in the south. Also Asia (widespread), Africa (Morocco, Algeria, Tunisia, Somalia).

**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 (western Canada, western USA), perhaps Pacific (New Caledonia).

**Squamarina oleosa** (Zahlbr.) 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, 500 \( \mu \)m thick; lower surface black, slightly tomentose. Cortex: 12 \( \mu \)m thick, of periclinal hyphae. Medulla: white, rather chalky, of loosely interwoven hyphae. Apothecia: sessile, slightly concave to flat, 1.2 - 2.5 mm diameter, not pruinose. Disc: pink-brown to orange-brown. Exciple: usually visible externally as a thin, slightly raised rim, ±concolourous with disc; in section: 100 \( \mu \)m wide, basically of radiating hyphae, but developing an almost cellular texture though individual hyphae still discernible. Thalline margin: present in young apothecia, but becoming excluded. Epitheicum: pale brown, K-, pigment soluble in K. Hymenium: 75 \( \mu \)m tall, colourless in lower part, upper part sometimes with epithelial pigment, KI+ blue. Hypothecium: 80 - 100 \( \mu \)m tall, colourless. Paraphyses: simple, 1.5 \( \mu \)m wide at base, 2 - 2.5 \( \mu \)m at apex, not capitulate. Ascii: 50 - 55 x 10 \( \mu \)m, narrowly clavate to almost cylindrical, ±Bacidia type. Ascospores: colourless, simple, narrowly ellipsoid, 8 per ascus, 15 - 17.5 x 4.5 - 5 \( \mu \)m, ends subrounded to pointed. Chemistry: medulla K-, C-, KC-, P+ yellow, I-; thallus K-, C-, KC-, UV-. Photobiont: green.

Externally very similar to *S. cartilaginea*, but easily separated microscopically by the longer ascospores with more acute ends.

Cretan and Peloponnesian. On calcareous rock at altitudes 80 - 1200 m. An uncommon, or perhaps overlooked, species.

Southern Europe, from Spain to Greece: reports from further north are doubtful. Also Macaronesia (Madeira) and apparently Asia (a very disjunct report for SW China).

**Squamarina periculosa** (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, and western Asia (Syria).

**Squamarina stella-petraea** Poelt (1958)

Thallus: squamulose, to 8 cm diameter, brown to green, but surface obscured almost everywhere by dense white pruinina, 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 \( \mu \)m thick, colourless to pale grey-brown, outermost 10 - 15 \( \mu \)m structureless, elsewhere of broad, mostly vertical hyphae, but structure obscured by abundant fine crystals, about 1 \( \mu \)m wide, not soluble in K, slightly soluble in N. Medulla: white, chalky, formed of a dense network of broad hyphae, 4 - 6 \( \mu \)m wide, almost opaque in section because of abundant fine crystals about 1 \( \mu \)m 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. Exciple: sometimes visible externally as a thin ring ±concolourous with disc & often slightly raised; in section: 80 - 120 \( \mu \)m wide, colourless to pale brown, structure obscured by abundant fine crystals. Thalline margin: present in young apothecia, strongly white pruinose, becoming excluded. Epitheicum: brown to grey-brown, K-, pigment soluble in K, with abundant fine crystals. Hymenium: 60 \( \mu \)m tall, colourless in lower part, upper part often with epithelial pigment and fine crystals. Hypothecium: 80 - 100 \( \mu \)m 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 \( \mu \)m wide in lower part, scarcely broadening towards apex, not capitulate or moniliform, sometimes with visible septa. Ascospores: colourless, simple, ellipsoid, 15 x 5 \( \mu \)m, 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 (though in long wave light sometimes appearing +white by reflection). Photobiont: green, cells globose, 8 - 12 \( \mu \)m diameter, forming a continuous, ±regular layer 40 - 70 \( \mu \)m thick.

Well characterised by the radiating but not elongated marginal lobes, and the dense white pruinina. Could perhaps be confused with *Lecanora pruinosa* but that is C+ orange.

Attica and Peloponnesian. On rock or soil, usually calcareous, or overgrowing bryophytes on those substrates, at altitudes 20 - 1200 m.

Basically circum-Mediterranean. Spain to Greece (but also in Hungary). Also western Asia (Turkey, Syria, Israel, Jordan), N. Africa (Morocco, Tunisia).
Staurolemma Körb. (1867)

in: Verh. k. k. zool.-bot. Ges. Wien 17: 707


Superficially resembles Collema (and long regarded as belonging in Collemataceae) but differs markedly from that genus in the structure of the ascus and in the epithelial pigment. The simple ascospores, with a prominent wall, are also not characteristic of Collema.

Staurolemma omphalarioides (Anzi) P. M. Jorg. & Henssen (1993)


Thallus: foliose but lobes often indistinct except near margin of thallus, to 1 cm diameter, homoiomerous. Lobes: when well-developed (at margins of thallus) 2 - 5 mm wide, rounded, weakly adpressed but with ascending margins, thin, about 50 µm thick; 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 and (in material seen) beginning to develop on thatlline exciple. Upper and lower cortex: absent, but hyphae becoming much more concentrated near the surface; in centre of lobes the hyphae are 1.5 - 4 µm wide, anastomosed, without visible septa. Apothecia: frequent, flat, 0.25 - 0.8 mm diameter, sessile or shortly stalked, laminal and marginal, not pruinose. Disc: black, matt. Exciple: not visible externally; in section: 30 µm wide, cellular, though the cells become less distinct towards the thalline margin; present, brown, clearly contrasting in colour with the disc and most of the thallus, thin but persistent, though eventually becoming slightly discontinuous; in section: 35 µm wide. Epithecium: dark brown with a very faint purplish tinge, K-, but becoming dull grey in K. Hymenium: ±colourless, 100 µm tall. Hypothecium: 100 - 140 µm tall, consisting 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, formed 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 they have a hemispherical, dull grey cap of pigment, which appears to be internal. Asci: narrowly clavate to clavate, 55 - 67 x 15 - 23 µm, wall KI+ blue, but no apical structures visible in KI (not Collema type). Ascospores: colourless, simple, 15 x 9 - 10 µm, ellipsoid, with a 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 Collema species until the apothecia are sectioned. However, the simple ascospores and other microscopical 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 species, with no marked preference, but it avoids strongly acidic and strongly nutrient enriched bark.

Mediterranean/Atlantic (map in Jorgensen & Henssen 1993). Southern Europe, and Atlantic margin to as far north as Norway. Also Macaronesia, Asia (Turkey, Israel, Syria, Iran), N. Africa (Morocco, Algeria, Tunisia).

Staurothele Norman (1852)


Type: S. clopima (Wahlenb. ex Ach.) Th. Fr. (= S. drummondii). Family: Verrucariaceae. 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 71 names at species rank are presently referred here, but many denote 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.

If present in Greece, probably restricted to high altitude. (*S. orbicularis*)

2 Thallus superficial (though it may be thin). Perithecia immersed in thallus or at least parly emergent from substrate; never wholly immersed in substrate. Thallus ± dark brown, superficial. Involucrellum present.

33 Hymenial algal cells globose or slightly ellipsoid (Note 1).

44 Thallus superficial, fairly well developed. Perithecia not in pits in rock. On frequently submerged siliceous rock. (S. *orbicularis*)

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*)

33 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 Asci with (2) 4 or more ascospores.

22 On soil or amongst bryophytes and on plant debris.

33 Hymenial algal cells globose or ± cuboid, 3 - 4 µm diameter (Note 1). Ascospores colourless, 28 - 33 µm long. (S. *geoica*)

3 Hymenial algal cells distinctly longer than wide when mature (young cells are often globose or cuboid) (Note 1). Ascospores 36 - 43 x 13 - 17 µm. (S. *terricola*)

2 On rock.

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. (S. *rupifraga*)

4 Perithecia 0.4 - 0.6 mm diameter. Ascospores colourless or eventually becoming pinkish or yellow-brown, 4 - 8 per ascus.

55 Mature ascospores colourless or with a pink 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 rock. Thallus, substrate and hymenial algal cells varius.

44 Hymenial algal cells globose or ± cuboid, 3 - 4 µm diameter (Note 1). Thallus superficial. Perithecia half emergent. Mature ascospores brown. (This is a poorly known taxon: don't record it without further investigation.) **S. sienae**

4 Hymenial algal cells distinctly longer than wide when mature (young cells are 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 *Polyblastia ventosa* A. Massal. (1855), and the correct name appears to be *Staurothele ventosa* (A. Massal.) P. Syd. A conservation proposal would probably succeed.

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 to date); in section: 50%
immersed, 300 - 400 µm tall x 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 and well developed, 700 µm diameter, attached only at uppermost part of exciple. Paraphyses: disappearing early. Periphyses: abundant in upper half of perithecia, 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, 8 per ascus, 27 - 37 x 13 - 15 µm. Photobiont: green, not Trebouxia.

Staurotheleimmersa (A. Massal.) Dalla Torre & Sarnth. (1902)
in: Fl. Tirol 4: 553; Porphyriospora immersa A. Massal. (1855) in: Framm. Lichenogr. 23

Thallus: immersed, inapparent or forming a very pale brown stain, to 4 cm diameter. Perithecia: black, 0.25 - 0.3 mm diameter, with a flat or dimpled top, immersed in pits in substrate; in section: 360 - 400 µm tall x 350 - 460 µm wide, containing algal cells. Exciple: black throughout. Involucrellum: poorly developed and not very distinct from exciple. Paraphyses: disappearing early. Ascospores: colourless to very pale green, muriform, 28 - 38 x 11 - 17 µm. Photobiont: green; cells in hymenium globose to square, 2.5 - 3 µm diameter.

Staurothele orbicularis var. orientalis J. Steiner (1910)
in: Ann. 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)
in: [need to investigate]

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)
in: Deutschl. Fl. 2: 128. The name is conserved against Stereocaulon (Schreb.) Schrad. (1794)

Type: S. paschale (L.) Hoffm. Family: Stereocaulaceae. 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.

Only one species is likely to be present in Greece, so no description is given.

Over 130 species worldwide, about 35 in Europe. Most occur on acidic rock in cold climates. Stereocaulon is poorly represented in Mediterranean regions, where it seems to be almost restricted to volcanic substrates.

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.
S. vesuvianum s. lat. is present throughout Europe: in northern regions not restricted to volcanic rock. Also Macaronesia, Asia (widespread), Africa (Kenya, Tanzania, Uganda, Reunion Is, perhaps also west Africa), N. America (scattered, mainly along both coasts, from the arctic to cool parts of USA), perhaps Caribbean (Jamaica - old report), C. America (CR, Nicaragua), S. America (widespread), Australasia (Tasmania, both islands of NZ), Pacific (Hawaii), Antarctica (widespread).

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.

Stereocaulon vesuvianum f. santorinense (J. Steiner) I. M. Lamb (1969)
My single collection is scanty. The podetia are not well developed, though there are numerous phyllocladia with the dark centre characteristic of S. vesuvianum. However, the thallus reacts P-, and the medulla reacts only very faintly P+ yellowish, whereas the expected reaction for S. vesuvianum is P+ red. The presence of S. vesuvianum at the Peloponnesian site concerned - a volcanic one - is perfectly plausible, but unfortunately no further material of this species was located on a return visit to this site 7 years later.
Santorini and Methana Peninsula of Peloponnes, on lava. The Peloponnes collection was from an altitude of 430 m.

Stigmidium Trevis. (1860)
in: Consp. Verruc. 17
Type: S. schaereri (A. Massal.) Trevis. Family: Mycosphaerellaceae. 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 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 70 species of lichenicolous ascomycetes, at least 55 of which have been reported for Europe.

111 Fungus forming galls on thallus of host. (S. ephedes)
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.
3333333 On Acharospora. Ascospores 14.5 - 18 x 6 - 9 µm. (S. rouxianum)
3333333 On Aspicilia calcarea. Ascospores 22 - 30 x 4.5 - 9 µm. (S. aggregatum)
3333333 On Dermatocarpon. Ascospores 17 - 20 x 4.5 - 5 µm. (S. stygnospilum)
333333 On Graphis scripta. Ascospores 14 - 19 x 3 - 5 µm. (S. microspilum)
333 On Parmeliaceae.
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. Ascospores 13 - 15 x 3.5 - 5 µm. Ascomata 55 - 70 µm diameter. (S. leucopelleae)
3 On Pertusaria. Ascospores 11.5 - 18 x 4.5 - 6 µm. (S. eucrine)
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 restricted to apothecia of host.
444 On Pleurosticta acetabulum. (S. acetabuli)
44 On Physcia. (S. 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. Ascospores 1-septate.

66 Ascomata 60 - 100 (140) µm diameter. Short, pendent interascal filaments present. Hymenium gel I+ violet. On Squamarina cartilaginea. (S. cartilagineae)

6 Ascomata not exceeding 75 µm diameter. Pendent interascal filaments absent or poorly developed. Hymenial gel I-. On Protoparmelia species (i.e. Lecanora muralis aggregate) or on Lecanora polytropa. **S. squamariae**

3 Ascomata growing mostly on host thallus. (S. degelii), (S. gyrophorarum), (S. marinum), (S. psorae), (S. rouxianum), (S. squamarinicola)

2 Perithecial wall brown everywhere.

33 Most ascospores 5 or more µm wide. (S. aggregatum), (S. cerinae), (S. collematis), (S. epixanthum), (S. humidum), (S. johnii)

3 Most ascospores less than 5 µm wide.

444 Ascospores to 12 µm long. If does not key out below, see also next branch.

55555 On Acaeospora, especially A. fuscata. **S. fuscatae**

55555 On Anapytchia ciliaris. (S. hageniae) Greek report needs confirmation.

55555 On Placnythium nigrum. (S. placynthii)

555 On Ramalina. (S. ramalinae)

55 On Solorina. (S. solordinarium)

5 On Toninia, especially T. tristis. **S. tabacinae**

44 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 In thallus of Toninia tristis. 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 Aspicilia 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. punctillillum)

**Stigmidium congestum** (Körb.) Triebel (1991)


Perithecia: black, 0.03 - 0.12 mm diameter, 50 - 100% imersed in thallus or apothecia of host, sometimes several in one apothecium, often turning apothecia black; in section: subglobose, 53 - 110 µm tall x 40 - 100 µm wide. Exciepl: 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 constricted at septum, 8 per ascus., 8 - 15 x 2.5 - 4 µm

Scattered throughout Greece at altitudes 550 to about 2000 m. Recorded on *Collema flaccidum*, *Lecanora carpinea*, *Lecanora chlorotera* and *Lecidella elaeochroma*.

Quite widely distributed in Europe, though most records are for northern and western regions. Distribution outside Europe uncertain owing to confusion with other species, but reported for Macaronesia, Asia (Turkey, Iran, Russia) N. Africa (Morocco, Egypt), C. America (Mexico), Australasia (both islands of NZ. At least some of the records for Asia and N. Africa are modern and reliable. Reports for USA are said to be incorrect, so those for C. America may also be unreliable.

**Stigmidium fuscatae** (Arnold) R. Sant. (1988)

in: *Thunbergia* 6: 17; *Arthopyrenia fuscatae* Arnold (1874) in: *Flora* 57: 139

First published as *Pharcidia lichenum var. fuscatae* Arnold (1872), but that name is invalid as the specific name had
Stigmidium lecidellae Triebel, Cl. Roux & Le Coeur (1995)

There description here is based on a single, rather scanty collection. For a more detailed description see Roux & Triebel (1994).

Perithecia: 80 - 100% immersed in apothecia of host, several per apothecium, forming black dots 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.

It is not clear to me whether the ascospores "septa" are true septe, i.e. are continuous with the wall of the ascospore, or are merely discontinuities in the ascospore contents.

Kefallonia and Peloponnese. The Peloponnesian collection was on *Lecidella elaeochroma*, which was itself on bark of *Abies cephalonica* at an altitude of 1160 m. No substrate or altitude was reported for the collection from 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 *Leanora muralis*. The altitude, though not stated, must have been fairly close to sea level.

Central and southern Europe. Also Asia (Turkey, Iran, Russia), N. Africa (Morocco), N. America (scattered in western half), C. America (Mexico).

Stigmidium tabacinae (Arnold) Triebel (1989)
in: *Bibl. Lich.* 35: 236; *Pharcidia tabacinae* Arnold (1881) in: *Flora* 64: 176; *Arthopyrenia glebarum* Arnold; *Sphaerulina tabacinae* (Arnold) Vouaux


Crete and Corfu, at altitudes 0 - 1500 m on *Toninia diffracta* and *Toninia sedifolia*.

Widely distributed in Europe, so far as one can judge from the rather few records. Also Macaronesia, Asia (Turkey, Iran, Russia), N. America (Arizona, California, New Mexico).

Stigmidium xanthoparmeliarum Hafellner (1994)


Thessaly, on *Xanthoparmelia stenophylla* at an altitude of 320 m.

Central and southern Europe; absent from Scandinavia. Also Asia (Turkey, Iran, Russia), N. America (California, New Mexico).

**Strangospora Körb. (1860)**

in: Parerga Lichenol. 173

Type: *S. pinicola* (A. Massal.) Körb. Family: *Strangosporaceae*. Literature: Smith et al. (2009) treat all the European species except *S. torvula*, a northern taxon that will not occur in Greece.

Seven species, 5 of which are known from Europe; two of them are northern and will not occur 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)
in: Carmer, in: [need to investigate]; Biotorella microhaema Norman (1865) in: Th. Fr., in: Botaniska Notiser 1865: 99
Descriptions: Clauzade & Roux (1985) as Biotorella microhaema, Nash et al. (2007); Smith et al. (2009).
Present in Macedonia, scattered in cooler parts of USA, mainly in the west, perhaps S. America (Uruguay).

Strangospora moriformis "(Ach.)" Stein (1879)
On page 5, Acharius cites Sphaeria moriformis Pers., but with a "?", so he must be treated as introducing a new species, not making a new combination. On p333 of the Addenda, he definitely includes the name Schizoxylon sepincola Pers. as a synonym, thus making Arthonia moriformis Ach. a superfluous name and not legitimate. Depending on what Stein wrote (not yet seen), conservation may be required.
Descriptions: Clauzade & Roux (1985); Nash et al. (2007); Smith et al. (2009).
Athos, on wood at an altitude of 1200 m.
Widely distributed in northern and central Europe, but very rare in the south. Also Asia (widespread), N. America (southern Canada, scattered in USA mainly in the west).

Strigula Fr. : Fr. (1823)
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 rarely encountered.

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.
22 Ascospores 3-septate. (S. calcarea)
2 Ascospores submariform. (S. porinoides)

Strigula affinis (A. Massal.) R. C. Harris (1980)
The combination was made in February 1980. A combination in Bryologist 83: 18 dates from March 1980. The name first appeared in a 1975 Ph.D. thesis (not seen) but is probably not effectively published there.
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.
Widely distributed in southern and central Europe. Also Australasia (NZS). Said not to be present in N. America.

Description: Clauzade & Roux (1985) as Porina zizyphi.
Crete and Naxos, on bark at altitudes 350 - 700 m. The only phorophyte explicitly reported is Quercus.
Scattered in Europe, usually in the warmer and more humid parts. Also Macaronesia (Canary Is), western Asia (Syria, Turkey).
**Synalissa Fr. (1825)**

in: Syst. Orb. Veg. 1: 297


*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.


Very scattered, with no clear pattern. On rock (usually calcareous) or on soil at altitudes 0 - 2300 m. Most of Europe. Also Macaronesia, Asia (widespread), northern Africa (Morocco, Algeria Socotra), perhaps N. America (BC, very scattered in USA).

**Teloschistes Norman (1852)**

in: Conatus Praem. Gen. Lich. 16-17. The name is purely Greek, and there is no corresponding form in classical Latin. Several authors skilled in the classical languages, especially Vainio, have treated the name as of feminine gender, e.g. as in *T. flavicans* f. *hirtella* Vain. (1890), and he is probably correct as far as Ancient Greek usage is concerned. However, Norman himself treated the name as of masculine gender, and his usage should be followed. Note also that there is no justification for spelling the name *Theloschistes*, as has sometimes been done.

Type: *T. flavicans* (Sw.) Norman. Family: Teloschistaceae. Literature: Smith et al. (2009) cover the two European species.

Until recently, about 30 species were placed in *Teloschistes*. A number of segregate genera have recently been proposed, including *Seirophora* and *Xanthoanaptychia*. *Seirophora* seems to be well founded, but the status of *Xanthoanaptychia* is not clear to me, so for the moment I am not placing *T. chrysophthalmos* there. With this circumscription *Teloschistes* contains two species in Europe. They are most commonly found in regions with warm, 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 *chrysophthalum*, 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). Very scattered, with no clear pattern. On bark at altitudes 20 - 150 m. The only phorophyte explicitly reported was *Olea*.

Oceanic regions of western Europe and in the western Mediterranean; rare in the eastern Mediterranean. Also Macaronesia, western Asia (Turkey), Africa (widespread outside humid tropics), N. America (southern Canada, fairly widespread in USA), C. America (Mexico), S. America (widespread), Australasia (widespread), Pacific (Tahiti).

**Teloschistes flavicans** (Sw.) Norman (1852)

in: Conatus Praem. Gen. Lich. 17; *Lichen flavicans* Sw. (1788) in: 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.
Parts of Europe with a warm, or at least mild temperate, oceanic climate. Its presence as far east as Greece is surprising, but it is reported from Cyprus, even further east. Also Macaronesia (widespread), Asia (widespread), Malesia (widespread), Africa (widespread from E. Africa southwards), N. America (Newfoundland, widespread in USA but absent from continental interior), Caribbean (widespread), C. America (widespread), S. America (widespread), Australasia (widespread in humid temperate parts), Pacific (Hawaii, Tonga).

Tephromela M. Choisy (1929)


Type: T. atra (Huds.) Hafellner. Family: Tephromelataceae. Literature: The only widespread species, T. atra, is discussed in all the standard Floras.

Now that several species formerly placed have have been moved to Calvitimela, Tephromela contains about 38 species. Six occur in Europe, but in southern Europe only one is widespread.

11 Lichenicolous on Lecanora. (T. campesstricola)
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

in: Kalb, in: Lichenes Neotropici. Fasc. VII, no. 297; Lichen ater Huds. (1762) in: Fl. Angl. 445; Lecanora atra (Huds.) Ach.; Lecanora atra var. aegaica Szatala; (?) Lecanora atra var. applanata J. Steiner; Lecanora atra var. calcarea Jatta; Lecanora atra f. corticola (Hepp) Rabenh.; Lecanora atra var. deplanata J. Steiner; Lecanora atra γ (= var. discolor (Duby) Schae.; (?) Lecanora atra f. flavescens Harm.; (?) Lecanora atra var. flavescens (Harm.) Boistel; (?) Lecanora atra var. macedonica J. Steiner; Lecanora atra var. vulgaris Schae.; nom. inval.; Lecanora coilocarpa auct. graec. p.p.; Tephromela atra var. calcarea (Jatta) Clauzade & Cl. Roux; Tephromela atra var. terulosa (Flörke) Hafellner

Thallus: crustose, 2 - 10 cm diameter, white to pale grey, not pruinose, continuous to (more commonly) areolate, often warty, without vegetative propagules, to 600 µm thick at warts. Areoles (when present): 0.2 - 3.5 mm wide, subrounded to subangilar, flat to slightly convex. Prothallus: sometimes present, black. Cortex: rather poorly developed, almost a pseudocortex, 20 - 30 µm thick, colourless in lower part, sometimes pale brown in outer part, K-, pigment soluble in K; rather poorly structured but hyphae perpendicular to surface in lower parts and parallel to surface in upper parts sometimes apparent. Medulla: white, of broad loose hyphae often encrusted with large crystals to 6 µm. Apothecia: usually abundant, submersed when young, later sessile to sessile, flat to slightly convex, usually rounded and regular but sometimes becoming irregular when old, not pruinose, 0.3 - 1.5 mm diameter. Disc: black, usually slightly shiny and very finely warty (x32). Exciple: not visible externally; in section: poorly developed, 0 - 25 µm wide, pale brown when present. Thalline margin: present, prominent, persistent, 0.07 - 0.1 mm wide, usually smooth but sometimes becoming crenulate or discontinuous in old apothecia; in section: 80 - 110 µm wide, of which cortex 25 µm. Epithecium: dark grey to purple-brown, K+ red-purple, N+ red. Hymenium: 65 - 135 µm tall, usually purple or purple-brown, rarely acicolourless, K+ red-purple or purple intensifying, N+ red, KI+ blue. Hypothecium: 100 µm tall, usually colourless to pale brown but upper part sometimes with purple pigment. Paraphyses: sometimes branched, 1 (3) µm wide in lower part, apex 3 - 5 µm (including a gelatinous sheath that surrounds it), not capitate, often with visible septa. Asci: 60 - 70 x 10 - 12 µm, narrowly clavate, Bacidia type. Ascospores: colourless, simple (rarely 1-septate), ellipsoid, 8 per ascus, 11 - 15 x (4) 6 - 8 µm, with a distinct Lecanora-type wall. Pycnidia: black, 0.1 - 0.15 mm diameter, 100% immersed; in section: colourless except at surface, 150 µm tall, 80 µm wide, single chambered. Conidia: colourless, filiform, ±straight, (6) 13 - 15 x ¾ µm. Chemistry: thallus K+ yellow (reaction often faint), C-, KC-, P-, UV- or + faintly whiteish; medulla K-, C-, KC- or KC+ fleeting mauve > dull orange-brown (reaction patchy), P-, I+ brown-purple. Photobiont: green; cells globose, 10 - 15 µm diameter, forming a ±regular, usually continuous layer 30 - 50 µm thick.

The fairly large, rather robust, pale grey, K+ yellow thallus with prominent black lecanorine apothecia make this species easy to recognise. In case of doubt, the purple hymenial pigment is diagnostic.

Common throughout Greece at all altitudes. Fairly indifferent as to substrate. Most commonly found on rock (calcareous or siliceous but with a slight preference for the latter) - 67% of records - but sometimes on bark (28%) and
occasionally on wood. Recorded from a wide range of phorophytes with no obvious preferences.

*T. atra* s. lat. is present throughout Europe. Also Macaronesia (widespread), Asia (widespread), Malesia (PNG, Sabah), Africa (widespread), N. America (widespread), C. America (Mexico), S. America (widespread), Australasia (widespread), Pacific (Hawaii, Tuamotu; perhaps New Caledonia - old report), Antarctica (widespread in subantarctic islands and Antarctic Peninsula).

Tephromela atra var. cypria (Körb.) Nimis (1993)
in: The lichens of Italy 683; *Lecanora cypria* Körb. (1862) in: [need to investigate - need title of paper & page range; note also that date may be 1861]; *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.

Description: Discussed briefly in Nimis (1993 :683).

Scattered, in the islands of the Aegean and adjacent coasts of the mainland. On rock at altitudes 100 - 1400 m. Southern Europe, from Italy to Cyprus. Also Macaronesia, Asia (southern Siberia).

**Thallinocarpon Å. E. Dahl (1950)**

in: *Meddel. Grønl. 150(2): 140*


Two species, but one is only known from Greenland.

**Thallinocarpon nigritellum** (Lettau) P. M. Jørg. (2007)


Crete and Paros, on siliceous rock at altitudes 40 - 375 m. This is a northern or alpine species, and confirmation of the Greek reports is desirable. Confusion with species of *Gonohymenia* or *Lempholemma* is possible.

*T. nigritellum* has a wide, but very scattered distribution, in Europe, from Norway to Greece. Also Macaronesia, Asia (Turkey, Syria, Bahrain, Russia), Africa (Socotra), N. America (BC, scattered in USA), C. America (Mexico).

**Thelenella Nyl. (1855)**


Type: *T. modesta* (Nyl.) Nyl. Family: *Thelenellaceae*. 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: 175-177) and Morgan-Jones & Swinscow (1965) give detailed treatments of some of these taxa. Nash et al. (2002) is also helpful. When searching for information, note that many taxa presently referred to *Thelenella* were formerly treated in *Microglaena* or *Chromatochlamys*.

A rather poorly known genus of about 28 species, of which 11 are known in Europe. It is rarely encountered in Greece.

Some of the taxa included here may belong in *Chromatochlamys*, but they are retained here until I have clarified the delimitation of the two genera.

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. rb 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** (Serví) H. Mayrhofer & Poelt (1987)


Description: Clauzade & Roux (1985).

NW Peloponnese, on bark of *Abies cephalonica* at an altitude of 1200 m.

Iberian Peninsula, France, Greece and Cyprus. Also Asia (Syria, Taiwan; the latter seems doubtful to me).

**Thelenella modesta** (Nyl.) Nyl. (1855)


The reference in 1855 to the supposed basionym is not at all clear. The name could, alternatively, be regarded as a new name validated by a descriptio generico-specifica.

The earliest name may be *Endocarpon verrucosum f. umbonatum* Wallr. (1833), but it does not have priority at the rank of species.

Descriptions: Clauzade & Roux (1985, 1989); Nash et al. (2002); Smith et al. (2009).

Very scattered, with no clear pattern. On bark at altitudes 0 - 550 m. Recorded from *Ficus carica*, *Pistacia lentiscus*, and two species of *Prunus*.

Distributed widely, but thinly and irregularly, in southern and central Europe; ranging as far north as Scotland and southern Scandinavia. Also Asia (Israel, Russia, Chagos Is), N. Africa (Morocco), N. America (California), C. America (Guatemala), perhaps S. America, Australasia (Queensland).

**Thelenella muscorum** (Fr.) Vain. (1899)


The nomenclature needs to be sorted out, as the basionym is not legitimate (unless sanctioned), 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. in *Flora* 41: 633-634. 1858. 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.

Widely distributed in Europe as far north as Svalbard, but very rare south of the Alps. Also Macaronesia, Asia (Turkey, Iran, Russia, Taiwan), N. Africa (Morocco, Tunisia), N. America (Saskatchewan, scattered in USA), C. America (Mexico), Antarctica (subantarctic islands)

**Thelidium A. Massal.** (1855)

in: Framm. Lichenogr. 15. (Körber's treatment, in Syst. Lich. Germ. 353. 1855, is later.)


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.

*T. brachysporum* (Zschacke) Serví is not included in the key, as I have insufficient information.

11 Punctiform soralia present. (T. rimosum)

1 Soralia absent.

22 Thallus immersed in calcareous rock. Perithecia entirely immersed in pits in rock. Involucrellum present or absent.

33 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*

3 Involucrellum present. Ascospores 10 - 15 (16) x 6.5 - 8.5 µm. *T. impressum*

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 \( \mu \text{m} \) long. Thallus brown. **T. minimum**
   4 Most ascospores more than 15 \( \mu \text{m} \) long. Thallus colour various.
   555 Thallus black. Ascospores 21 - 30 x 9 - 13 \( \mu \text{m} \). (T. obscurum)
   55 Thallus rust-brown or ochre yellow. Ascospores 25 - 45 x 14 - 18 \( \mu \text{m} \). (T. methorium)
   5 Thallus green-brown. Ascospores 15 - 25 x 76 - 10 \( \mu \text{m} \). (T. olivaceum)
3 Thallus white or pale grey, often inconspicuous.
   44 Ascospores 1-3 septate, septum sometimes indistinct, length less than 35 \( \mu \text{m} \).
   555 Ascospores 10 - 15 (16) x 6.5 - 8.5 \( \mu \text{m} \). Probably restricted to the uplands **T. impressum**
   55 Ascospores 16 - 20 x 9 - 11 \( \mu \text{m} \). At low altitudes. **T. ccticum**
   5 Ascospores 19 - 32 x 10 - 14 \( \mu \text{m} \). **T. pyrenophorum**

**Thelidium brachysporum** (Zschacke) Servit (1946)
in: [need to investigate - bibliographical details incomplete]; **Thelidium absconditum** f. brachysporum Zschacke (1926)
in: [need to investigate - bibliographical problem]
   Description: none seen.
   Mt. Olympus, on calcareous rock at altitudes around 2000 m.
   Known only from Germany, Slovakia and Greece.

**Thelidium ccticum** J. Steiner (1917)
   Description: See the protologue.
   Crete, at altitudes 50 - 300 m. No substrate was reported.
   Known only from Greece.

**Thelidium decipiens** (Hepp ex Nyl.) Kremp. (1861)
   The nomenclatural situation needs to be clarified. Priority at species rank of the epithet **decipiens** probably dates from 1861. (The name **Sagedia decipiens** (Hepp ex Nyl.) Hepp ex Arnold (1858), in Flora 41: 554, is validly published but probably a later homonym.) The name **Verrucaria crassa** Eschw. (1833) may be synonymous, but the synonymy is disputed. The name **Amphoridium amylaceum** A. Massal. (1854) is thought to be synonymous, in which case the correct name for this taxon is **Thelidium amylaceum** (A. Massal.) A. Massal. The name **Sagedia umbrosa** Hepp (1860) is also thought to 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.
   Widely distributed in Europe to about the Arctic Circle. Also Macaronesia, Asia (widespread in Russia; also Tajikistan, Mongolia), N. Africa (Algeria), N. America (Alberta, Newfoundland, scattered in USA), perhaps S. America (Brazil - if **Verrucaria crassa** Eschw. is synonymous).

**Thelidium impressum** (Müll. Arg.) Zschacke (1920)
   Thallus: crustose, immersed, inconspicuous, to 2 cm diameter (in material seen). Perithecia: black, 0.15 - 0.2 mm diameter, partly or entirely immersed in pits in substrate; in section: 220 x 220 \( \mu \text{m} \) (excluding involucrellum). Exciple: colourless or pale brown in lower part, dark brown to black in upper part which merges with involucrellum. Involucrellum: present, 300 \( \mu \text{m} \) diameter. Paraphyses: disappearing early. Ascospores: colourless, 1-septate when mature (sometimes simple when immature), ellipsoid to tadpole shaped, 8 per ascus, 14 - 16 x 5 - 8 \( \mu \text{m} \) (in material seen). 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.
   Scattered in the western half of Europe, from Portugal and Spain to the British Is. Except for the Greek records, which are disjunct, its eastern limit appears to be Slovakia. 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.

Thallus: crustose, immersed. Perithecia: black, 0.35 - 0.4 mm diameter, 80 - 100% immersed in pits in substrate; in section: 600 µm tall x 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. Very 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 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.

Basically a species of central Europe. Absent from British Is, Baltic States and the Nordic Countries. There are very few reports from south of the Alps. Also Asia (Israel, Japan), perhaps N. America, C. America (Mexico).

Thelidium papulare (Fr.) Arnold (1885)

The earliest name may be *Verrucaria rubella* Chaub. (1821), but it is not legitimate, being a later homonym of *V. rubella* Hoffm. (1796). Chaubard's epithet was not legitimated until 1855.

Thallus: crustose, grey, inconspicuous, very thin in most places but 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 x 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 the 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, 8 per ascus, 40 - 47 x 17 - 19 µm.

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 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 (Alaska, Newfoundland, Michigan), 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 central and northern Europe, but rare south of the Alps. Also Asia (Russia, Tajikistan, perhaps elsewhere), N. America (Alaska, Canada, mainly in cooler parts of USA), Antarctica (Antarctic Peninsula).

Thelocarpon Nyl. (1853)

Type: *T. laureri* (Flot.) Nyl. Family: *Thelocarpaceae* Literature: The genus was monographed by Salisbury (1966), and this is still a valuable reference, 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 23 species, 3 of which are lichenicolous and several of which are lichenised. All are inconspicuous and rarely encountered. There is only a single record 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 Algal sheath present. Ascospores simple, ±oblong or ellipsoid-cylindrical
   33 Ascospores about 50 per ascus, 4 - 6 (10) x 2 µm. Lichenicolous. (T. epibolum)
   3 Ascospores 12 - 16 per ascus, 9.5 - 12 x 5 - 6.5 µm. Terricolous. (T. macchiae)

2 Algal sheath absent. 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.

Scattered, but fairly widely distributed, in Europe, though in the south probably confined to the mountains. Also Macaronesia (Canary Is), Asia (Russia), N. America (scattered in USA), S. America (Chile), Australasia (Tasmania).

**Thelomma** A. Massal. (1860)


Type: *T. mammosum* (Hepp) Tibell. (Massalongo typified the genus on *Cyphelium mammosum* Hepp, but did not validly publish the name *Thelomma mammosum*.) Family: *Caliciaceae*. Literature: Muñiz & Hladun (2011) is the best starting point, but Clauzade & Roux (1985) is still useful.

Seven species of mazediate, crustose lichens, 3 of which are known in Europe.

11 Thallus smooth. Apothecia 1 - 1.5 mm diameter, located on erect verrucae. Ascospores 13 - 16 µm wide. (T. mammosum)

1 Thallus granular. Apothecia 0.5 - 1 mm diameter, not located on erect verrucae. Ascospores 10 - 14 µm wide. **T. siliceum**

**Thelomma siliceum** (Fée) Tibell (1976)


Islands of the southern Aegean, on siliceous rock at altitudes 50 - 700 m.

Scattered in southern Europe. Also western Asia (Israel). Rare throughout its range.

**Thelopsis** Nyl. (1855)


Eleven species, 6 of which occur in Europe. Only one has been reported for Greece.

111 Ascospores simple. (T. flaveola)

11 Ascospores 1-septate.
   22 Thallus immersed. Apothecia red-brown, 0.2 - 0.4 mm diameter. Ascospores 3 - 5 µm wide. On rock. (T. foveoata)
   2 Thallus superficial. Apothecia pale, 0.4 - 0.5 mm diameter. Ascospores 5 - 8 µm wide. On rock or bark. **T. isiaca**

1 Ascospores 3-septate. (T. lojkana), (T. rubella)
Thelopsis isiaca Stizenb. (1895)
Thallus: crustose, grey, superficial but very thin. Perithecia: resembling small warts; in section: 520 µm tall x 480 µm wide, slightly pyriform. Exciple: distinctly cellular; in upper part the cells become more elongated and develop into periphyses. Asci: 180 x 16 - 20 µm. Ascospores: colourless, 1-septate, ellipsoid, about 32 per ascus, 12.5 - 15 x 6 µm, f. Photobiont: *Trentepohlia*. 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 - 200 m. Reported from *Juniperus phoenicea*, *J. oxycedrus* subsp. *macrocarpa* and *Quercus macrolepis*.
Fairly widely distributed in Europe, especially in the south, but nowhere common. Also Macaronesia, eastern Asia (Hong Kong), N. Africa (Morocco, Egypt, Zimbabwe; St Helena), N. America (California), C. America (Mexico) Australasia (Victoria).

Thelotrema Ach. (1803)
in: Methodus 130
Type: *T. lepadinum* (Ach.) Ach. Family: *Graphidaceae*. 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), but it includes far more information than needed for the few European species.
About 100 species of predominantly tropical, corticolous lichens. Only four occur in Europe, and most of them are strongly western. Only one, *T. lepadinum*, has a broad range in Europe.

Thrombium Wallr. (1831)
Type: *T. epigaeum* (Pers.) Wallr. Family: *Thrombiaceae*. 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. The genus as a whole is not very well known.

Thrombium melaspermizum J. Steiner (1898)
Description: See the protologue. Only known from the type collection, which is on limestone from Mt. Giona in Sterea Ellada. This species does not appear to have been mentioned in the literature since its original description, expect for a
combination into *Phaeothrombis* 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 with the genus, but they are described as 'mox fuscae', whereas all other species of *Thrombium* known to me have colourless (or, rarely, blue-green) ascospores. The thallus is described as endolithic.

**Thyrea**  A. Massal. (1856)

in: Sched. Crit. 75

Type: *T. plecostospora* A. Massal. Family: Lichinaceae. Literature: Moreni & 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).

The genus is not well known. About 14 names at species rank are presently referred here, but the actual number of species is probably fewer. About 6 names refer to European taxa.

11 Thallus squamulose. (*T. plecostospora*)
1 Thallus umbilicate foliose.

22 Lobes narrow, branched, erect. **T. confusa**
2 Lobes brown, 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)

Descriptions: Ahti et al. (2007); Moreno & Egea (1992b); Nash et al. (2002), or see the protologue.

Very scattered, with no clear pattern. On calcareous rock and soil at altitudes 0 - 2300 m.

Widespread in southern and central Europe, reaching southern Scandinavia but not British Is. Also Asia (widespread), northern Africa (Egypt, Socotra), N. America (scattered in USA), C. America (Mexico), Australasia (NSW).

**Tomasellia**  A. Massal. (1856)
in: *Flora* 39: 283-284


About 18 species of non-lichenised ascomycetes. They occur in habitats which are often investigated by lichenologists, who have sometimes studied the genus as a result. About 4 species occur in Europe.

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.

Scattered in southern and central Europe, but absent from truly Mediterranean vegetation. Also western Asia (Turkey).
Toninia A. Massal. (1852)


Thallus: crustose, squamulose in most species, crustose in a few. Cortex: well developed, usually of sometimes anastomosed hyphae oriented predominantly perpendicular to surface, occasionally appearing almost cellular; a well-developed epinecral layer often also present. Medulla: white, of loosely interwoven, broad hyphae without (or with very few) crystals. Apothecia: usually sessile, medium to large, sometimes pruinose. Disc: black. Thalline margin: absent. Exciple: black, often excluded in mature apothecia; in section often pigmented, formed of distinct hyphae, sometimes anastomosed, on an overall radiating trend. Epitheciun: with grey, brown or greenish pigments, K- or K+ violet, N- or N+ violet or red-violet. Paraphyses: simple to branched, rather broad, clavate to slightly capitate, apical cell with a pigment layer. Ascii: ±Bacidia type. Ascospores: colourless, simple to multi-septate, narrowly ellipsoid or fusiform, 8 per ascus. Chemistry: no lichen substances by spot tests: medulla K-, C-, KC-, P-, I-; thallus UV-. Photobiont: green, trebouxioid, but some species are often closely associated with cyanobacteria.

*Toninia* has about 75 species, of which about 40 occur in Europe. It is very 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. acarnanica* (Harm.) Zahlbr. is not included in the key, as I have insufficient information.

**Key to Toninia main groups:**

11 Epitheciun grey, K+ violet (Sedifolia grey pigment). Ascospores 1-septate (in Greek species). Group 1

1 Epitheciun 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. Epitheciun 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. Epitheciun N- or N+ violet. Ascospores (0) 1 - 7 -septate. Group 4

**Key to Toninia group 1:** Epitheciun grey, K+ violet.

11 Not lichenised. Parasitic on Leptogium or Collema. (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. Pseudocyphellae small, often irregular. 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. *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. *T. candida*

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

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. sedifolia*
3 Thallus entirely without pruina. Hypothecium colourless to brown.  
4 Hypothecium pale brown to colourless. Ascospores 16 - 24 µm long. **T. taurica**
4 Hypothecium brown to dark red-brown. Ascospores 10 - 17 µm long. **T. massata**

(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.

111 Ascospores simple. On various species of crustose lichens. **T. verrucariae**
11 Ascospores 1-septate. On Usnicula calcaria. **T. episema**
1 Ascospores (1) 3 (5) -septate. On various hosts.
22 Ascospores 18.5 - 29 µm long. On Degelia plumbea. **T. plumina**
2 Ascospores 9.5 - 16 µm long. On Lecanora and Lecidella. **T. subfuscæ**

**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. **thalloedæmaëformis**
1 Ascospores mainly 1-septate. Epithecium brown, sometimes with a blue tinge.
22 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.
33 Thallus not pruinase. Ascospores 20 - 42 µm long, 1 - 7 -septate. (T. ruginosa)
3 Thallus with at least some pruina. Ascospores 12 - 20 µm long, usually 3-septate. **T. lutosæ**
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. squaïdæ**
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 3-septate. **T. philippeæ**
6 Ascospores 1-septate. (T. mesoiæda)
5 Thallus subsquamulose to squamulose. On rock or soil.
66 Thallus of discrete squamules. Ascospores 1 - 3 -septate.
77 Epithecium dark olive-brown to bright green. Squamules pale grey to dark brown, often with a green
tine, 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. aromatica**  
7 Epithecium usually dark brown (only sometimes with faint green tinge). Squamules dark brown or dark grey, without maculae, but often with elongated depressions. Epithecium N- (or almost). Nearly always overgrowing lichens with blue-green photobiont, especially Placynthium. **T. verrucarioides**  
6 Thallus of densely proliferating granules or squamules. Ascospores 3 - 7-septate. **T. cretica**

**Toninia acarmanica** (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 soil at altitudes 0 - 700 m.

Commonest in southern Europe, but scattered to as far north as southern Scandinavia. Absent from British Is. Also Macaronesia, western Asia (Turkey, Syria, Israel; widespread in Arabian Peninsula), N. Africa (Morocco, Tunisia, Egypt).

**Toninia aromatica** (Sm.) A. Massal. (1855)  
in: Framm. lichenogr. 24; *Lichen aromaticus* Sm. (1807) in: Smith & Sowerby, English Botany Vol. 25, table 1777; (?) *Toninia aromatica* f. candida Zahlbr.; (?) *Toninia aromatica* var. subecrustacea Szatala

Thallus: squamulose, pale brown to brown or (when fresh) with a green tinge, not pruinose, 5 cm diameter. Squamules: adpressed, contiguous or less commonly discrete, flat to convex, with white maculae that may be very distinct or rather obscure, 0.25 - 1.5 mm wide, 600 µm thick. Cortex: 35 - 60 µm thick (including epinecral layer which is sometimes present and which grades into the cortex without a distinct break), colourless to pale brown, of anastomosed hyphae, K-. Medulla: white. Apothecia: 0.25 - 1 mm diameter, sessile, slightly concave when young, often becoming convex later, not pruinose. Disc: black. Exciple: black, initially fairly prominent, 0.05 - 0.1 mm wide, but becoming excluded; in section: 70 µm wide, very dark brown, of hyphae on an overall radiating trend (details obscured by pigment). Thalline margin: absent. Epithecium: pale blue-green to green-black, sometimes also with some red-brown pigment, K- (pigment not soluble), N+ violet. Hymenium: 60 - 80 µm tall, colourless or with some epithecial pigment in upper part. Hypothecium: red-brown or purple-brown to very dark brown, 170 - 250 µm thick, K- or + purple intensifying, N- (or almost). Paraphyses: branched in upper part, 2 µm wide at base, 3 µm at apex, sometimes slightly capitate, apical cell with pigment cap. Ascospores: colourless, ±fusiform but ends rounded, 1-septate or 3-septate, 8 per ascus, 15 - 20 x 4 - 5 µm. Pycnidia: laminal, black, 0.1 mm diameter; in section: 50% immersed, ±globose but with a rather flat top, 170 µm tall, 150 µm wide, wall dark brown everywhere. Conidia: colourless, usually curved, occasionally straight, 13 - 17 x ¾ µm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus UV+ faintly whiteish (?reflection). Photobiont: green, trebouxioid (but lower part of thallus sometimes with inclusions of cyanobacteria, and/or non-trebouxioid green algae); cells globose, 10 - 15 µm diameter. Photobiont layer: discontinuous, very irregular, 35 - 130 µm thick.

The pale coloured, maculate squamules which lack pruina are fairly distinctive. The green epithecial pigment and dark coloured hypothecium confirm the determination.

Widely distributed in the southern half of Greece, but rare in the north. On calcareous rock and calcareous soil at all altitudes, but commonest below 500 m (80% of records).

Most of Europe. Also Macaronesia, Asia (widespread), Africa (throughout N. Africa; also Somalia, S. Africa; St Helena), N. America (widespread but scattered), C. America (Mexico), S. America (Venezuela, perhaps elsewhere), Australasia (eastern Australia, widespread in NZ).

**Toninia athallina** (Hepp) Timdal (1991)  
**Tonia cinereovirens** (Schaer.) A. Massal. (1852)

Thallus: squamulose, to 4 cm diameter, to 0.6 mm thick where squamae overlap. Squamae: 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 hyphae oriented ±perpendicular to surface. Medulla: white. Apothecia: sessile, flat to convex, 0.7 - 1 mm diameter, sometimes with slight white pruina on disc. Disc: black. 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. Thalline margin: absent. Epithecium: blue-black, K+ brown-red to violet. Hymenium: 70 µm tall, colourless or with epithecial pigment in upper part. Hypothecium: 75 µm, colourless.

Paraphyses: 1.5 - 2 µm wide at base, 2.5 - 3 µm at apex, slightly capitate, apical cell with diffusive dark pigment. Asci: 45 - 50 x 12 - 13 µm, clavate, ±Bacidiella type. Ascosporas: colourless, ± ellipsoid, 1-septate (when mature), 8 per ascus, 9 - 13 x 3 - 6.5 µm. Photobiont: green.

Easily separated by its ascosporas from other species with endolithic thallus and black, lecideine apothecia.

**Clauzadea immersa** has simple ascospores. *Rinodina immersa* has brown ascospores.

Most reports are from the Peloponnese, but also present on the mainland further north. On calcareous rock at altitudes 250 m and above. Perhaps overlooked.

Widely distributed in Europe. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (Colorado).

**Tonia candida** (Weber) Th. Fr. (1867)

Thallus: squamulose, 1 - 4 cm diameter, entirely covered in dense, white or blue-white, farinose pruina; pruina soluble in N but not in K. Squamae: adpressed, convex, 1.5 - 4 mm wide, 240 - 400 µm thick. Cortex: 25 - 30 µm thick, colourless, cellular; cells 5 - 10 x 5 µm, long axis perpendicular to surface; K-, N-. Medulla: white; in section: sometimes pale brown, of loosely interwoven, broad (4 - 5 µm) hyphae, sometimes with a few small crystals (1 µm or less). Apothecia: generally present but often well camouflaged by pruina, sub sessile to sessile, slightly convex, 0.75 - 1.2 mm diameter. Disc: black below pruina. Exciple: visible externally under pruina but not prominent; in section: 80 µm wide, pale brown in inner part, grey near surface, of anastomosed hyphae on an overall radiating trend, lumina of hyphae visible. Thalline margin: absent. Epithecium: dark brown to grey, K+ violet, N+ violet. Hymenium: 55 µm tall, colourless, KI+ blue. Hypothecium: pale brown to orange-brown, not opaque. Paraphyses: usually simple, 1 - 2 µm wide in lower part, 2.5 - 3 µm at apex, often slightly capitate, sometimes with visible septa. Asci: 45 - 50 x 12 - 13 µm, clavate, ±Bacidiella type. Ascosporas: colourless, 1-septate, ± fusiform but one end often more rounded than the other, 8 per ascus, 22 - 24 x 3 - 4 µm. Chemistry: medulla K-, C-, KC-, P-, I--; thallus UV+ whiteish (perhaps by reflection). Photobiont: green, cells globose, 10 - 15 µm diameter, forming a continuous, regular layer 45 - 50 µm thick.

Easily recognised by the combination of dense farinose pruina, Sedifolia grey pigment in the apothecia, and its occurrence only on limestone.

Scattered throughout much of Greece. On calcareous rock at all altitudes.

Widely distributed in Europe, perhaps reaching the Arctic Circle, though absent from British Is. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (Alberta, western USA). Reports for Macaronesia are incorrect.

**Tonia cinereovirens** (Schaer.) A. Massal. (1852)

Thallus: squamulose, to 4 cm diameter, to 0.6 mm thick where squamae overlap. Squamae: 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 hyphae oriented ±perpendicular to surface. Medulla: white. Apothecia: sessile, flat to convex, 0.7 - 1 mm diameter, sometimes with slight white pruina on disc. Disc: black. 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. Thalline margin: absent. Epithecium: blue-black, K-, N+ brown-red to violet. Hymenium: 70 µm tall, colourless or with epithecial pigment in upper part. Hypothecium: 75 µm, colourless. Paraphyses: 1.5 - 2 µm wide at base, 2.5 - 3 µm at apex, slightly capitate, apical cell with external pigment layer. Ascosporas: 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 squamae 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, with a very few reports for the Nordic Countries. Absent from British Is, Benelux and Baltic States. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, Tunisia, Kenya), N. America (Arizona), C. America (Mexico), S. America (Peru, perhaps Chile).

**Toninia cretica** Timdal (1991)
Description: See the protologue.
Crete, on calcareous rock at altitudes 600 to about 2000 m.
Known only from Crete.

**Toninia diffracta** (A. Massal.) Zahlbr. (1901)

Thallus: squamulose, 1 - 3 cm diameter, covered everywhere by dense, white, granular pruina that is soluble in NH4OAc but not in K. Squamus: 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 elongated perpendicular to surface; 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. 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. Thalline margin: absent. Epithecium: grey to bluish-black, K+ violet, N+ violet to red-violet. Hymenium: 70 - 75 µm tall, colourless or almost so. Hypothecium: 75 - 125 µm tall, brown to red-brown. Paraphyses: not coherent, 1.5 µm wide at base, often with visible septa, not capitate. Ascospores: colourless, 1-septate, fusiform with rounded ends, 18 - 20 µm x 4 - 5 µm. Chemistry: thallus UV+ whiteish (perhaps by reflection). Photobiont: green, cells globose, 8 - 12 µm diameter, forming a continuous, regular layer 40 - 60 µm thick. This species is unlikely to be confused with any other.

Distinguished from *T. candida* by the coarser pruina and the uniformly strongly pigmented exciple. The rather rare *T. rosulata* 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.

Widely distributed 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 capitate, apical cell pigmented. Asci: 35 - 45 x 12 µm, clavate. Ascospores: colourless, 1-septate, ellipsoid, 8 per ascus, 12 x 3.5 µm. This species is unlikely to be confused with any other.

Widely distributed in the southern half of Greece, at altitudes 0 - 520 m, but there are no reports for the northern half. Usually parasitic on *Aspicilia calarea*, though there is a single 19th century report from *Rinodinella controversa*.

Widely distributed in Europe to as far north as British Is. Also Macaronesia (Canary Is), N. Africa (Morocco, Algeria, Tunisia).

**Toninia lutosa** (Ach.) Timdal (1991)
Description: Nash et al. (2002); Nimis & Martellos (2004); Timdal (1991).
Crete, on calcareous rock at altitudes around 250 m.

Southern Europe, from Spain to Greece, and the Alps. Also Asia (Israel, southern Siberia, Inner Mongolia), Africa (Algeria, Tunisia, Namibia, Cape Province of S. Africa), N. America (Arizona, Colorado, New Mexico), C. America (Mexico).
Toninia massata (Tuck.) Herre (1910)

Descriptions: Nags et al. (2002); Nimis & Martellos (2004); Timdal (1991)

Crete and southern Peloponnese, on soil at altitudes 10 - 350 m.

Southern Europe, from Iberian Peninsula to Cyprus, Ukraine and southern Russia. Also Macaronesia (widespread), Asia (Russia, Kazakhstan, Tajikistan), perhaps Africa (Socotra), N. America (widespread in western half of USA), C. America (Mexico).

Toninia opuntioides (Vill.) Timdal (1991)

Thallus: squamulose, grey-green to blue-grey, forming patches to about 4 cm diameter. Squamules: strongly vertically flattened, ascending, sometimes overlapping, often white pruinose at tips. Pseudocyphellae: absent. Cortex: 25 - 35 µm thick, colourless (or almost), cellular, cells 5 - 7 x 2.5 - 4 µm, long axis perpendicular to surface. Medulla: white, of loosely interwoven hyphae 3 - 3.5 µm wide, without crystals. Apothecia: sessile, flat, 1 - 2 mm diameter, sometimes slightly white pruinose. Disc: black, matt. Exciple: black, thin, 0.05 mm wide, sometimes becoming almost excluded; in section: 60 - 75 µm wide, mostly rather uniformly brown, red-brown or purple-brown but sometimes with some grey pigment near surface, formed of hyphae on an overall radiating trend, lumina often visible; brown pigment K+ purple-brown intensifying. Thalline margin: absent. Epithecium: grey, K+ violet, N+ red-violet. Hymenium: 65 - 70 µm tall, colourless or with pale grey pigment in upper parts. Hypothecium: 80 - 100 µm tall, dark brown, sometimes paler brown in uppermost and lowermost parts, K+ purple-brown. Paraphyses: simple, 1.5 µm wide at base, 3 µm at apex, slightly capitate, apical cell with a thin layer of grey pigment. Ascospores: colourless, 1-septate, ± fusiform, one end often more rounded than the other, 15 - 19 x 3 m. Chemistry: medulla K-, C-, KC-, P-, I-; thallus UV-.

Photobiont: green.

The strongly vertically flattened squamules are distinctive, and when present this species can not be confused with any other. However, poorly developed specimens could be confused with *T. sedifolia* unless detailed chemical investigation (chromatography) is undertaken: see Timdal (1991).

Widely distributed in the southern half of Greece, rare in the north. On calcareous rock or calcareous soil at all altitudes.

Widely distributed in Europe to as far north as southern Scandinavia, but commonest in the south. Also Asia (Turkey, Kirgizistan, widespread in Russia), N. Africa (Morocco, Algeria, Tunisia), N. America (northern and western Canada).

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. Absent from British Is. Also Asia (widespread but scattered as far east as Mongolia), N. Africa (Algeria), N. America (southern Canada, western half of USA).

Toninia physaroides (Opiz) Zahlbr. (1926)


Chios, on limestone at an altitude of 1280 m. Also reported for Crete in Timdal (1991), but with no further information.

Widely distributed 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).

Toninia plumbina (Anzi) Hafellner & Timdal (1991)


Epiros, on *Degelia atlantica* and *Degelia plumbea* at altitudes 630 - 735 m.
**Toninia rosulata** (Anzi) H. Olivier (1911)

My only collection is much too scanty for me to prepare an adequate description, but the Sedifolia grey apothecial pigment, the coarsely granular (at least in places) pruina, and the colourless hypothecium clearly indicate that it belongs to *T. rosulata*. For published descriptions see: Nimis & Martellos (2004; Smith et al. (2009); Timdal (1991).

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; very rare south of the Alps and confined to the highest mountains. Also Asia (Turkey, eastern Siberia).

**Toninia sedifolia** (Scop.) Timdal (1991)

Thallus: squamulose, to about 8 cm diameter but often much less, pale brown to grey, usually white or blue-white pruinose in places. Squamules: adpressed, discrete to contiguous, usually convex, not overlapping, rounded when discrete, sometimes rather irregular when contiguous, 0.4 - 3.5 mm wide, 600 - 700 µm thick. Pseudocyphellae: absent. Cortex: 25 - 50 µm thick, mostly colourless, sometimes very pale brown in places, cellular, cells 6 - 7 x 3 - 5 µm, long axis perpendicular to surface; sometimes overlain by a thin (5 - 10 µm), colourless, structureless layer. Medulla: white, of loosely interwoven hyphae 2.5 - 4 µm wide, generally without crystals. Apothecia: usually present, sessile, slightly concave to flat when young, sometimes becoming convex later, (0.4) 0.6 - 4.5 mm diameter, sometimes white or blue-white pruinose especially when young. Disc: black, matt. Exciple: thin, 0.05 - 0.1 mm, black, usually persistent but sometimes excluded in very old convex apothecia; in section 70 µm wide, fairly uniformly pale brown to purple-brown or red-brown but sometimes with some grey pigment in outermost part, of anastomosed hyphae on an overall radiating trend, lumina of hyphae often visible, K- or K+ intensifying purple-brown. Thalline margin: absent. Epitheicum: grey, but traces of brown or green pigments sometimes also present, K+ violet, N+ red-purple. Hymenium: (45) 50 - 75 (85) µm tall, mostly colourless but sometimes with some epithelial pigment in upper part. Hypothecium: 50 - 150 µm tall, distribution of pigment rather variable but part always dark brown or dark red-brown, sometimes paler brown in lower parts, occasionally pale brown in a thin zone just below hymenium, N+ red-brown (red intensifying). Paraphyses: not coherent, 1.5 - 3 µm wide in lower part, 3 - 6 µm at apex, simple, with visible septa, sometimes capitate, occasionally slightly moniliform, apical cell with thin external grey pigment cap. Ascospores: colourless, 1-septate, fusiform, ends at least slightly pointed, 15 - 23 x 3 - 4 µm. Chemistry: medulla K-, C-, KC-, P-, I-; thallus UV-.

Photobiont: green, cells globose, 8 - 12 µm diameter, forming a continuous, ±regular later 40 - 60 µm thick. Could be confused with *T. physaroides* or *T. toepfferi* if the pseudocyphellae of those species are overlooked, but the combination of *pruinose* squamules and a *dark* hypothecium excludes them. For separation from *T. opuntioides* see under that species.

Throughout Greece, and very common in the southern half of the country. At all altitudes. Usually on calcareous soil, less commonly on calcareous rock or overgrowing bryophytes on calcareous rock. The few reports from bark are probably either incorrect or may refer to the very basal parts of the tree where the substrate is mixed with soil. The lichenicolous fungus *Stigmidium tibacinae* has been reported once form this lichen.

Almost throughout Europe, avoiding only parts of eastern Europe with a strongly continental climate. Also Macaronesia, Asia (widespread), Africa (throughout N. Africa, also Somalia; St Helena), N. America (widespread, but absent from much of eastern USA), C. America (Mexico), S. America (Argentina, perhaps Chile), Australasia (widespread in Australia, NZN).

**Toninia squalida** (Ach.) A. Massal. (1852)

The earliest validly published name is *Lecidea atrorufa* var. *squamrosa* Ach. (1808), but it does not have priority at the rank of species.

Descriptions: Nash et al. (2002); Nimis & Martellos (2004); Smith et al. (2009); Timdal (1991).

Chios and Crete, on rock (calcareous and non-calcareous) at altitudes 350 - 480 m. Widely distributed in Europe. Also Macaronesia, Asia (Turkey, widespread in Russia, Nepal), N. Africa (Morocco),
N. America (widely distributed, but almost restricted to western half), C. America (Mexico), Pacific (Hawaii).

**Toninia subfuscæ (Arnold ex Zwackh) Timdal (1991)**


Reported for Samos in Timdal (1991), but with no further information.

Widely distributed 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 (especially) central Europe, with scattered records to as far north as southern Scandinavia. Absent from British Is. Also Asia (widespread as far east as Tajikistan), N. Africa (Morocco, Algeria).

**Toninia toepfferi (Stein) Navas (1913)**


My only collection is rather scanty, so the description is incomplete. For a fuller description see Timdal (1991).

Thallus: squamulose, 2 x 1 cm (in the only material seen), dark green when fresh, becoming brown in the 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 a prominent white margin. Cortex: 35 µm tall, colourless, cellular except for the outermost 5 µm which lacks structure, cells 5 - 10 x 2 - 4 µm, long axis perpendicular to surface. Medulla: white. Apothecia: sessile, rounded to slightly irregular, convex, 0.5 - 1.2 mm diameter, not pruinose. Disc: black, matt. Exciple: excluded early. Thalline margin: absent. Epithecium: grey, K+ violet. Hymenium: 70 µm tall, colourless or with some epithelial 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.

Probably Mediterranean/Macaronesian. Spain to Cyprus. Also Macaronesia (widespread but not Azores). I am sceptical of a report for 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.

Inappropriately named, as it is by no means restricted to central Asia (map in Timdal, 1991). Widely distributed in southern and central Europe, with some rather disjoint reports for Greenland. Absent from British Is, Baltic States and the Nordic Countries. Also Asia (widespread, though not reaching the east coast), N. Africa (Morocco, Algeria), 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 and sometimes almost hollow, sometimes with a black
margin. Hypothallus: black, sometimes present. 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, almost without crystals. Apothecia: 0.5 - 2.1 mm diameter, soon becoming convex, not pruinose. Disc: black. Exciple: black, becoming excluded; in section: red-brown in outer part, sometimes colourless in inner part. Thalline margin: absent. 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, colourless to pale brown. Paraphyses: simple, broad, 3 µm at base, 4 µm at apex, slightly capitate, apex strongly pigmented. 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, upper surface zygocystic but lower surface often irregular.

The usually simple ascospores mean that this species is unlikely to be confused with others of the genus. *T. tristis* subsp. *thalloedaemiformis* has contiguous squamules and is never terricolous.

Crete and Peloponnese. On calcareous soil or on poorly consolidated calcareous sandstone at altitudes 0 - 500 m. Basically Mediterranean/Macaronesian. Portugal to Cyprus; also just outside the Mediterranean Basin, in and around the Alps. Also Macaronesia (warmer parts), N. Africa (Morocco, Algeria, Tunisia).


Thallus: squamulose, to 5 cm diameter, brown to dark brown, not pruinose. Squamules: 0.7 - 3 mm wide, convex, contiguous and 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 ±-perpendicular to surface in upper half, more randomly oriented in lower half; K-. Medulla: white, of loosely interwoven hyphae 3.5 - 4 µm wide, without crystals. Lower surface: 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. 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. Thalline margin: absent. Epithecium: 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, sclerotic to slightly capitate, apical cell with a 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 the 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. Conidia: colourless, 16 - 22 x 1.5 µm, usually curved. Chemistry: medulla K-, C-, KC-, P-, I-; thallus UV-. Photobiont: green, cells globose, 10 - 13 µm diameter. Photobiont layer: 60 - 125 µm thick, continuous, with a very regular upper surface, lower surface somewhat diffuse and irregular.

Differs from subsp. *pseudoatabacina* in its substrate and in having more contiguous squamules.

Scattered, mainly in the southern half of Greece, never very far from the sea. On calcareous rock at altitudes 0 - 900 m, but rare above 500 m.

Only Crete and Greece.


Description: Clauzade, Diederich & Roux (1989) as *Lecidea verrucariae*.

Southern Crete, close to sea level. Parasitic on species of *Verrucariaceae* (reported as *Bagliettoa parmigera* and *Verrucaria* sp.).

Iberian Peninsula, France (the Mediterranean Iles d’Hyeres), Greece and Ireland only. These few reports suggest a Mediterranean/Atlantic distribution.


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 but sometimes appearing almost cellular. Apothecia: sessile, often convex, 0.3 - 1 mm diameter, not pruinose. Disc: black. 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 (finer details obscured by pigmentation). Thalline margin: absent. Epithecium: brown, sometimes with traces of red-brown or purple-brown, but never green, K-, N-. Hymenium: 70 - 80 µm tall, colourless to pale orange-brown in lower part, upper part sometimes with some epithelial pigment. Hypothecium: about 170 µm tall but 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 zellipsoid, sometimes slightly ranunculiform, 12 - 13 x 4 - 4.5 µm. Chemistry: thallus UV-.

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. Abbott (2009) did not accept a 19th century report from a site near sea level in Attica. That report remains doubtful, and may refer to T. aromatica. However, I recently collected what is undoubtedly this species in the Peloponnese at an altitude of 1230 m. It was parasitic on Placynthium nigrum.

Widely distributed in central and northern Europe, but rare in the south. Also Asia (southern and eastern Siberia), N. Africa (Morocco, Algeria), N. America (widely distributed but scattered in the western half).

**Topelia P. M. Jørg. & Vězda (1984)**

in: *Nova Hedwigia, Beihefte* 79: 502


A rather poorly known genus of 6 species, 3 of which occur in Europe.

11 Ascospores 18 - 20 µm long, with a perispore. Perithecia black. On rock. **T. heterospora**

1 Ascospores 20 - 30 µm long, without a 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)**


**Topelia rosea (Servit) P. M. Jørg. & Vězda (1984)**

in: *Nova Hedwigia, Beihefte* 79: 507; *Microglaena rosea* Servit (1952) in: Webbia 8: 419


**Tornabea Östh. (1980)**


Type: *T. scutellifera* (With.) J. R. Laundon. Family: Physciaceae. Literature: Nimis & Tretiach (1997) is a brief monograph, but the single species is also treated in all the standard Floras.

**Tornabea scutellifera (With.) J. R. Laundon (1984)**

(Ach.) Østbr.; *Tornabeniopsis atlantica* (Ach.) Follm.

Descriptions: Clauzade & Roux (1985) as *Tornabea atlantica*; Nash et al. (2002); Smith et al. (2009).

Islands of the southern Aegean, including Crete. On bark (*Pinus brutia*) and siliceous rock at altitudes 200 - 900 m. Scattered in southern and western Europe, usually near the sea. Also Macaronesia, Asia (widespread as far east as Himalayas), Africa (widespread in N. Africa; also Socotra, Somalia, Sudan), N. America (California), C. America (Mexico) S. America (Chile, perhaps Peru).

**Trapelia M. Choisy (1929)**


Type: *T. coarctata* (Sm.) M. Choisy. Family: *Trapeliaceae*. Literature: Smith et al. (2009) treat all the species that are likely to occur in Greece. Orange (2018) clarifies the status of some of the species.

As presently delimited, *Trapelia* contains about 15 species, 5 of which occur in Europe. The genus is not common in Greece.

Because *Trapelia* and *Trapeliopsis* are very closely related, this key covers both genera. All taxa 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. (Trapelia corticola)

5 On siliceous rock, or on plant debris. (Trapelia obtegens) Greek report doubtful.

4 Soredia absent. 

55 Areoles not overlapping. Thallus thinning to margin. Margin not lobed, areoles indistinct there. **Trapelia coarctata**

5 Areoles sometimes overlapping. ± convex. Thallus with a ±abrupt margin. Margin slightly lobed. areoles distinct there. (Trapelia glebulosa), (Trapeliopsis 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. lb 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 with a preference for moist, acidic substrata so uncommon in areas with a Mediterranean climate. Also Macaronesia (widespread), Asia (widespread), Malesia (widespread), Africa (Morocco, S. Africa, Madagascar, St Helena), N. America (widespread from Alaska to cooler parts of USA but not in continental interior), Caribbean (PR), C. America (CR, Guatemala, Mexico), S. America (widespread) Australasia (widespread), Pacific (Hawaii), Antarctica (subantarctic islands).
**Trapeliopsis Hertel & Gotth. Schneid. (1980)**


- **Type:** *T. wallrothii* (Flörke ex Spreng.) Hertel & Gotth. Schneid. **Family:** Trapeliaceae. **Literature:** Clauzade & Roux (1985) treat all the European species. Smith et al. (2009) treat all those that are likely to occur in Greece.

*Trapeliopsis* has not been satisfactorily delimited from *Trapelia*, and the two genera may prove to be synonymous (in which case the name *Trapelia* would have priority). For the key to species, see under *Trapelia*.

**Trapeliopsis flexuosa** (Fr.) Coppins & P. James (1984)


The earliest name is *Biatora viridescens* var. *sapinea* Fr. (1822), but it does not have priority at the rank of species.

*Descriptions:* Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).

Rare and scattered in the northern half of Greece. On bark or wood at altitudes 700 - 1200 m. Reported phorophytes include *Castanea* and *Olea*.

Widely distributed in northern and central Europe, but in the south much less common and probably confined to the uplands. Also Macaronesia, Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread except for hottest parts of USA), C. America (CR, Mexico), perhaps S. America (Bolivia, Brazil), Australasia (widespread), Pacific (Hawaii). Some reports may be unreliable, owing to confusion with other species.

**Trapeliopsis granulosa** (Hoffm.) Lumbsch (1983)


The name *Lichen granulosus* Ehrh. (1785) is a nomen nudum. The correct name may be *Trapeliopsis muscorum* (F. H. Wigg.) ined., based on *Verrucaria muscorum* F. H. Wigg. (= *Lichen muscorum* Weber (1778), nom. illeg - later homonym), but the name does not appear to have been typified.

*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.

Almost all of Europe, but it requires moist, acidic substrata so is uncommon in Mediterranean regions. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, S. Africa, Madagascar), N. America (almost everywhere), Caribbean (PR), C. America (CR), S. America (widespread), Australasia (SE Australia, both islands of NZ), Antarctica (Antarctic Peninsula).

**Trapeliopsis wallrothii** (Flörke ex Spreng.) Hertel & Gotth. Schneid. (1980)


Sprengel ascribed the name *Lecidea wallrothii* to "Flörk. 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 interpretation 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 since it has a preference for moist, acidic substrata it is uncommon in areas with a Mediterranean climate. Also Macaronesia, Asia (Siberia, Hong Kong), perhaps S. America (Brazil). Reports for N. America probably refer to *T. californica*.

**Tremella Pers. (1794)**

in: *Neues Mag. Bot.* 1:111

- **Type:** *T. mesenterica* Schaeff. : Fr., which is not lichenicolous. The type is conserved. **Family:** Tremellaceae (Basidiomycota). However, lichenicolous taxa presently referred to *Tremella* may prove to belong elsewhere. **Literature:** Lichenicolous species are monographed in Diederich (1996).

About 250 species of basidiomycetes, none lichenised. About 50 lichenicolous species have been formally described. About 25 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 determination of 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 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, resulting in galls or not.
22 Basidia eventually resulting in galls. On Lecanora chlorotera. Mature basidia 2-4-celled, with transverse, oblique or longitudinal septa. (T. macrobasidiata)
2 Basidia not resulting in 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. caloplacea**
5 On Rinodina. (T. rinodinae)

1 Basidia growing on the thallus of the host, often resulting in 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 longitudinal septa.
55 Mature basidial cells elongate, much longer than septum.
66 Basidiomata causing gall formation on thallus of host. On Physcia. **T. christiansenii**
6 Basidiomata not causing gall formation. On Hypocenomyce scalaris. (T. hypocemomyces)
5 Mature basidial cells not much longer than septum. (T. hypogymniaceae), (T. lichenicolae), (T. lobariaeareum), (T. macrocrateris), (T. normandiniae), (T. phaeographidisi)
4 Basidia mainly with transverse septa. (T. cladonialae), (T. hypogymniaceae), (T. lobariaeareum), (T. phaeographidisis)
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. lichenicolae), (T. parmeliarum), (T. pertusariae), (T. wirthii)

**Tremella caloplacea** (Zahlbr.) Diederich (2003)
Description: Diederich (1996) as *Tremella* sp. 1.
Crete, on *Caloplaca aurantia* at an altitude of about 800 m.
Widely distributed in Europe, judging from the few records to date. It ranges from Greenland to Greece. Also 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 (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.
Tremolecia M. Choisy (1953)

in: [need to investigate - bibliographical details incomplete]
  Type: T. dicksonii (J. F. Gmel.) M. Choisy (= T. atrata). Family: Hymeneliaceae. Literature: The single species is discussed in all the standard Floras.

Tremolecia atrata (Ach.) Hertel (1977)
in: [need to investigate - there is a bibliographical problem]; Gyalecta atrata Ach. (1808) in: K. Sv. Vet.-Akad. Handl. 29: 229
  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)
in: Acta Fauna Fl. Univ. (Bucuresti), Ser. II, Bot. 1(5-6): 6. The name commemorates Edward Tuckerman, but the double 'n' in the generic name is an intentional Latinisation.
  Type: T. ciliaris (Ach.) Gyeln. Family: Parmeliaceae. Literature: The only species that is likely to occur in Greece is discussed in all the standard Floras.
  About 12 species of cetrarioid lichens, most of which occur in North America and eastern Asia. Four occur in Europe, but only one is widespread.

Tuckermannopsis chlorophylla (Wildl.) Hale (1987)
  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 mountains. Also Macaronesia, Asia (widespread), Africa (S. Africa), N. America (scattered, mainly in the west, from Alaska to cooler parts of USA), C. America (Mexico), southern S. America (Argentina, Chile), Australasia (Tasmania, NZN).

Umbilicaria Hoffm. (1789)
in: Descr. Pl. Cl. Crypt. vol. 1, part 1, fasc. 1: 8. The name is conserved against the homotypic Omphalodes Mill. (1754), and against Umbilicaria Heist. ex Fabr. (1759), a vascular plant genus.
  Type: U. hyperborea (Ach.) Hoffm. Family: Umbilicariaceae. Literature: Clauzade & Roux (1985) treat all the widespread European species. This includes all the species that are likely to occur in Greece. There are better descriptions of some of them in Smith et al. (2009) and Nash et al. (2004).
  About 90 species, some 42 of which have occur in 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. polyrhizos)
  3 Lower surface grey or brown-grey. Thallus a single lobe. U. vellea
2 Rhizines absent.
   33 Upper surface with a network of veins, except near margin. **U. nylanderiana**
3 Upper surface without veins.
   44 Upper surface brown, at least in outer part.
      55 Thallus a single lobe. Central part of thallus, over the umbo, raised and white areolate. (U. iberica)
   5 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 warted-areolate. **U. spodochroa**
   4 Lower surface pale-grey, often with a pink tinge, smooth or slightly warted-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 perhaps does not merit formal recognition, has never been reported for Greece.

Widely distributed and fairly common in central and northern Europe; uncommon south of the Alps. According to Nimis (1993), southern populations may represent a distinct taxon. Also Macaronesia, Asia (widespread), N. America.

**Umbilicaria cylindrica** (L.) Delise (1830)


Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Scattered in the northern half of Greece. On siliceous rock at altitudes 1070 - 2500 m.
Widely distributed in Europe, but south of the Alps restricted to the mountains. Also Asia (widespread), Africa (Morocco, perhaps Ethiopia - old report), N. America (widespread from Alaska to cooler parts of USA but avoiding continental interior), perhaps S. America (Argentina), Australasia (SE Australia, both islands of NZ). Reports for Antarctica may be incorrect.

**Umbilicaria deusta** (L.) Baumg. (1790).

in: Fl. Lips. 571; *Lichen deustus* L. (1753) in: Sp. Pl. 1150. (The name has a conserved type.)

Descriptions: Clauzade & Roux (1985); Nash et al. (2004); Smith et al. (2009).
Known from a few localities in northern Greece, on siliceous rock at altitudes 1100 - 1800 m.
Most of Europe, but rare in the south and confined to the mountains. Also Asia (widespread), N. America (widespread from Alaska to cooler parts of USA), Australasia (NZS).

**Umbilicaria grisea** Hoffm. (1796)

in: Deutschl. Fl. 2: 111; *Gyrophora hirsuta* β (= var.) *grisea* (Hoffm.) Th. Fr.

Descriptions: Clauzade & Roux (1985); Smith et al. (2009).
Scattered in the northern part of the mainland. On siliceous rock in the uplands.
Widely distributed in Europe, though commonest in the west. Also Macaronesia, central Asia (Kazakhstan, southern Siberia, Mongolia), N. Africa (Morocco), perhaps S. America (Argentina), Australasia (NZS). Reports for N. America appear to be incorrect.

**Umbilicaria nylanderiana** (Zahlbr.) H. Magn. (1937)


The earliest name is *Gyrophora heteroidea* v. *corrugata* Ach. It was combined into *Umbilicaria* by Nylander, but Nyander's name is an illegitimate later homonym of *U. corrugata* Hoffm.
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.
Scattered in northern and central Europe. South of the Alps confined to high mountains. Also Asia (Turkey, Russia, Kazakhstan, Mongolia), N. America (very scattered in Canada and USA), S. America (Andes and cold regions), Australasia (scattered in cold parts), Antarctica (Antarctic Peninsula and nearby islands).

Umbilicaria polyphylla (L.) Baumg. (1790)
in: Fl. Lips. 571; Lichen polyphyllus L. (1753) in: 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, Uganda, S. Africa), N. America (widespread from Alaska to cooler parts of USA), S. America (Chile, Colombia, Falkland Is, Venezuela), Australasia (cooler parts), Antarctica (S. Georgia).

Umbilicaria spadochroa (Hoffm.) DC. (1805)
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 that this species is present in Greece.
Throughout Europe as far south as the Alps and Pyrenees, but very rare in Mediterranean regions. Also Macaronesia, Asia (widespread), North Africa (Morocco). Reports from North and South America are probably unreliable.

Umbilicaria subglabra (Nyl.) Harm. (1909)
Western Crete, on siliceous rock at an altitude of about 800 m.
Widely distributed in central Europe, but almost absent from northern and NW Europe (there is a single, disjunct report for Sweden), and very rare south of the Alps. Also Asia (Turkey, Armenia, Kazakhstan, Russia), 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. Hofmann's name has not been typified, and I do not know whether any original material still exists. 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 would be 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 crustulosa var. badiofusca.
Widely distributed in Europe, but in the south confined to the mountains. Also Macaronesia, Asia (widespread), Africa (Morocco, Kenya, Tanzania, Uganda), N. America (widespread from Alaska to cooler parts of USA), perhaps S. America (Argentina, Peru), Australasia (both islands of NZ).

Unguiculariopsis Rehm (1909)
in: Annales Mycologici 7(5): 400
Type: U. ilicincola (Berk. & Broome) Rehm, one of the non-lichenicolous species of the genus. Family: Hyaloscyphaceae. 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 14 are lichenicolous. 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. \(\mu\)m 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 \(\mu\)m long. On Evernia prunastri. U. lettaui
3 Marginal hairs straight, slightly curved, or wavy, more than 25 \(\mu\)m long.
44 Semi-mature asci thickened at apex. On Acrocordia gemmata. (U. acrocordiae)
4 Semi-mature asci not thickened at apex. On other hosts.
55 Marginal hairs solid and refractive in upper part, 18 - 57 x 3.5 - 4.5 \(\mu\)m. On Bilimbia. (U. refractica)
5 Marginal hairs not solid or refractive. On other hosts.
66 Marginal hairs 15 - 35 x 2.3 - 3.5 \(\mu\)m. Ascospores 7 - 9 x 2.5 - 3.5 \(\mu\)m. On thallus of Lecanora (especially L. chlorotera and L. carpinea). U. thallophila
6 Marginal hairs 15 - 70 x 1.5 - 3 \(\mu\)m. Ascospores 4 - 5.5 x 2 - 2.5 \(\mu\)m. On lower surface of Lobaria scrobiculata. (U. manriquei)

**Unguiculariopsis lettaui** (Grummann) Coppins (1990)
Descriptions: Diederich & Etayo (2000), and Hawksworth, Atienza & Coppins (2010).
Epiros, on Evernia prunastri at an altitude of 750 m.
Western Europe to as far north as southern Scandinavia, and along the Mediterranean. Also Macaronesia (Canary Is), Asia (Turkey), N. America (California, Oregon).

**Unguiculariopsis thallophila** (P. Karst.) W. Y. Zhuang (1988)
Description: Clauzade, Diederich & Roux (1989); Hawksworth, Atienza & Coppins (2010).
Epiros, on undetermined species of Lecanora at altitudes 750 - 830 m.
Probably throughout Europe. Also Macaronesia (Canary Is), Asia (Russia), N. America (California, Utah).

**Usnea** Dill. ex Adans. (1763)
in: Fam. Pl. 2: 7. The name is unusual for lichen genera, as it is very old but does not come from the classical languages. It reached Europe in the late 15th century, via Arabic. The word still exists in modern Arabic (as 'ushman') and also modern Persian; it is usually translated as "moss" or "moss on trees", but probably denotes any long, pendent epiphyte. Pendent epiphytic mosses and lichens are unlikely to have been present in the region of northern Arabia where the Arabic language originated, as the climate is unsuitable, so it seems unlikely that the word originated in Arabic. However, I have not been able to establish whether it originated in Persian or elsewhere, e.g. Syriac.

Type: Not clearly designated. Both U. florida (L.) F. H. Wigg. and U. plicata (L.) F. H. Wigg. (= U. barbata) have been mentioned in recent publications. Family: Parmeliaceae. Literature: There is great taxonomic confusion within this genus, and most publications dating from before the 21st century are best ignored. The only keys to European species that I have found useful are those in Randlane et al. (2009) and Roux (2007). The former is recommended, as it also 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), Clerc (2006), Fos & Clerc (2000), James (2003), McCarthy & Mallett (2004), Swinscow & Krog (1979), and Swinscow & Krog (1988). For once, Clauzade & Roux (1985) can not be recommended. Use of most pre-2000 publications will lead only to frustration and incorrect determinations. 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 basic and easily recognised pattern, but there is great variability otherwise. The levels of many species have proved difficult to define, partly because the species themselves are often variable, but also because the characters that have proved most useful for separating species are generally very different from those employed in other genera. It has taken many years for lichenologists to learn which are the most effective characters. The difficulties intrinsic to the genus itself have been compounded by earlier workers, especially Motyka, who have
caused great taxonomic confusion by defining 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 invariably, 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 true number present is, again, rather uncertain. In the Peloponnese, I can only definitely confirm the presence of two species, but I also have collections that I have not been able to determine.

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 reported world distribution for each species must also be interpreted with care.

My own repeated attempts to construct a workable 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 that follows is basically theirs, with minor modifications.

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.

In the Peloponnese, at least, only a few species are common. Material with abundant, prominent, excavate soralia is likely to be *U. lapponica*. Distinctly pendent thalli without soralia, or with punctiform soralia, are likely to be *U. barbata*.

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 also 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.

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*

22 Cortex without pigment, 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 the 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-
5 Branches even in thickness, tapering gradually towards apices, without foveoles or ridges. Medulla usually compact (sometimes loose in U. lapponica).

6 Base blackened (Note 6). Medulla K+ yellow > orange (no crystals).

77 Soralia abundant, distinctly excavate when mature. Isidia absent. Both cortex and medulla thick. U. lapponica

7 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 + yellow-brown).

7 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.

55 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. dasaea) Greek report doubtful.

6 Base often with distinct annular cracks. Stictic acid (K+ yellow or orange, without crystals) present. U. flammea

5 Isidia present all along the branches. Soralia punctiform. Medulla loose, K-. (Note 4) U. hirta

4 Papillae present on at least some branches.

55 Secondary branches distinctly constricted at their base. Medulla loose.

66 Isidia absent. U. esperantiana

6 Isidia present. U. cornuta

5 Secondary branches not or only slightly constricted at their base. Medulla loose or compact.

666 Isidia usually abundant.

7 Branches of uneven thickness, irregularly swollen, apical parts often sinuous. Soralia punctiform, usually not expanding, with ± tall isidia. (U. diplotypus)

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. U. praetervisa

9 Norstictic acid absent. Lichen substances reacting K-, K+ yellow or K+ orange, but without crystals. 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. Fibris present. Salazinic acid (K+ yellow > orange) present. (U. silesiaca)

8 Base pale green or brown, not blackened. Fibris absent or few. Protocetraric acid (K- or K+ slightly yellow-brown) present. U. subsccabrosa

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. diplotypus)

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 a maritime climate. U. wasmuthii

9 Soralia punctiform when young, later becoming rounded. Chemistry various, but norstictic acid
usually present. Not restricted to sites with a 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. lapponica**

9 Norstictic acid usually present. Branches without foveoles and depressions. **U. fulvoreagens**

(1) In a transverse section of a branch viewed under the transmission microscope the cortex in most species has a pale orange-brown colour, at least in its outer part. This is not the orange-red 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 this couplet.

(3) U. chaetoophora 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 numerous branches before reaching a decision. The two species also differ in the density of their medulla.

(5) Other chemotypes are known but are very rare and/or not expected to 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 supporting branch in such a way that it is not obvious where the thallus ends and the (usually dark coloured) bark begins. Material that appears to lack blackening should be scrutinised carefully, to see whether any trace can be detected.

(7) Eroded fibrils may resemble papillae, but they are ecorticate 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)


Descriptions: Randline et al. (2009); Smith et al. (2009).

Scattered in much of Greece, at altitudes 0 - 1600 m. Most reports are from bark. A 19th century report from calcareous rock might refer to a detached thallus.

Widely distributed in southern and central Europe, reaching British Is and Baltic States but not the Nordic countries. Also Macaronesia, Asia (widespread), Malesia (Java, PNG), Africa (widespread outside deserts and the humid tropics), S. America (widespread), Australasia (SE Australia, widespread in NZ), Pacific (widespread), perhaps Antarctica (S. Georgia as *U. capillacea*). Surprisingly, absent from N. America.

**Usnea barbata** (L.) F. H. Wigg. (1780)

in: Prim. Fl. Holsat. 91; *Lichen barbatus* L. (1753) in: Sp. Pl. 1155; (?) *Usnea barbata* var. **scabrosa** Müll. Arg.; *Usnea caucasica* Vain.; (?) *Usnea caucasica* var. *barbatiiformis* Räsänen; *Usnea dasopoga* var. *plicata* (L.) Cromb.; *Usnea pendulina* Motyka; *Usnea plicata* (L.) F. H. Wigg; *Usnea prostrata* Vain. ex Räsänen; *Usnea scabrata* Nyl.; *Usnea tortuosa* De Not.

Thallus: green, rarely with a 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, and usually with at least a few foveoles, folds or (less commonly) ridges; secondary branches not, or scarcely, narrowed at base. 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 dissolves in K. Medulla: white, 17 - 27% of branch diameter, very loose, especially in inner part (a single hypha may extend from the axis almost to the photobiont layer without crossing any other hyphae and even without branching); hyphae 2.5 - 4 µm wide, sometimes encrusted with a few (never many) crystals. Apothecia: very rare (only a single apothecium seen), 4 mm diameter, rather thin, with a 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 µm diameter, forming a layer 45 - 55 µm thick.

The absent or inconspicuous soralia easily distinguish this species from the other common Peloponnesian species *U. lapponica*. However, collections should be checked against *U. dasopoga* (not reliably reported for Peloponnes) with which *U. barbata* could be confused.

Fairly common on the mainland, and also known from a few of the islands. Recorded from altitudes 150 to at least 1800 m, but rare below 800 m. Always epiphytic. About two-thirds of reports are from conifers. This seems to be the commonest species of *Usnea* in Greece.

Most of Europe to as far north as southern Scandinavia, but in the south probably restricted to the uplands. Also Macaronesia, Asia (Turkey, Russia, Mongolia, China), Africa (Morocco, Ethiopia, S. Africa), N. America (western Canada, western USA; reports for elsewhere may be unreliable), C. America (Mexico), S. America (widespread), Australasia (Tasmania), Pacific (widespread). Many reports from outside Europe are old, and may be unreliable.

**Usnea ceratina** Ach. (1810)
in: Lichenogr. Universalis 619-620

Descriptions: Randlane et al. (2009); Smith et al. (2009).

Rare and scattered on the mainland, in the uplands. On bark.

Most of Europe to as far north as southern Sweden, but in the south restricted to the uplands. Also Macaronesia (Canary Is, Madeira; reports for Azores incorrect), Asia (widespread from Himalayas eastward), probably Malesia, Africa (fairly widespread), N. America (scattered in temperate parts of both coasts, also near the Great Lakes), C. America (CR, El Salvador, Guatemala, Mexico), S. America (widespread), Australasia (eastern Australia), Pacific (Marquesas, Tahiti).

**Usnea cornuta** Körb. (1859)
in: Parerga Lichenol. 2

The earliest name is *Usnea ceratina* var. *inflata* Duby (1830), but it does not have priority at the rank of species. The name *Usnea inflata* Delise ex Duby (1830) was not validly published.

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.

Widely distributed in parts of Europe with a temperate to warm, maritime climate. Known from SW Norway but otherwise absent from the Nordic Countries. Absent from large areas of eastern Europe. Also Macaronesia, eastern Asia (China, Taiwan, Japan), Malesia (Sabah), Africa (S. Africa), N. America (BC, Nova Scotia, both coasts of USA), perhaps Caribbean (Guadeloupe, St Lucia), C. America (Mexico), S. America (Colombia, Venezuela), Australasia (widespread in temperate parts), Pacific (Hawaii).

**Usnea dasopoga** (Ach.) Nyl. (1876)

For the spelling of the epithet, see Arcadia (2013).

Descriptions: Randlane et al. (2009); Smith et al. (2009) as *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 a little beyond the Arctic Circle, but uncommon in the south. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (Morocco, Socotra, S. Africa), N. America (widespread outside warmer parts of USA), S. America (Colombia; perhaps Bolivia - old report), Pacific (widespread). Reports for Australasia are probably incorrect. Records for other hot regions (Pacific, perhaps also S. Africa, Socotra) also seem doubtful to me.

**Usnea esperantiana** P. Clerc (1992)
in: 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. Fibres: 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 µm 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 µm diameter, forming clumps to about 30 µm diameter in outermost part of medulla, not forming a regular layer.
Many characters overlap with *U. lapponica*, 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. The only substrate explicitly specified was *Phillyrea*.

Few records, but probably a species of the Atlantic margin (to Scotland) and the Mediterranean (with an outlier in the Russian Caucasus). Also Macaronesia, western N. America (BC to Oregon), C. America (Mexico), S. America.

**Usnea flammea** Stirt. (1881)

Descriptions: Randlane et al. (2009); Smith et al. (2009).

Islands of the southern Aegean, on bark at altitudes 800 - 850 m.

Basically a species of western Europe, to as far north as Norway. Uncommon away from the Atlantic margin, though there are a few reports for northern Italy, Croatia and Greece. Also Macaronesia, N. America (Nova Scotia).

**Usnea flavocardia** Räsänen (1936)
in: *Revista Univ. Santiago* 21: 139; *Usnea wirthii* P. Clerc

Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Macedonia and Ikaria, on bark. The Macedonian record was from an altitude of about 150 m.

Mostly the Atlantic margin of Europe to as far north as British Is, but also in Corsica and Greece. Also Macaronesia, N. Africa (Tunisia), N. America (Nova Scotia, west coast from BC to California), C. America (Mexico), S. America (Chile, Peru), Australasia (NZN).

**Usnea florida** (L.) F. H. Wigg. (1780)

Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Very 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.

Much of Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Socotra; also old reports from elsewhere), C. America (CR, Guatemala, Mexico, perhaps Panama), S. America (widespread), Pacific (Hawaii, Tahiti). Reports for Malesia incorrect. Status in N. America disputed.

**Usnea fulvoreagens** (Räsänen) Räsänen (1935)
The single Greek report, for Macedonia, was not accepted by Abbott (2009). It might be a mis-determination of *U. lapponica*.

**Usnea glabrata** (Ach.) Vain. (1915)

Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).

Scattered, in the northern half of Greece, on bark at altitudes of 100 - 1500 m. Not reported from conifers.

Widely distributed in Europe, to as far north as southern Scandinavia, but uncommon in the south. Also Macaronesia, Asia (Russia, Mongolia, China, Japan), N. America (scattered, mainly in the west, from Alaska to cool parts of USA), C. America (Mexico). Reports from some other regions, under other names, may belong here, but the synonymy is not certain.

**Usnea hirta** (L.) F. H. Wigg. (1780)

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, though in regions with a Mediterranean climate probably restricted to the uplands. Also Macaronesia, Asia (widespread), Africa (widespread; most records as *U. leprosa*), N. America (widespread in areas that are not too hot or too dry), C. America (Mexico), Pacific (New Caledonia). Status in S. America unclear: reports for Colombia, at least, are incorrect.
Usnea intermedia (A. Massal.) Jatta (1909)
The earliest name is Usnea florida var. rigida Ach. (1810), but Massalongo's epithet has priority at the rank of species.
  Descriptions: Nash et al. (2007); Randlane et al. (2009).
  Rare, in Thessaly. On bark at altitudes 150 - 1250 m.
  Mostly central Europe, with a few reports from south of the Alps. Also Asia (Russia, China, both as U. hapalotera), N. America (BC, western USA), C. America (Mexico).

Usnea laponica Vain. (1925)
in: [need to investigate - bibliographical info incomplete]; Usnea perplectans Stirt. If the synonymy were to be confirmed, Stirton's name would be the correct one.
  Thallus: green, subpendent to pendent, to 18 cm long. Branches: fairly regular; secondary branches not or scarcely narrowed at base. 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 recorded for Greece. U. esperantiana has branches that are much more twisted. U. fulvoreaegens, which is rather unlikely to occur in Greece, is similar but has norstictic acid.
  Scattered, on the mainland, at altitudes 500 - 1200 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 U. fulvoreaegens. Widely distributed in Europe, though absent from British Is. Also Macaronesia, western Asia (widespread), N. Africa (Morocco), N. America (scattered from southern Canada to cooler parts of USA), C. America (Mexico).

Usnea pinkertonii Stirt. (1882)
in: Scottish Naturalist 6(7):294-295
  Description: See the protologue.
  The only report is from Sterea Ellada, at high altitude. The substrate was not reported.
  This poorly known taxon is known in Europe only from Bulgaria and Greece. Elsewhere, reliably known only from Egypt, from where it was described, though Dodge reported it for Ethiopia and Kenya.

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. Also Asia (Japan), N. America (scattered in USA).

Usnea rubicunda Stirt. (1881)
in: Scott. Nat. 6(3): 102
  Island of Kassos, on bark at an altitude of 600 m.
  Throughout Macaronesia, Mediterranean Europe, and western Europe as far north as British Isles, but absent from the Nordic Countries and rare in eastern Europe. Also Asia (widespread), Africa (widespread outside humid tropics), N. America (widespread in temperate and warm parts), Caribbean (PR), C. America (widespread), S. America (widespread), Australasia (widespread outside desert regions), Pacific (Hawaii).

Usnea subfloridana Stirt. (1882)
  The earliest name is Lichen comosus Ach. (1795), but the epithet is not available in Usnea because of U. comosa Pers. (1826).
Descriptions: Nash et al. (2007); Randlane et al. (2009); Smith et al. (2009).
Rare and scattered, with no clear pattern, at altitudes 50 - 1250 m. Usually on bark, but recorded once from wood. Most of Europe. Also Macaronesia, Asia (widespread), Africa (Morocco, widespread in E. Africa; also Zaire, S. Africa), N. America (widespread in cold and temperate regions), C. America (El Salvador, Mexico), S. America (widespread if U. subcomosa is synonymous).

Usnea subscabrosa Nyl. ex Motyka (1937)
in: Monograph 2(1): 313
Karpathos and Kassos, on bark at altitudes 600 - 710 m.
Macaronesia and western Europe as far north as British Isles, with a few records from further east in the Mediterranean (Italy, Croatia, Greece). Also N. Africa (Morocco), N. America (SE and SW Canada, widespread in USA), Caribbean (Cuba, Jamaica), C. America (Mexico), S. America (Brazil, Uruguay, perhaps elsewhere), Pacific (Hawaii).

Usnea wasmuthii Räsänen (1931)
in: [need to investigate - bibliographical info confused]
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 (scattered in USA), and perhaps elsewhere.

Vahliella P. M. Jørg. (2008)
in: Lichenologist 40(3): 222
Diffs from Pannaria in the small-squamulose, rather than foliose, growth form, and in the absence of pannarin. Formerly included in Fuscopannaria, but separated from that genus by the structure of the ascus apex.
Eight species, of which 4 occur in Europe.

1 Isidia present. Thallus ±crustose, terricolous. (V. atlantica) Greek report tentative.
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 always blue-grey and those of V. leucophaea are always 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.

Vahlilea leucophaea (Vahl) P. M. Jørg. (2008)
in: Lichenologist 40(3): 224; Lichen leucophaeus Vahl (1787) in: 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. Widely distributed in Europe, but nowhere very common. Also Macaronesia, Asia (widespread), N. Africa (Algeria), N. America (mostly eastern and western USA, just extending into Canada along both coasts), C. America (Mexico), S. America (Argentina, Chile).

Vahlilea 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. Exciple: pale orange, paler than disc, persistent but sometimes becoming thin and irregular; in section: of hyphae with elongate lumina & thick walls, and appearing cellular. Thalline margin: absent or excluded early. Epithecium: orange-brown to brown, K-, (pigment not soluble in K). Hymenium: 70 - 120 µm tall, colourless to very pale yellow, I+ blue slowly becoming 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 F. ignobilis. It is easy to separate from that species provided that the ascospores examined carefully.

In the literature V. saubinetii is often described as having a grey thallus. The two Peloponnesian collections have squamules that are unambiguously brown. A few squamules are grey-brown but hardly any are truly grey. Prof. P. M. Jørgensen has kindly examined a specimen from one of these collections and confirmed that it does belong to V. saubinetii (pers. comm.). (That specimen is now in BG.)

Scattered, with no clear pattern. On bark, usually of deciduous species of Quercus, at altitudes 100 - 1200 m.

Rare in Europe, and almost restricted to the south, though there are a very few records for central Europe. Also Macaronesia, Asia (southern Siberia, Mongolia), N. America (Pacific Northwest, though some or all reports may refer to a different taxon than the European one).

Verrucaria Schrad. (1794)


Type: V. rupestris Schrad. (= V. muralis). 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).


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, we have a transitional situation where some natural segregates have been recognised but Verrucaria itself remains heterogeneous. The genus (in either circumscription) is difficult, as there are rather few characters available, and some species are quite variable. These unavoidable difficulties have been compounded by those 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 difficult, and it will remain difficult until the genus has been properly monographed in SE Europe. The present treatment is provisional and I am aware that it 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, especially ascospore sizes, are often unreliable.

The genus contains a large number of poorly known taxa and names of uncertain application. V. acroretella, V. buschirensis, V. oloryza, V. stenospora, V. tetanocarpa, V. viridicans and V. werneri are problematic for one reason or another, and are not included in the keys.

Key to Verrucaria main groups

11 Mature ascospores brown; or thallus on soil, bark or wood. Group 1.
1 Mature ascospores colourless. On rock, or parasitic on saxicolous lichens.
   22 Aquatic, on marine rocks. See Hydropunctaria (Formerly treated as Group 2.)
   22 Aquatic, on freshwater rocks. Group 3.
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. Group 4.
  55 Ascospores mostly less than 20 µm long. Group 4A
  5 Ascospores mostly 20 or more µm long. Group 4B
4 Thallus immersed or very thin (Note 2). 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, or ascospores not colourless

11 Mature ascospores brown. ("V." phaeosperma)
1 Mature ascospores colourless.
22 On soil. V. geophila
  2 On bark or wood. (V. phloeophila), (V. sorbinea), (V. viridigrana), (V. xyloxena)

Key to Verrucaria group 3: 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 µm long. (V. aquatilis)
2 Most ascospores more then 9 µm 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 4A: Saxicolous, not aquatic, thallus superficial, ascospores mostly less than 20 µm long.

1111 Thallus blue-grey.
  22 Thallus continuous. Parabagliettoa disjuncta
    2 Thallus cracked or cracked-areolate. V. caerulea
111 Thallus with a green or olive tinge.
  22 Perithecia 0.15 - 0.2 mm diameter (including exciple). Ascospores 12 - 16 x 5 - 6 µm. (V. dolosa)
  2 Perithecia 0.2 - 0.3 mm diameter (including exciple). Ascospores 15 - 20 x 6 - 8 µm. V. floerkeana
11 Thallus pale grey, whitish or white (sometimes yellowish), often not very apparent.
  22 Thallus cracked or cracked-areolate.
  33 Perithecium marginal, or between areoles.
    44 Areoles white-grey pruinose, with black rim. Apex of perithecium often flattened.
      55 Ascospores 11 - 15 x 5 - 7 µm. Verruculopsis lecideoides
      5 Ascospores 17 - 22 x 7.5 - 9 µm. (V. beltramianiana)
    4 Areoles brown, not pruinose, without black rim. Apex of perithecium not flattened. Verruculopsis minuta
3 Perithecium central in areoles, not between areoles.
  44 Mature areoles with black margin. Perithecium entirely immersed.
    55 Thallus with elongated marginal areoles. Placopyrenium fuscellum
    5 Marginal areoles not elongated, or thallus not areolate. (V. crustulosa) Greek report doubtful, but discussed below.
  4 Areoles without black margin. Perithecium immersed or not.
    55 Perithecium distinctly flat-topped, entirely immersed. Thallus grey, not white. V. caerulea
    5 Perithecium not flat-topped, immersed or not.
      66 Thallus continuous or only locally cracked. Involucrellum present. Perithecium about 50% immersed. V. muralis
      6 Thallus distinctly cracked or areolate. Involucrellum absent. Perithecium 50 - 100% immersed. (V. ochrostoma)
2 Thallus verrucose-areolate. (V. sphaerospora) (If thallus squamulose-areolate, see Placocarpus schaereri.)
1 Thallus brown to black. (If material does not key out, consider V. dolosa and V. floerkeana, which are said sometimes to lack a green tinge, and are then brown.)
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. Ascospores 10 - 17 µm long. Surface of larger areoles often with a network of fine black cracks. Black prothallus usually present. V. polysticta
      5 Perithecia not completely immersed. Prothallus present of absent.
         6 Perithecia 30 - 80 percent immersed. Ascospores 14 - 30 µm long. Basal part of exciple pale brown to black (Note 1). Prothallus absent. V. nigrescens

(1) 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 4B: Saxicolous, not aquatic, thallus superficial, ascospores mostly more than 20 µm long.

11 Thallus blue-grey. (V. cryptica)
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 Aspicilia calcarea. See Placopyrenium canellum
   4 Not parasitic.
      55 Areoles with black margin. (V. crustulosa) Greek report doubtful, but discussed below.
      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).
22 Thallus thin, barely superficial; ±continuous (sometimes cracked in places).
      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)
   3 Perithecia no more than 50% immersed. Involucrellum present. Usually on siliceous rock. V. fusconigrescens
22 Thallus distinctly superficial, cracked-areolate or areolate, very thick (sometimes more than 0.5 mm).
33 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.
3 Thallus grey-brown.  V. mucronum
2 Thallus distinctly superficial, cracked-areolate or areolate, but not very thick (distinctly less than 0.5 mm).
33 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.  On calcareous rock.  (V. cataleptoides) Greek report doubtful, but discussed below.
3 Thallus without distinct black or brown basal layer.  On calcareous or siliceous rock.
44 Involucrellum ±conical, present almost to base of perithecia.  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
4 Involucrellum ±flat, only present in upper part of perithecium.  Perithecia often distinctly pear-shaped or bottle shaped.  On calcareous rock.
   55 Involucrellum clearly distinct from exciple.  Thallus brown, without a green tinge.  (V. tabacina)
5 Involucrellum merged with exciple.  Thallus brown to green-brown.  V. viridula

(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 the cortex).  Perithecia completely immersed.  Ascospores 18 - 28 x 10 - 12 µm.  See Bagliettoa
1 Thallus green, brown, dark brown or black.
   22 Ascospores less than 30 µm long.  (V. viridicans) Greek report uncertain.  Some collections of some group 4A species might also key out here, so in case of doubt consult that key too.
   2 Ascospores more than 30 µm long.
      33 Involucrellum present.
         44 Involucrellum entirely fused with exciple.  V. viridula
9 Involucrellum not entirely fused with exciple.  V. cinereorufa
3 Involucrellum absent, or almost absent.  V. veronensis
1 Thallus pale grey, whitish or white (sometimes yellowish), often rather indistinct.
   22 Perithecia ±entirely immersed.
      33 Ascospores mostly less than 20 µm long.
         44 Involucrellum present, clearly different from exciple, which is pale at base.  V. muralis
9 Involucrellum absent, or not very distinct from exciple.
      55 Oil cells (macrospheroids) 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
3 Ascospores mostly more than 20 µm long.
   444 Perithecia pinkish in upper part, colourless in lower part.  (V. ionaspicarpa)
4 Perithecia mostly colourless, only ±black at top.  V. eggerthii
4 Perithecia entirely black  V. hochstetteri
2 Perithecia half-emergent.
   33 Ascospores mostly less than 20 µm long.
      44 Exciple entirely black, not very distinct from involucrellum.  V. murina
9 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.
44. Exciple colourless at base. Involucrellum present. **V. muralis**
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**

**Verrucaria acrotella** Ach. (1803)
in: Methodus 123; **Verrucaria papillosa** f. acrotella (Ach.) Arnold

The application of this name is uncertain since, according to Swinscow (1968), the type is in very poor condition. Although accepted by Abbott (2009), this cannot be regarded as a good species, and the name should be deleted from the Greek list.

**Verrucaria aethiobola** Wahlenb. ex Ach. (1803)
Included in Abbott (2009) who regarded **V. cataleptoides** as synonymous, but treated here under that name.

**Verrucaria apatela** (A. Massal.) Trevis. (1860)
in: Conspr. Verruc. 7; **Lithothea apatela** A. Massal. (1855) in: Framm. Lichenogr. 23

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.
Sicily, Croatia and Greece. Also Asia (Syria), N. Africa (Egypt).

**Verrucaria buschirensis** J. Steiner (1896)
Description: Discussed in Steiner (1898 :178), but no adequate description seen.
Sterea Ellada, on limestone in the 19th Century. Otherwise reported only from Iran, and probably not a good species.

**Verrucaria caerulea** DC. (1805)
in: Lamarck & de Candolle, Fl. Franc., Ed. 3, 2: 318 (sometimes cited as 'coerulea'); **Involucrethae plumbea** (Ach.) Servit; **Thelidium plumbeum** (Ach.) Servit; **Verrucaria caerulea** f. fuscà (Schaer.) Hayek; **Verrucaria glauca**n Ach.; (?) **Verrucaria glaucina** f. sublobulata Servit; **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 altitudes 0 - 2400 m.
Widely distributed in Europe to about the Arctic Circle. Also Asia (widespread), N. Africa (Morocco, Algeria), N. America (California, perhaps elsewhere in USA), Australasia (Victoria, NZS).

**Verrucaria cataleptoides** (Nyl.) Nyl. (1861)

Regarded by Abbott (2009) as a synonym of **V. aethiobola**, but treated by Krzewicka (2012) as an independent species. For a description see Krzewicka (2012). There is a single 19th century report, but it was from siliceous rock, whereas this species is thought to be restricted to calcareous rock, so the report must be regarded as doubtful.
Verrucaria cinereorufa Schaer. (1836)
Abbott (2009) referred a single Peloponnesian collection here, but the determination seems doubtful to me. For a description see Clauzade & Roux (1985).
Known only from Attica, where it occurred on limestone at an altitude of about 20 m.
Scattered reports from Greenland to Greece, but they do not show any obvious pattern. I have not seen any reports from outside Europe.

Verrucaria crustulosa Nyl. ex Lamy (1880)
in: Bull. Soc. Bot. Fr. 25: 493 (This is a nomen novum for Endocarpon crassum Anzi (1864), the epithet crassa being unavailable in Verrucaria owing to V. crassa Eschw., 1833.); Dermatocarpon crassum (Anzi) Zahlbr.
Evia, on limestone at an altitude of 30 m. Abbott (2009) regarded the single Greek report as in need of confirmation.
Most of the rather few reports of V. crustulosa are for the southern parts of central Europe. It does not occur further north than the Czech Republic. In Italy restricted to the Alps, but it is known from further south in Europe, from Corsica. The species is too poorly known to be dogmatic, but these reports suggest that if present in Greece it ought to be montane. Also western Asia (Iran).

Verrucaria eggerthii J. Steiner (1911)
Description: Clauzade & Roux (1985).
Corfu, on calcareous rock at an altitude of 100 m.
Only Sicily, Croatia, Montenegro and Greece.

Verrucaria foveolata (Flörke) A. Massal. (1852)
Thallus: crustose, ±immersed to superficial but very thin, continuous, pale grey or with a 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 thick 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, 8 per ascus, 20 - 28 x 10 - 15 µm. Photobiont: green.
Differs from V. hochstetteri in having a better developed thallus and partly emergent perithecia. Some authors subsume it under that species.
Peloponnesian and Crete. Not common. On calcareous rock at altitudes 150 - 1200 m.
Widely distributed in Europe to about the Arctic Circle. Also Asia (Israel, Syria, Russia).

Verrucaria fusca Pers. ex Nyl. (1861)
Often cited with authorship Pers. ex Ach. (1810) from Lichenogr. universalis 291, but not validly published there. Unfortunately Nylander's name is a later homonym of V. fusca (Schaer.) Kremp. (1858). If this is a good species then 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, ranging as far north as southern Sweden. The Greek report is the only one that I have seen from south of the Alps. Also Asia (southern Siberia), N. America (Arizona, California), C. America (Mexico).
Verrucaria fuscoatroides 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 external view, about 50% immersed in thallus; in section: 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 perithecium, sometimes almost to base. Paraphyses: disappearing early. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 23 - 35 x 11 - 15 μm. Scattered in Peloponnesse and Crete at altitudes 0 - 1200 m. The Peloponnesian records are from siliceous rock. That for Crete is from limestone.

The few reports of this rather poorly known taxon are scattered from Finland to Greece. Also N. America (Arizona, California).

Verrucaria fusconigrescens Nyl. (1873)
- The earliest name is *Verrucaria virens* var. *obfuscans* Nyl. (1866), but the epithet *obfuscans* was not used at species rank until 1881.
- Descriptions: Clauzade & Roux (1985); Krzewicka (2012); Smith et al. (2009).
- Islands of the southern Aegean, on siliceous rock at altitudes 50 - 670 m.
- Widely distributed in Europe to as far north as southern Scandinavia, but avoiding the continental climate of much of eastern Europe. Also Asia (Taiwan), N. Africa (Morocco, Algeria), N. America, Australasia (Tasmania, NZS).

Verrucaria geophila Zahlbr. (1909)
- The name is not legitimate, being a later homonym of *V. geophila* Nyl. in *Flora* 48: 356. 1856. Nylander's name is not synonymous. Nylander stated "Sit varietas *V. pyrenophora*", 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 eventually retained in *Verrucaria* s. str. then conservation would be desirable.
- My only collection is rather scanty, so the description is not extensive.
- Thallus: crustose, inconspicuous, to 2 cm diameter (in material seen). 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 (in material seen), 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, 8 per ascus, 20 - 26 x 13 - 17 μm.
- The terricolous habit is unique among *Verrucaria* species likely to be encountered in Greece.
- Rare and scattered in the southern half of Greece. On soil at altitudes 100 - 200 m. The Peloponnesion collection was on non-calcareous soil but the other Greek reports do not indicate soil type.
- Scattered rather thinly throughout much of Europe, from Finland to Cyprus, but absent from maritime areas of western Europe. Also western Asia (Turkey).

Verrucaria hochstetteri Fr. (1831)
- Two earlier names, *Verrucaria harrimanni* Ach. (1810) and *Patellaria carpinea* Balb. (1828), might be synonymous, but the synonymy does not appear to have been definitely established in either case.
- 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, Egypt), Australasia (S. Australia, Victoria), perhaps Pacific (New Caledonia).
Verrucaria interrupta  (Anzi ex Arnold) J. Steiner (1911)
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.
Austria, Lombardy in Italy, and Greece. Also western Asia (Syria). Some authors regard the name as a synonym of V. calciseda, which may explain why there are few reports.

Verrucaria macrostoma DC. (1805)
Descriptions: Clauzade & Roux (1985); Krzewicka (2012); Nash et al. (2007); Smith et al. (2009).
Scattered, with no clear pattern. On calcareous rock at altitudes 0 - 300 m.
Widely distributed in Europe to as far north as southern Scandinavia. Also Asia (widespread), N. Africa (Morocco, Algeria, Tunisia), N. America (Arizona, California; at least some other reports are incorrect), C. America (Mexico), perhaps S. America (Argentina, Chile), Australasia (both islands of NZ).

Verrucaria maculiformis Kremp. (1858)
in: Flora 41: 303.
Mountains of northern Peloponnese. On limestone at high altitude.
Widely distributed in Europe to as far north as southern Scandinavia. Also Asia (western Siberia, perhaps elsewhere), N. Africa (Morocco).

Verrucaria mortarii (Arnold) Arnold ex Lamy (1880)
Verrucaria viridula var. mortarii (Arnold) J. Steiner
The name is not legitimate, being a later homonym of V. mortarii Leight. (1879). A nomen novum will be required, if this is maintained as a good species.
Sterea Ellada, on calcareous rock at an altitude of 1150 m.
Scattered reports from Denmark to Greece. Also N. Africa (Morocco).

Verrucaria muralis Ach. (1803)
in: Methodus 115; Verrucaria rupestris Schrad., nom. illeg.; Verrucaria rupestris f. confluens (Arnold) Arnold; (?) Verrucaria rupestris var. hypophaea auct. graec.
Several earlier names are, or may be, synonymous. (1) Verrucaria petrosa (J. F. Gmel.) Humb. (1793), based on Lichen petrosus J. F. Gmel. but the synonymy has probably never been established with certainty. (2) Verrucaria weberi Humb. (1793). The synonymy has not been established with certainty. (3) Verrucaria rupestris Schrad. (1794) is synonymous but not legitimate, being a later homonym of V. rupestris (Scop.) F. H. Wigg. (4) Lichen schraderi Ach. (May 1799) is a superfluous name for Lichen petrosus J. F. Gmel., and also a later homony of Lichen schraderi Bernh. (February 1799).
To clarify the nomenclature, it will be necessary to determine the application of the name Lichen petrosus J. F. Gmel. If authentic material exists, it will be in LINN.
Two of the three Peloponnesian collections that Abbott (2009) referred here probably belong elsewhere, and the third does not agree in all respects with published description of this species. The description is based on that third collection. For a descriptions see: Krzewicka (2012); Smith et al. (2009).
Thallus: crustose, immersed, inconspicuous, to 2 cm diameter. Prothallus: absent. Perithecia: 60 - 80% immersed, black, 0.2 mm diameter; in section: 200 - 300 µm tall, 150 - 220 µm wide (excluding involucrellum). Exciple: colourless. Involucrellum: present, 220 - 280 µm diameter, not extending away from perithecum or far down. Ascospores: colourless, simple, ellipsoid, 15 - 16 x 6.5 - 7 µm.
Comparison with other species not possible until this species is better understood in Greece.
Scattered throughout Greece, usually not very far from the sea. On rock, usually calcareous, at altitudes 0 - 1500 m. Throughout Europe to about the Arctic Circle. Also Asia (widespread), N. Africa (Morocco, Algeria, Mauritania), 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)
As I have only a single, rather scanty collection the description is brief. For a published description see Smith et al. (2009).
Thallus: immersed, grey, 1.5 cm diameter (in material seen to date). Perithecia: black, 0.15 mm diameter, 65% immersed; in section: 200 µm tall x 175 µm wide. Exciple: dark in lower part. Ascospores: colourless, simple, 12 - 16 x 4 - 7 µm.
Characterised by the immersed thallus, partly emergent perithecia, dark exciple and small ascospores.
Scattered throughout Greece. Not very common. On calcareous rock at all altitudes.
Widely distributed in Europe to as far north as southern Scandinavia. Also western Asia (Syria).

Verrucaria murorum (A. Massal.) Lindau (1913)
Descriptions: 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 presented here.
Southern and central Europe, though absent from the west (e.g. Iberian Peninsula, France). Also Asia (Tajikistan), N. Africa (Morocco), N. America (Arizona).

Verrucaria nigrescens Pers. (1795)
According to Zahlbruckner's Catalogus, the earliest name is Lichen carbonarius Wulf. (1787) in Schrift. Ges. Naturf. Freunde Berlin 8(1):93-96. Wulfen's herbarium still exists, so it might be possible to determine the application of Wulfen's name with certainty. If it is indeed synonymous, conservation will be required, as the epithet carbonaria is available in Verrucaria.
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, 40 - 80% immersed; in section: 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 peritheciun; at least in upper half of peritheciun these often have distinct elongated lumina, giving a weakly cellular appearance. Involucrellum: present, robust, 250 - 500 µm diameter, not spreading, extending about halfway down peritheciun. Paraphyses: disappearing early. Periphytes: abundant in upper half of peritheciun, with visible septa, moniliform, 4 - 5 µm wide. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 13 - 30 x 7 - 15 µm. Conidia: (observed incidentally) 5 x 1 µm, bacilliform. Photobiont: green, not Trebouxoid (chloroplast not prominent), cells 5 - 7 x 5 µm. Photobiont layer: 10 - 50 µm thick, continuous (within an areole), regular but sometimes cup-shaped and becoming thinner towards the margins of the areole, where the upper margin of the black basal layer rises closer to the 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, perhaps S. Africa), N. America (widespread), perhaps Caribbean (Bahamas), C. America (Mexico), perhaps S. America (Chile), Australasia (SE Australia, NZS).

Verrucaria oloryza A. Massal. [date not known]
in: [need to investigate]; Verrucaria "oloryza" auct.
Description: none seen.
Kefalonia. No other information was reported.
The Greek report is the only one that I have seen.
Verrucaria periphysata Zahlbr. (1919)
Description: See the protologue.
Lefkada and Samos, on limestone at altitudes 50 - 200 m.
Only Croatia and Greece.

Verrucaria pinguicula A. Massal. (1856)
in: Lotos 6: 80; Verrucaria integra (Nyl.) Nyl.
Thallus: crustose, superficial but thin (to 100 µm), brown (but not dark brown), smooth or slightly cracked, sometimes discontinuous. Perithecia: black, 0.2 - 0.3 mm diameter, 40 - 50% immersed; in section: ±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.
Southern and central Europe, to as far north as England. Also eastern Asia (Russian Far East, Hong Kong, Taiwan), N. Africa (Morocco, Algeria, Egypt), N. America (perhaps Alaska; also a few eastern coastal states of USA).

Verrucaria polysticta Borrer (1834)
in: Hooker & Sowerby, Engl. Bot. Suppl. 2, tab. 2741; Verrucaria fuscella var. nigricans Nyl.; Verrucaria nigricans (Nyl.) Zschacke
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 - 15 x 5 - 7 µm.
The network of fine black cracks on the surface of the areoles is distinctive when present.
Scattered 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 Aspicilia spp. may refer to Heteroplacidium fusculum.
Scattered, mainly in northern and central Europe. Apart from the Greek reports, it does not appear to be known south of the Alps. Also Asia (Turkey, Jordan, southern Urals), N. Africa (Morocco), perhaps the Americas.

Verrucaria ruderum DC. (1805)
in: Lamarck & de Candolle, Fl. Franç., Ed. 3, 2: 318
Description: Clauzade & Roux (1985).
Crete and Ikaria, on calcareous rock at altitudes 0 - 50 m.
Scattered, mainly in the western half of Europe, from southern Scandinavia to Sicily, though absent from British Is. In central Europe, no further east than Slovakia. Also reported, rather doubtfully in my view, for Caribbean (Bermuda).

Verrucaria stenospora (J. Steiner) Zahlbr. (1921)
Description: See the protologue which, unfortunately, is not adequate for modern needs.
Sterea Ellada, on limestone at high altitude.
Known only from the Greek type collection. It is unlikely that this is an independent species, but it will be necessary to study the type to determine the correct application of the name.
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.
Southern Europe and the southern parts of central Europe. Probably absent from the Atlantic margin, though there is a report for (some part of) France. Also Asia (southern Siberia, Tajikistan), N. Africa (Morocco).

Verrucaria viridula  (Schrad.) Ach.  (1803)
in: Methodus (Suppl.) 16;  Endocarpon viridulum Schrad. (1794) in: Spic. Fl. Germ. 192;  Lithoic e a controversa f. viridula (Arnold) Arnold;  Lithoic e a 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 external view, about 50% immersed in thallus; in section: 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, 8 per ascus, 22 - 35 x 9 - 20 µm.
Scattered throughout the southern half of Greece, but also reported from Corfu. On calcareous rock at all altitudes.
Widely distributed in Europe to as far north as southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, S. Africa), N. America (scattered in Canada and USA, but absent from the east of the continent), perhaps C. America, Australasia (Tasmania 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)
Type: V. aegyptiaca (Müll. Arg.) J. Steiner. Family: Verrucariaceae. Literature: The genus was recently resurrected by Navarro-Rosinés, Roux & Gueidan (2007) for a group of "Verrucaria" species parasitic on Caloplaca and Xanthoria. They monograph the genus and provide a key.
About 23 species, most of which are not well known. About 21 are reported for Europe.
11 Medulla ±I+. blue. (V. helvetica), (V. granulosaria), (V. tarracnonensis)
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 (V. coronataria), (V. inconnexaria), (V. lactearia), (V. latericola), (V. navasarai), (V. pusillaria)

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.

**Verruculopsis Gueidan, Nav.-Ros. & Cl. Roux (2007)**
This recent segregate from *Verrucaria* has 5 species, most of which are parasitic. All occur in Europe.

11 On anthraquinone-containing Caloplaca species, or on Xanthoria elegans. (V. flavescentaria), (V. irubescentis), (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 lecideoides** (A. Massal.) Gueidan & Cl. Roux (2007) var. lecideoides
Descriptions: 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*.
Widely distributed in southern and central Europe; its northern limit appears to be Belgium. Also Macaronesia, Asia (widespread as far east as Mongolia), N. Africa (Algeria, Morocco), N. America (Saskatchewan, scattered in western USA), C. America (Mexico).

**Verruculopsis lecideoides var. fraudulosa** (Nyl.) Nav.-Ros., Cl. Roux & Gueidan (2007)
Description: Nash et al. (2007) as *Verrucaria fraudulosa*.
Peloponnese and Ios. On calcareous and siliceous rock at altitudes around 100 m.
Known only from Germany, Greece and California.

**Verruculopsis minuta** (A. Massal.) Krzewicka (2012)
The name is not validly published, as Krzewicka did not cite the basionym.
Descriptions: Clauzade & Roux (1985) as *Verrucaria lecideoides var. minutata*; Krzewicka (2012); Nash et al. (2007) as *Verrucaria minor*.
Scattered, with no clear pattern. Parasitic on *Caloplaca variabilis*, or directly on calcareous rock, at altitudes 100 - 1400 m.
Eastern half of central and southern Europe. Also Asia (Syria, Iran), N. Africa (Morocco), N. America (Arizona), Australasia (eastern and southern Australia).
Vouauxiella Petr. & Syd. (1927)

This genus of lichenicolous fungi has just two species, both present in Europe. They are probably fairly common, but are inconspicuous and there are few Greek records.

11 Conidia smooth-walled. V. lichenicola
1 Conidia with distinct ornamentation. V. verrucosa

Vouauxiella lichenicola (Linds.) Petr. & Syd. (1927)
Descriptions: Clauzade, Diederich & Roux (1989); Nash et al. (2004).
Widely distributed in Europe. Also Macaronesia, western Asia (Turkey, Israel), N. Africa (Morocco, Tunisia), N. America (widespread in USA), C. America (Mexico).

Vouauxiella verrucosa (Vouaux) Petr. & Syd. (1927)
Pycnidia: black, 0.06 - 0.12 mm diameter, with a 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, globose, ellipsoid or pyriform (but usually taller than wide), 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.
Peloponnesse, at an altitude of 765 m, on Lecanora horiza.
Widely distributed in the western half of Europe to as far north as British Is and Denmark. Also Macaronesia (Canary Is), Asia (Pakistan), N. Africa (Morocco), N. America (Virginia).

Vulpicida J. E. Mattsson & M. J. Lai (1993)
in: Mycotaxon 46: 427
Six species, four of which occur in Europe. They were formerly included in Cetraria. Only one species is likely to occur in Greece.

Vulpicida pinastri (Scop.) J. E. Mattsson & M. J. Lai (1993)
in: Mycotaxon 46: 428; Lichen pinastri Scop. (1772) in: Fl. Carniol. Ed. 2, 2: 382; Cetraria pinastri (Scop.) Gray
Descriptions: Clauzade & Roux (1985) as Cetraria pinastri; Nash et al. (2002); Smith et al. (2009); Thell & Moberg (2011).
Scattered on the mainland of northern Greece. On acidic bark and 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 from Alaska to cool parts of USA).

Waynea Moberg (1990)
in: Lichenologist 22(3): 249
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. giralitiae)
   2 Ascospores (3) 5 - 7 -septate, 30 - 45 µm long. **W. cretica**

**Waynea cretica** Llop (2006)
in: *Lichenologist* 38(6): 521-523
   Description: see the protologue.
   Crete, on bark of Acer *sempervirens* at an altitude of about 150 m.
   Known only from Crete and Portugal

   Ikaria, on bark at an unspecified altitude.
   Scattered in southern Europe. Also Macaronesia (Canary Is), Africa (Algeria; St Helena). Reports for N. America are incorrect.

**Xanthoparmelia** (Vain.) Hale (1974)
   Type: *X. conspersa* (Ach.) Hale. Family: *Parmeliaceae*. Literature: Until very recently, 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 of species are brief, however, and can usefully be supplemented by information in Brodo et al. (2001) and Nash et al. (2004), which between them treat many of the European species. For the recently described *X. isidiovagans* and *X. subverrucigera* see Blanco, Crespo & Elix (2005: 97-99).

   *X. taractica* (Kremp.) Hale is not a European species, but the name, or its synonym *Parmelia taractica* Kremp, has sometimes appeared in European floras. Most usages of the name by European authors, including Clauzade & Roux (1985), correspond to *X. stenophylla*. Some British authors have used the name for *X. conspersa*, according to Coppins (2004a).

   Thallus foliose, heteromorous, 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.

   Diffsers from *Parmelia* in the colour of the upper surface. Diffsers 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 600 species are recognised at present, though this total may be artificially high as some species have been separated 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.

   *Xanthoparmelia* is best represented in the Southern Hemisphere, especially in South Africa and Australia, and the European flora, with only about 23 species, is comparatively poor. Its species usually occur on siliceous rock, or 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 Isidia present.
   22 Thallus vagrant, free-growing on soil. (*X. isidiovagans*)
   2 Thallus saxicolous, attached to substrate.
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.

444 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

44 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

4 Medulla K-. (X. subramigera)

11 Isidia absent. Soralia present. X. mougeotii

1 Isidia and soralia absent.

22 On soil. (X. camtschadalis), (X. desertorum), (X. pseudo hungarica), (X. subdiffluens)

2 On rock.

33 Lower surface pale brown or mottled. Not restricted to uplands.

444 Medulla K- or K+ yellow-brown. X. protomatrace

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)

3 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. vicentinii)

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, concolourous 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 x 160 μm wide, ±colourless. Conidia: colourless, bacilliform to bifusiform, 5 - 6 x ¾ 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 records, especially older ones, might refer to other species of the genus. On siliceous rock at altitudes 0 - 1600 m, but uncommon above 1000 m.

Widely distributed in Europe. Also Macaronesia (widespread), Asia (widespread), Africa (fairly widespread in northern and southern Africa), N. America (southern Canada, widespread in USA), perhaps Caribbean (St Lucia), C. America (CR, Guatemala, Mexico), S. America (widespread) Pacific (Hawaii, Marquesas, New Caledonia). Reports for Australasia are probably 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 from Italy and Greece, but perhaps overlooked. Also N. America (southern Canada, widespread in USA), Caribbean (DR), C. America (Guatemala, Mexico), S. America (Brazil, Uruguay, Venezuela).

Xanthoparmelia mougetii (Schaer. ex D. Dietr.) Hale (1974)
Descriptions: Clauzade & Roux (1985) as *Parmelia mougetii*; 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 Asia (? - old report), Africa (South Africa), N. America (scattered), Caribbean (Dominican Republic), perhaps C. America, S. America (widespread), Pacific (Hawaii)

Xanthoparmelia plittii (Gyeln.) Hale (1974)
Description: 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 (though perhaps overlooked). Also Macaronesia (Canary Is), southern Africa (Angola, S. Africa, Zimbabwe), N. America (southern Canada, throughout USA), 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.
My original collection became badly damaged by moulds and had to be discarded. The brief description above is based on notes made soon after the specimen was collected. A more recent collection is assigned here only tentatively.
Rare and scattered, with no clear pattern. On siliceous rock and on soil at altitudes 100 - 670 m.
Widespread in warmer parts of Europe, but present to as far north as England and southern Norway. Also Asia (Saudi Arabia, Mongolia, China).

Xanthoparmelia stenophylla (Ach.) Ahti & D. Hawksw. (2005)
Nomenclatural issues are discussed at length in Ahti & Hawksworth (2005), who show that the correct epithet is *stenophylla*, not *somloensis*.
Fairly common in the northern half of Greece, very rare 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.
Much of Europe, except for the far north. Also Macaronesia, Asia (widespread), Africa (Morocco, Ethiopia, Zimbabwe, S. Africa), N. America (southern Canada, widespread in USA mainly in the east), perhaps Caribbean (St Lucia), C. America (Mexico), S. America (Argentina, Colombia, Ecuador Venezuela).

Xanthoparmelia tinctina (Maheu & A. Gillet) Hale (1974)
in: *Phytologia* 28(5): 489; *Parmelia tinctina* Maheu & A. Gillet (1925) in: [need to investigate - bibliographical info incomplete]
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, warty or deeply cracked. Upper surface: pale yellow-green, yellow-green or green at the 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 a parallel agglutinated hyphae. Isidia: always present, often abundant in central part of thallus, sometimes also present on thalline exciple, 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 but sometimes becoming 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, but 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 a 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. Exciple: not visible externally. Thalline margin: present, sometimes isidiate, smooth, persistent, 100 - 160 µm wide in upper part, of which cortex 20 - 30 µm. Epithecium: colourless to brown, K-. Hymenium: colourless, 40 - 55 µm tall, KI- or almost. Subhymenium: ecolourless, 25 µm tall, of anastomosed hyphae on a general horizontal trend (structure best observed in K). Hypothecium: colourless, 40 - 50 µm tall, 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 capitate, not moniliform, upper part of apical cell sometimes with a thin crescent of brown pigment. Asc: 40 x 17 - 20 µm, broadly clavate, Lecanora type. Ascospores: colourless, simple, ellipsoid, 8 per ascus, 10 - 12 x 5 - 6.5 µm, wall not prominent. Chemistry: thallus K- (but medulla reaction may show through in spot tests), C-, KC-, P-, UV+ pale green in marginal parts, central part UV-; medulla K+ strongly red (diffusing an 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. Photobiont: green, cells globose, 10 - 13 µm diameter. Photobiont layer: 30 - 45 µm thick, usually continuous and regular, sometimes becoming discontinuous and irregular in older, warted or cracked parts of thallus. Easily recognised by the globose isidia and the K+ deep red reaction of the medulla.

Throughout Greece, though not especially common. On siliceous rock, occasionally on (presumably leached) calcareous rock, at altitudes 0 - 1250 m. The lichenicolous fungus Nesolechia oxyxypora has been reported once from this lichen.

Widespread in warmer parts of Europe, reaching England and southern Scandinavia. Also Macaronesia, Asia (widespread), Africa (Morocco, Algeria, throughout E. Africa, S. Africa), N. America (Arizona), C. America (Mexico), perhaps S. America (Argentina). Reports for Australasia probably incorrect. Status in North America has been debated, but according to Nash et al. (2004) it is present there (and in Mexico).

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-.

Rare and scattered, with no clear pattern. On siliceous rock or on bark of Olea europaea at altitudes 10 - 30 m. There is also a poorly localised report for Crete.

Southern Europe and the southern part of central Europe. Also Macaronesia, Africa (Kenya, Zimbabwe, Lesotho, S. Africa), Caribbean (St Thomas Is), Pacific (Easter Isl).

Xanthoria (Fr.) Th. Fr. (1860)

Type: X. partitina (L.) Th. Fr. Family: Teloschistaceae. 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 will be necessary to consult the primary literature, especially: Kondratyuk (1997), Kondratyuk & Poelt (1997), Kondratyuk et al. (2001)

**Xanthoria** is used here in the traditional sense: species of *Teloschistaceae* with a foliose growth habit, or subcrustose but with a lower cortex. The genus *Xanthomendoza* was recently described for those species lacking rhizines and with bacilliform conidia, leaving in a more narrowly defined *Xanthoria* species without rhizines (attachment organs hapters or absent) and with ellipsoid conidia; *Xanthomendoza* does appear to be a natural group. Molecular studies show that even in the narrower sense, *Xanthoria* is not well separated from *Caloplaca*, see Sochting & Lutzoni (2003), and as a result nomenclature in *Teloschistaceae* is likely to be unstable for many years. For practical reasons, I prefer to retain the traditional nomenclature for the time being; it works, and is stable.

Because the genus is rather artificial in its present circumscription, 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, polarilocular ascospores.

In this sense, *Xanthoria* contains about 49 species, of which about 18 occur in Europe. The occur on most substrates except leaves, but show a preference for slightly nutrient enriched habitats.

### 111 Isidia or isidia-like projections present. Usually on calcareous rock, less commonly on mossy soil.

#### 22 Thallus with narrow lobes; apices to 1 mm across. Thallus with or without a reddish tinge.

- **33 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. 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. papillifera**

- **3 Isidia soon breaking down into soredia. Thallus yellow or orange, without a red tinge. X. sorediata**

#### 2 Thallus with broad lobes; apices 1 - 7 mm across. Thallus usually without a reddish tinge.

- **33 Isidia 0.1 - 0.7 mm diameter; irregularly globose or peg-like, sometimes becoming flattened and lobule-like. X. calcicola**
- **3 Isidia cylindrical or coralloid, to 0.5 (0.7) mm tall. X. stilligera**
- **3 Isidia granular or cylindrical, 0.1 - 0.3 mm tall. X. mediterranea**

### 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. fulva), (X. oregana)**
- **3 Thallus larger, generally at least 10 mm diameter.**
  - **44 Lobes 3 - 5 mm long. X. fallax**
  - **4 Lobes 5 - 8 mm long. X. ulophyllodes**

#### 2 Lower surface ± without rhizines (Note 1).

- **33 Thallus to 3 (5) mm diameter. (X. nowakii), (X. ukrainica)**
- **3 Thallus larger, usually at least 10 mm diameter.**
  - **44 Thallus rosette-forming; lobes adpressed. X. sorediata**
  - **4 Thallus cushion-forming; lobes ascending. X. candelaria**

### 1 Isidia, soralia and blastidia absent.

#### 22 Thallus well-developed, distinctly foliose.

- **33 Lobes strongly convex. Nearly always on rock.**
  - **44 Medulla with bundles of dense hyphae. On coastal rock, especially siliceous volcanic rock. (X. 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.**
    - **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. 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. 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**
All the material that I have seen was from siliceous rock, but there are reports in the literature for calcareous rock too. *calcicola* can be resolved by examining the upper surface of the lobes, which is smoother in

This species can be mistaken for *Xanthoria parietina* also have a surface that is finely roughened in at least a few places.


1. Many species are attached by hapters, not rhizines. Informally, rhizines are "long and thin" (much longer than wide) whereas hapters are generally "short and fat" (wider than long, or 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 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 aureola** (Ach.) Erichsen (1930)


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, acellular, 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. 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. Thalline margin: orange-yellow, paler than disc, persistent; in section: 80 - 125 µm wide at sides of apothecia, to 200 µm on lower surface. 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. Asci: 50 - 55 x 17 - 20 µm, ±clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoidal, 8 per ascus, 13 - 15 x 7 - 7.5 µm, septum 7 - 7.5 µm. 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*.

Known only from Greece and Cyprus.
It remains unclear to me whether X. aureola and 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, rare and scattered 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 X. aureola to 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 widely distributed in Europe. Also Macaronesia, Asia (Israel, Turkey, Iran, Russia), N. Africa (Morocco, Algeria, Egypt; perhaps S. Africa - old report), S. America (Chile), perhaps Antarctica (St Paul Is - old report). Reports for Australasia are incorrect; some other Southern Hemisphere reports may also be unreliable.

**Xanthoria calcicola** Oxner (1937)

in: Viznachnik lishajnikiv URSS 302; (?) Parmelia paretina f. saxicola Hepp; Xanthoria paretina f. congranulata (Cromb.) Hillmann

Thallus: foliose, forming rosettes to 6 cm diameter, mostly orange to dark orange, but pale orange in a thin, marginal zone; 130 - 180 µm 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 µm long, 450 µm wide, of colourless, agglutinated hyphae oriented along the hapter, without a cortex. Upper cortex: 20 - 30 mm thick, orange in outer 5 - 10 µm, colourless in inner part, of distinctly rounded (never angular) cells 6 - 8 µm diameter; K+ red, diffusing a red pigment into solution where it forms minute crystals. Lower cortex: 15 µm thick, orange in outer 2 - 5 µm, colourless in inner part, of rounded cells 3 - 4 µm diameter; K+ red (as for upper cortex). Medulla: of loose, but not interwoven, hyphae oriented parallel to the long axis of the 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. Exciple: not conspicuous externally; in section: 20 - 40 µm wide, orange-brown at surface, colourless in inner part, zhyphal, just a few elongated lumina sometimes present in outermost part. Thalline margin: yellow to orange, persistent; in section: 125 - 160 µm, cortex cellular. Epitheicum: orange-brown, K+ red, pigment diffusing into solution and forming minute crystals. Hymenium: 80 µm tall, colourless. Subhymenium: well differentiated, 50 - 60 µm tall, very pale yellow-grey. Hypothecium: 25 - 35 µm tall, colourless. Paraphyses: usually not moniliform. Ascii: 53 - 70 x 18 - 20 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, lumina often forming an hourglass shape when young, ellipsoid, 8 per ascus, 12 - 12.5 x 7 - 8 µm, septum 5 - 6.5 µm. Pycnidia: sometimes frequent, arising on the apex of isidia where they appear as dark orange dots, darker than the rest of the isidium, 0.1 mm wide; in section: 100% immersed in an isidium, ±globose, 250 µm tall, 200 µm wide, orange-brown in a surface layer 30 µm thick, colourless elsewhere, without an obvious wall. Conidia: colourless, ellipsoid, 2.5 x 1 µm. Chemistry: thallus K+ purple. Photobiont: green, cells globose, 10 - 15 µm diameter, forming a continuous layer 25 - 30 µm thick.

This is a distinctive species, and it is not likely to be confused with any other. However, see the note under X. aureola.

Throughout Greece, but perhaps commoner in the southern half of the country. Usually on calcareous or siliceous rock, occasionally on bark, at altitudes 0 - 700 m.

Widely distributed 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.

**Xanthoria candelaria** (L.) Th. Fr. (1861)


Kondratyuk & Kärnefelt (1997) suggested that X. candelaria var. discolor, the type of which is from Mt. Olympus, may be a synonym of X. oregana (as X. poeltii). If correct, it would be the only Greek record of this species. However, they had not seen the type of 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 uncommon in the south restricted to the mountains. Also Macaronesia, Asia (widespread), Malesia (Sabah), Africa (Ethiopia, Kenya, Namibia), N. America (widespread), Caribbean (Cuba), C. America (Mexico), S. America (widespread), Australasia (both islands of NZ), Antarctica (widespread).

**Xanthoria elegans** (Link) Th. Fr. (1860)

in: Lich. Arct. 69; Lichen elegans Link (1791) in: Ann. Naturges. 1: 37; Caloplaque elegans (Link) Th. Fr.; (?) Gasparrinia elegans (Link) Th. Fr.; (?) Gasparrinia elegans var. tenuis (Wahlenb.) Stein; (?) Physcia elegans f. fasciata Arnold; 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 m thick. Lower surface: probably attached by hapters, but only immature ones seen. Upper cortex: 15 - 20 m thick, mostly orange, formed of hyphae perpendicular to surface; these sometimes swell producing a weak cellular texture; K+ red, diffusing red pigment into solution. Lower cortex: 30 - 38 m thick, orange in outermost 5 m, elsewhere colourless, structure as for upper cortex; pigmented part K+ red, as for upper cortex. Medulla: mostly formed of broad (3 - 4 m wide), loose, anastomosing hyphae, often of irregular orientation but in other places tending to align along the lobe axis; sometimes with distinct gaps that are almost devoid of hyphae. Apothecia: abundant, sessile, flat to slightly convex, not pruinose, 0.5 - 1 mm diameter. Disc: orange to dark orange. Exciple: not apparent externally; in section: not very well developed, 12 - 30 m wide, hyphal. Thalline margin: orange, slightly paler than disc, smooth, persistent; in section: 100 - 200 m wide, cortex 40 - 50 m wide. Epithecium: orange-brown to brown-orange, K+ red, diffusing red pigment into solution. Hymenium: 60 - 80 m tall, colourless. Hypothecium: 40 - 50 m tall, colourless, the upper part forming a poorly differentiated subhymenium. Paraphyses: 1 m wide at base, 3 - 4 m at apex, simple, moniliform. Asc: narrowly clavate, 50 - 62 x 14 - 17 m, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 10 - 12 x 6 - 7 m, septum 3.5 - 4 m. Photobiont: green, cells globose, 10 - 17 m diameter, aggregated into large clumps between which hyphae from the medulla pass directly up to the cortex; forming a discontinuous layer 60 - 120 m 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.

Rather thinly scattered throughout much of Greece. On rock, usually calcareous, at altitudes 0 - 2800 m, but most reports are from above 1500 m. My only collection was parasitised by some 'black dots' but the parasite was too scanty to determine.

Subcosmopolitan outside the tropics. Throughout Europe. Also Macaronesia, Asia (widespread), Malesia (PNG), Africa (widespread), N. America (widespread), C. America (CR, Mexico), S. America (widespread), Australasia (NZ), Antarctica (widespread).

Xanthoria fallax (Hepp) Arnold (1881)

The name Physcia fallax Arnold in Flora 41: 307. 1858. is a nomen nudum, and though validly published by Arnold in Flora 42): 146-147. 1859. it is a later homonym of P. fallax (Weber) DC.

The earliest name is Lecanora candelaria var. substellaris Ach. (1810), but it does not have priority at the rank of species. Lecanora candelaria var. substellata Ach. (1814) is a superfluous name for L. candelaria var. substellaris.


Scattered in the northern half of the mainland, on bark at altitudes 700 - 1500 m. Reported from Prunus pseudomeniaca and Ulmus.

Widely distributed 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, Brazil, Uruguay). Pacific (Hawaii).


Thallus: foliose, to 3 cm diameter, orange to dark orange, not pruinose, without vegetative propagules but with numerous warts in central part. Lobes: 0.7 - 2 mm wide at margin of thallus, flat to slightly convex, 160 - 260 m thick in marginal parts. Rhizines: frequent, white to pale yellow, simple, to 0.9 mm long, about 70 m wide along much of their length, to 130 m wide near the base; they begin development as downward bumps on the lower cortex and are entirely cellular until they reach a length of 70 - 100 m, thereafter they are clearly formed of agglutinated hyphae parallel to the axis of the rhizine; cortex absent. Upper cortex: 20 - 30 m thick, orange in outer 5 - 10 m, colourless elsewhere, cellular; cells isodiametric or slightly elongated with long axis perpendicular to surface, 5 - 9 x 5 m; K+ red, diffusing red pigment into solution where it forms minute crystals. Lower cortex: 25 - 50 m thick. Lower surface: ±adpressed, 280 - 380 m thick. Rhizines: frequent, white to pale yellow, simple, to 0.9 mm long, about 70 m wide along much of their length, to 130 m wide near the base; they begin development as downward bumps on the lower cortex and are entirely cellular until they reach a length of 70 - 100 m, thereafter they are clearly formed of agglutinated hyphae parallel to the axis of the rhizine; cortex absent. Upper cortex: 20 - 30 m thick, orange in outer 5 - 10 m, colourless elsewhere, cellular; cells isodiametric or slightly elongated with long axis perpendicular to surface, 5 - 9 x 5 m; K+ red, diffusing red pigment into solution where it forms minute crystals. Lower cortex: 25 - 50 m thick. Lower surface: ±adpressed, 280 - 380 m thick. Rhizines: frequent, white to pale yellow, simple, to 0.9 mm long, about 70 m wide along much of their length, to 130 m wide near the base; they begin development as downward bumps on the lower cortex and are entirely cellular until they reach a length of 70 - 100 m, thereafter they are clearly formed of agglutinated hyphae parallel to the axis of the rhizine; cortex absent. Upper cortex: 20 - 30 m thick, orange in outer 5 - 10 m, colourless elsewhere, cellular; cells isodiametric or slightly elongated with long axis perpendicular to surface, 5 - 9 x 5 m; K+ red, diffusing red pigment into solution where it forms minute crystals. Lower cortex: 25 - 50 m thick. Lower surface: ±adpressed, 280 - 380 m thick.
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 other Xanthoria species. 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 Peloponnesian collection has both 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 at least good photographs. Unfortunately, the only description I have for X. hermonii is the rather brief one in Wasser & Nevo (2005). At present, it is not entirely clear to which species the Greek material should be referred. Further collections are needed to clarify the matter.

Peloponnes, 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 and Israel.

Xanthoria mediterranea Giralt, Poelt & Nimis (1993)
in: Giralt, Nimis & Poelt, in: J. Hattori Bot. Lab. 74: 275; Xanthoria isidioidea (Beltr.) Szatala

The application of the name isidioidea is disputed, but if synonymous it is the correct name for this lichen.


Crete and Corfu, on siliceous rock at altitudes 20 - 100 m.

Basically circum-Mediterranean/Macaronesian. Southern Europe, from Iberian Peninsula to Cyprus, as well as Bulgaria and Ukraine. Also Macaronesia (Canary Is), western Asia (Israel, Jordan), N. Africa (Egypt, Libya).

Xanthoria monofoliosa S. Y. Kondr. & Kärnefelt (2008)
in: Kondratyuk, Kärnefelt, Elix & Thell in: Siatertia 15: 275-277. Unfortunately, the name is not validly published (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 et al.'s concept of X. monofoliosa, a few 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.

Thallus: foliaceous, 2 cm diameter, orange, not pruinose. Lobes: distinctly elongate, 1.5 - 4 x 0.5 - 1 mm, sometimes slightly concave or with concave depressions, dichotomously branched, not overlapping, 150 - 220 µm thick; tips rounded to blunt, slightly wavy but not dissected. Lower surface: white. Rhizines: absent. Isidia: absent. Soralia: absent.

Cortex: 20 - 25 µm thick, brown-orange in outer part, colourless to pale brown-orange in inner part, K+ purple-red.

Medulla: white, of loosely interwoven hyphae oriented mainly horizontally. Lower cortex: 20 - 25 µm thick, usually colourless, occasionally with some brown-orange pigment in a very thin outer layer, of vertical hyphae with expended lumina and appearing ±cellular; lumina 5 - 10 x 5 µm, long axis vertical. Apothecia: common, sessile, 0.5 - 1 mm diameter, distinctly concave when young, often becoming ±flat later, not pruinose. Disc: yellow-orange. Exciple: present but usually inapparent externally; in section: colourless in inner part, brown-orange in outer part, of ±radiating hyphae, pigmented part K+ purple-red. Thalline margin: persistent, orange-yellow, often slightly paler than disc; in section: 75 - 100 µm wide. Epitheciwm: brown-orange, K+ purple-red. Hymenium: 70 µm tall, colourless.


Rhodes and Peloponnes at altitudes 275 - 850 m on bark of Populus and Quercus pubescens. Both localities were not far from the sea.

In Europe only known from Greece. Also Macaronesia (Canary Is), Asia (Israel), Africa (S. Africa).

Xanthoria papillifera (Vain.) Poelt (1954)

The earliest name is Lecanora elegans (indefinite rank) ectaniza Nyl. (1883), but it is a nomen nudum. The first legitimate use of the epithet ectaniza appears to date from 1902.


The only Greek report is a single record in the literature for the Peloponnese, as X. aureola var. ectaniza (Nyl.) Poelt. at high altitude. Nylander's ectaniza is usually taken to be synonymous with X. papillifera, but I wonder whether the Greek report might correspond to the narrow-lobed (and non-isidiate) morph of X. parietina discussed under that species.

Distribution not well known. Perhaps primarily a species of central Europe, with a few reports for south of the Alps.
Also Macaronesia (Canary Is), Asia (Israel, Kazakhstan, southern Siberia, Tajikistan), N. Africa (Tunisia).

Xanthoria parietina (L.) Th. Fr. (1860)
in: Lich. Arct. 67; Lichen parietinus L. (1753) in: Sp. Pl. 1143; Parmelia parietina (L.) Ach.; (?) Parmelia parietina f. corticola Hepp; Parmelia rutilans (Ach.) Ach.; Physcia parietina (L.) De Not.; (?) Xanthoria coralloidea (Flot. ex Hillmann) Szatala; Xanthoria parietina var. adpressa Mereschk.; Xanthoria parietina f. chlorina (Chevall.) H. Olivier; Xanthoria parietina var. chlorina (Chevall.) H. Olivier; (?) Xanthoria parietina var. elegantissima Zahlbr.; 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. græc.; Xanthoria parietina f. polyphylla (Flot.) Hillmann; Xanthoria parietina var. retirogusa J. Steiner ex Zahlbr.; Xanthoria parietina f. virens (Wed.) 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 (elongated in narrow-lobed morph), sometimes with a few folds or wrinkles, usually smooth on a fine scale (rarely roughened by a 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 (not rhizines). 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. Excircle: usually not apparent externally; in section: 15 - 20 µm wide, basically hyphal, though a few elongated lumina sometimes present in outermost part. 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. Epitheicum: 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 and slightly opaque, individual hyphae not apparent. Hypothecium: 15 - 35 µm tall, colourless, individual hyphae usually visible, oriented mainly horizontally. Paraphyses: simple, slightly moniliform, 1.5 µm wide in lower part, 3 µm at apex. Ascii: 55 - 60 x 15 µm, clavate, Teloschistes type. Ascospores: colourless, polarilocular, ellipsoid, 8 per ascus, 12 - 13 x 7 - 8 µm, septum 7 - 8 µm; in young ascospores the lumina are often rounded and joined together in an hourglass shape, later they move apart and the neck joining them narrows. 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 a surface layer 10 - 20 µm thick, elsewhere colourless, without distinct wall. Conidia: colourless, ellipsoid to almost bacilliform, 2 x 1 µm. Chemistry: thallus K+ purple, C-, P-, UV+ dull orange-red; medulla K-, C-, KC-, P-, I-. Photobiont: green, trebouxioid, cells globose, 7 - 12 µm diameter, forming a ±continuous layer 25 - 100 µm thick.

The absence of rhizines, the abundant apothecia, and the large, rounded lobes are distinctive.

Some authors consider Xanthoria steineri I. M. Lamb to be a distinct taxon, but the only descriptions that I have seen, in Galun (1970) and Wasser & Nevo (2005), suggest to me that it is based on shaded, immature X. parietina. It is said to be corticicolous, to 3 cm diameter, and with a green tinge, all of which is consistent with X. parietina, the green tinge being common in shaded specimens. X. steineri is said to have ascospore lumina "in the form of two drops connected at their acute ends" but this is what one often sees in some immature and semi-mature ascospores of X. parietina.

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 Cercidospora epicarphinea (as C. xanthoriae), Opegrapha physciaria and Xanthoriconia physciae have been reported from this host.

Xanthoria parietina is subcosmopolitan outside the humid tropics.
Xanthoria sorediata (Vain.) Poelt (1954)

At the rank of species the name X. scandinavica de Lesd. (1959) has priority, if synonymous.


Thinly scattered throughout Greece. On calcareous rock at altitudes 1100 - 2150 m. (A report for Rhodes, from close to sea level, may refer to X. elegans.)

Widely distributed in central and northern Europe, but rare south of the Alps. Also Macaronesia, Asia (widespread), N. Africa (Morocco), N. America (widespread in cooler parts), 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 Giralt, Poelt & Nimis (1993)
in: Giralt, Nimis & Poelt, in: J. Hattori Bot. Lab. 74: 281. (Synonyms: probably none, but see note under Xanthoria mediterranea.)


Rhodes, at close to sea level. The substrate was not reported.

Southern Europe, from the Iberian Peninsula to Cyprus; also southern Russia. Also Asia (Israel, Iran, southern Siberia), N. Africa (Morocco, Tunisia, Egypt).

Xanthoria ulophyllodes Räsänen (1931)

The earliest name is Parmelia parietina var. fibrillosa Schaer. (1850), but it does not have priority at the rank of species.

Descriptions: Nash et al. (2004) as Xanthomendoza ulophyllodes; Smith et al. (2009).

Macedonia, at an unknown altitude on bark of Populus.

Commonest in central Europe, ranging only as far north as southern Sweden, and very rare south of the Alps. Also Asia (widespread), N. America (Manitoba, scattered in cooler parts of USA).

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 can not be confused with any other.

Reported only from Peloponnese and Naxos, but probably much more widely distributed. Always on the apothecia of Xanthoria parietina. At altitudes 20 - 160 m, and perhaps confined to truly Mediterranean vegetation.

Widely distributed in Europe. Also Macaronesia (Canary Is), Asia (Israel, Iran), Australasia (Australia, both islands of NZ).

Xylographa (Fr : Fr.) Fr. (1836)
in: Fl. Scan. 344; Stictis B. (= unranked) Xylographa Fr. : Fr. (1822) in: Syst. Mycol. 2: 197


About 20 species, 6 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. soralifera)
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
22 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.
Northern and Central Europe. Very rare south of the Alps. Also Asia (Turkey, Tibet), North America (scattered in cold regions).

Xylographa parallela (Ach. : Fr.) Behlen & Desberger (? 1836)
in: [need to investigate - bibliographical data incomplete]; Lichen parallelus Ach. (1799) in: Lichenogr. Svec. Prodr. 23-24 (Sanctioned in Syst. Mycol. 2(1): 197 as Sticta parallela); Xylographa abietina var. parallela (Ach. : Fr.) Redinger
The earliest name is Hysterium abietinum Pers. (1796), but Acharius's epithet is sanctioned.

Thallus: crustose, very thin, pale grey to pale brown, forming patches elongated along the grain of the wood, to 4 x 1 cm, sometimes delimited by a 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 the same distance into the substrate. Apothecia: elongated along the grain of the substrate, 0.35 - 2 x 0.1 - 0.2 mm, Disc: very dark brown to black. 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 dissolves in K). Thalline margin: absent. Epithecium: brown, sometimes with an irregular upper surface, K- (pigment, except for that within the paraphyses, dissolves). 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 a 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 (no apical apparatus). Ascospores: colourless, simple, ellipsoid, 8 per ascus, 11 - 13 x 5.5 - 6 µm. 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 looking for 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 phorophyte explicitly recorded is Juniperus (J. drupacea and J. oxycedrus).

Widely distributed in Europe, though south of the Alps confined to the mountains. Also Asia (widespread), Malesia (PNG), N. Africa (Morocco), N. America (widespread from Alaska to cold parts of USA), Australasia (both islands of NZ).

Xylographa trunciseda (Th. Fr.) Minks ex Redinger (1938)
in: Deutschlands Kryptogamenflora 9(2.1): 216; Lecidea trunciseda Th. Fr. (1874) in: Lichenogr. Scand. 467
Description: Spribille et al. (2014).
Epiros, on wood of Pinus nigra at an altitude of 965 m.

Northern and Central Europe. Very rare south of the Alps. Also Asia (Siberia, China, perhaps Taiwan), North America (widespread in cold parts).
**Xylopsora Bendiksby & Timdal (2013)**

in: *Taxon* 62(5): 952-953

- **Type:** *X. friesii* (Ach.) Bendiksby & Timdal. Family: *Umbilicariaceae*. Literature: The two species are treated in the standard floras, under *Hypocenomyce*.

- **Description:** Bendiksby & Timdal (2013), or see the description of *X. friesii* below.

- A group of two species, formerly placed in *Hypocenomyce*, but not closely relate 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** (Leight. 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.

- Distributed mainly from the Alps to southern Scandinavia, though said also to be present in Croatia and Ukraine. The Cretan record is very disjunct. Also Asia (western Siberia).

**Xylopsora friesii** (Ach.) Bendiksby & Timdal (2013)


- The apothecia in the author's collection were immature, and no ascospores were found. The material was assigned to *X. friesii*, rather than *X. caradocensis* for three reasons. (1) The squamules were shiny, not dull. (2) Numerous apothecia were present, even though immature. (3) Apart from the Cretan record mentioned above, *X. caradocensis* has never been reported from south of the Alps, whereas *X. friesii*, though rare south of the Alps, has been reported from Tuscany, the Canary Islands and Morocco. There is also an earlier report for the Peloponnesse, in Harmand & Maire (1909). On the other hand, the squamules in the author's collection were rather folded and irregular, something which is often found in *X. caradocensis*.

- A full description will have to await the collection of better-developed material. For published descriptions see: Clauzade & Roux (1985); Nash et al. (2002); Smith et al. (2009), all as *Hypocenomyce friesii*.

- *X. caradocensis* differs in having mostly septate ascospores and squamules that are not shiny.

- A rare species, know from two sites in the Peloponnesse and one in Epiros, at altitudes 700 - 1750 m, on bark (the only phorophyte explicitly reported was *Pinus laricio*) and on wood of *Crataegus pycnoloba*.

- Most European records are from north of the Alps, to as far north as northern Norway; south of the Alps it is rare. Also Macaronesia (Canary Is), Asia (Russia, Japan), N. Africa (Morocco), N. America (widespread in southern Canada and northern USA), perhaps C. America. Reports for Australia are probably incorrect.

**Zahlbrucknerella Herre (1912)**


- Eleven species, two of which occur Europe. Only one is likely to be present in Greece, where the genus is rare.

**Zahlbrucknerella calcarea** (Herre) Zahlbr. (1924)


- Epiros, on calcareous rock at an altitude of 1100 m.

- A rather inconspicuous species of basic rocks that is widely distributed in Europe, though nowhere common. Also Asia (Tajikistan, China), Africa (Lesotho), N. America (BC, California, Colorado), Australasia (Tasmania, both islands
of NZ).

**Zwackhiomyces Grube & Hafellner (1990)**

in: *Nova Hedwigia* 51(3): 305-310


There is a more recent key to all species in Calatayud et al. (2007).

About 24 species of lichenicolous fungi, of which about 17 occur in Europe. Many are rarely reported, and their distribution is not well known. The key here includes those species whose occurrence in Greece seems likely on the basis of what is known today about their overall distribution. However, some of the less well-known species might possibly occur here too. In case of difficulty, consult the comprehensive key in Calatayud et al. (2007); what follows is a simplified version of their key.

11 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. cervinæ)

33 Ascospores mostly 19 - 30 µm long.

44 On Aspicilia contorta subsp. hoffmaniana (and perhaps on related taxa). (Z. aspiciliae)

4 On Protoblastenia rupestris. (Z. dispersus)

3 Ascospores mostly less than 19 µm long. On other hosts.

44 Perithecia mostly 170 - 270 µm diameter in section.

55 Ascospores often 6 per ascus. Ascospores 15 - 21 x 5.5 - 8.5 µm. On Caloplaca and Xanthoria. **Z. coepulonus**

5 Ascospores 8 per ascus.

66 Ascospores 11 - 17 x 4 - 7 µm. On Lecanora dispersa. **Z. inconspicuus**

6 Ascospores 15 - 20 x 6 - 7 µm. On Aspicilia calcarea. (Z. calcariae)

4 Perithecia mostly 90 - 170 µm diameter in section.

55 Perithecia sunken, ±gall-forming. Ascospores 11 - 17 x 3 - 5.5 µm. On Porpidia. (Z. martinatianus)

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. lithoicæ)

1 On foliose lichens.

22 On Xanthoria. **Z. coepulonus**

2 Not on Xanthoria. (Z. enchinulatus) known only from Physcionia distorta. (Z. melanohalae) known from Melanohalea. (Z. turcicus) which is reported from Physcia. Several other species (on various hosts) that do not seem very likely to occur in Greece would also key out here.

(1) If on Aspicilia, consider also the rather poorly known "Didymella" sphinctrinoides. ascipiliicola

**Zwackhiomyces coepulonus** (Norman) Grube & R. Sant. (1990)

in: Grube & Hafellner, in: *Nova Hedwigia* 51(3): 310; Arthopyrenia coepulona Norman (1868) in: *Botaniska Notiser* 1868: 192; *Cercidospora sphinctrinoides* var. *physiciola* (Zopf) J. Steiner; *Cercidospora sphinctrinoides* var. *transmutans* (J. Steiner) J. Steiner; *Cercidospora transmutans* J. Steiner


Scattered, on Crete and the mainland, at altitudes 1100 - 2000 m, on species of *Caloplaca*.

Scattered in Europe, mostly in cool to cold regions. Also Macaronesia, Asia (Turkey, Israel, Russia, Mongolia), Africa (Ethiopia), N. America.

**Zwackhiomyces inconspicuus** Grube & Hafellner (1990)

in: *Nova Hedwigia* 51(3): 320-322

Description: See the protologue.

Crete, at an altitude of 1600 m, on *Lecanora dispersa*.

Known only from Germany and Greece.
Zwackhiomyces sphinctrinoides (Zwackh) Grube & Hafellner (1990) s. lat.
in: Nova Hedwigia 51(3): 327; Endococcus sphinctrinoides Zwackh (1864) in: 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). N. America (Alaska).
References

I have seen all the publications listed here, except for the schedae to Vēzda’s Lichenes Selecti Exsiccati, for which I have seen a partial transcript prepared by Dr. A. Şenkardüşler. If the reference you seek is not here, it refers to a publication that I have not seen; those publications are listed in the Appendix.

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 alphabetic 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.

Many of these publications, especially the old ones, are cited in the main text only for the place of publication of names. Although it is not common practice to do so, I list them because there is so much confusion in the citation of old publications that it seems sensible to be as explicit as possible, and in an electronic document space is not a constraint. For more extensive information on the nomenclature of Greek lichens, see lichensofgreece.com


Acharius, E. (1799 [‘1798’]). Lichenographiae sveciae prodromus. XXIV + 264pp., + 2 Tables. Linkopiæ [=Linköping], D. G. Björn This was published about May 1799.

Acharius, E. (1803a). Methodus qua omnes detectos lichenes secundum organa carpomorpha ad genera, species et varietates redigere atque observationibus illustrare. LV + 394pp., F. D. D. Ulrich, Stockholm. Pages 53, 184 and 185 not seen (missing in my copy). (1) For infra-specific taxa Acharius used only a single rank, denoted by Greek letters, throughout this work. These taxa must be regarded as being at the rank of variety (Article 35.4). (2) For several new taxa in this work, Acharius cites the name Wahlenberg after the habitat and locality of the new taxon, but not after the name itself nor after the description. There is nothing to indicate that Wahlenberg either chose the name of these new taxa or wrote the descriptions of them. Since the descriptions are written in Acharius’s usual style, there is, in my view, every reason to suppose that Wahlenberg did not write them. The most natural interpretation of Acharius’s reference to Wahlenberg, it seems to me, is that the latter had collected the lichens, and therefore was able to provide information on habitat and locality that Acharius could not otherwise have provided. There is no reason to suppose that Wahlenberg contributed to Methodus in any other way. If this view is correct, then authorship of these new names must be attributed to Ach., not to Wahlenb., and not even to Wahlenb. ex Ach. Less commonly, Acharius cites other authors in the same way. For a very few new names, Acharius cites ”Wahlenberg Msc.” after the new name: authorship in these cases can be ascribed to Wahlenb. ex Ach.

Acharius, E. (1803b). Supplementum. Species quamplures novas descriptas nec non observationes varias complectens, quod praeviae suae Methodo Lichenum adiuncta auctor. 52pp., F. D. D. Ulrich, Stockholm


Acharius, E. (1808b). Förteckning på de i Sverige växande arter af lavervarns familj (fortsettning)). Kongliga Vetenskaps Academiens Nya Handlingar 29: 228-237


Acharius, E. (1810). Lichenographia Universalis. In qua Lichenes omnes detectos, adiectis observationibus et figuris horum vegetabiliaum naturam et organorum carpomorphorum structuram illustrantibus, ad genera, species,
varietates differentiis et observationibus sollicité definitas reedit. 689pp., Just. Frid. Danckwerts, Gottingae Pages 460 and 466 are missing in my copy. For infra-specific taxa Acharius used only a single rank, denoted by Greek letters, throughout this work. These taxa must be regarded as being at the rank of variety (Article 35.4).

Acharius, E. (1814a). Synopsis Methodica Lichenum, sistens omnes hujus ordinis naturalis detectas plantas, quas, secundum genera, species et varietates dispositit, characteribus et differentiis emendatis definitivit, nec non synonymis et observationibus selectis illustravit. 392 pp, Svabanorg et Soc., Lund. Reprint by Richmond Publishing Co., Richmond, 1978. SBN 85546 202 7. Acharius uses two levels of infra-specific taxa in this work. Taxa at the higher of these infra-specific ranks are introduced with a Greek letters, and those at the lower rank by a Latin letters. These ranks can be interpreted as variety and form respectively; see Acharius's remarks on pVIII of the Praemenda.

Acharius, E. (1814b). Monographie der Lichenen-Gattung Pyrenula. Mit Abbildungen aller bisher bekannten Arten. Magazin der Gesellschaft naturforschender Freunde zu Berlin 6(1): 3-25. This was published early in the year, before Synopsis Methodica Lichenum, which was published late in the year


Adanson, M. (1763). Familles des Plantes. II. Partie. 24 + 640pp., Paris Material relevant to lichens is on pages 6, 7 and 11.


Ahti, T. & Hawksworth, D. L. (2005). 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


Anzi, M. (1860). Catalogus lichenum quos in Provincia Sondriensi collegit et ordinavit et in ordinem systematicum digessit presbyter M. Anzi. 120pp., Tip. C. Franchi, Novi-Comi. Anzi uses four infra-specific ranks. The highest is denoted by a greek letter and the lowest by a sequence of one or more asterisks. In between these are two other ranks denoted respectively by a lowewrcase latin letter and a digit; the relative rank of these two is nowhere indicated. A greek letter definitely denotes the rank of variety: see for example the remarks under nos. 27, 57, 77, 82 and 114. (Under 57 the reference to C. squamosa var. epiphylla refers to a taxon treated by Anzi with a greek letter.) A sequence of asterisks definitely denotes the rank of form: see for example the remarks under nos. 54, 66, 72, 90, 91, 105, 106. There are fewer indications of what Anzi meant by the two intermediate ranks, but such
evidence as there is implies the rank of form: for lowercase Latin letters see nos. 67 and 134 and for digit see under no. 236. Since this is inconsistent with his use of asterisks also to denote the rank of form, I regard lowercase Latin letters and digits as denoting an undefined rank.


Anzi, M. (1866). Neosymbola lichenum rariorum vel novorum Italiae superioris. Atti Della Societa Italiana Di Scienca Naturali Milano 9: 241-258 (Reprinted the same year as an independent publication with pages numbered 1 to 18)


Arnold, F. (1858). Die Lichenen des fränkischen Jura. Flora 41: 81-95, 97-98, 99-100, 305-324, 329-337, 473-486, 500-508, 531-542, 550-558, 691-702 Caution: pages 530-562 (inclusive) of volume 41 of Flora were accidentally printed with the incorrect page numbers 230-262. Note also that, despite what the title might suggest, all Arnold's localities are in southern Germany. This is also the case for papers published under the same title in later years.


Arnold, F. (1871e ['1870']). Lichenologische Fragmente IX. Flora 53: 465-488


Arnold, F. (1875a). Lichenologische Fragmenten XVIII. Flora 58: 150-155


Arnold, F. (1880c). Lichenologische Ausflüge in Tirol XX. Predazzo. Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien 29: 351-394. Although the publication date might have been expected to be 1879, from the journal volume number, the cover page bears the date 1880.


Baglietto, F. (1857). Enumerazione dei licheni di Liguria. Memorie della Reale Accademia delle Scienze di Torino, Serie Seconda 17: 373-444. (1) The journal cover page bears the date 1858, but according to Stafleu & Cowan it was published in 1857. I have followed Stafleu & Cowan. (2) Also issued separately later the same year, reprinted from the journal. (3) A single greek letter indicates the rank of variety (see comment on page 384 under Anaptychia tenella var. hispida) and a single lowercase Latin character indicates the rank of form (see comment on page 410 under Cladonia fimbriata f. cornuta).


Batsch, A. (1786). Elenuschus Fungorum. Continuatio prima. 279pp., Halle


Brotherus, V. F. (1898). Contribution à la flora lichenologique de l’Asie Centrale. *Öfversigt af Finska Vetenskaps-Societetens Förhållningar* 40: 1-13 Although the list was published by Brotherus, it is clear from page 1 that the lichenology is by Nylander

Browne, P. (1756). *The Civil and Natural History of Jamaica*. 503 pp. + 49 Tables, London [Only the part dealing with Cladonia seen]


Davies, H. (1794). Descriptions of four new British lichens. *Transactions of the Linnean Society* 2: 283-285 (& plate 28). The date of this publication is sometimes quoted as 1793, but this appears to be incorrect. Although the paper was read at the Linnaean Society on 5 February 1793, this does not amount to effective publication.

The work was effectively published in the corresponding volume of *Transactions*, which bears the date 1794.


de Notaris, G. (1846a). Frammenti lichenografici di un lavoro inedito. *Giornale Botanico Italiano* Anno II, 1(1): 174-224. [This was also published separately later the same year as a reprint.]


Dickson, J. (1785). *Fasciculus plantarum cryptogamicarum Britanniae.* 26 pp., Londini

Dickson, J. (1790). *Fasciculus secundus plantarum cryptogamicarum Britanniae.* 31 pp + Tables IV - VI, Londini

Dickson, J. (1793). *Fasciculus tertius plantarum cryptogamicarum Britanniae.* 24 pp., Dickson & Nicol, Londini


Duby, J. E. (1830). *Aug. Pyrami de Candolle Botanicon Gallicum, seu synopsis plantanum in flora Gallica descriptarum. Editio secunda. Pars secunda. Ex herbariis et achedis Candollianis propriisque digestum.* pp545-1068 Paris. This was issued in two volumes, with consecutive pagination. Lichens are on pp 593-677, which is in the second volume. Many new names and new combinations in this publication are attributed by Duby to Delise. As regards new combinations, Delise contributed to Duby's work "in some way" - in the Preface to volume 1 he is explicitly thanked for his assistance, and the treatment of the genus *Cenomyce* is based on a manuscript by him - and according to Article 46.2 combinations attributed by Duby to Delise must therefore be cited with Delise alone as author. New names are more difficult. For the genus *Cenomyce*, Duby used a manuscript by Delise, and seems simply to have reproduced the entire manuscript - a footnote to page 619 includes the phrase *hoc in articulo toto ex eius manuscripto excepto* - which implies that Delise both wrote the description and provided the name; these new names in *Cenomyce* must therefore be attributed to Delise alone (Article 46.2). However, new names in other genera which Duby attributed to Delise are introduced as (Delise in litt.) or (Delise ined.), followed by a description. It is not stated that Delise wrote any of these description, so authorship of these names must be attributed to Duby, or to Delise ex Duby.


Durieu, M. C. (1846 - 1848). *Flore d'Algérie. Cryptogamie. Première Partie. In: Exploration scientifique de l'Algérie.* 631pp., Imprimérie Royale, Paris. (1) Pages 1 - 200 were published in 1846. Pages 201-240 were published in 1846 or 1847; I have assumed 1846. Pages 241-280 were published in 1847 or 1848; I have assumed 1847. Pages 281-560 were published in 1848. Subsequent pages are not relevant to lichens. (2) The section on lichens appears to have been written jointly by Durieu & Montagne, so authorship of new names should be ascribed to both unless a single name is explicitly indicated. (3) The authors use two infra-specific ranks, denoted respectively by a single Greek letter and a single lowercase Latin letter. The former denotes the rank of variety, as is clear from the remark on page 205. The latter denotes the rank of form, as is clear from the remark on page 239.

Eckfeldt, J. W. (1889). Some new North American lichens. *Bulletin of the Torrey Botanical Club* 16(4): 104-106. Only new names, not their descriptions are ascribed to Nylander. Although Nylander might have written the descriptions, that is not enough to cite names with authorship "Nyl." They must be cited with authorship Eckfeldt ex Nyl.


Eggerth jun. (This is probably Eggerth, K.) (1887). Nachtrag zur LichenFlora von Corfu. *Flora* 70: 482

Ehrhart, F. (1789). *Beiträge zur Naturkunde. Viertel Band.* 184pp., Hanover & Osnabrück


Ekman, S. & Svensson, M. (2014). *Brianaria* (Psoraceae), a new genus to accommodate the *Micarea sylvicola*


Flagey, C. (1895). Lichenes Algerienses exsiccati: Troisième Centurie. [This is preceded by corrections to Centuries I & II]. Revue Mycologique 17: 101-115
Flörke, H. G. (1828). De Cladoniis, difficillimo lichenum genere, commentatio nova. 186pp., Stillcr, Rostock. (1) Flörke uses two infra-specific ranks, denoted by a single lowercase Greek character and a single lowercase Latin character respectively. The former is of higher rank. Since the first paragraph of his Praemonenda uses the Latin words for variety and form, it seems reasonable to interpret these ranks as variety and form respectively. (In the text itself he uses the word variety rather indiscriminately to refer to both ranks; see, for example, page 38.) (2) Rarely, as on page 54, he uses a repeated lowercase Latin letter to denote a rank below that of form. However, taxa introduced in that way are never explicitly named.
Flotow, J. (1849). Dr. Rabenhorst's Lichenes Italic. Die Lichenen, welche der Dr. L. Rabenhorst auf seiner Reise durch die östlichen und südlichen Provinzen Italiens im Jahre 1847 gesammelt hat. Litha 22: 353-382
Flotow, J. (1850f). Lichenes Floraes Silesiae. Uebersicht der Arbeiten und Veränderungen der Schlesischen Gesellschaft für vaterländerische Kultur im Jahre 1849: 98-135. (1) Often cited with date 1849, but the journal cover page bears the date 1850. (2) Flotow uses numerous infra-specific ranks, the highest of which is indicated by a single Greek letter (and nothing else). On pages 106-107 Flotow clearly seems to be using this to mean the rank of variety (see Cladonia degenerans var. furfuracea), as was the normal 19th century practice. Infra-specific ranks denoted in other ways probably do not have a well-defined rank.
Forssell, K. B. J. (1885). Beiträge zur Kenntnis der Anatomie und Systematik der Gloeolichen. 118pp., Stockholm. This is a preprint from Nova Acta Regiae Societatis Scientiarum Upsaliensis, Seriei Tertiae, 13 (Fasc. 2, 6): 1-118. 1887


Fries, E. M. (1826). *Novae schedulae criticae de lichenibus Suecanis* (numbers 211 - 270, corresponding to fascicles 8 and 9). 34pp., Lundiae. This appears to have been issued as Parts 2, 3 and 4, covering fascicles 8 and 9, at various dates in December 1826. Pagination is consecutive across the parts and fascicles. Fascicle 8 is on pages 1 - 22, fascicle 9 on pages 22 - 34.

Fries, E. M. (1827b). *Novae schedulae criticae de lichenibus Suecanis. Fusicularis decimus tertius*. 22pp., Lundiae


Fries uses a confusing assemblage of infra-specific ranks in this publication, but there are three main ones. In order of decreasing rank (the order is clear from the typography) they are: (i)indicated by an asterisk or a cross sign and a repeat of the genus name, e.g. Sticta silvatica *Sticta fuliginosa on p52; (ii)indicated by a Greek character, e.g. Parmelia saxatilis β P. omphalodes on p62; (iii)indicated by a lowercase Latin character, e.g.Cetraria glauca b. sterilis on p38. I noticed 16 passages of text that refer to taxa of type (iii) and which give some evidence as to the rank in conventional terms: in 14 of these passages Fries uses the word *forma*, in 2 he uses the word *varietas*. Although Fries's usage is not as consistent as one might like, I regard this as good enough evidence to establish that type (iii) denotes the rank of form. (Whether one agrees with my conclusion or not, it is certainly not acceptable to interpret type (iii) taxa as having the rank of variety, as many authors have done.) For type (ii) I noticed 7 relevant passages of text: 4 of these use the word *varietas*, and 3 use the word *forma*. I am willing to regard this as sufficient to establish that type (ii) denotes the rank of variety, though the point could be debated. Unfortunately, I could not find any comparable evidence for type (i). Informally, it is convenient to regard type (i) as subspecies, but for formal purposes the rank of type (i) taxa must be regarded as undefined. [Note also that Fries had certainly seen a copy of Duby's *Botanicon Gallicum* (see under Parmelia *Parmelia saxatilis on p192); this is relevant when deciding whether to interpret a few of Fries's names as new combinations or new taxa.]

Fries, E. M. (1836 ['1835']). *Corpus Florarum Provincialium Sueciae. I. Floram Scanicam*. 346pp., Uppsala


Fries, T. M. (1860). *Lichenes Arctoi Europae Groenlandiaeque hactenus cogniti*. 298pp., Upsaliae. (1) This is a preprint of *Nova Acta Regiae Societatis Scientiarum Upsaliensis, S0er. III 3: 103-398. 1861. (2) Fries denotes infra-specific taxa in 4 ways. (i) By far the commonest way is with a single Greek letter. These names are varieties, as is clear from his remark on page 11 of the preface "Varietates quoque ... tantum numerum ...", and as is also made explicit in numerous places elsewhere, e.g. on page 28 where he refers to "var. [beta]". (ii) With a lowercase Latin letter. These are forms: see for example p43 and the final sentence on page 42. (iii) With an asterisk and a repetition of the (abbreviated) generic name. I can not find any evidence that associates a definite rank with these names and they must be treaked as of indeterminate rank (though informally they could be regarded as subspecies). (iv) With an asterisk and no repetition of the generic name. These can be regarded as forms: see the remark on page 158 "Forma * pungens".


Fries, T. M. (1867b). 2. Nya Skandinaviska laf-arter (Forts.). *Botaniska Notiser* 1867(6-7): 105-110

Fries, T. M. (1871). *Lichenographica Scandinavica sive dispositio lichenum in Dania, Suecia, Norvegia, Fennia,
Lapponia Rossica hactenus collectorum. I. 324pp. Berling, Upsala (1) The infra-generic rank used most commonly is introduced by a Greek letter. Fries was not entirely consistent about what this denotes. For example, on pages 16 - 17 he refers to the infra-specific taxa within U. barbata with both the word form and the word variety. He was equally ambiguous elsewhere (see, for example, pages 25 - 26). It seems best to regard them as varieties, since that is what previous authors usually meant by a Greek latter, and this choice is as consistent with what Fries himself wrote as seems possible given his own ambiguity. (2) He occasionally uses an asterisk to denote an infra-specific rank. Judging from the remarks on page 26 and 36, this denotes the rank of form. (3) Taxa introduced by an asterisk and a repetition of the generic name are subspecies; see page 271


Haláczky, E. See: Steiner, J.


Hepp, J. A. P. (1857). *Abbildungen und Beschreibung der Sporen zum I. II. III und IV. Band der Flechten Europas*. Zurich. (1) This has numbers 1 to 233. (2) This is said to be an exact copy of the text accompanying Hepp's exsiccate Die Flechten Europas, which I have not seen and I cite it as though it were the exsiccate itself.

Hepp, J. A. P. (1858). *Abbildungen und Beschreibung der Sporen zum V. VI. VII und VIII. Band der Flechten Europas. II. Heft*. Zurich (1) This has numbers 234 to 478. (2) Other comments as above.

Hepp, J. A. P. (1860). *Abbildungen und Beschreibung der Sporen zum IX. X. XI und XII. Band der Flechten Europas. III. Heft*. Zurich (1) This has numbers 479 to 716. (2) Other comments as above.


Hoffmann, G. F. (1791). *Plantae lichenosae. Descriptio et *Adumbratio Plantarum* et classe *cryptogamica* Linnaei qua Lichenes dicuntur. Volumen Secundum. Fascic. I*. 21pp., Crustium, Leipzig. Although the date is listed in Stafleu & Cowan, Taxonomic Literature 2: 240 as "1794", this fascicle was certainly published before then. Laundon, in Lichenologist 3: 70. 1963 gives good evidence for a 1791 date. Also, Gmelin (1792: 1361), in the discussion of *Lichen vitellinus*, gives an unambiguous reference to Hoffmann's work, and the detail with which he does so makes it certain that Gmelin must have seen Hoffmann's work. There is a similar citations at page 1378, and on page 1376 Gmelin links the name *Lichen subuliformis* with Hoffmann. Also, Lamarck (1792: 477) is aware of a link between Hoffmann and the name *Lichen ochroleucus* Ehrh., which means that he too had probably seen Hoffmann's work.


Hoffmann, G. F. (1796 [1795]). *Deutschlands Flora oder botanisches Taschenbuch. Zweyter Theil für das Jahr 1795*. 240pp., Johan Jacob Palm, Erlangen. (1) Names preceded by a number are undoubtedly at
the rank of species. Hoffmann is not very explicit about the status of sections beginning with a name not preceded by a number, but there is evidence (see pages 113, 121, 125 and the Vorbeicht section), albeit scanty, that these names are to be understood as subordinate to the preceding numbered name, though there is no clear evidence that allows them to be interpreted as having any particular rank. In other words, I agree with Krog and James in Norw. J. Bot. 24: 27 that these name have an indefinite infra-specific rank within the preceding numbered species. (2) Names introduced within a section, almost as an aside, appear to be at the rank of species: see for example page 177, where the word species is used in close conjunction to V. decolorans in the discussion that follows V. decolorans. (3) Krog and James note that an asterisk preceding a name means that the material was collected at G3ottingen; in this work, therefore, an asterisk has no nomenclatural significance.


Hooker, W. J. & Sowerby, J. (1831). Supplement to the English Botany of the late Sir J. E. Smith and Mr. Sowerby. Vol. 1. Tabs. 2593 - 2692, London Although an “Advertisement” near the front is dated July 1829, both the front cover and the dedication page bear the date 1831


Hue, A. M. (1910b). Lichenes morphologic et anatomic dispostu. (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 Stafleu & 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.)

Humboldt, F. A. (1793). Florae Fribergensis specimen plantas cryptogamicas praesertim subterraneae exhibens. 189pp, Berolini


Xanthodactylon (Teloschistaceae, lichenized ascomycetes). Sauteria 15: 265-282


Körber, G. W. (1848). Grundriss der Kryptogamen-Kunde. 203pp., Breslau

Körber, G. W. (1853). Sertum Sudeticum continens novas lichenum species. Denkschrift von der Schlesischen Gesellschaft für vaterlandische Kultur 1853: 231-238. Probably published before Massalongo’s Memorie lichenografiche, as on page 148 of that work Massalongo ascribes the name Pertusaria ocellata to Körber

Körber, G. W. (1855). Systema lichenum Germaniae. 97 - 459pp., Trewendt & Granier, Breslau. (1) Pages 1 - 96 were published in 1854. It is not known whether pages 97 - 192 were published in 1854 or 1855. I have assumed the latter. (2) Körber uses numerous different ways of indicating infra-specific ranks. In order of descending rank these are: (i) a Greek letter; (ii) a lowercase Latin letter; (iii) a number; (iv) one or more asterisks. He appears to have regarded the first of these as equivalent to variety; for example, on p283 he states that “Var. β ist eine schon „... Varietät ...“. He appears to have regarded the second of them as equivalent to form; for example, on p13 he uses the phrase ”... in der Formen b und c.”. However, I can not find any clear and consistent statement(s) that allows his third and fourth ranks to be interpreted as any of the conventional ranks. Some authors, e.g. Hawksworth (1972a), have treated the fourth rank as equivalent to “form”; and while this may be convenient, it does not appear to be strictly correct.

Körber, G. W. (1859). Parerga lichenologica Erste Lieferung. 96pp., Breslau. This work is closely associated with Systema Lichenum Germaniae, and the conventions for infra-specific names should be regarded as the same.


Körber, G. W. (1867b). Lichenes novi, a Dr. Weiss in Dalmatia lecti. Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien 17: 703-70


Krempehlhuber, A. (1861i). Die Lichenen-Flora Bayerns. Denkschriften der königl. bayer. botanischen Gesellschaft zu Regensburg 4(2): 1-317. (1)Also published separately the same year, with identical pagination. (2) Infra-specific epithets introduced with a single lowercase Greek character at the the rank of variety. See page 92, and the reference to var. alpha. (3) Infra-specific epithets introduced with a single lowercase Latin character are at the rank of form. See page 105, and the reference to "Die Form a". (4) Infra-specific epithets introduced with a single digit are at a lower rank than form, and epithets introduced with one or more asterisks are at an even lower rank, but I can not find any evidence that relates either of these to a standard rank.


Krzewicka, B. (2012). A revision of Verrucaria s. 1. (Verrucariaceae) in Poland. Polish Botanical Studies 27: 3-143


Lamarck, J. (1779 ['1778']). Flore française, Tome Premier. Méthode Analytique. 132pp., Paris [The Flora Françoise was issued in 3 volumes. The section Méthode Analytique appears to have been published as a supplement to Volume 1]
Lamarck, J. B. A. P. M. (1792). *Encyclopédie Méthodique, Botanique. Tome 3*. 759 pp., Paris. The entire Encyclopédie was published in 8 volumes, but lichens only appear in Volume 3. Lichens are on pages 470 - 508 of that volume. Each lichen is introduced with a name in French, but this is immediately followed by a Latin name, in binomial form, so new names in this work are validly published. The title page bears the date 1789, but it was certainly published after that; for example, it cites the second Fascicle of Dickson’s Fasciculus Plantarum Cryptogamicarum Britanniae, which was published in 1790.


Lamy de la Chapelle, E. (1880 ["1878"]). Catalogue raisonné des lichens du Mont-Dore et de la Haute-Vienne. *Bulletin de la Société Botanique de France* 25: 321-536 Caution: in this publication, the author intends that numbered taxa introduced with an asterisk are to be understood as subspecies of the most recent preceeding numbered taxon that lacks an asterisk. Note that new combinations and nomina nova that Lamy cited with an asterisk should therefore be ascribed to him alone.

nytta. 358pp., Uppsala


Linnaeus, C. (1753). Species plantarum, exhibentes plantas rite cognitas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas. 2 vols., Holmiae [=Stockholm]. Volume 1 is pages 1-560, volume 2 is pages 561-1200 + index. Lichens are on pages 1140-1158, 1168-1169 and 1175.


Linnaeus, C. (1763). Species plantarum. 2nd edition. Volume 2. 785-1684pp., Holmiae [=Stockholm]. Lichens are on pp1606-1624 (Volume 1, which was published in 1762, does not treat lichens.)

Linnaeus, C. (1767a). Mantissa Plantarum Generum Editionis VI et Specierum Editionis II. 142pp., Salvius, Stockholm. Lichens are on pp131-133. Note that pages 131 and 133 are mis-numbered as 231 and 233


Linnaeus, C. (1770b). Systema Naturae. Volume 3. 236pp., I. T. Trattner, Vindobonae. No edition is stated on the title page. This volume deals with minerals, but at the end it also includes Appendices to volumes 1 (zoology) and 2 (botany).


Lönnroth, J. (1858a). Descriptiones generum specierumque lichenum, quas novas inventit vel limitibus novis determinavit. Flora 41: 611-620, 627-635


Luyken, I. A. (1809). Tentamen Historiae Lichenum in Genere quâ accedunt Primae Lineae Distributionis novae. 102pp., Göttingen. When Luyken introduces new generic names that he ascribes to Acharius, he does not at that point explicitly ascribe the description to Acharius. However it is fairly clear, from the remark on page 82, that descriptions are those of Acharius. They are in fact abbreviations of those in Lichenographia Universalis. New generic names should therefore probably be ascribed to "Ach.", rather than "Ach. ex Luyken"


Mackay, J. T. (1836). Flora Hibernica, comprising the flowering plants, ferns, characeae, musci, hepaticae, lichenes and algae of Ireland, arranged according to the natural system, with a synopsis of the genera according to the Linnaean system. Part Second, comprising the musci, hepaticae and lichenes. 279pp., William Curry Jun. and Company, Dublin Lichens are on pp71-156, 257-260. It is stated on page x of the Introduction that the section on lichens was written by Taylor.


Mann, W. (1825). Lichenum in Bohemia observatorum dispositio succintaque descriptio. 107pp., Pragae


Massalongo, A. (1852b). Synopsis Lichenum Blasteniosporum. Flora 35: 561-576 In this paper Massalongo uses only a single infra-specific rank, denoted by Greek latters, so these can be treated as at the rank of variety.


Massalongo, A. (1853). Memorie lichenografiche con un’appendice alle ricerche sull’autonomia dei licheni crustosi. 183pp. + 29 Tables, H. F. Münster, Verona. (1) The publication date is 1853, not 1855 as sometimes stated. The
front cover does state 1853, but the typography of the final digit is not very clear and the "3" could easily be mistaken for "5". The work was reviewed in Flora 37(20): 316, dated 28 May 1854. (2) The section called an Appendix to Ricerche sull' autonomia is not an independent work. The numbering of the lichens discussed continues on directly from that in the main part of Memorie lichenografiche.

Massalongo, A. (1855c). De cryptogamis nonnullis novis agri Veronensis. Flora 38: 241-244

Massalongo, A. (1852d). Ricerche sull'autonomia dei licheni crustosi e materiali per la loro naturale ordinazione. xiv + 207pp., with 398 Figures., A. Frizerio, Verona. Massalongo refers on page v of the preface to varieties and forms. His usual way of denoting infra-specific ranks is by a Greek character or a lowercase Latin character. It is clear from the typography that the former has a high rank. Greek characters can thus be taken to mean variety, lowercase Latin characters to mean form. For one species only, Lecanora polytropa on pp12-13, he uses uppercase Latin characters. When discussing one of the infra-specific taxa within that species, L. polytropa C. acrystacea he uses the word variety, so these are probably best regarded as varieties too.

Massalongo, A. (1855d). Schedulae criticae in Lichenos exsiccatos Italiae. (Fascicles 2 - 10). 41-188pp., Typis Antonellianis, Verona. Pages 1 - 40, comprising fascicle 1, were published in 1855.


Massalongo, A. (1856d ['1855']). Schedulae criticae in Lichenos exsiccatos Italiae. (Fascicles 2 - 10). 41-188pp., Typis Antonellianis, Verona. [This was published after Frammenti lichenografici, which it often cites. It was published after the first three parts (pages 1 - 288) of Körber's Systema Lichenenum Germaniae, and before the forth part (pages 385 - 459). I follow Jørgensen & Henssen, in Taxon 39: 346. 1990, in assuming that it was published before the fourth part (pages 289-384).]


Massalongo, A. (1856d ['1855']). Schedulae criticae in Lichenos exsiccatos Italiae. (Fascicles 2 - 10). 41-188pp., Typis Antonellianis, Verona. [This was published after Frammenti lichenografici, which it often cites. It was published after the first three parts (pages 1 - 288) of Körber's Systema Lichenenum Germaniae, and before the forth part (pages 385 - 459). I follow Jørgensen & Henssen, in Taxon 39: 346. 1990, in assuming that it was published before the fourth part (pages 289-384).]

Massalongo, A. (1855c). De cryptogamis nonnullis novis agri Veronensis. Flora 38: 241-244

Massalongo, A. (1855d). Schedulae criticae in Lichenos exsiccatos Italiae. (Fascicles 2 - 10). 41-188pp., Typis Antonellianis, Verona. [This was published after Frammenti lichenografici, which it often cites. It was published after the first three parts (pages 1 - 288) of Körber's Systema Lichenenum Germaniae, and before the forth part (pages 385 - 459). I follow Jørgensen & Henssen, in Taxon 39: 346. 1990, in assuming that it was published before the fourth part (pages 289-384).]

Massalongo, A. (1855c). De cryptogamis nonnullis novis agri Veronensis. Flora 38: 241-244
University Press


Mudd, W. (1861). *A manual of British lichens, containing descriptions of all species and varieties, and five plates, with figures of the spores of one hundred and thirty species, illustrative of the genera.* 309 + xxi pp. & 5 plates, Darlington. [For infra-specific names, Mudd uses two categories: a higher rank denoted by Greek letters and a lower rank denoted by uppercase Latin characters. Unfortunately, he does not make any statement that allows these ranks to be understood as variety and form respectively (or as any other standard ranks). As a result, none of his infra-specific taxa have a standard rank.]


Mémoires de la Société de Physique et d’Histoire Naturelle de Genève 16: 343-435. (1) Infra-specific taxa introduced with a single lowercase Greek letter have the rank of variety. See, for example, the remark on page 362 in Cladonia rangiferina pumila, where Müller uses the phrase "la variété beta". (2) Infra-specific taxa introduced with a single lowercase Latin letter have the rank of form. See for example Anaptychia ciliaris b. angusta on page 367, where Müller uses the phrase "Cette forme". (3) Müller ascribes many names to "Hepp in litt." but nowhere is there any clear statement that Hepp wrote any of the accompanying descriptions. Such new names must therefore be cited with authorship "Hepp ex Müll. Arg.", not Hepp (in Müll. Arg.). (4) Published as an independent reprint later the same year, with pagination starting at 1.


Müller, J. (1874c). Lichenologische Beiträge. 2. Flora 57: 331-335, 348-352


Müller, J. (1884b). Enumerationis Lichenum aegyptiacorum. Supplementum primum, continens Lichenes a celeberr. W. Barbey (Barb.), Dr. Schweinfurth (Schwf.) et Dr. Ascherson (Aschers.) alisque in Aegypto recenser lectos. Revue Mycologique 6: 15-20


Müller, J. (1899c). Lichenologische Beiträge. XXXI. Flora 72: 142-147


Müller-Argoviensis. See: Müller, J.


Nees von Esenbeck, C. G. (1820). Horae physicae berolinenses. 128pp., Bonn


Nimis, P. L. (2016). The lichens of Italy. A second annotated catalogue. 739pp., Trieste


Norman, J. M. (1852). Conatus praemissus redactionis novae generum nonnullorum lichenum. 40pp., Christiania. [This is a preprint, with independent pagination, of Nytt Magazin for Naturvidenskapene 7(3): 213-252, published in 1853]


Nylander, W. (1854c). Tvenn nya systemer för Lafvarne. Botaniska Notiser 1854(5-6): 72-88. This seems to be by Nylander, though authorship is not explicit.


Nylander, W. (1857c). Prodromus Lichenographiae Galliae et Algeriae. Actes de la Société Linnéenne de Bordeaux 21: 249-467 (1) Nylander uses an asterisk to denote a rank between species and variety, but I can not find any evidence to indicate that the rank of subspecies was intended. (2) Reprinted the same year, as an independent publication with pages numbered 3 to 221


Nylander, W. (1861l). Lichenes scandinavie sive prodromus Lichenographiae Scandinavie. Notiser ur Stillskpets pro Fauna et Flora Fenntca Förhandlingar 5: 1-312. (1) Also published separately the same year, with identical pagination. (2) Nylander sometimes uses one or more asterisks to indicate an infra-specific rank. I can not find any evidence that this was intended to denote one of the standard ranks, and such names in this publication should be regarded as not having a standard rank.


Nylander, W. (1870). Recognitio monographica Ramalinarum. Bulletin de la Société Linnéenne de Normandie, Série II 4: 101-181 In additional to the conventional rank of variety, Nylander uses an asterisk to denote a rank between species and variety. Informally, it can be taken to mean subspecies.


Nylander, W. (1873c). Observata lichenologica in Pyrenaeis orientalibus. IV. Collioure. V. Perpinianum. *Flora* 56: 193-207 [On p197 of this publication, under the name L. murorum * subsoluta, Nylander states "Videtur propria saltem subspecies". This indicates that, in accordance with his normal practice, he regarded an asterisk (or series of asterisks) as denoting the rank of subspecies. Article 35.5 implies that this usage can be applied in other parts of "Observata lichenologica in Pyrenaeis orientalibus ", such as Nylander (1872c), even though there is nothing in those other parts explicitly stating what rank is to be understood by "*".]


Pérez-Ortega, S. & Etayo, J. (2010). Labriscarpón gen. nov. for Melaspidea canariensis, with the description of Buellieilla protoparmeliopsis sp. nov. from South America. Lichenologist 42(3): 271-276

Persoon, C. H. (1794a). Einige Bemerkungen über die Flechten: Nebst Beschreibungen einiger neuen Arten aus dieser Familie der Aftermoose. Annalen der Botanik (Usteri) 7: 1-32, 155-158 [Confusingly, this is also Volume 1 of Neue Annalen der Botanik]

Persoon, C. H. (1794b). Nähere Bestimmung und Beschreibungen einer sich nahe verwandter Pflanzen. Annalen der Botanik (Usteri) 11: 5-32 [Confusingly, this is also Volume 5 of Neue Annalen der Botanik]


Persoon, C. H. (1795). Botanische Beobachtungen, aus einem Briefe des Hr. Persoon, an den Herausgeber. Annalen der Botanik (Usteri) 14: 33-39 [Confusingly, this is also Volume 8 of Neue Annalen der Botanik]

Persoon, C. H. (1797). Tentamen dispositionis methodicae fungorum in classes, ordines genera et familias, cum supplemento adjecto. 76pp. + 4 Tables, Wolf, Leipzig
Naturkunde 2(1): 9-20
Botanique de France Mémoires 22: 1-72
Staatssammlung München 2(11): 11-31
der Botanischen Staatssammlung München 2(19-20): 411-573
Lichenologica 9: 1-258
Pokorny, A. (1860). Flora des ungarischen Tieflandes. Verhandlungen der kaiserlich-königlichen zoologisch-
botanischen Gesellschaft in Wien 10: 283-290
Pollini, C. (1816). Horti et provinciae veronensis plantae novae vel minus cognitae quas descriptionibus et
was also reprinted separately the same year]
University Press. ISBN 0 19 281998 4
Peninsula and the Balearic Islands. Lichenologist 42(6): 637-684
briefly, in a library. Brief notes made, but not studied thoroughly.]
Printzen, C. (2001). Corticolous and lignicolous species of Lecanora (Lecanoraceae, Lecanorales) with usnic or
isousnic acid in the Sonoran Desert region. Bryologist 104(3): 382-409
Printzen, C. & Otte, V. (2005). Biatora longispora, new to Europe, and a revised key to European and
Macaronesian Biatora species. Graphis Scripta 17(2): 56-61
Puget, F. (1866). Sur la végétation di Salève et du territoire qui s’étend de cette montagne au Mont du Vauche.
Bulletin de la Société Botanique de France Session Extraordinaire 13: 61-91 (Lichens are on pages 87-91.)
Abtheilung. 130pp., Leipzig Rabenhorst uses three levels of infra-specific rank. The highest is denoted by an
upper case Latin letter, the next by a lower case Latin letter, and the lowest by a Greek letter. It is clear from the
section headings on page 20 (and also the treatment of Omphalodium on page 122) that the middle rank is that of
variety. I can not find any evidence indicating what was intended by the first and third levels, and they must, I
think, be regarded as not having a standard rank.
Rabenhorst, L. (1871i). Übersicht der von Herrn Prof. Dr. Haussknecht im Orient gesammelten Kryptogamen
(Fortsetzung). Hedwigia 10(12): 177-180
Press.
l’Académie Royale des Sciences de l’Institut de France 6: 81-174 [Although volume 6 is stated on the cover page
to be for the year 1823, it was not printed until 1827. The 1823 date is difficult to understand, as Rambold’s paper
is stated to have been read to the Académie in 1826, not 1823.]
100: 419-462
Räisänen, V. (1943). Novae et minime notae species et variationes ex genere Rhizocarpon (Ram.) Th. Fr. Feddes
Repertorium Specierum Novarum Regni Vegetabilis 52(2): 136-143


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Saint-Amans, J. F. B. de (1821). Flore Agenaise ou description méthodique des plantes observées dans le Département de Lot-et-Garonne et dans quelques parties des départements voisins. 629pp., Noubel, Agen. The entire section on lichens is attributed to Chaubard on page 8, so it is not correct to use "ex St.-Amans" in author citations of new names.


Schaerer, L. E. (1850). Enumeratio critica lichenum europaeorum, quos ex nova methodo digerit. XXXVI + 327pp., Bernae. Schaeber uses two kinds of infra-specific ranks, the higher of which is indicated by a Greek latter and the lower by a lowercase Latin letter. On page v of the Protatatio he refers to "... species cum suis variatibus ac formis ...", so it seems reasonable to interpret these two ranks as variety and form respectively.


Lichens are on pages 115 - 140


Scopoli, J. A. (1772). Flora Carniolica Exhibens Plantas Carnioliae Indigens et distributas in classes, genera, species, varietates, ordine Linnaeana. Tom. II. Editio secunda aucta et reformata. 496pp +65 Tables +index,
Ioannis Pavli Krauss, Vindobonensis


Sibthorp, J. (1816). *Floria Graecae Prodromus*. Volume 2, Part 2. pages 211-422, London [Volume 2 part 1 was published in 1813. The whole work was actually published by J. E. Smith, but the lichens were collected and determined by Sibthorp, and to make this clear I have cited the work under Sibthorp’s name.]


Smith, J. E. & Sowerby, J. (1807c). *English Botany, or coloured figures of British plants, with their essential

Smith, J. E. & Sowerby, J. (1808b). English Botany, or coloured figures of British plants, with their essential characters, synonyms, and places of growth. Vol. 27. Tab. 1873 - 1944. London

Smith, J. E. & Sowerby, J. (1812). English Botany, or coloured figures of British plants, with their essential characters, synonyms, and places of growth. Vol. 34. Tab. 2377 - 2448, London


[This may have been published in 1824.]


Szatala, O. (1940). Adatok a Balkánfelszignet és KisÁzsia zzymoflórájának ismeretéhez [=Contributions a la connaissance de la flora lichénologique de la péninsule des Balkans et de l'Asie mineure]. Borbasia 2: 33-50


Szatala, O. (1941b). Adatok görösszag zzymoflórájához. I. Athos-felszignet (Hagion Oros) [=Contributions a la connaissance des lichens de la Grèce. I. La presqu'ile Athos (Hagion Oros)]. Borbasia 3(8-10): 113-136


Szatala, O. ("1943b"). Lichenes. pp27-47 (+181) In: Rechinger, K. H., Neue Beitragé zur Flora von Kreta. Denkschriften der Akademie der Wissenschaften Wien, Mathem.-Naturw. KLasse, 105(2): 1-184 [Only the pages relevant to lichens seen.] Note: This work was certainly published later than 1943, as it cites a 1944 paper by Rásián, but I have not been able to determine the year of publication.

**Find out year***


Tornabene, F. (1984). Lichenographica Sicula. Atti dell’Accademia Gioenia di Scienze Naturali di Catania, Serie Seconda 5: 1-63. Often cited with date 1849. However, the journal itself bears the date 1848 and I can not find anything that clearly indicates a later date


Trevisan, V. (1862). Summa lichenum coniocarporum. Flora 45: 3-7


Tuckerman, E. (1845b). An enumeration of North American lichens. 59pp., Cambridge. Most infra-specific names are denoted by a single Greek letter. Occasionally a lowercase Latin letter is used to denote a lower rank. Tuckerman clearly states (page 46) that his arrangement is based on “the Friesian system as it is presented in the Lichenographia Europaea Reformata”, so it seems reasonable to assume that these designations were intended to have the same meaning as in that work of Fries, namely variety and form respectively.


Amherst


Turner, D. (1804). Descriptions of four new British Lichens. *Transactions of the Linnean Society of London* 7: 86-95. The paper was read in January 1803, but apparently was not published until late 1804


Vainio, E. (1887). Monographia Cladoniarum Universalis. Pars prima. *Acta Societatis pro Fauna et Flora Fennica* 4: 1-509 [Reprint by Otto Koeltz Science Publishers, Koenigstein, 1978. ISBN 3-87429-135-9] In this work taxa introduced with one or more asterisks are intended to be contained within a previous taxon introduced without an asterisk. For example, the taxon *Cl. macilenta*, on p98 is NOT *Cladonia macilenta*; it is *Cladonia floerkeana* *Cl. macilenta*, i.e. *Cladonia bacillaris* subsp. *macilenta*. Taxa introduced with a Greek letter but no asterisk have the rank of variety. Taxa introduced with one or more asterisks and a Greek letter have the rank of form. For example, the taxon *β Squamigera*, on p109, is *Cladonia floerkeana* subsp. *macilenta* var. *styracella* f. *squamigera*. Vainio makes it clear that *Cl*. means subspecies; see, for example, p58 where he explicitly refers to *C. papillaria* *Cl. apoda* as a subspecies, in the phrase "Forsan haec subspecies est ...". For taxa introduced with a Greek letter but no asterisk see, for example, *C. sylvatica* γ *laevigata* on p34 and the phrase "Statuta podetiorum haec variatio ...", or p40 where a name is explicitly introduced as *Var. γ granulosa*. For taxa introduced with an asterisk and a Greek letter see, for example, *C. floerkeana* *β intermedia*, which he refers to on p80 with the phrase "... ad statum hujus formae...". Vainio does occasionally use the Latin word "forma" to refer to varieties, but this can be regarded as merely an informal use of the word. Overall, his usage is consistent enough, in my opinion, to establish, for formal nomenclatural purposes, that the ranks of his infra-specific taxa are subspecies, variety and form. In other words, they do need to be considered in matters of priority (see Article 35.3).

Vainio, E. A. (1890a). Etude sur la classification naturelle et la morphologie des lichens du Brésil. Pars prima. *Acta Societatis pro Fauna et Flora Fennica* 7(1): 1-247 (1)As in many of Vainio's publications, he uses an asterisk to indicate the rank of subspecies. See, for example, page 87, where it is explicitly stated that *Lecanora pallidostroamina* *L. mesoxanthoides* is a new subspecies (of *L. pallidostroamina*). (2)In this, as in many of his other publications, he sometimes introduces a new epithet at a point in a sentence where Latin requires the use of the accusative case. For example, on p6, *Ad ramulos ... f. spinuliferam ... legi*. Vainio's usage is correct, but the epithet when quoted in the nominative case, as it must be when the name of the taxon is used alone, is "spinulifera", not "spinuliferam".


Vécza, A. (1990). Bacidina genus novum familiae Lecidaceae s. lat. (Ascomycetes lichenisati). Folia Geobotanica et Phytotaxonomica 25(4): 431-432 This is sometimes said to have been published in 1991. I have not been able to establish the facts.


Wallroth, F. G. (1831). Flora Cryptogamica Germaniae. Pars Prior continens Filices, Lichenista, Muscos et Lichenes. 654pp., Norimberga [=Nuremberg]. Lichens are on pages 235-584. The volume seems to have been issued as an independent volume, comprising Sectio II, Tomus III, of Compendium Florae Germanicae, edited by M. J. Bluff and C A Fingerhuth. I have cited it as "Fl. Crypt. Germ. 1" as that seems to correspond most closely to Wallroth's contribution.


Weigel, C. E. (1772). Observationes Botanicae. 51pp.+ 3 Tab., Gryphiæa

Weis [sic], F. W. (1770). Plantae Cryptogamicae Floraet Gottingensis. 333pp., Vendenhoecch, Gottingæ


Wiggers, F. H. (1780). Primitiae Floraet Holsaticeae. 112pp., Kiliae


Zedda, L. (2002). The epiphytic lichens on *Quercus* in Sardinia (Italy) and their value as ecological indicators. *Englera* 24: 5-457


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.
alga. (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.
apotheclium. (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 ascii and related organs.
ascomycete. A large group of fungi, characterised by forming sexual spores within asci. Most lichenised fungi are ascomycetes.
ascomспор. The sexual spore of an ascomycete.
asccus. (pl. ascii). 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.
axil. The indentation from which two lobes, or two segments of the same lobe, diverge.
Australia. When used without qualification, this includes Tasmania, Lord Howe Island and Norfolk Island. It does not include the subantarctic Macquarie Island.

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 asc 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.

Catenate. 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.

Cephalodium. (pl. cephalodia). 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.
**cilia.** (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.

**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, 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.

**corticolous.** 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.
epitheci um. 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.
foliicolous. Occurring on leaves.
foliose. 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).
homoioomerous. 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.

Scleroplechentenchyma 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 proper 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 perithecium.

**isidate.** Possessing isidia.

**isidiium.** (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 a thin section it may not work, as the K can send any lichen substance into solution, so none remain when the C arrives.

**KI.** 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 ascis from paraphyses. The KI reaction of the apex varies during development of the ascus, and observations should be made only on ascis that are mature but undischarged, and if possible on ascis 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 ascis as possible, as even with mature ascis 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 ascis 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 ascis to discharge; this is undesirable, as important characters of the apex can generally only be observed in undischarged ascis. 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 ascis 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.** Ascis 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.

**Lecidea type.** Ascis with small, strongly KI+ blue region near top.

**Lecidella type.** Similar to Lecanora type, but the KI-region 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.

**Lichenicalous.** 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. lilellae). 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 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. mazaedii). (Or sometimes "mazedium" and "mazedia"). A type of ascus 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.

**muriform.** 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 is one of the few lichen substances whose presence can easily be demonstrated without chromatography. When K is applied to a thin section containing norstictic acid, a yellowish pigment diffuses into solution and, after a minute or two, needle-shaped red crystals form. (Use as little K as possible. If you add too much K, norstictic acid will dissolve and produce a yellowish solution, but it may be too dilute for crystals to form.) Atranorin 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.

**NZN.** 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.

**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.

**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.

perispore. 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 my self 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, any 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.

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.

placodioid. Possessing distinct, lobe-like (but completely attached), radiating structures at the margin. Only crustose lichens may be placodioid.

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'.

Porpidia type. Asci with an apical dome that is mostly KI- except for a central KI+ blue tube.

PR. Puerto Rico.

proper exciple. (This term is being phased out as I revise sections of the Flora, and replaced with "exciple".) 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.

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. pseudocyphellae). 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.

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-. In K it diffuses a yellow pigment 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. Containing septa. 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. (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.

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 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 proper 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 asci 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 long axis of the lobe.

**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 helpful 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 amout of light at visible wavelengths and, in a dark viewing cabinet, reflection of this light from a pale colored thallus may be easily noticed. Care should be taken to distinguish such reflections from a true fluorescence. **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 mentioned, 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), Roccellographaceae (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 (4,122): Mycosphaerellaceae (0,111)
  - Eremithallales (75,0): Melaspileaceae (75,0)
  - Lichenonciales (0,14): Lichenonciaceae (0,14)
  - Lichenostigmatales (0,36): Phaeococcomycetiaceae (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): Trypethelaceae (450,0)

- Fam. Inc. Sed. in Dothideomycetes: Dacampiaceae (0,93)

- **Eurotiomycetes** (1504,83)
  - Chaetothyriomycetidae (1405,81)
  - Pyrenulales (325,0): Pyrenulaceae (310,0)
  - Verrucariales (1068,63): Verrucariaceae (1066,51)
  - Mycocaliciomycetidae (99,1)
  - Mycocaliciales (99,1): Sphinctrinaceae (99,1)

- **Laboulbeniomycetes** (0,1)

- **Lecanoromycetes** (16415,85)
  - Acarosporomycetidae (307,0)
  - Acarosporales (307,0): Acarosporaceae (307,0)
  - Candelariomycetidae (86,0)
  - Candelariales (86,0): Candelariaceae (83,0), Pycnoraceae (3,0)
  - Lecanoromycetidae (11421,41)
  - Caliciales (1487,0): Caliciaceae (803,0), Physciaceae (684,0)
  - Lecanorales (6607,38): Carbonicolaceae (3,0), Catilliariaceae (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), Gyalectaceae (93,1), Odontotremaeae (0,21), Phlyctidaceae (33,0), Porinaceae (443,0), Sagiolechiaceae (5,0), Stictidaceae (45,9), Thellenellaceae (51,0), Thrombiaceae (17,0)
Pertusariales (1117,0): Icmadophilaceae (44,0), Megasporaceae (296,0), Ochrolechiaceae (76,0), Pertusariaceae (678,0)

Umbilicariomycetidae (191,3)
Sarrameanales (22,0): Sarrameanaceae (11,0), Schaeereriaceae (11,0)

Trapeliaceae (179,0): Trapeliaceae (179,0)

Umbilicariaceae (185,3): Elixiaceae (3,0), Fuscideaeae (58,3), Ophioparmeaeae (11,0), Umbilicariaceae (113,0)

Lichenomycetes (395,0)

Lichinales (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)

Xyylonomycetes (0,0)

Ord. Inc. Sed in Pezizomycotina: Thelocarpales (24,0): Thelocarpaceae (24,0)

Fam. Inc. Sed. in Pezizomycotina: Dactyllosporaceae (0,45), Strangosporaceae (7,0), Xanthopyreniaceae (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; none are reliably reported for Greece. Sixty percent of lichenicolous basidiomycetes are presently placed in the genus Tremella; those species are mostly rare and poorly known. There is only a single Greek report.

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.

**Coniothyriomycetes** 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.

**Leotiomycetes** 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.

**Orbiliomycetes** 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.
Appendix: The Peloponnese

The British naturalist and landscape historian Oliver Rackham once remarked that "The Peloponnese is a grand and wonderful land", and he continued to develop this theme in several paragraphs of rather florid prose (Grove & Rackham, 2001: 185). We share his enthusiasm, even if we choose not to imitate his style.

A discussion of the Peloponnese is quite a good introduction to Greece in general, as much of what can be said applies, at least approximately, to many other parts of the country. However, other regions do differ. Some obvious differences to bear in mind are: (1) The geology of Greece as a whole is more varied than that of the Peloponnese. In particular, some regions are not dominated by limestone. (2) Northern Greece has a climate that is much colder in winter. (3) Some of the islands, especially some small islands in the Aegean, have a more maritime climate than anywhere in the Peloponnese. (4) In some parts of Greece, human influence has been much greater than in the Peloponnese.

Basic statistics

The Peloponnese forms the southern part of mainland Greece. It is connected to the rest of Greece by the Isthmus of Corinth. The Isthmus is narrow, only about 6 km broad, and the Peloponnese is almost an island; the suffix -nese is from the Greek word for ‘island’. Since 1893, when it was artificially separated from the mainland by the Corinth Canal, it has been an island in reality. Because it is largely self-contained, and because it differs in a number of ways from other parts of Greece, it is a natural region to choose for floristic study.

Its area, excluding offshore islands, is about 21420 square km, or about 16% of the total area of Greece. It is slightly smaller than Sicily (25708 square km) or Sardinia (24090 square km) but much larger than Cyprus (9267 square km), Crete (8700 square km) or Corsica (also 8700 square km). If it were truly an island, it would be the third largest island in the Mediterranean. To compare it with a region that is better known lichenologically, the Peloponnese is the size of a few English counties combined, or about one-sixth of the total area of England.

Latitude ranges from 36° 22´ N, at Cape Tenaro at the southern tip of the Mani peninsula, to 38° 29´ N at a point on the southern shore of the Gulf of Corinth, just north-east of the city of Patra. This is similar to Sicily, much of Andalucia, and the Algarve; and thus further south than most of Italy, Spain and Portugal. It is about the same as the northernmost tip of Africa.

Longitude ranges from 21° 07´ E, at Cape Tripiti, some 35 km north-west of the town of Pirgos, to 23° 32´ E just south-east of the town of Galatas. This is about halfway between Sicily and the western coast of Turkey.

The coastline is very indented, especially in the south and east. Although the Peloponnese extends 218 km from north to south, and 210 km from east to west (and over 240 km along its longest axis), nowhere is more than 54 km from the sea. From ancient times its shape has been compared to a leaf of a plane tree (Platanus orientalis), with five lobes extending out into the sea from the central core; and even if the fifth lobe, the one in the north-west, owes a little to poetic license, the other four are obvious enough.

Most of the Peloponnese is mountainous, or at least hilly, and flat land is scarce. Along much of the coast the land descends precipitously to the sea. In other parts there is a narrow coastal strip. Extensive coastal plains are few. The largest is the plain of the River Evrotas, which extends from near Sparti to the sea, but that near the ancient town of Argos is also notable, as well as being historically important; it supported the even older civilisation of Mycenae. There are other small coastal plains. There are also some inland plains. The largest contains the modern town of Tripoli; it exceeds 100 square km in area and is at an altitude of 750 m. It was formed by tectonic activity. Inland plains come in all sizes, down to small basins in limestone covering just a few hundred square metres.

Nowhere is below sea level. The maximum altitude is 2408 m, in the Taígetos Mountains. Three other mountain ranges, Killini (Ziria), Helmos (Aroania) and Erymanthos exceed 2000 m, and three others, Menalo, Parnon and Panachaiko nearly attain that altitude. Although these altitudes are not far below the highest point in Greece, 2917 m on Mount Olympus, the comparison is misleading from a botanical point of view, as Olympus, like the other high mountains of northern Greece, experiences a much colder winter climate.

Geology

Greece is a rocky country; except in the large plain of Thessaly, and in smaller plains elsewhere, rocks outcrop almost everywhere, and the Peloponnese is no exception. The abundance of rock is due in part to the rugged topography, but millennia of grazing and soil erosion must also have played some part. Saxicolous lichens have benefited accordingly.

Information on the geology of the Peloponnese, and of Greece as a whole, is scattered through many specialised technical publications written in numerous languages. For the non-specialist, the best introduction in English is Higgins & Higgins (1996); the authors are a father and son team, one a geologist, the other a classical scholar and archaeologist,
so the perspective is not too narrow. Those who can read Greek may prefer Mountrakis (1985) or Papanikolaou (2015); the latter is better as a general introduction. The bibliography in Sipman & Raus (2002) mentions a book in German, which I have not seen. Geological maps of most of Greece exist at a scale of 1:50,000, but are difficult to obtain, very expensive, and probably not very helpful to most lichenologists. More useful might be the 1:250,000 scale map of the Peloponnese that I once saw (on an office wall), but I have not been able to obtain a copy. What follows draws quite heavily on my own observations.

The geology of Greece is very complex. However, for the lichenologist, all that really matters is the mineralogy of the rocks at the surface. How they got to be that way, i.e. the historical geology, can usually be ignored. The geology at depth is also irrelevant. A one sentence summary of the geology of Greece would note that there is a core of old, metamorphic rocks, well exposed in central and parts of northern Greece, and that younger, mostly sedimentary, rocks are draped around this core and predominate around many of the edges of the country. This is, of course, a gross simplification, but what matters here is that the Peloponnese is definitely one of these edges, and that it is composed almost entirely of these younger rocks. They are nearly all of marine origin, and were uplifted as the African plate moved northward and the Tethys Ocean shrank. This plate movement continues, and the area is notorious for its seismicity.

Most of the rocks are sedimentary, and most of the sediments are carbonates rather than clastics; limestone dominates the geology of the Peloponnese. Limestone occurs from sea level to the highest altitudes; indeed, it forms all the high mountains. In areas where other rocks are present it usually forms the summits of the hills, being a hard rock that is resistant to erosion. I would estimate that at least three-quarters of the Peloponnese has limestone at the surface. This means that the biology of saxicolous and terricolous lichens is predominantly the biology of calcicoles.

Other types of sedimentary rock do exist. Mudstones, shales and alluvial sediments, all of which are soft and therefore poor substrates for lichens, occur in large areas near Corinth and along parts of the northern coast of the Peloponnese. Because of rapid uplift of this region in the last 2 million years, these rocks are unstable and easily eroded; there are some well-developed badland areas. Alluvial sediments also cover smaller areas in some river valleys and drained lakes elsewhere. Another, fairly narrow, band of clastic sediments runs parallel to the north-west and the northern part of the west coast, and it includes what appear to be the only sandstones in the Peloponnese. These moderately calcareous sandstones are not well consolidated, so they erode easily and good outcrops are few. However, in a few places there are good exposures associated with prominent escarpments. The lichen flora of the sandstones is rather poor.

Poor quality coals outcrop near Megalopoli, but I have not studied their flora; casual observation suggests that it is poor. Evaporites are rare, but Higgins & Higgins (1996) report that there are small areas of gypsum in the west. I have not seen them, and their lichen flora has never been studied. Their areal extent is probably too small to support the specialised gypsum flora that occurs in, for example, parts of NE Spain.

Pebbles of chert (flint) sometimes occur within limestone, though they are not common. They carry a flora characteristic of hard, siliceous rocks.

Metamorphic rocks also occur. The commonest are schists, which occur patchily in and around the Parnon and Tägettos mountains and occasionally elsewhere. They bear a flora characteristic of aciditic, but not strongly acidic, substrates. Hard, and thus nutrient-poor, metamorphic rocks are rare, and usually occur as small outcrops that presumably got incorporated into the surrounding rock by some geological accident. I have not found any such outcrops above 1750 m altitude, and the very rich lichen flora of hard acidic rocks that occurs in arctic-alpine regions is probably entirely absent from the Peloponnese.

Ceramic roof tiles provide a common man-made substrate that must resemble hard acidic rock, as these tiles often bear Rhizocarpon geographicum. I have not studied their lichen flora.

Igneous rocks occur on the Methana peninsula and on the adjacent part of the main body of the Peloponnese. This peninsula lies on a line of volcanic activity that stretches from Sousaki (north-east of Corinth), through Methana, to the islands of Milos, Santorini and Nisyros; it is the surface expression of a zone of melting in subducting oceanic crust. On Methana itself, there are fresh lavas at the site of the small eruption that occurred in the third century BC. Their lichen flora is that of aciditic, but not strongly acidic, rock. Other rocks on the Methana peninsula, and on the nearby mainland, are also igneous, though older. They bear a similar, but not identical, lichen flora. Higgins & Higgins (1996) state that very small outcrops of andesite, or similar rock, occur in places in the Peloponnese; the only one they mention explicitly is near Sparti.

There are no basic igneous rocks (such as basalt) and no plutonic rocks (such as granite) anywhere in the Peloponnese. Ophiolitic rocks occur in numerous places in SE Europe, from the Balkans southwards, but are present in the Peloponnese only in a small part of the eastern Argolid; the lichens of that small region have not been studied.

So far as I know, no rocks in the Peloponnese have been enriched in metals to an extent that would influence their lichen flora. There are ancient silver mines near Athens, but I am not aware of any past metal mining in the Peloponnese.
Climate

Blondel & Aronson (1999: 91-95) discuss the types of climate found around the Mediterranean, including its mountains. They recognise eight zones, from very hot to very cold, and the six middle ones occur in the Peloponnese. In other words, the Peloponnese displays great variety of climate, but without extremes.

Climate in the Mediterranean becomes more continental on moving east, and the Peloponnese experiences a markedly more continental climate than southern Spain. The proximity of the sea does exert some moderating effect, but winter weather can be surprisingly cold at times. Humidity tends to be low in most places most of the time. Lichen species requiring an oceanic climate are thus absent, or confined to a few small, unusually favourable localities in the extreme west, or restricted to the mountains.

The climate at sea level is generally warm. Mean annual temperature is around 18°C, varying slightly with location, and the mean temperature of the hottest month exceeds 25°C. Winters are not harsh but, as noted above, some cold weather can be expected from time to time. Slight frosts can occur in winter, especially on clear, still nights, but severe frosts are rare, though very damaging when they do occur. Citrus fruit can be grown reliably.

Precipitation at sea level decreases markedly from west to east. At Kalamata, in the west but not the extreme west, it is 839 mm, whereas at Athens (outside the Peloponnese, but probably fairly representative of the easternmost parts) it is only 384 mm (Grove & Rackham, 2001: 24). Note, however, that the western figure is much less than that found not very far away along the Dalmatian coast (well over 2000 mm), and the eastern figure is not that of a desert; once again, extremes are absent. Precipitation does affect the lichen vegetation, and sites at sea level in the west usually have both more species and more lichen biomass than those in the east. In some sea-level sites in the east, it may be hard to find any epiphytic lichens. Saxicolous lichens tend to fare better, but I have seen one site on the east coast where there were absolutely no lichens at all on any substrate at sea level, though lichens were common nearby at an altitude of 200 m.

There is usually a prolonged summer drought, though this may be moderated slightly by thunderstorms, which are frequent and sometimes violent.

Upland areas are significant in Peloponnesian biology, because half of the region lies above 500 m altitude. With increasing altitude temperature falls and precipitation increases, though good statistics are hard to come by. Tripoli, at 750 m altitude, has a mean annual temperature of about 14°C (estimated from information in Polunin, 1987: 14). It is about halfway across the Peloponnesse from west to east, yet it receives about 932 mm of rainfall (Polunin, 1987: 14); at the same longitude at sea level one would expect around 600 mm. In winter at such altitudes there can be occasional periods of 2-3 weeks of continuously wet weather. Severe ground frosts are not unusual; one of -17°C was recorded in Tripoli early in 2004, but Tripoli lies in a basin, so frosts are often a few degrees more severe than in other places at the same altitude. Large-scale, arable agriculture is still possible at this level, though not all crops can be grown; citrus, for example, is impossible, and though olives can survive at 800 m altitude they do not yield a commercial crop above 500 m.

Large towns do not occur above 750 m altitude, but small towns may be found up to about 1000 m and villages to about 1200 m, though the higher villages are inhabited only in summer. The short growing season and the greater frequency of spring and autumn frosts make arable agriculture difficult above 1000 m. Winter in the upland areas is long and quite cold. The author lives at 780 m, and finds it necessary to heat the house for 6 months of the year, from about 1200 m, though this may be moderated slightly by thunderstorms, which are frequent and sometimes violent.

At least up to an altitude of 1500 m, there is never a continuous snow cover throughout the winter. The usual pattern at middle altitudes is a moderate to heavy fall, typically of 20 - 100 cm, which then gradually melts over a period of one to a few weeks; this pattern is repeated more than once in a typical winter. Above 2000 m, a few snow patches may last until May in a typical year, or until June in an unusually snowy one, but the climate is not cold enough to support permanent, or even semi-permanent, snow. Alpine lichens are therefore scarce and few in number and strongly chionophilic lichens are absent, though I should add that very few sites at the highest altitudes have yet been studied.

Whatever the altitude or season, sunshine is usually abundant. Cloudy and wet weather can occur, especially in winter, but does not often last for more than a few days. As a result, waterlogged or very wet habitats are rare outside truly marine or freshwater sites, and the latter are now rare. Strongly leached substrates are also rare. Lichens requiring moist, acidic conditions are thus rare or absent: genera like Micarea or Trapelia, for example, are very poorly represented, and the Cladonia flora is poor in number of species.

The Peloponnese is not a windy place. Wind probably has little effect on most biological systems here.
Vegetation

So far as I know, there has never been a systematic study of the vegetation types of the Peloponnese. These notes therefore rely mainly on my own observations and are inevitably limited and informal.

The Peloponnese has a rich vascular plant flora, with at least 2200 species. (I know little about the bryophyte flora or that of the non-lichenised fungi, but I would imagine that the former is not very rich and that the latter is poorly known.) Good information on the vascular plants is rather inaccessible, and will remain so until the Flora Hellenica project is complete; at present, only two of its projected nine volumes have appeared. However, most of this diversity is irrelevant to a lichenologist. A few simple structural properties of the vegetation matter more.

Over large areas, the vegetation is dominated by woody shrubs. The main shrubs may be as little as 0.5 metres or as much as 3 metres tall, depending on precipitation, grazing intensity, fire and altitude. In these habitats fully grown trees may be absent altogether, but more commonly they are present as scattered individuals. The distinction between the 'shrubs' and the 'scattered trees' is usually clear and distinct, but at some sites there is more of a continuum, perhaps the result of a reduction in grazing pressure. Shrublands may be found at all altitudes and on all soil types, but are most characteristic of limestone and of altitudes below about 1000 m; a different, montane form occurs above 1700 m. The Greek terms phrygana or roumani are sometimes used for this vegetation type, but the more familiar French terms maquis and garrigue can be applied just as well to the (non-montane) shrublands.

Shrublands occur over a wide range of altitude, in a wide range of climatic conditions, and on a variety of soils, so the species of shrub involved and the species of trees scattered through them vary substantially, making generalisations difficult. Saxicolous lichens are always well represented unless the underlying rock is too soft to provide a stable substrate, or there has been a recent fire and there are no outcrops of rocks large enough to have acted as refugia. The habitat is usually quite open and this favours saxicolous lichens that require sunny conditions. Shade species are less common; whether or not they occur at a site, and their abundance if they do, depend mainly on whether rocks outcrop and/or weather in a way that provides shaded microhabitats. Closed shrublands, which are uncommon, and closed patches in open shrublands, tend to have too much shade to be good habitats for saxicolous lichens; also, they rarely persist long enough to be good habitats for most shade-loving lichens. The abundance of terricolous species depends mainly on the intensity of trampling by grazing animals. Too much trampling is deleterious, though it rarely eliminates the commoner species entirely, as they tend to retreat to small, protected soil pockets in rock crevices. When trampling pressure is low or moderate, terricolous species may be abundant and conspicuous, but these terricolous communities are never very rich in number of species.

The epiphytic flora of shrublands depends mainly on the frequency and number of trees. Shrubs themselves do support lichens, sometimes in quantity, but they are usually common and widespread species. Pioneer species (such as Caloplaca pyræcea, Lecanora "carpinea" s. lat., L. "chlarotera" s. lat., L. horiza, Lecidella elaeochroma and Rinodina sophodes) can nearly always be found on the shrubs, however degraded the site. The habitat is usually quite open and this favours saxicolous lichens that require sunny conditions. Shade species are less common; whether or not they occur at a site, and their abundance if they do, depend mainly on whether rocks outcrop and/or weather in a way that provides shaded microhabitats. Closed shrublands, which are uncommon, and closed patches in open shrublands, tend to have too much shade to be good habitats for saxicolous lichens; also, they rarely persist long enough to be good habitats for most shade-loving lichens. The abundance of terricolous species depends mainly on the intensity of trampling by grazing animals. Too much trampling is deleterious, though it rarely eliminates the commoner species entirely, as they tend to retreat to small, protected soil pockets in rock crevices. When trampling pressure is low or moderate, terricolous species may be abundant and conspicuous, but these terricolous communities are never very rich in number of species.

Habitats dominated by trees, rather than shrubs, occur in many places, but a useful, if informal, distinction can be made between montane forests, above about 1000 m, and lowland forests, below that altitude. The montane forests are dominated by one of two conifers: Pinus nigra and the endemic Greek fir Abies cephalonica. (Fagus sylvatica, which forms upland forests in central Greece, does not occur in the Peloponnese.) Abies cephalonica is rich in lichens, especially macrolichens, but Pinus nigra is not. Numerous other trees are usually present in the montane forests: species of Juniperus are widespread all altitudes, and are sometimes common, and various species of deciduous tree often occur at the lower altitudes, though rarely in large numbers. The larger, terricolous lichens, such as Peltigera species, tend to be common; smaller, crustose, terricolous species are not common but sometimes occur on mosses. Saxicolous lichens are easily smothered by fallen needles or overgrown by bryophytes unless outcrops are reasonably large, and these forests are not notable for their saxicolous lichens. Overall, however, the lichen flora of the montane forests, especially the epiphytic lichen flora, is one of the outstanding features of Peloponnesian lichenology.

All the montane forests have been subjected to some degree of human disturbance for a very long time, and there are no true patches of old-growth forest left. The more demanding taxa characteristic of such forests in other parts of the world, such as many calicioid lichens and fungi, simply do not occur here. Although parts of these forests may look, at first glance, like almost pristine wilderness, study of their history reveals otherwise. For example, the Abies forests of the Menalo Mountains, which now form a large, continuous expanse of apparently little disturbed forest were, in fact, at one time much grazed, and probably reduced to just scattered patches. The government of the newly independent Greece sought advice from an Austrian forestry expert in the 1840s on how to manage the Menalo forests, and as a
result grazing was largely curtailed and the forests were allowed to regenerate (Thanassis Homatos, pers. comm.).

Below 1000 m altitude, there are some quite extensive plantations, usually of various Pinus species, but occasionally of Eucalyptus, but they are rarely of much lichenological interest. Large and botanically interesting forests are not common. They occur in only two regions, so far as I am aware. In the north-west, the ancient Forest of Foloi, which I have not yet studied, occupies an area of heavy clay soils and is dominated by species of Quercus. In the south-east, around the Parnon Mountains, fairly extensive forests of Castanea sativa occur near the villages of Kastri and of Kastanitsa. This species supports a rich epiphytic lichen flora, but unfortunately its future is threatened by chestnut blight, recently introduced to Greece.

Other lowland woods occur, but many of them are small, in and around agricultural areas, and influenced to varying degrees by human activity, all of which make it difficult to classify them and to generalise about them. However, their contribution to lichen diversity may be significant. These semi-natural woods, often dominated by Quercus species, merge into semi-agricultural ones, arising from neglected walnut groves, olive groves, etc., which may also have a significant lichen flora, and then into more intensively managed, agricultural formations, which tend to be of less interest. More natural small patches of woodland are occasionally encountered, especially on steep slopes, and they can have a rich lichen flora.

There are two other distinct, and easily recognisable, types of lowland wood. One consists of Platanus orientalis forming a narrow ribbon of woodland along watercourses. The trees are sometimes old and large, but these apparent advantages for lichens are offset by the nature of the bark, which flakes off easily and, judging from the few sites that I have studied in detail, these trees do not have an outstanding lichen flora. The other distinct type consists of Salix species in poorly drained areas; I have not studied any examples.

Natural vegetation lacking woody plants occurs in a few places. When it occurs where there is much bare rock, such as at high altitudes or on steep cliffs, its lichen flora usually resembles that of the more open types of shrubland, but without the epiphytic species. Sites without woody plants and also lacking bare rock are limited to the few sandy, muddy or grassy communities near the coast. These support very few lichens, except sometimes on man-made structures.

Agricultural communities can be divided into those on large areas of ±flat land, suitable for mechanization, and those on areas of poorer or hilly land. The former support a moderately intensive agricultural, though not nearly as intensive as in countries like the Netherlands or the U.K., and are poor in lichens except where uncultivated areas provide refugia. To a lichenologist, and perhaps also to a lichen, the latter usually resemble shrublands or woodlands, albeit sometimes rather disturbed or complex ones.

Freshwater aquatic vegetation is of little importance. Most lakes have been drained, and the strongly seasonal precipitation means that very few watercourses flow all year round. I have not yet looked seriously for aquatic lichens, but casual observations suggest that they are absent or very rare.

Despite the long coastline, marine lichens are probably also rare, though there are some species, maritime rather than strictly marine, that are only found near the sea. The tidal range in the Mediterranean is small, and most coastal rocks are limestone, both of which are unfavourable to the development of rich communities of marine lichens. I have not recorded any strictly marine lichens (though I have not yet examined many marine sites).

The humidity is too low to support foliicolous lichens; I have not found any, though I have looked. The shrub Buxus sempervirens, which supports foliicolous lichens in southern Spain, is not native to the Peloponnese (and is planted only rarely, in towns). It is present in northern Greece, and its lichen flora was reported in Christensen (2000), who did not find any foliicolous species. However, since foliicolous lichens have been reported from Spain, Italy and Turkey, they may yet turn up in Greece.

Human influence

In comparison with much of Europe, the Peloponnese gives the impression of having a fairly intact lichen flora. However, this statement must be interpreted with care. Human influence has been present for millenia, and any species unable to tolerate even low levels of human disturbance will have vanished long ago. What we see now is a flora that is moderately robust in the presence of a limited degree of human disturbance, but which has never been subjected to, and probably could not survive, the sorts of drastic disturbance that have impoverished the lichen flora of large areas of north-western Europe.

The human population is small, so direct human pressure is not great. The largest town, Patra, has only about 200,000 people, and the second largest, Kalamata, has around 40,000. On the other hand, nowhere is more than a few kilometres from a village - there are no ‘wilderness’ areas - so low intensity human pressure is pervasive.

Agriculture is not a threat to the lichen flora, though it may be a serious threat to some other groups of organisms, e.g. by draining the few remaining wetlands. Most agriculture is of low to medium intensity. It does not generate much pollution by nutrient-enrichment (e.g. by ammonia, or fertilisers), and in any case the lowland lichen flora is largely adapted to nutrient-rich conditions.
The Peloponnese has never supported much industry, so sulphur dioxide pollution from the burning of coal has never been a major problem. Today, there is only one significant source of sulphur dioxide pollution, the electricity generating station near Megalopoli. Its effects were reported in Riga-Karandinos & Karandinos (1998). The power station certainly causes some degree of local pollution - the coal has quite a high sulphur content and in certain weather conditions large amounts of smoke can be seen to accumulate above the plain of Megalopoli - but the fact that these authors were able to study pollution by determining contaminant levels in two rather sensitive species, Anaptychia ciliaris and Lobaria pulmonaria, present in the (quite small) plain of Megalopoli indicates that those species were able to survive there or at least close by. Pollution levels could not, therefore, have been extreme. This power station has been blamed by some people (though not by the authors cited above) for causing the death of many trees in the Menalo mountains, which lie east of Megalopoli, but my own observations are strongly at variance with this suggestion; it appears to me that the dead trees, which are numerous in some places, died from drought. (A reduction in grazing pressure has allowed many young trees to grow, intensifying competition for water.)

Pollution from oxides of nitrogen from motor vehicles also appears to be negligible. One might have expected the notorious photochemical smog of Athens to have exerted a damaging effect, since Athens is not far from the east coast of the Peloponnese, but I have not found any evidence of this. This may be a matter of prevailing winds, or of the coastal mountains protecting the rest of the Peloponnese, or of limestone (and lime-rich dust) buffering the worst effects; or perhaps I haven't looked hard enough.

Fire has always been a component of many of the ecosystems in the Peloponnese, and to some extent they are adapted to it, but present conditions are abnormal and fire is today a most serious threat. Rural areas have suffered much depopulation in the last half century, and this has contributed to a substantial reduction in grazing by sheep and goats. The grazing pressure has dropped by a factor of 10 - 100 in many areas. This has resulted in a buildup of combustible material, so fires now can be more intense than formerly. In addition, large numbers of new tracks have been bulldozed, sometimes with little justification, into quite remote areas, and these have facilitated access by people who would not previously have entered these areas and who may not take adequate precautions against fire. In the summer of 2007, about 8% of the entire Peloponnese burned. The montane forests are especially vulnerable because they are not very extensive; in 2000, about 25% of the forest in the Menalo region were destroyed in a single fire; this most important of all Greece's Abies cephalonica forests will not regenerate easily, as young Abies trees can only survive in a shaded microhabitat. Fire on this scale, if repeated, will devastate the entire ecosystem on the Peloponnese. The fires of 2007, for example, destroyed a site near the town of Zacharo that supported several western Mediterranean species that are very rare in Greece; it may have been their only Peloponnesian site.

Human induced global warming will certainly affect the Greek lichen flora, and probably adversely. Species that are presently confined to the very highest altitudes, e.g. Fulgensia australis, will probably be eliminated. Precipitation in Greece is expected to decline by about 40% by mid century, so large fires may become more common. This would cause major changes, as the present vegetation is not in equilibrium with such a fire regime.
Appendix: Supplementary references

This appendix exists more for the convenience of the author than of the reader, and most readers can ignore it. It lists publications that I have not yet studied, but which I need eventually to check to ensure that nomenclatural information is cited correctly in the main text. Most of them will be transferred to the ordinary References section after I have seen them. Some of these publications are here because they have proved difficult to obtain, others because I have not yet found time to study them. The list may contain errors. Alphabetical suffices to the year of publication are independent of those in the main References section.


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