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AN AUTOMATICALLY PRODUCED IDENTIFICATION KEY TO THE LICHENS OF MT VALERIO (TRIESTE, NE ITALY)

UNA CHIAVE DI IDENTIFICAZIONE DEI LICHENI DEL MONTE VALERIO (TRIESTE, NE ITALIA) PRODOTTA AUTOMATICAMENTE

Abstract - An identification key to the 110 lichens known from Mt Valerio (Trieste) is presented as a contribution to the study of the biodiversity of this area. The key was produced using FRIDA (FRiendly IDentificAtion), a new computerised tool for the automatic creation of interactive identification tools.
Key words: Biodiversity, Identification keys, Interactive keys, Lichens, Trieste, Italy.

Riassunto breve - *Viene presentata una chiave di identificazione dei 110 licheni noti per il M. Valerio (Trieste) come contributo allo studio della biodiversità di quest'area. La chiave è stata prodotta usando FRIDA (FRiendly IDentificAtion), un nuovo strumento informatico per la creazione di chiavi computerizzate ed interattive.*
Parole chiave: *Biodiversità, Chiavi di identificazione, Chiavi interattive, Licheni, Trieste, Italia.*

Introduction

Starting from 2001, two national projects, co-ordinated by prof. P. L. Nimis, Department of Biology, University of Trieste and involving several Italian Universities, focused on the development of computerised databases and interactive identification tools accessible via Internet for different groups of plants and fungi of Italy. Computerised floras may provide updated information on biodiversity, and readily generate products such as regional-local floras (e.g. of a biotope, a natural park, a province). Interactive identification tools may simplify identification, by adopting user-friendly interfaces, easy-to-look-at characters, and multi-criteria filters. An original and flexible computerised system, FRIDA (FRiendly IDentificAtion), was developed by the senior author. The keys produced by FRIDA may be delimited on the basis of different criteria: the species of a biotope or of an administrative region, plants with red flowers, lichens with black, lecanorine apothecia, etc. They are available in two forms: 1) paper-printed, with traditional dichotomous keys, descriptions and images; 2) interactive form, accessible on-line, with friendly user interfaces.

Mt Valerio hosts the Botanical Garden of the University of Trieste and a naturalistic path (http://www.univ.trieste.it/~biologia/ortoval/valerio.htm). The biotope was used for many years by zoologists and botanists for scientific and didactic purposes. At present 363 taxa of higher plants, 272 fungi, 110 lichens, 28 myxomicetes, 50 liverworts and mosses, 39 invertebrates, 51 birds and 19 other vertebrates are known from this area. Lichen diversity of Mt Valerio was investigated by the junior author (CASTELLO, 2001). An identification key to the lichens of Mt Valerio, automatically created by FRIDA, is presented here in the paper-printed form.

Survey area

Mt Valerio is a low hill (215 m) in the north-east suburban area of Trieste; it belongs to the first hilly zone which arises from the urban centre to the Karst plateau, facing the Gulf of Trieste. The University of Trieste lies on the southern and western side of the hill.

The climate of this area is submediterrean, strongly influenced by the Adriatic Sea, with dry summer and winter, rainy autumn and spring, and occasional frosts in winter. Annual precipitation is 1016,9 mm; average yearly temperature is 14,1 C° (Codogno, ined.; period of observation: 1901-1990). Prevailing winds are the cold and dry Bora, blowing in winter from east north-east, and the southern, mild and humid Scirocco.

The substrate is Flysch, a base-rich formation of alternating sandstones and marls; in natural areas many sandstone boulders and stones are on soil surface. In the survey area there are also man-made substrata such as small walls of sandstone, walls and buildings of cement, calcareous stones brought from the Karst plateau in 1963-1965 for the construction of the Botanical Garden of the University.

The survey area has a surface of ca. 0,25 km^2. It hosts both highly disturbed sites (the University centre, residential zones and backyards, roads with low traffic) and more or less natural sites with different types of vegetation. Small mixed oak woods with *Quercus petraea* and *Q. pubescens* are on the western and southern side of the hill, respectively. A wood of *Carpinus orientalis* lies on the more humid part of the western side, and an artificial pine wood of *Pinus nigra* is on the north and east sides. Shrublands with *Spartium junceum* and more or less close formations of *Robinia pseudoacacia* are mainly located on the south-east side of the hill.

Material and methods

The key to the 110 lichen species occurring in the area of Mt Valerio was created by the program FRIDA (FRiendly IdentificAtor) on the basis of the floristic list published by CASTELLO (2001), and of several databases and archives of morpho-anatomical, chemical, ecological and distributional data, which are part of ITALIC, the Information System on Italian Lichens (http://dbiodbs.univ.trieste.it/) (NIMIS & MARTELLOS, 2002; NIMIS, 2003).

Lichens were collected in 1998-1999 in the different environments of Mt Valerio: trunks of *Quercus petraea*, *Q. pubescens*, *Carpinus orientalis, Ulmus minor*, *Pinus nigra*; walls of cement and sandstone, mortar, sandstone boulders and stones on soil surface in natural formations, calcareous stones, soil. Floristic data were integrated by herbarium samples from TSB and information from the literature (CASTELLO, 2001). The material is kept in TSB. Identification was mainly based on CLAUZADE & ROUX (1985) and monographs of critical taxa; the complete floristic list with remarks on ecology or taxonomic aspects of critical taxa is in CASTELLO (2001). Nomenclature follows NIMIS & MARTELLOS (2003).

FRIDA

FRIDA was developed by the senior author starting from 2001; it attracted the interest of AREA Science Park Trieste in the framework of project SISTER, which financed the promotion of its products, and its patenting by the University of Trieste.

Procedures and functions of FRIDA are written in PL/SQL language, running on a Oracle Database Server, which is connected to the Web by an Oracle Application Server. FRIDA is flexible, its use does not require learning any special language nor using codes to input information, and is able to export data in several other formats. A detailed description of procedures and functions of FRIDA are out of the scope of this paper, and will be detailed in a forthcoming paper. Further information about the software and its features can be asked by e-mail to the senior author. FRIDA can automatically generate both interactive identification tools accessible on-line, and traditional paper-printed identification keys, and can be easily connected to ecological, taxonomical or distributional archives. In the on-line versions, the user can specify any set of ecological, distributional, morphological or chemical characters. These act as "filters" for reducing the set of species included in the key. Partial on-line access to keys produced by FRIDA is available through ITALIC (http:/dbiodbs.univ.trieste.it/), limited to terricolous lichens of Italy (NIMIS & MARTELLOS, 2004).

The key

The key is based on a hierarchy of characters, taxa being separated on the basis of those which come first in the hierarchy. The keys produced by FRIDA are not organised according to systematic criteria, and especially not by genera. FRIDA, however, can generate more "ortodox" keys, just by changing the order of characters. In the present key, characters are ranked according to the simplicity of observation, and complexity and price of instruments required to observe them: a) bare eyes, b) magnifying lens helping the eyes, c) a few easy-to-get chemical reagents, d) a cheap light microscope, e) a UV-lamp, f) a professional light microscope, g) access to chromatography, scanning electron microscopy, etc. The order of the main characters adopted for producing the key is as follows:

1. substratum;

2. growth form;
3. general colour of thallus;
4. photobiont;
5. macroscopic characters, such as the presence of pseudocyphellae, cilia, rhizines, whether a fruticose thallus is filamentous or not, whether the lower surface of foliose lichens is dark or pale, etc.;
6. presence/absence of vegetative propagules (isidia and soredia), and their general features;
7. type of ascomata;
8. general colour of the ascomata;
9. colour reactions of thallus and medulla, using usual reagents: potassium hydroxide (K), sodium hypochlorite (C), paraphenylenediamine (P), iodine (I) solutions;
10. anatomical characters observed on hand-made sections with a light microscope, such as spore shape and colour, ascomata features;
11. colour of thallus and medulla as seen under a UV-lamp;
12. several, rather variable morphological features of the thallus, or of the ascomata, e.g. form, size and shape of the areolae in crustose lichens;
13. detailed anatomical characters observed in sections, such as chemical reactions of thallus and ascomata, presence, size and shape of crystals, fine structure of spore walls, spore size, etc.;
14. presence of specific lichen substances, detected by thin layer chromatography (TLC).

The automatically produced key was slightly adapted to provide a suitable paper-printed form. The following abbreviations are used in the text: "incl." = including; "esp." = especially.

Key to the lichen species

1 On soil, terricolous bryophytes, plant debris **2**

1 On bark, wood or rock **4**

2 Thallus densely ramified, shrub-like ..... ***Cladonia furcata*** (Huds.) Schrad.
Thallus fruticose, greenish grey, shrubby, K- or K+ brownish, C-, KC-, P+ red, UV-. Primary thallus squamulose, the squamules mostly ephemeral, middle-sized (1-4 mm long and broad), crenate, ascending, glaucescent above, white below. Podetia elongate, ramified, to 8 (-10) cm tall, forming irregular tufts, with pointed apices and smooth surface, sparsely squamulose. Apothecia rare, dark brown, convex. Asci *Porpidia*-type. Spores 1-celled, hyaline, ellipsoid, 8 per ascus. Pycnidia dark, semi-immersed on the tips of podetia. Conidia cylindrical. Photobiont chlorococcoid. With fumarprotocetraric acid, sometimes with traces of atranorin.
Note: a holarctic, temperate to boreal-montane lichen, found on soil, amongst mosses, sometimes on bark and lignum, in areas with calcareous or siliceous base-rich rocks; more hygrophytic than *C. rangiformis*; surprisingly rare along the Adriatic part of the peninsula.

2 Thallus not or scarcely ramified, never shrub-like **3**

3 Thallus P+ red. Medulla UV- ..... ***Cladonia coniocraea*** (Flörke) Spreng.
Thallus fruticose, grey to whitish, K-, C-, KC-, P+ red, UV-. Primary thallus squamulose, the squamules usually persisting, middle-sized, crenate to entire, convex to concave, grey, olive-green to brownish above, white below, often becoming sorediate. Podetia bacilliform, corticate only at base, 1-4 cm tall, 0.5-2 mm thick, usually unbranched, with pointed ends, only occasionally with very small cups, with a corticate and sometimes squamulose zone below, farinose-sorediate above. Apothecia terminal, brown, convex. Asci *Porpidia*-type. Spores 1-celled, hyaline, 8 per ascus. Photobiont chlorococcoid. With fumarprotocetraric acid.
Note: a widespread, holarctic species, found on a wide variety of organic substrata, incl. bark, and then mostly on basal parts of boles, but mostly on soil rich in humus and rotten wood. Common throughout Italy.

3 Thallus P+ yellow changing to red. Medulla UV+ white ..... ***Cladonia rei*** Schaer.
Thallus fruticose, pale brownish grey, K-, C-, KC-, P+ yellow changing to orange-red, UV+ white. Primary thallus squamulose, the squamules small, incised, greenish to pale brownish grey above, white below. Podetia elongate, 1-5 cm tall, simple or sparingly branched, with pointed apices, occasionally with irregular small cups, often corticate and squamulose at the base, farinose-sorediate above. Apothecia rather frequent, terminal, brown, convex. Asci *Porpidia*-type. Spores 1-celled, hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid. With homosekikaic acid and accessory fumarprotocetraric acid.
Note: a mainly temperate, probably holarctic species, found on mineral, clay and base-rich soil, mostly in slightly disturbed habitats such as on track sides and clearings of light forests and heaths. Hitherto known only from the north, mostly below the montane belt; to be looked for further along the Apennines, in areas with siliceous substrata.

4 On bark or wood **5**

4 On rock **41**

5 Thallus squamulose ..... ***Normandina pulchella*** (Borrer) Nyl.
Thallus squamulose, glaucous- to greyish-green, K-, C-, KC-, P-. Squamules 1-2 mm wide, rounded, concave, scattered or aggregated to form colonies. Lower surface white-tomentose. Upper cortex pseudoparenchymatous or evanescent, without a distinct lower cortex. Soredia farinose. Soralia marginal. Photobiont chlorococcoid.
Note: a mild-temperate lichen, most often found on epiphytic *Frullania* and other liverworts; most common in NE and Tyrrhenian Italy, very rare along the E side of the Peninsula.

5! Thallus leprose ..... ***Lepraria lobificans*** Nyl.
Thallus leprose, greenish grey to whitish grey, rarely bluish green, usually diffuse, without marginal lobes, or, more rarely, faintly sublobate at margin, composed by convex granules forming a thick, powdery crust, K- or K+ yellow, C-, KC- or KC+ yellow, P+ orange. Granules up to 500 µm in diam., with protruding short hyphae, but never clam-shaped. Medulla thick, white, UV+ reddish violet, the hyphae 1.5-5 µm thick. Photobiont chlorococcoid, the cells spherical, to 21 µm diam. With atranorin and stictic acid, and variable amounts of constictic acid and zeorin.
Note: in the lower parts of trunks, but also on rocks, lignum, soil and mosses; also occurring in rather polluted areas and on faces wetted by rain; one of the most common species of the genus in Italy, often confused with *L. incana* in the past. Certainly widespread throughout the country.

5! Thallus fruticose **6**

5 Thallus crustose or foliose **9**

6 Branches with a compact central axis ..... ***Usnea subfloridana*** Stirt.
Thallus fruticose, 3-10 (-20) cm long, at first more or less erect, sometimes becoming pendulous. Main branches up to 1.5 mm diam. Thallus often rather straight, irregularly branched with few to abundant fibrils to 1 cm long arising at right angles from the branches, surface reddish brown, more rarely green-grey with more or less red-brown flecks, often irregularly articulate, but segments not conspicuously inflated, tubercles abundant and conspicuous on main branches, often eroded at apices forming coarsely granular soredia, which are occasionally intermixed with a few secondarily corticate isidia; papillae frequent on main branches but absent on fibrils. Two chemotypes occur: a) with thamnolic and ± alectorialic acids (medulla K+ yellow, P+ yellow-orange, UV-) and b) with squamatic acid (medulla K-, P-, UV+ whitish blue).
Note: on branches of trees in relatively closed forests (but then in the upper parts of the crowns), and on isolated trees; one of the few species of *Usnea* which, albeit with stunted specimens, is also found at low altitudes and in relatively disturbed habitats.

6 Branches without a compact central axis **7**

7 Without soredia or isidia, K-. Ascospores 2-celled ..... ***Ramalina fastigiata*** (Pers.) Ach.
Thallus fruticose, greenish, shrubby, K-, C-, KC-, P-. Branches flattened, 1-2 (3) mm wide, contiguous, ramified. Medulla lax, K-, C-, KC-, P-, UV-. Apothecia frequent, lecanorine, terminal, strongly constricted, with plane, pale greenish-brown disk and smooth margin. Ascospores 2-celled, hyaline, reniform, curved, 8 per ascus, 12-16 x 5-6 micron. Photobiont chlorococcoid. With evernic acid.
Note: a widespread, mainly temperate lichen, found on broad-leaved, more rarely coniferous trees in open stands; still common throughout Italy, but almost extinct in the plains of the north; some morphs from humid beech forests of the south deserve further studies.

7 With soredia or isidia, K+ yellow. Ascospores 1-celled **8**

8 With soredia. Undersurface pale ..... ***Evernia prunastri*** (L.) Ach.
Thallus fruticose, greenish-yellow to grey in usnic acid-deficient morphs (f. *herinii*), wrinkled, bifacial, subpendulous, K+ yellow, C-, KC-, P-. Branches (2) 3-6 mm wide, elongate, flattened, ramified with down-turned edges. Undersurface whitish. Medulla K-, C-, KC-, P-, UV-. Soredia whitish. Soralia marginal. Apothecia rare, lecanorine. Ascospores 1-celled, hyaline, ellipsoid, thin-walled, 8 per ascus, 7-11 x 4-6 micron. Pycnidia dark, immersed. Conidia acicular. Photobiont chlorococcoid. With evernic and ± usnic acids, atranorin.
Note: a widespread holarctic lichen, rare only in managed situations and in dry habitats, otherwise one of the most common epiphytic fruticose lichens of Italy.

8 With isidia. Undersurface black at the center, whitish to pinkish at the tips of the branches ..... ***Pseudevernia furfuracea*** (L.) Zopf. v. ***furfuracea***
Thallus fruticose, grey to brownish grey, bifacial, loosely attached to the substratum, K+ yellow, C-, KC-, P-. Branches (2) 3-6 mm wide, elongate, flattened, ascending, with down-turned and entire edges. Undersurface black, whitish to pinkish at the tip. Medulla K-, C-, KC-, P-. Isidia cylindrical, diffuse. Apothecia rare, lecanorine, sessile, strongly constricted, with dark brown disk. Ascospores hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid. With physodic acid.
Note: a cool-temperate to boreal-montane lichen, abundant only in the Alps, much rarer in the Apennines; exceptionally reaching the plains of the north on very acid substrata.

9 Thallus crustose **10**

9 Thallus foliose **22**

10 Thallus yellow **11**

10 Thallus of other colours **12**

11 With soredia. 8 spores per ascus ..... ***Candelariella reflexa*** (Nyl.) Lettau
Thallus crustose, yellow, greenish-yellow in shade, K-. Soredia diffuse, yellow. Apothecia rare, lecanorine, sessile, up to 1 mm diam. Apothecial disk yellow, plane, K-. Margin thin, yellow, K-. Epihymenium yellow, K-. Hymenium J+ violet. Subhymenium colourless. Ascospores 1 (2)-celled, hyaline, oblong-obtuse, 8 per ascus, 10-17 x 4-6 micron. Photobiont chlorococcoid. Do not confuse the scattered granules of *Candelariella xanthostigma* with the soredia of *C. reflexa*! The thallus of *C. reflexa* is composed by small squamules, soon completely covered by soredia; forms without such squamules, with punctiform farinose soredia still await elucidation.
Note: a mild-temperate, holarctic lichen, found on isolated trees, esp. along waysides and in agricultural areas; somehow rarer along the Adriatic side of the Peninsula, and rare throughout Mediterranean Italy.

11 Without soredia. 12-16 spores per ascus ..... ***Candelariella xanthostigma*** (Ach.) Lettau
Thallus crustose, yellow, granulose, K-. Granules sparse to crowded, convex, corticate. Apothecia frequent, lecanorine, sessile, up to 1.2 mm diam. Apothecial disk yellow, plane. Margin thin, yellow, concolorous with disk. Epihymenium yellow, K-. Hymenium J+ violet. Subhymenium colourless. Ascospores 1 (2)-celled, hyaline, oblong-obtuse, 12-16 per ascus, (8) 9-12 (13) x 4-5 micron. Photobiont chlorococcoid. The granules of *C. xanthostigma* should not be confused with the true soredia of *C. reflexa*.
Note: a mild-temperate to cool-temperate, perhaps holarctic species, found on bark of more or less isolated trees, esp. oaks, but also on conifers, much more rarely on lignum.

12 With soredia **13**

12 Without soredia **18**

13 Thallus K+ yellow or yellow changing to red **14**

13 Thallus K- **16**

14 Thallus K+ yellow changing to red, P+ orange-red ..... ***Phlyctis argena*** (Spreng.) Flot.
Thallus crustose, grey to whitish grey, thin, hemiendosubstratic, continuous or sparingly cracked, K+ yellow changing to red, C-, KC-, P+ orange-red. Prothallus pale. Soredia diffuse, granular, grey, usually paler than thallus, K+ yellow changing to red, C-, KC+ orange, P+ orange. Medulla UV-. Apothecia rare, 0.2-0.4 mm diam, immersed in thalline warts. Ascospores many-celled, (75-) 100-140 (-145) x 25-50 micron, hyaline, muriform broadly ellipsoid, 1 per ascus. Photobiont chlorococcoid. With norstictic acid.
Note: a subtropical to southern boreal-montane, holartic lichen, an aggressive colonizer of smooth bark (e.g. of *Carpinus*), with optimum in the deciduous forest belts.

14 Thallus K+ yellow, P- **15**

15 Thallus C+ yellow changing to red. Soredia K+ yelow, P-, C+ orange, KC+ orange ..... ***Lecanora expallens*** Ach.
Thallus crustose, yellowish green, granulose to cracked-areolate, K+ yellow, C+ yellow changing to red, P-. Soredia initially arising from discrete soralia, soon becoming diffuse, farinose, yellowish green, K+ yellow, C+ orange, KC+ orange, P-. Apothecia rare, lecanorine, sessile, 0.3-0.8 (1.5) mm diam. Apothecial disk greenish to pale greenish brown. Margin thin, sorediate. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 10-16 x 4-7 micron. Photobiont chlorococcoid. With zeorin, tiophanic and usnic acids.
Note: a mainly temperate species, found on acid, generally rough bark, esp. abundant on *Quercus cerris*, in open woodlands, sometimes on lignum.

15 Thallus C-. Soredia K+ yellow changing to red, P+ yellow, C- or C+ yellowish, KC+ yellow ..... ***Buellia griseovirens*** (Sm.) Almb.
Thallus crustose, grey, thin, hemiendosubstratic, K+ yellow, C-, KC+ yellow, P-. Prothallus grey-black. Soredia greyish-green, with a yellowish tinge when abraded, K+ yellow changing to red, C- or C+ yellowish, KC+ yellow, P+ yellow. Soralia maculiform. Apothecia rare 0.4-1 mm diam, sessile, with black disk. Ascospores many-celled, not hyaline, ellipsoid, submuriform, 8 per ascus, (13-) 15-28 x 7-13 micron. Photobiont chlorococcoid. With atranorin, norstictic acid and traces of other substances of the stictic acid complex.
Note: a probably holarctic, temperate to southern boreal-montane lichen found on smooth bark of deciduous trees and shrubs in rather humid, but well-lit situations, rarely on wood; optimum above the Mediterranean belt, rarer in heavily managed areas.

16 Thallus C+ red, KC+ red ..... ***Trapeliopsis flexuosa*** (Fr.) Coppins & P. James
Thallus crustose, greyish-green, areolate, K-, C+ red, KC+ red, P-. Areolae up to 0.5 mm wide, angular, convex, contiguous. Soredia grey-green to dark blue-green, K-, C+ red, KC+ red, P-. Soralia maculiform, prominent, sometimes becoming confluent. Apothecia rare, without a thalline margin, sessile, up to 0.7 mm diam., with plane disk. Ascospores 1-celled, hyaline, ellipsoid, thick-walled, 8 per ascus, 7-9.5 x 2.5-4 micron. Photobiont chlorococcoid. With gyrophoric acid.
Note: a widespread, temperate to boreal-montane, circumpolar lichen, found on lignum (often on wooden fences) and acid bark, esp. of *Pinus* and *Castanea*.

16 Thallus C-, KC- **17**

17 Soredia C+ red, KC+ red ..... ***Ochrolechia arborea*** (Kreyer) Almb.
Thallus crustose, whitish to greenish-grey, continuous, K-, C-, KC-, P-. Soredia greyish-green, K-, C+ red, KC+ red, P-. Soralia maculiform, sunken. Medulla K-, C+ red, KC+ red, P-, UV+ orange. Apothecia rare, lecanorine, sessile, strongly constricted, up to 1 mm diam., with pinkish and plane disk. Apothecial margin prominent, thick, whitish. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid.
Note: a mild-temperate lichen, found on isolated deciduous trees with mineral-rich bark.

17 Soredia C-, KC- ..... ***Pertusaria albescens*** (Huds.) M. Choisy & Werner
Thallus crustose, smooth to coarsely warted, often rimose-cracked, grey, with a white prothallus, K-, C-, KC-, P-. Soredia granular, white, K-, C-, KC-, P-. Soralia maculiform, central, plane to concave, often marginate. Medulla UV-. Apothecia rare up to 4 mm diam, lecanorine, immersed in thalline warts. Ascospores hyaline, 170-300 x 50-115 micron, 1-2 per ascus. Photobiont chlorococcoid. With fatty acids.
Note: a widespread, mainly temperate lichen, found on bark; with optimum on old oaks; rare in agricultural areas and in the Mediterranean belt, most common in deciduous open woodlands.

18 Apothecia lecanorine, with a thalline margin containing algal cells **19**

18 Apothecia non lecanorine, without a thalline margin **20**

19 Thallus whitish to pale grey, K+ yellow, C-, KC- ..... ***Lecanora chlarotera*** Nyl.
Thallus crustose, continuous, whitish to pale grey, K+ yellow, C-, KC-, P-. Apothecia frequent, lecanorine, sessile, up to 1.5 mm diam. Apothecial disk pale brown, plane, C-, P-. Margin thick, whitish to pale grey. Epihymenium with a layer of crystals 0.5-7 micron in diam. Ascospores 1-celled, hyaline, broadly ellipsoid, 8 per ascus, 10-14 x 6-8 micron. Photobiont chlorococcoid. With atranorin, gangaleoidin, sometimes with roccellic acid and/or californin.
Note: this is certainly the most common epiphytic *Lecanora* throughout the country.

19 Thallus greenish to greenish-white, K-, C+ yellow, KC+ yellow ..... ***Lecanora symmicta*** (Ach.) Ach.
Thallus crustose, greenish to greenish-white, thin, granulose to irregular areolate, K-, C+ yellow, KC+ yellow, P-. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 1 mm diam. Apothecial disk greenish to pale greenish brown, convex. Margin indistinct, thin. Paraphyses anastomosing, slightly thickened above. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 9-15.5 (-16) x 4-5 (-6) micron. Photobiont chlorococcoid. Conidia 18-25 x 0.5-1 micron, thread- to arc-like. Thallus corticate, without projecting crystals after storage. With usnic acid, xanthone, zeorine.
Note: a holarctic, boreal-montane to temperate lichen, found on acid bark, often on twigs of shrubs; most frequent in the north.

20 Thallus K+ yellow. Spores 1-celled ..... ***Lecidella elaeochroma*** (Ach.) M. Choisy
Thallus crustose, grey to yellowish, continuous, wrinkled, K+ yellow, C-, KC-, P-. Prothallus dark. Apothecia frequent, without a thalline margin, sessile, strongly constricted, up to 1.5 mm diam. Apothecial disk black, often shiny esp. when young, brown in shade-forms. Margin smooth, black. Epihymenium bluish green to grey-blue, K-, C-. Subhymenium brown, paler above. Paraphyses simple, slightly thickened above, free. Margin (section) bluish green to grey-blue. Asci clavate. Ascospores 1-celled, hyaline, ellipsoid, thick-walled, 8 per ascus, 7-16 x 7-8 micron. Pycnidia dark, immersed. Conidia filiform. Photobiont chlorococcoid. With arthothelin and granulosin.
Note: this is the commonest epiphytic lichen of Italy, with an extraordinarily wide ecological and altitudinal range; morphs with a yellowish thallus (v. *flavicans*) are frequent in the south.

20 Thallus K-. Spores more than 1-celled **21**

21 Spores hyaline, 6-8-celled. Apothecial margin indistinct .....
..... ***Scoliciosporum chlorococcum*** (Stenh.) Vězda
Thallus crustose, greyish green, granulose, K-, C-, KC-, P-. Apothecia frequent, without a thalline margin, sessile, slightly constricted, up to 0.4 mm diam. Apothecial disk red brown to dark brown-black. convex, K-, C-, KC-, P-. Margin indistinct. Epihymenium brownish, K-, C-, P-, KC-. Paraphyses anastomosing, ramified, not apically thickened. Ascospores 6-8-celled, hyaline, fusiform, 8 per ascus, 20-40 x 4-5 micron. Photobiont chlorococcoid.
Note: a widespread holarctic, ecologically wide-ranging species, found on bark (esp. of *Fagus*), lignum and siliceous rocks; tolerant to air pollution.

21 Spores not hyaline, 2-celled. Apothecial margin distinct .....
..... ***Amandinea punctata*** (Hoffm.) Coppins & Scheid.
Thallus crustose, pale grey, thin, rimose to areolate, K-, C-, KC-, P-, UV-. Medulla I-. Apothecia frequent, rounded, without a thalline margin, sessile, slightly constricted, 0.2-0.6 mm diam. Apothecial disk black, flat at the beginning, then rapidly convex. Margin thin, smooth, black, indistinct in old apothecia. Epithecium brown. Hypothecium brown. Paraphyses slightly thickened above. Asci *Bacidia*-type, distinctly thickened at the apex, with a I+ blue tholus, the outer gelatinous coat I+ pale blue. Spores 2-celled, pigmented, ellipsoid, thin-walled, not ornamented, 8 per ascus, 12-15 x 6-8 µm. Pycnidia dark, immersed, not common. Conidia filiform. Photobiont chlorococcoid.
Note: in its present circumscription, an almost cosmopolitan lichen, found on a wide variety of substrata, including bark, lignum, siliceous rocks, roofing tiles, brick, and thin layers of soil; the Italian material is heterogeneous and in need of revision; terricolous samples are very rare.

22 Thallus dark, from black to dark brown **23**

22 Thallus of other colours **24**

23 With isidia, without soredia .....
..... ***Melanelia fuliginosa*** (Duby) Essl. ssp. ***glabratula*** (Lamy) Hafellner & Türk
Thallus foliose, red-brown to olive-brown, shiny, orbicular, K-, C-, KC-, P-. Lobes (2-) 3 (-4.5) mm wide, flattened, adpressed to the substratum, flat, elongate, contiguous or overlapping. Isidia cylindrical, smooth, becoming branched-coralloid. Rhizines dark, simple, abundant at margin. Medulla K- or K+ violet, C+ red, KC+ red, P-, UV-. Apothecia rare, lecanorine, sessile, strongly constricted, up to 5 mm diam. Apothecial disk brown, with thick, brown margin. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 10-14 x 5.5-8 micron. Photobiont chlorococcoid. Similar to *M. subaurifera*, but lobes more shiny, and without yellowish punctiform soralia. With lecanoric acid and rodophyscin.
Note: a mainly temperate, ecologically wide-ranging species, occurring both on wayside trees and in open forests (e.g. on *Fagus*).

23 With soredia sometimes becoming isidioid ..... ***Melanelia subaurifera*** (Nyl.) Essl.
Thallus foliose, brown to greenish-brown, thin, orbicular, K-, C-, KC-, P-. Lobes (2) 3-6 mm wide, elongate, flattened, smooth, contiguous, adpressed to the substratum. Soredia becoming isidioid, yellowish. Soralia punctiform, laminar, plane. Undersurface black. Rhizines dark. Medulla compact, K-, C+ red, KC+ red, P-, UV-. Apothecia rare, lecanorine, sessile, strongly constricted. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 9-12 x 5.5-7 micron. Photobiont chlorococcoid. Similar to *M. fuliginosa* ssp. *glabratula*, but lobes less shiny, and with yellowish round soredia from which isidial clusters develop. With lecanoric acid and subauriferin.
Note: a mainly temperate, pioneer species of smooth bark, e.g. on twigs of shrubs and trees, but also found on boles of oaks in open woodlands and parklands.

24 Thallus from bright yellow to red **25**

24 Thallus of other colours **26**

25 With soredia. Thallus K-. Lobes narrow, up to 0.5 mm ..... ***Candelaria concolor*** (Dicks.) Stein

Thallus foliose, yellow to greenish-yellow in shade, K-, C-, KC-, P-. Lobes up to 0.5 mm wide, linear, flattened, adpressed to the substratum. Edge deeply incised. Soredia granular, yellow. Rhizines pale, ramified. Apothecia rare, lecanorine, sessile, up to 1 mm diam. Apothecial disk yellow, plane. Margin granulose, yellow, concolorous with disk. Epihymenium K-. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 6-14 x 4-6 micron. Photobiont chlorococcoid.
Note: a mild-temperate, probably holarctic species found on bark, more rarely on calciferous substrata, mostly on isolated trees in agricultural areas, on wayside trees, etc.; rare in the Mediterranean belt, and less common along the Adriatic side of the Peninsula.

25 Without soredia. Thallus K+ red. Lobes (2) 3-6 mm wide ..... ***Xanthoria parietina*** (L.) Th. Fr.
Thallus foliose, from yellowish green to orange, orbicular, K+ red, C-, KC-, P-. Lobes (2) 3-6 mm wide, elongate, flattened, contiguous, adpressed to the substratum. Rhizines pale, simple, sparse at margin. Apothecia frequent, lecanorine, sessile, strongly constricted, up to 3 mm diam. Apothecial disk orange, plane. Margin thin, smooth. Epihymenium K+ red. Ascospores 2-celled, hyaline, ellipsoid, polar-diblastic, 8 per ascus, (10) 12-16 x 6-9 micron. Photobiont chlorococcoid.
Note: cosmopolitan, absent only from heavily polluted areas; mainly epiphytic, but sometimes present on calciferous or basic siliceous rocks.

26 Without soredia or isidia **27**

26 With soredia or isidia **28**

27 Thallus K+ yellow ..... ***Physcia biziana*** (A. Massal.) Zahlbr. v. ***biziana***
Thallus foliose, white to grey, densely white-pruinose, orbicular, K+ yellow, C-, KC-, P-. Lobes 1-2 (3) mm wide, elongate, contiguous, adpressed to the substratum, with rounded ends. Undersurface brownish. Rhizines pale, simple. Medulla K-. Apothecia frequent, lecanorine, sessile, strongly constricted, up to 3 mm diam. Apothecial disk black, plane. Margin whitish, pruinose, from grey to white. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 13-20 x 7-12 micron. Photobiont chlorococcoid.
Note: a mediterranean to mild-temperate species, found on isolated trees at low altitudes throughout the country.

27 Thallus K- ..... ***Physconia distorta*** (With.) J. R. Laundon
Thallus foliose, from whitish to brownish depending on the amount of pruina, orbicular, lobulate, K-, C-, KC-, P-. Lobes 1-2 (3) mm wide, elongate, flattened, contiguous, adpressed to the substratum. Undersurface black. Rhizines dark, squarrose. Upper cortex prosoplectenchymatous. Medulla white, K-, UV-. Apothecia frequent, lecanorine, sessile, up to 5 mm diam. Apothecial disk black. Margin paler than disk, pruinose, from brownish grey to white. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 26-38 x 13-20 micron. Photobiont chlorococcoid.
Note: a mediterranean to temperate lichen of isolated trees; rare in truly Mediterranean vegetation and in polluted areas.

28 With pseudocyphellae **29**

28 Without pseudocyphellae **31**

29 Pseudocyphellae punctiform. Medulla K-, C+ red ..... ***Punctelia subrudecta*** (Nyl.) Krog
Thallus foliose, grey to grey-brown, orbicular, smooth, K+ yellow, C-, KC-, P-. Lobes 6-10 mm wide, elongate, contiguous, adpressed to the substratum, with rounded ends. Pseudocyphellae punctiform, on upper surface. Soredia farinose, white, K-, C+ red, KC+ red, P-. Soralia maculiform, laminar. Undersurface pale, esp. at the margin. Rhizines pale, simple. Medulla K-, C+ red, KC+ red, P-, UV-. Apothecia rare, lecanorine, sessile, strongly constricted, with brown disk. Ascospores hyaline, 8 per ascus, 14-18 x 12-15 micron. Conidia cylindrical. Photobiont chlorococcoid.
Note: a mainly temperate species, found on bark of isolated deciduous trees; ecologically intermediate between *Xanthorion* and *Parmelion*; quite rare along the East side of the Peninsula, and in the eu-Mediterranean belt.

29 Pseudocyphellae linear. Medulla K+ yellow changing to red, C- **30**

30 With soredia. Spores 11-15 x 6-8 micron ..... ***Parmelia sulcata*** Taylor
Thallus foliose, grey to greyish-green, sometimes darker with age, K+ yellow, C-, KC-, P- or P+ yellowish, UV-. Lobes (1-) 3-8 mm broad, flattened, truncate at the tips and margins, with slight netting and sulcation due linear pseudocyphellae which give rise to linear soralia. Lower surface black, brown and shiny at margin. Rhizines dark, mostly simple or bifurcate, abundant but much shorter at margin. Medulla K+ yellow changing to orange-red, KC+ orange, P+ orange-red, UV-. Apothecia rare, lecanorine, strongly constricted. Disk brown, margin thick, usually sorediate. Asci *Lecanora*-type, thick-walled, the apex I+ blue with a wide, divergent axial body. Spores 1-celled, hyaline, ellipsoid, 8 per ascus, 11-15 x 6-8 µm. Pycnidia dark, immersed. Conidia rod-shaped. Photobiont chlorococcoid. With atranorin (cortex), and salazinic acid (medulla).
Note: mainly epiphytic, but sometimes overgrowing terricolous mosses, esp. in humid areas; certainly the

most common and wide-ranging *Parmelia* in Italy, also present near large urban settlements in the north, rare only in the eu-Mediterranean belt.

30 With isidia. Spores 15-19 x 8-12 micron ..... ***Parmelia saxatilis*** (L.) Ach.
Thallus foliose, grey to greyish-green, sometimes darker with age, K+ yellow, C-, KC-, P- or P+ yellowish, UV-. Lobes 3-8 mm broad, elongate, contiguous or radiating, truncate, with an angular edge, with slight netting and sulcation. Pseudocyphellae linear, on upper surface, often more evident at the tip of lobes. Isidia cylindrical, simple to ramified, diffuse, often darker at the tip. Lower surface black, brown and shining at margin. Rhizines dark, mostly simple, abundant at margin. Medulla white, K+ yellow changing to red, C-, KC+ orange, P+ orange-red, UV-. Apothecia rare, rounded, lecanorine, sessile, strongly constricted, to 1 cm diam. Margin distinct, thick, isidiose. Asci *Lecanora*-type, thick-walled, the apex I+ blue with a wide, divergent axial body. Spores 1-celled, hyaline, ellipsoid, 8 per ascus, 13-19 x 8-12 µm. Pycnidia dark, immersed. Conidia rod-shaped. Photobiont chlorococcoid. With atranorin (cortex), salazinic acid and variable amounts of lobaric and norstictic acids (medulla).
Note: mainly epiphytic, more rarely saxicolous or overgrowing terricolous mosses in humid areas; somehow heterogeneous in Italy; some populations near the Tyrrhenian coast might deserve further study; in humid situations, this species can also occur in the Mediterranean belt.

31 Lobes > 3 mm wide **32**

31 Lobes < 3 mm wide **36**

32 Lobes with marginal cilia. Thallus K+ yellow changing to red. Medulla K+ yellow ..... ***Parmotrema chinense*** (Osbeck) Hale & Ati
Thallus foliose, grey, K+ yellow changing to red, C-, KC-, P-. Lobes 6-10 mm wide, rounded, concave, ascending. Edge up-turned, with marginal cilia. Soredia farinose, whitish. Soralia capitate, marginal, prominent. Undersurface black, brown at margin. Rhizines dark, simple, sparse at margin. Medulla compact, K+ yellow, C-, KC+ yellow, P+ orange, UV-. Apothecia rare, lecanorine. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid.
Note: a mainly mild-temperate lichen, found on bark and mossy rocks; on isolated trees only in humid areas, otherwise in light woodlands, restricted to the mossy base of trunks; exceptionally reaching the dry-continental Alpine valleys in sheltered situations. This, the most common species of the genus in Italy, is extremely rare along the eastern side of the Peninsula.

32 Lobes without marginal cilia. Thallus K+ yellow. Medulla K- **33**

33 Undersurface without rhizines ..... ***Pseudevernia furfuracea*** (L.) Zopf v. ***furfuracea***
Thallus fruticose, grey to brownish grey, bifacial, loosely attached to the substratum, K+ yellow, C-, KC-, P-. Branches (2) 3-6 mm wide, elongate, flattened, ascending, with down-turned and entire edges. Undersurface black, whitish to pinkish at the tip. Medulla K-, C-, KC-, P-. Isidia cylindrical, diffuse. Apothecia rare, lecanorine, sessile, strongly constricted, with dark brown disk. Ascospores hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid.
Note: a cool-temperate to boreal-montane lichen, abundant only in the Alps, much rarer in the Apennines; exceptionally reaching the plains of the north on very acid substrata.

33 Undersurface with rhizines **34**

34 With isidia, without soredia ..... ***Parmelina tiliacea*** (Hoffm.) Hale
Thallus foliose, grey, K+ yellow, C-, KC-, P- or P+ yellowish, UV-. Lobes usually broad (6-10 mm), flattened, very smooth, with rounded ends and an undulate edge, bearing diffuse, cylindrical, simple or rarely weakly ramified isidia, which are often denser and longer in the centre; the colour of the isidia ranges to (mostly) grey to almost black, esp. at the tips. Lower surface black, brown at margin. Rhizines dark, mostly simple, abundant but shorter at margin. Medulla K-, C+ red, KC+ red, P-, UV-. Apothecia very rare, rounded, lecanorine, sessile, strongly constricted, to 8 mm diam. Disk brown, margin thick, smooth, grey. Asci *Lecanora*-type, thick-walled, the apex I+ blue with a wide, divergent axial body. Spores 1-celled, hyaline, broadly ellipsoid, 8 per ascus, 9-10 x 6-8 µm. Conidia bacilliform. Photobiont chlorococcoid. With atranorin in the upper cortex and lecanoric acid in the medulla.
Note: a mainly mild-temperate lichen, mostly found on broad-leaved trees, sometimes on mossy rocks and on terricolous bryophytes; rare only in somehow continental areas, as along the E part of the peninsula.

34 With soredia, without isidia **35**

35 Thallus greenish-yellow. Soralia laminar. Soredia granular, greenish-yellow. Medulla P+ orange ..... ***Flavoparmelia caperata*** (L.) Hale
Thallus foliose, greenish yellow, wrinkled, K+ yellow, C-, KC+ yellow, P-. Lobes 6-10 mm wide, elongate, flattened, contiguous, adpressed to the substratum, with rounded ends. Soredia diffuse, granular, greenish yellow. Soralia laminar. Undersurface black, brown at margin. Rhizines dark, simple, abundant at margin. Medulla K-, C-, KC+ red, P+ orange, UV-. Apothecia rare, lecanorine, sessile, strongly constricted, with brown disk. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 15-20 x 8-10 micron. Photobiont chlorococcoid.
Note: a mild-temperate lichen, found on isolated deciduous, more rarely evergreen trees, only exceptionally on rocks (e.g. on North-exposed faces of basic siliceous rocks in dry-continental Alpine valleys); abundant in the submediterranean belt (except along the Adriatic side of the Peninsula, more subject to dry-cold winds), rarer elsewhere; in humid areas common also in eu-Mediterranean vegetation, in arid areas restricted to sheltered situations, e.g. inside open forests.

35 Thallus grey. Soralia apical. Soredia farinose, grey. Medulla P- ..... ***Hypotrachyna revoluta*** (Flörke) Hale
Thallus foliose, grey, loosely attached to the substratum, K+ yellow, C-, KC-, P-. Lobes (2) 3-6 mm wide, elongate, flattened, smooth. Edge down-turned. Soredia diffuse, farinose, grey, K-, C+ red, KC+ red, P-. Soralia apical. Undersurface black. Rhizines dark, abundant at margin. Medulla K-, C+ red, KC+ red, P-, UV-. Apothecia rare, lecanorine, sessile, strongly constricted, with brown disk. Ascospores 1-celled, hyaline, broadly ellipsoid, 8 per ascus, 11-16 x 8-10 micron. Photobiont chlorococcoid.
Note: a mild-temperate lichen, found on deciduous trees, exceptionally on mossy siliceous rocks in humid areas; very much declining, and absent from urban areas.

36 Lobes with marginal cilia **37**

36 Lobes without marginal cilia **38**

37 Soralia helmet-shaped ..... ***Physcia adscendens*** (Fr.) H. Olivier
Thallus foliose, white to pale grey, white spotted in older parts, thin, loosely attached, K+ yellow, C-, KC-, P-. Lobes 0.5-1 mm wide, linear, flattened, ascending. Edge with marginal cilia. Soredia farinose, whitish to greenish white. Soralia helmet-shaped, apical. Rhizines pale, simple. Apothecia rare, lecanorine, sessile, strongly constricted, with black disk and white margin. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 16-23 x 7-10 micron. Photobiont chlorococcoid.
Note: a widespread, holarctic lichen, one of the most common species of the genus throughout the country, mostly on isolated trees, but also on walls, and eutrophicated calciferous rocks.

37 Soralia labriform ..... ***Physcia tenella*** (Scop.) DC.
Thallus foliose, white to pale grey, white spotted in older parts, thin, loosely attached, K+ yellow, C-, KC-, P-. Lobes 0.5-1 mm wide, linear, flattened, ascending. Edge with marginal cilia. Soredia farinose, whitish to greenish white. Soralia labriform, apical. Rhizines pale, simple. Apothecia rare, lecanorine, sessile, strongly constricted, with black surface and white margin. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 16-23 x 7-10 micron. Photobiont chlorococcoid.
Note: a mainly temperate species; less common, at least in Italy, and perhaps less nitrophyc than *Ph. adscendens*.

38 Lobes hollow. Thallus K+ yellow changing to red. Spores 1-celled ..... ***Hypogymnia physodes*** (L.) Nyl.
Thallus foliose, grey, thick, smooth, K+ yellow changing to red, C-, KC+ yellow changing to red, P-. Lobes 1-2 (3) mm wide, elongate, convex, contiguous, with rounded ends. Soredia farinose, white to grey, K+ yellow changing to red, C-, KC+ yellow changing to red, P+ red. Soralia labriform, apical. Undersurface black, with a brown rim. Medulla white, hollow, K-, C-, KC+ red, P+ red, UV+ pale violet-blue. Apothecia rare, lecanorine, substipitate, with brown disk. Ascospores 1-celled, hyaline, broadly ellipsoid, 8 per ascus. Photobiont chlorococcoid.
Note: a widespread holarctic lichen, still common throughout the country, and even occurring, albeit sporadically and with poorly developed specimens, in relatively polluted areas of the Po-plain; optimum in natural habitats.

38 Lobes not hollow, flat in section. Thallus K-. Spores 2-celled **39**

39 Soralia linear, marginal. Soredia granular ..... ***Physconia grisea*** (Lam.) Poelt ssp. ***grisea***
Thallus foliose, from pale grey to brownish depending on the amount of pruina, orbicular, lobulate, K-, C-, KC-, P-. Pruina at the periphery of the thallus. Lobes 1-2 (3) mm wide, elongate, flattened, adpressed to the substratum. Soredia granular, grey. Soralia linear, marginal. Undersurface whitish. Rhizines pale, simple. Upper cortex paraplectenchymatous. Medulla whitish to white, K-, C-, KC-, P-. Apothecia rare, lecanorine, sessile, up to 3 mm diam., with black disk and grey margin. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 27-34 x 14-17 micron. Photobiont chlorococcoid.
Note: a mainly mild-temperate, perhaps holarctic lichen, found both on bark (often on basal parts of isolated trees) and on calciferous rocks (esp. calcareous sandstone, e.g. on walls); locally common in urban areas.

39 Soralia maculiform. Soredia farinose **40**

40 Lobes < 0.5 mm wide. Thallus grey to pale brown. With a few, incospicuous, very short rhizines ..... ***Hyperphyscia adglutinata*** (Flörke) H. Mayrhofer & Poelt

Thallus foliose, grey to pale brown, thin, orbicular, smooth, K-, C-, KC-, P-. Lobes up to 0.5 mm wide, elongate, flattened, smooth, adpressed to the substratum, with rounded ends. Soredia farinose, grey to yellowish brown. Soralia maculiform, laminar. Apothecia rare, lecanorine, sessile, up to 1 mm diam., with brown disk. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 13-18 x 7-10 micron. Pycnidia dark, semi-immersed. Conidia filiform. Photobiont chlorococcoid.
Note: a widespread mild-temperate species, common throughout Italy on isolated, mostly deciduous trees, also in areas with intensive agriculture (esp. in the Po-plain).

40 Lobes 0.5-1 mm wide. Thallus grey to brownish-grey. Rhizines dark, abundant at margin ..... ***Phaeophyscia orbicularis*** (Neck.) Moberg
Thallus foliose, grey to brownish-grey, orbicular, K-, C-, KC-, P-. Lobes 0.5-1 mm wide, elongate, flattened, adpressed to the substratum. Soredia farinose, greenish grey. Soralia maculiform, laminar. Rhizines dark, simple, abundant at margin. Medulla K-, C-. Apothecia rare, lecanorine, sessile, strongly constricted, with brown and plane disk. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 16-28 x 7-13 micron. Photobiont chlorococcoid.
Note: a holarctic, very polymorphic, ecologically wide-ranging and common species, common also within settlements on a wide variety of substrata.

41 Thallus squamulose **42**

41 Thallus not squamulose, foliose or crustose **44**

42 With apothecia. Spores (2-) 4-celled, hyaline, 8 per ascus ..... ***Toninia aromatica*** (Sm.) A. Massal.
Thallus squamulose, pale grey to greenish brown, often white-spotted, dull, rarely faintly pruinose, K-, C-, KC-, P-. Squamules up to 4 mm diam., mostly somewhat convex, orbicular to irregular, scattered to aggregated. Lower surface pale brown. Medulla K-, C-, KC-, P-. Apothecia frequent, without a thalline margin, sessile, strongly constricted, up to 1.5 mm diam. Disk black, rarely faintly pruinose, flat, smooth. Margin distinct, smooth, black. Epithecium dark olivaceous green to bright green, K-, C-, P-, N+ violet, KC-. Hymenium colourless. Hypothecium dark reddish brown in lower part, paler in upper part. Paraphyses anastomosing, distinctly thickened above, free. Margin (section) dark reddish brown, K-, N-. Asci *Bacidia*-type, clavate. Spores (2-) 4-celled, hyaline, ellipsoid-cylindrical, 8 per ascus, 11-22.5 x 4-5.5 µm. Pycnidia dark, immersed. Conidia filiform. Photobiont chlorococcoid. Without lichen substances.
Note: a holarctic species with a wide latitudinal range, found on horizontal to weakly inclined surfaces of calcareous to basic siliceous substrata, incl. brick and roofing tiles in urban environments. Most common in Tyrrhenian Italy, below the montane belt.

42 With perithecia. Spores not hyaline, muriform, 2 per ascus **43**

43 Lower surface of squamules pale. Rhizines absent ..... ***Endocarpon pallidum*** Ach.
Thallus squamulose, pale greenish grey to brownish, green when wet, smooth, dull, closely adpressed to the substratum, K-, C-, KC-, P-, UV-. Squamules 1-4 mm broad, 0.2-0.3 µm thick, rounded to irregularly lobed, flattened, smooth, contiguous, usually non imbricate, with only slightly up-turned margin. Lower surface whitish to pale brown, with a few bundles of hyaline rhizohyphae which are ca. 2.5 µm thick. Upper cortex paraplectenchymatous. Perithecia frequent, globose to broadly pyriform, fully immersed, to 0.4 mm diam., the apex concolourous with thallus or darker, without involucrellum. Perithecial wall dark throughout, brown to black, ca. 30 µm thick. Paraphyses absent, substituted by periphyses. Hymenium colourless, I+ brown-red. Hymenial algae ellipsoid to globose 3-5 µm in diam. Asci bitunicate, thin-walled, clavate to cylindrical-clavate, the wall I-. Spores pigmented, ellipsoid, muriform, (1-) 2 per ascus, 28-40 x 11-16 µm, the apical spore smaller. Pycnidia black, immersed, inconspicuous. Conidia shortly bacilliform, 3-5 x < 1 µm. Photobiont chlorococcoid. Without lichen substances.
Note: a mainly southern lichen, found in open, dry, calcareous grasslands; the epithet "pallidum" was often used in the past to designate *E. adscendens*. Italian distribution poorly known.

43 Lower surface of squamules dark. Rhizines present ..... ***Endocarpon pusillum*** Hedw.
Thallus squamulose, pale greenish grey to brownish, green when wet, closely adpressed to the substratum, K-, C-, KC-, P-, UV-. Squamules 0.7-3 mm broad, 0.15-0.25 mm thick, usually weakly to deeply lobate, flattened, smooth, scattered to contiguous, non imbricate, fully adnate or rarely with with a slightly up-turned margin. Lower surface black, with conspicuous black rhizines anchoring and linking the squamules, and colourless to dark rhizohyphae. Rhizines moderately to richly branched, to several mm long. Upper cortex paraplectenchymatous, 30-70 µm thick, overlain by a thin to thick amorphous layer. Lower cortex more or less paraplectenchymatous in upper part, brown-black. Perithecia frequent, subglobose, fully immersed, to 0.4 mm diam. Perithecial wall brown-black to black throughout, 20-30 µm thick. Paraphyses absent, substituted by periphyses. Hymenial algae subglobose to ellipsoid-oblong. Hymenium colourless, I+ brown-red. Asci bitunicate, thin-walled, clavate, the wall I-. Spores pigmented, ellipsoid, muriform, (1-) 2 per ascus, 16-50 (-60) x 13-26 µm, the apical spore smaller. Pycnidia immersed, to 0.3 mm broad. Conidia bacilliform, 3-5 x < 1 µm. Photobiont chlorococcoid. Without lichen substances.

Note: the genus *Endocarpon* badly needs revision; *E. pusillum* in the sense of most European authors is heterogeneous, and perhaps could be subdivided into several species. The Italian distribution is poorly known, due to problems in the delimitation towards related taxa.

44 Thallus foliose **45**

44 Thallus crustose **55**

45 Thallus orange to bright yellow-orange ..... ***Xanthoria calcicola*** Oksner
Thallus foliose, orange, orbicular, often with convex knots at the centre, K+ red, C-, KC-, P-. Lobes (2-) 3-6 mm broad, elongated, rounded at tips, weakly concave to flattened. Lower surface pale orange to yellowish grey, attached by scattered hapters. Apothecia rare, lecanorine, sessile, strongly constricted. Disk orange, margin thick, smooth to verruculose. Epithecium K+ red. Asci clavate, bitunicate, thickened at apex with a broad internal beak, I+ blue in the outer part of the apex. Spores 2-celled, hyaline, ellipsoid, polar-diblastic, 8 per ascus. Photobiont chlorococcoid. With anthraquinones (parietin).
Note: a mainly mediterranean to mild-temperate lichen, found on the top of isolated calcareous and basic-siliceous boulders, and, limited to the W side of the Peninsula, abundant on roofing tiles; in strongly eutrophicated situations it can occasionally overgrow bryophytes and plant remains.

45! Thallus from black to brown **46**

45 Thallus not dark, from white to greenish, grey or brownish-grey **49**

46 Photobiont chlorococcoid. Thallus not gelatinous when wet ... ***Neofuscelia pulla*** (Ach.) Essl. s. lat.
Thallus foliose, brown, K-. Lobes (2) 3-6 mm wide, flattened, adpressed to the substratum. Undersurface black. Rhizines dark, simple, abundant at margin. Medulla K-, C+ red, KC+ red, P-, UV+ white. Apothecia frequent, lecanorine, sessile, up to 6 mm diam., with brown margin and disk. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 7-11 x 4-6 micron. Photobiont chlorococcoid. With stenosporic and/or divaricatic acids plus gyrophoric acid.
Note: a mainly temperate to mediterranean species, found on exposed siliceous rocks, incl. pebbles, exceptionally also on limestone, reaching above treeline in dry-continental Alpine areas.

46 Photobiont cyanobacterial. Thallus gelatinous when wet **47**

47 Without isidia. Spores 4-celled ..... ***Collema polycarpon*** Hoffm. ssp. ***polycarpon***
Thallus foliose, gelatinous when wet, black, thick, K-, C-, KC-, P-. Lobes 1-2 (3) mm wide, elongate, convex, adpressed to the substratum. Edge up-turned. Apothecia frequent, lecanorine, sessile, up to 2 mm diam. Apothecial disk brown to black; margin thick, smooth. Ascospores 4-celled, hyaline, ellipsoid, 8 per ascus, 18-28 x 6.5-8.5 micron. Photobiont cyanobacterial. Excipulum euthyplectenchymatous.
Note: a widespread holarctic species, found on exposed, hard, calciferous rocks and dolomite, from the lowland to above treeline.

47 With isidia. Spores more than 4-celled, submuriform **48**

48 Lobes rounded, 6-10 mm wide. Thallus 0.2-0.5 mm thick when moist, minutely striated when dry ... ***Collema auriforme*** (With.) Coppins & J. R. Laundon
Thallus foliose, gelatinous when wet, black, 0.2-0.5 mm thick when moist, minutely striated when dry, K-, C-, KC-, P-. Lobes 6-10 mm wide, rounded, flattened, adpressed to the substratum, with rounded ends. Edge entire. Isidia granulose, diffuse, simple. Upper and lower cortex absent. Apothecia rare, lecanorine, sessile, with brown to black disk and thick margin. Ascospores submuriform, hyaline, ellipsoid, 8 per ascus, 26-36 x 8.5-13 micron. Photobiont cyanobacterial. Excipulum euparaplectenchymatous.
Note: a temperate to southern boreal-montane, holarctic lichen found on calcicolous mosses, rarely directly on rock in sheltered situations, e.g. in woodlands or on shaded walls; rare within settlements and in areas with intensive agriculture.

48 Lobes elongate, (2) 3-6 mm wide. Thallus up to 0.2 mm thick when moist, not minutely striated when dry ..... ***Collema fuscovirens*** (With.) J. R. Laundon
Thallus foliose, gelatinous when wet, black, up to 0.2 mm thick when moist, not minutely striated when dry, K-, C-, KC-, P-. Lobes (2) 3-6 mm wide, elongate, flattened, adpressed to the substratum, with rounded ends. Isidia granulose, diffuse, simple. Apothecia rare, lecanorine, lateral, sessile, up to 1.5 mm diam., with brown to black disk and thick margin. Ascospores submuriform, hyaline, ellipsoid, 8 per ascus, 15-24 x 6.5-13 micron. Photobiont cyanobacterial. Excipulum euparaplectenchymatous.
Note: a widespread holarctic lichen, found on calciferous rocks, more rarely on epilithic mosses; in moderately sheltered sites with some water seepage after rain; one of the most common species of the genus in Italy.

49 Without soredia and isidia ..... ***Xanthoparmelia somloensis*** (Gyeln.) Hale
Thallus foliose, yellowish green, K+ yellow, C-, KC-, P-. Lobes (2) 3-6 mm wide, elongate, flattened, adpressed to the substratum, isotomic-dichotomous, imbricate. Undersurface pale. Rhizines pale, simple.

Upper and lower cortex paraplectenchymatous. Medulla K+ yellow changing to red, C-. Apothecia frequent, lecanorine, sessile, strongly constricted, with brown, smooth disk. Asci bitunicate, clavate. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus. Pycnidia dark, immersed. Conidia cylindrical. Photobiont chlorococcoid. With salazinic acid.
Note: on weathered siliceous rocks and mineral soil in open, dry situations, with a very wide altitudinal range.

49 With soredia or isidia **50**

50 Thallus greenish-yellow, with isidia. Lobe width > 3 mm ..... ***Xanthoparmelia conspersa*** (Ach.) Hale
Thallus foliose, greenish yellow, smooth. Lobes (2) 3-6 mm wide, flattened, adpressed to the substratum. Isidia cylindrical, coralloid. Undersurface black. Medulla K+ yellow or K+ yellow changing to red, C-, KC+ orange, P+ orange, UV-. Apothecia rare, lecanorine, sessile, strongly constricted, 2-8 mm diam., with plane disk. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 6-10 x 4-5 micron. Photobiont chlorococcoid.
Note: on siliceous rocks wetted by rain, incl. pebbles near the ground; restricted to upland areas in the south; less frequent than the vicariant *X. tinctina* in the Mediterranean belt.

50 Thallus white to brownish-grey, with soredia. Lobe width < 3 mm **51**

51 Lobes with marginal cilia. Thallus K+ yellow ..... ***Physcia adscendens*** (Fr.) H. Olivier
Thallus foliose, white to pale grey, white spotted in older parts, K+ yellow, C-, KC-, P-. Lobes < 0.5 mm wide, linear, flattened, ascending. Edge with marginal cilia at the edge. Soredia farinose, K+ yellow. Soralia helmet-shaped, apical. Undersurface white. Rhizines pale, simple. Apothecia rare, lecanorine. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid.
Note: a widespread, holarctic lichen, one of the most common species of the genus throughout the country, mostly on isolated trees, but also on walls, and eutrophicated calciferous rocks.

51 Lobes without marginal cilia. Thallus K- **52**

52 Undersurface black. Rhizines dark **53**

52 Undersurface whitish. Rhizines pale **54**

53 Soralia maculiform ..... ***Phaeophyscia orbicularis*** (Neck.) Moberg
Thallus foliose, grey to brownish grey, K-, C-, KC-, P-. Lobes 0.5-1 mm wide, elongate, flattened, adpressed to the substratum. Soredia farinose, whitish. Soralia maculiform. Undersurface black, with dark rhizines, abundant at margin. Medulla K-. Apothecia rare, lecanorine, sessile, strongly constricted. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 16-28 x 7-13 micron. Photobiont chlorococcoid.
Note: a holarctic, very polymorphic, ecologically wide-ranging and common species, common also within settlements on a wide variety of substrata.

53 Soralia labriform ..... ***Phaeophyscia hirsuta*** (Mereschk.) Essl.
Thallus foliose, grey, usually with thin transparent hairs, K-, C-, KC-, P-. Lobes 0.5-1 mm wide, elongate, flattened, adpressed to the substratum. Soredia farinose, whitish. Soralia labriform, apical. Undersurface black. Rhizines dark, simple. Medulla K-. Apothecia rare, lecanorine, sessile, strongly constricted. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 16-28 x 7-13 micron. Photobiont chlorococcoid.
Note: a mainly temperate lichen found on isolated trees, more rarely on rock, most common in Tyrrhenian Italy.

54 Soralia linear and marginal. Thallus pruinose at the periphery ..... ***Physconia grisea*** (Lam.) Poelt ssp. ***grisea***
Thallus foliose, grey, lobulate, K-, with whitish-grey pruina at the periphery. Lobes 1-2 (3) mm wide, adpressed to the substratum. Soredia granular. Soralia linear, marginal. Undersurface whitish. Rhizines pale, simple. Upper cortex paraplectenchymatous. Medulla whitish to white, K-. Apothecia rare, lecanorine, with black disk and grey margin. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus. Photobiont chlorococcoid.
Note: a mainly mild-temperate, perhaps holarctic lichen, found both on bark (often on basal parts of isolated trees) and on calciferous rocks (esp. calcareous sandstone, e.g. on walls); locally common in urban areas.

54 Soralia labriform. Thallus non pruinose ..... ***Phaeophyscia chloantha*** (Ach.) Moberg
Thallus foliose, grey to brownish, K-, C-, KC-, P-. Lobes 0.5-1 mm wide, flattened, smooth, contiguous, adpressed to the substratum. Soredia farinose, whitish. Soralia labriform. Undersurface whitish. Rhizines pale, simple. Medulla K-, C-, KC-, P-, UV-. Apothecia rare, lecanorine, sessile, strongly constricted. Ascospores 2-celled, not hyaline, ellipsoid, 8 per ascus, 16-28 x 7-13 micron. Photobiont chlorococcoid.
Note: a mild-temperate, typically submediterranean species occurring on a wide range of substrata (mostly on bark of isolated trees, but also on limestone in open woodlands), but never common in heavily disturbed habitats; rare along the East side of the Peninsula.

55 Thallus dark, from black to brown **56**

55 Thallus not dark **64**

56 Photobiont cyanobacterial (photobiont layer bluish green in section) **57**

56 Photobiont chlorococcoid (photobiont layer bright green in section) **58**

57 Photobiont *Scytonema* or *Rivularia*. Photobiont cells longer than 6 micron. Spores 2-4-celled, narrowly ellipsoid ..... ***Placynthium nigrum*** (Huds.) Gray
Thallus crustose, gelatinous when wet, jet black to brown black, sometimes grey-pruinose, granulose, K-, C-, KC-, P-. Prothallus dark. Apotecia frequent, sessile, slightly constricted, up to 1 mm diam. Apothecial disk brown to black, plane, smooth. Margin thin, black, often shining. Epihymenium blue-green. Subhymenium brown. Paraphyses simple. Asci cylindrical. Ascospores 2-4-celled, hyaline, narrowly ellipsoid, thin-walled, 8 per ascus, (7) 9-18 (22) x 3.5-5.5 (6) micron. Pycnidia dark, immersed. Conidia bacilliform. Photobiont cyanobacterial.
Note: a probably holarctic, subtropical to subarctic species, found on calciferous rocks, often near the ground, from the Mediterranean belt (only in shaded-humid situations) to the mountains; also common in small urban settlements (e.g. on north-facing walls).

57 Photobiont *Nostoc*. Photobiont cells shorter than 6 micron. Spores more than 4-celled, submuriform, broadly ellipsoid ..... ***Leptogium biatorinum*** (Nyl.) Leight.
Thallus crustose to small-subsquamulose, brownish black, thin, granulose-areolate, K-, C-, KC-, P-, UV-. Areolae granulose, crenate, flattened, contiguous, sometimes almost subsquamulose to lobulate. Apothecia frequent, lecanorine, rounded, sessile, slightly constricted, 0.4-0.8 mm diam. Disk brown, concave, margin thick. Epithecium very pale brownish. Hymenium and hypothecium colourless. Paraphyses conglutinate, mostly simple, the apices swollen. Asci narrowly clavate, the wall K/I+ blue, apical dome pale blue with a dark blue axial tube. Spores ellipsoid, submuriform, 8 per ascus, 24-32 x 13-16 µm. Photobiont *Nostoc*. Without lichen substances.
Note: a temperate ephemeral lichen of disturbed habitats, most frequent on concrete walls, but also found on calciferous soil; certainly more widespread, esp. in urban areas below the montane belt, but overlooked, or confused with other species.

58 With perithecia **59**

58 With apothecia **60**

59 Involucrellum dimidiate or extending down to the base of perithecium. Areolae < 0.5 mm wide. Spores 14-28 x 7-13 micron ..... ***Verrucaria nigrescens*** Pers.
Thallus crustose, chestnut to blackish brown, areolate, K-, C-, KC-, P-. Areolae < 0.5 mm wide, angular, contiguous. Medulla J-. Perithecia frequent, laminal, globose, fully immersed, with an involucrellum dimidiate or extending down to the base of the perithecium, 0.2-0.4 mm, with black surface. Perithecial wall dark throughout. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 14-28 x 7-13 micron. Photobiont chlorococcoid. Thallus with a black basal layer.
Note: a subcosmopoitan species, one of the most common saxicolous lichens throughout Italy, found both in urban and natural habitats, with a very wide ecological tolerance; several morphs from natural habitats, however, well deserve further study.

59 Involucrellum apical. Areolae 0.5-1 mm wide. Spores 18-35 x 10-17 micron ..... ***Verrucaria viridula*** (Schrad.) Ach.
Thallus crustose, brownish, becoming greenish brown when wet, up to 0.5 mm thick, areolate, K-, C-, KC-, P-. Areolae 0.5-1 mm wide, angular, contiguous. Medulla J-. Perithecia frequent, laminal, globose, fully immersed, with apical involucrellum, 0.2-0.4 mm diam. Perithecial surface black. Perithecial wall dark throughout. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 18-35 x 10-17 micron. Photobiont chlorococcoid. Involucrellum not diverging from the excipulum.
Note: an early colonizer of calciferous substrata, most common on small pebbles, also in urban areas (e.g. on roofing tiles); easily mistaken for *V. macrostoma*.

60 Spores 2-celled, 8 per ascus **61**

60 Spores 1-celled, more than 8 per ascus **62**

61 Apothecia not lecanorine, without a thalline margin. Apothecial disk black. Spores not polar-diblastic ..... ***Catillaria chalybeia*** (Borrer) A. Massal. v. ***chalybeia***
Thallus crustose, beige to more usually dark olivaceous to blackish or dark grey-brown, matt or slightly glossy, K-, P-. Prothallus black. Apothecia without a thalline margin, up to 1 mm diam. Apothecial disk black; margin black. Epithecium dark-brown to green black. Hymenium K-, N+ red, colourless or usually pale blue-green, at least in the lower part. Hypothecium dark brown, K-. Paraphyses simple or rarely forked, with dark-brown cap. Ascospores 2-celled, hyaline, 8 per ascus, 7.5-15 x 2-5 micron. Conidia 1.8-3.5 x 0.5-0.8 micron. Photobiont chlorococcoid.

Note: a holarctic, subtropical to arctic species, found on a wide range of siliceous substrata, incl. roofing tiles and brick, and even on gypsum, in sheltered situations and also on periodically inundated rocks; common both in natural and urban areas, esp. on walls (e.g. present within the urban area of Rome).

61 Apothecia lecanorine, with a thalline margin. Apothecial disk rusty-red. Spores polar-diblastic ..... ***Caloplaca crenularia*** (With.) J. R. Laundon

Thallus crustose, grey to dark grey, areolate, K-. Areolae angular, flattened, contiguous, adpressed to the substratum. Marginal areolae not elongated. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 1.5 mm diam., with a plane, rusty red, K+ red disk and thin, smooth, rusty red, K+ red margin. Epihymenium orange, K+ red. Subhymenium colourless. Ascospores 2-celled, hyaline, ellipsoid, polar-diblastic, 8 per ascus, 12-17 x 7-10 micron. Septum 4-7 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid.

Note: a temperate to subtropical species, found on a wide variety of siliceous rocks, on horizontal to weakly inclined faces; very heterogeneous, and in in need of revision.

62 Thallus KC+ red ..... ***Acarospora gallica*** H. Magn.

Thallus crustose, pale brown, areolate, smooth, K-, C+ red, KC+ red, P-. Areolae 1-2 (3) mm wide, flattened, contiguous, adpressed to the substratum, in clusters up to 3 cm diam. Undersurface whitish or very pale brownish. Medulla K-, C+ red, KC+ red, P-. Apothecia frequent, lecanorine, semi-immersed, up to 1 mm diam., with brown, plane, smooth disk and thin margin. Ascospores 1-celled, hyaline, ellipsoid, more than 32 per ascus, 3.5-5 x 1.5-2 micron. Photobiont chlorococcoid.

Note: a probably holarctic species of base-rich, weakly calciferous siliceous substrata, such as calcareous sandstone, brick, roofing tiles.

62 Thallus KC- **63**

63 Spores 16-32 per ascus, 9-16 x 6-9 micron. Apothecia up to 1 mm diam., plane ..... ***Acarospora oligospora*** (Nyl.) Arnold

Thallus crustose, dark brown, pruinose or not, areolate, smooth, K-, C-, KC-, P-. Areolae 0.2-1.4 mm wide, flattened, dispersed, adpressed to the substratum. Edge angular. Medulla K-, C-, KC-, P-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 1 mm diam. Apothecial disk dark brown, plane, smooth, K-, C-. Margin indistinct, thin. Paraphyses simple. Ascospores 1-celled, hyaline, ellipsoid, 16-32 per ascus, 9-16 x 6-9 micron. Pycnidia dark, immersed. Conidia broadly ellipsoid, 1-celled. Photobiont chlorococcoid.

Note: a holarctic-temperate species, found on basic siliceous rocks (e.g. calciferous sandstone and schist), usually on pebbles, but also on walls, roofing tiles, etc.; probably overlooked in Italy.

63 Spores more than 100 per ascus, 3-5 x 1.5-2 micron. Apothecia up to 0.5 mm diam., concave ..... ***Acarospora veronensis*** A. Massal.

Thallus crustose, dark chestnut brown, areolate, K-, C-, KC-, P-. Areolae 0.3-1.5 mm wide, flattened, smooth, adpressed to the substratum. Edge concolorous with thallus. Medulla K-, C-, KC-, P-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 0.5 mm diam. Apothecial disk brown, concave, umbonate, K-, C-. Margin indistinct, thin. Paraphyses simple. Ascospores 1-celled, hyaline, ellipsoid, more than 100 per ascus, 3-5 x 1.5-2 micron. Pycnidia dark, immersed. Conidia broadly ellipsoid, 1-celled. Photobiont chlorococcoid. Paraphyses 1.5-2 micron thick at the base. Algal layer regular-continuous in section.

Note: a holarctic early colonizer of base-rich siliceous pebbles, roofing tiles, walls, sometimes of soil and lignum, also in small settlements.

64 Thallus from yellow to orange **65**

64 Thallus not from yellow to orange **74**

65 With soredia **66**

65 Without soredia **67**

66 Thallus without marginal lobes, K+ red ..... ***Caloplaca citrina*** (Hoffm.) Th. Fr.

Thallus crustose, yellow to yellowish-green, areolate, K+ red. Areolae flattened, subsquamulose, adpressed to the substratum, subpeltate when young. Soredia diffuse, farinose, yellow to yellowish green, K+ red. Soralia marginal. Apothecia rare, lecanorine, sessile, with yellow, K+ red disk and thick, sorediate, yellow, K+ red margin. Epihymenium yellowish, K+ red. Subhymenium colourless. Ascospores hyaline, narrowly ellipsoid, polar-diblastic, 8 per ascus, 9-16 x 4-9 micron. Pycnidia orange-yellow, immersed. Conidia narrowly ellipsoid, 1-celled. Photobiont chlorococcoid. Thallus initially subsquamulose, but often transformed into a more or less uniform sorediate crust with age. Soredia less than 50 micron diam., initially marginal. Excipulum paraplectenchymatous.

Note: This is an almost cosmopolitan, but very heterogeneous taxon, and several different species might be involved. In Italy *C. citrina* s. str. is the most common species of the genus, occurring on a wide variety of substrata, from asbestos-cement, concrete and mortar to basic siliceous rocks or even eutrophicated wood; very tolerant to, and even favoured by eutrophication (e.g. urine-deposits); common also in large conurbations and along the main highways.

66 Thallus with radiating marginal lobes, K- ..... ***Candelariella medians*** (Nyl.) A. L. Sm.

Thallus crustose, yellow, with radiating marginal lobes, orbicular, K-, C+ orange, KC-, P-. Lobes 0.5-1 mm wide, elongate, flattened, contiguous, adpressed to the substratum. Soredia diffuse, granular, yellow. Apothecia rare, up to 2 mm diam, concolorous with thallus. Spores 12-18 x 5-7 micron, 8 per ascus. Epihymenium K-. Photobiont chlorococcoid.

Note: a mild-temperate lichen found on man-made calcareous substrata (churches, other monuments, top of statues in parks and of gravestones), esp. above the Mediterranean belt, but also on the top of isolated calcareous boulders in natural situations; abundant in small villages of the Apennines.

67 Thallus K- **68**

67 Thallus K+ red **69**

68 On calcareous substrata. Spores 8 per ascus ..... ***Candelariella aurella*** (Hoffm.) Zahlbr.

Thallus crustose, yellow, thin, K-, C+ orange, KC-, P-. Apothecia frequent, lecanorine, sessile, up to 1.5 mm diam. Apothecial disk yellow, plane, K-. Margin thin, concolorous with disk, K-. Epihymenium yellow, K-. Hymenium J+ violet. Subhymenium colourless. Ascospores 1 (2)-celled, hyaline, oblong-obtuse, 8 per ascus, 10-18 x 4-7 micron. Pycnidia immersed. Conidia oblong-obtuse. Photobiont chlorococcoid.

Note: a holarctic, subtropical to arctic-alpine, almost cosmopolitan species, found on a wide variety of calciferous substrata, from limestone and dolomite to mortar, asbestos-cement and concrete, exceptionally on eutrophicated and dusty lignum and bark.

68 On acid siliceous substrata. Spores 12-16 per ascus ..... ***Candelariella vitellina*** (Hoffm.) Müll. Arg.

Thallus crustose, from granulose to small-lobulate, with flat to weakly convex lobules (0.3-2 mm broad), orange-yellow, K- or K+ weakly orange-reddish, C- or C+ orange, KC-, P-. Apothecia frequent, lecanorine, sessile, up to 1.5 (-2) mm diam., rounded to irregular-lobate in shape. Disk orange-yellow, sometimes darkening, flat, K-. Margin thin, smooth to crenulate, concolorous with disk, K-. Epithecium yellow, granular, K-. Hymenium I+ blue. Hypothecium colourless. Asci clavate, with an apical dome which is I+ blue only in the internal, lower part, interrupted in the centre by a a paler blue strip. Spores 1 (2)-celled, hyaline, oblong-obtuse, (12) 16-32 per ascus, 9-15 x (3) 4-5 (6.5) micron. Pycnidia frequent, semi-immersed. Conidia bacilliform, 2.5-3 x 1-1.5 micron. Photobiont chlorococcoid. With calycin and pulvinic acid derivatives.

Note: a holarctic, variable, almost cosmopolitan lichen with a broad ecological range, found on a wide variety of siliceous rocks, on roofing tiles, brick, and sometimes on bryophytes, lignum and acid bark, from the mediterranean belt (where it is very rare) to above treeline in the Alps. The species, being extremely polymorphic and wide-ranging, is a good candidate for molecular studies.

69 Parasitic on other lichens **70**

69 Non parasitic on other lichens **71**

70 Episubstratic. On calcicolous epilithic lichens. Thallus orange to yellow ..... ***Caloplaca inconnexa*** (Nyl.) Zahlbr. v. ***inconnexa***

Thallus crustose, orange to yellow, with radiating marginal lobes, lobulate, K+ red, C-, P-. Lobes up to 0.5 mm wide, elongate, smooth, imbricate. Apothecia frequent, lecanorine, sessile, slightly constricted. Apothecial disk K+ red, C-, P-. Margin thin. Epihymenium orange, K+ red. Subhymenium colourless. Paraphyses not anastomosing, simple, distinctly thickened above. Asci clavate. Ascospores 2-celled, hyaline, ellipsoid, polar-diblastic, 8 per ascus, 9-15 x 3-8 micron. Spore septum 3-7 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid. Parasitic on calcicolous epilithic lichens.

Note: a mild-temperate species, found on the top of isolated calcareous boulders and rock outcrops, on calcareous rocks wetted by rain in sunny situations; esp. common on *Acarospora cervina* and *Aspicilia calcarea*.

70 Hemiendosubstratic. On endolithic lichens, esp. *Bagliettoa*-species. Thallus orange to greyish-orange ..... ***Caloplaca polycarpa*** (A. Massal.) Zahlbr.

Thallus crustose, orange to greyish-orange, thin, with radiating marginal lobes, hemiendosubstratic, continuous, K+ red, C-, P-. Lobes up to 0.5 mm wide, elongate, flattened, smooth. Apothecia frequent, lecanorine, sessile, slightly constricted. Apothecial disk orange, smooth, K+ red, C-, P-. Margin thin, orange. Epihymenium orange, K+ red. Subhymenium colourless. Paraphyses not anastomosing, simple, distinctly thickened above. Asci clavate. Ascospores 2-celled, hyaline, ellipsoid, polar-diblastic, 8 per

ascus, 9-15 x 3-8 micron. Spore septum 3-7 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid. Parasitic on endolithic lichens, esp. *Bagliettoa*-species.
Note: a mainly warm-temperate species, found on compact limestone and, more rarely, dolomite, in sheltered situations; optimum in open woodlands; in the Mediterranean belt confined to more humid-shaded situations.

71 Thallus with radiating marginal lobes **72**

71 Thallus without radiating marginal lobes **73**

72 Lobes plane. Cortex without underlying layer of crystals (cells evident). Thallus bright orange ..... ***Caloplaca aurantia*** (Pers.) Hellb.
Thallus crustose, bright orange, with radiating marginal lobes, orbicular, K+ red, C-, P-. Lobes elongate, flattened, smooth, contiguous. Apothecia frequent, lecanorine, sessile, slightly constricted. Apothecial disk orange, smooth, K+ red, C-, P-. Margin thin, orange. Epihymenium orange, K+ red. Subhymenium colourless. Paraphyses not anastomosing, simple. Asci clavate. Ascospores 2-celled, hyaline, lemon-shaped, polar-diblastic, 8 per ascus, 8-16 x 5-13 micron. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid. Cortex without underlying layer of crystals (cells evident).
Note: a mild-temperate to subtropical species, found on a wide variety of calciferous substrata; common in the mediterranean-submediterranean belts, rarer at higher altitudes, more helio- and thermophytic than the closely related *C. flavescens*.

72 Lobes convex. Cortex with underlying layer of crystals (masking the cells). Thallus yellowish-orange to (rarely) orange ..... ***Caloplaca flavescens*** (Huds.) J. R. Laundon
Thallus crustose, yellowish-orange to (rarely) orange, with radiating marginal lobes, orbicular, K+ red, C-, P-. Lobes 0.5-1 mm wide, elongate, convex, smooth, contiguous. Apothecia frequent, lecanorine, sessile, slightly constricted. Apothecial disk smooth, K+ red, C-, P-. Margin thin. Epihymenium orange, K+ red. Subhymenium colourless. Paraphyses not anastomosing, simple. Asci clavate. Ascospores 2-celled, hyaline, lemon-shaped, polar-diblastic, 8 per ascus, 8-16 x 5-13 micron. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid. Cortex with underlying layer of crystals (masking the cells).
Note: a mainly temperate species, found on limestone, dolomite, calciferous sandstone, sometimes on brick, mortar and roofing tiles; also found on walls, monuments etc., somehow less helio- and xerophytic than the closely related *C. aurantia*; sometimes ascending to above treeline in the mountains of the south.

73 Apothecia with yellow, plane disk and thick margin. Septum up to 3.5 micron long ..... ***Caloplaca crenulatella*** (Nyl.) H. Olivier
Thallus crustose, yellow, thin, K+ red, C-, P-. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 1.5 mm diam. Apothecial disk yellow, plane, K+ red, C-, P-. Margin thick, crenulate, yellow, paler than disk. Epihymenium orange, K+ red. Subhymenium colourless. Hymenium 45-80 micron tall. Paraphyses not anastomosing, simple, distinctly thickened above. Asci clavate. Ascospores 2-celled, hyaline, narrowly ellipsoid, polar-diblastic, 8 per ascus, 12-23 x 5-7 micron. Septum 2-3.5 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid.
Note: a mild-temperate to subtropical species, often found on calcareous walls; perhaps parasitic of *Verrucaria nigrescens* when young; very much misunderstood in the past.

73 Apothecia with orange, convex disk and thin margin. Septum up to 9 micron long ..... ***Caloplaca flavovirescens*** (Wulfen) Dalla Torre & Sarnth
Thallus crustose, from yellowish-grey to orange-yellow, thick, areolate to continuous, wrinkled, K+ red. Apothecia sessile, slightly constricted, up to 2 mm diam. Apothecial disk orange, convex, K+ red. Margin thin, smooth, yellow, paler than disk, K+ red. Epihymenium K+ red. Ascospores 2-celled, hyaline, ellipsoid, polar-diblastic, 8 per ascus, (13) 15-18 x 7-10 micron. Spore septum up to 9 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid.
Note: a mainly temperate species, with optimum on weakly calcareous sandstone and calcifeorus schists, on boulders and walls.

74 Photobiont trentepohlioid ..... ***Opegrapha rupestris*** Pers.
Thallus crustose, grey, thin, K-, C-, KC-, P-. Apothecia frequent, elongate-linear (lirelliform), without a thalline margin. Apothecial disk black, not exposed. Margin black, not transparent in thick sections. Asci clavate. Ascospores 4-celled, hyaline, ellipsoid, 8 per ascus, 13-19 x 5-6 micron. Photobiont trentepohlioid.
Note: an ecologically wide-ranging species, found both in natural habitats (esp. shaded niches of calcareous rocks in woodlands), and in moderately disturbed situations (such as on north-facing walls); it often grows on other crustose lichens (esp. *Bagliettoa* species).

74 Photobiont chlorococcoid **75**

75 With soredia or isidia **76**

75 Without soredia or isidia **77**

76 Thallus grey, with soredia. With bright rusty-red apothecia. Spores 2-celled ..... ***Caloplaca teicholyta*** (Ach.) J. Steiner
Thallus crustose, grey, thick, areolate, more or less clearly placodioid, smooth, K-, C-, KC-, P-. Soredia diffuse, granular. Soralia central. Upper cortex paraplectenchymatous. Apothecia rare, lecanorine, sessile, slightly constricted, up to 1.5 mm diam. Apothecial disk bright rusty red, plane, K+ red. Margin paler than disk. Epihymenium K+ red. Asci clavate. Ascospores hyaline, ellipsoid, polar-diblastic, 8 per ascus, 12-18 x 7-10 micron. Pycnidia immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid. Grey thalline margin sometimes present in young apothecia.
Note: a warm-temperate early colonizer of calciferous substrata (but very rare on pure limestone), often found on sandstone and mortar, mostly on man-made substrata (walls, monuments, roofing tiles, brick walls), common also in settlements.

76 Thallus yellowish to chestnut brown, with sorediose isidia. With black perithecia. Spores 1-celled .... ***Verrucaria tectorum*** (A. Massal.) Körb
Thallus crustose, yellowish to chestnut brown, thick, areolate, K-, C-, KC-, P-. Areolae 1-2 (3) mm wide, angular, contiguous. Medulla J-. Perithecia frequent, laminal, globose, fully immersed, with an involucrellum extending to the upper half, 0.4-0.8 mm. Perithecial surface black. Perithecial wall dark throughout. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 19-33 x 10-24 micron. Photobiont chlorococcoid.
Note: mainly on man-made substrata, incl. mortar walls, on steeply inclined faces.

77 With perithecia **78**

77 With apothecia **83**

78 Spores more than 4-celled, muriform ..... ***Staurothele ambrosiana*** (A. Massal.) Zschacke
Thallus crustose, grey, thin, continuous, K-, C-, KC-, P-. Perithecia half immersed, not flattened, 0.2-0.3 mm diam. Perithecial surface black. Ascospores many-celled, hyaline, ellipsoid, muriform, (1) 2 per ascus, 22-55 x 12-25 micron, brownish at maturity. Photobiont chlorococcoid. Hymenial algae more or less globose, 2-5 micron diam.
Note: on sheltered calcareous rocks in the mountains.

78 Spores 1-celled **79**

79 Thallus pinkish to violet ..... ***Verrucaria marmorea*** (Scop.) Arnold
Thallus crustose, pinkish to violet, often darker around the perithecia, thin, endosubstratic, smooth, K-, C-, KC-, P-. Perithecia globose, fully immersed, flattened, 0.2-0.3 mm. Surface dark. Perithecial wall light-coloured below. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 13-20 x 9-15 micron. Pycnidia immersed, 0,1 mm diam. Photobiont chlorococcoid.
Note: on hard, compact limestone in natural habitats; optimum in the submediterranean belt, but reaching higher altitudes in the south.

79! Thallus yellowish to brownish **80**

79 Thallus white to grey **81**

80 Thallus yellowish to chestnut brown. Involucrellum extending to the upper half. Areolae 1-2 (3) mm wide ..... ***Verrucaria macrostoma*** DC.
Thallus crustose, yellowish to chestnut brown, up to 2 mm thick, areolate, K-, C-, KC-, P-. Areolae 1-2 (3) mm wide, angular, contiguous. Medulla J-. Perithecia frequent, usually one per areolae, laminal, globose, fully immersed, with an involucrellum extending to the upper half, 0.4-0.8 mm diam. Perithecial surface black. Perithecial wall dark throughout. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 19-33 x 10-24 micron. Photobiont chlorococcoid.
Note: an early colonizer of walls (mortar, brick, cement, limestone) in urban settlements, more rarely found on calcareous rocks in natural environments, with a wide ecological amplitude, from horizontal to steeply inclined faces visited by birds.

80 Thallus brownish, becoming greenish brown when wet. Involucrellum apical. Areolae 0.5-1 mm wide ..... ***Verrucaria viridula*** (Schrad.) Ach.
Thallus crustose, brownish, becoming greenish brown when wet, up to 0.5 mm thick, areolate, K-, C-, KC-, P-. Areolae 0.5-1 mm wide, angular, contiguous. Medulla J-. Perithecia frequent, laminal, globose, fully immersed, with apical involucrellum, 0.2-0.4 mm diam. Perithecial surface black. Perithecial wall dark throughout. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 18-35 x 10-17 micron. Photobiont chlorococcoid. Involucrellum not diverging from the excipulum.
Note: an early colonizer of calciferous substrata, most common on small pebbles, also in urban areas (e.g. on roofing tiles); easily mistaken for *V. macrostoma*.

81 Apex of perithecium with radiating groves around the ostiole ..... ***Bagliettoa parmigera*** (J. Steiner) Vězda & Poelt

Thallus crustose, whitish, thin, endosubstratic, smooth, K-, C-, KC-, P-. Perithecia fully immersed, with apical involucrellum, 0.2-0.3 mm, with black surface. Perithecial wall dark throughout. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 13-25 x 7-12 micron. Photobiont chlorococcoid.
Note: a mainly mild-temperate lichen, found on compact limestone and in exposed situations, with optimum in the submediterranean belt; albeit rarely, also present in urban habitats (e.g. on monuments in Rome).

81 Apex of perithecium without radiating groves around the ostiole **82**

82 Thallus areolate, epilithic. Perithecia flattened, fully immersed ..... ***Verrucaria lecideoides*** (A. Massal.) Trevis.
Thallus crustose, greyish, thin, areolate, K-, C-, KC-, P-. Areolae < 0.5 mm wide, angular, flattened, contiguous. Perithecia marginal, globose, fully immersed, flattened, 0.2-0.4 mm diam., with an involucrellum extending to the upper half. Perithecial surface black. Perithecial wall light-coloured below. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 11-20 (25) x 5-11 micron. Photobiont chlorococcoid.
Note: on calcifeorus rocks, mostly limestone and dolomite, but also on base-rich siliceous substrata, in exposed situations (e.g. on the top of isolated boulders).

82 Thallus continuous, endosubstratic. Perithecia conical, not flattened, half immersed ..... ***Verrucaria muralis*** Ach.
Thallus crustose, from pale grey to greyish brown endosubstratic, continuous, K-, C-, KC-, P-. Perithecia conical, half immersed, not flattened, with an involucrellum extending to the upper half, 0.2-0.4 mm. Perithecial surface black. Perithecial wall light-coloured below. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 15-25 x 8-13 micron. Photobiont chlorococcoid.
Note: an early colonizer of pebbles, mortar walls, brick and roofing tiles.

83 Apothecia non lecanorine, without a thalline margin **84**

83 Apothecia lecanorine, with a thalline margin containing algal cells **97**

84 Apothecial disk orange or dirty orange **85**

84 Apothecial disk dark brown to black **86**

85 Spores 2-celled, polar-diblastic ..... ***Caloplaca holocarpa*** (Ach.) A. E. Wade
Thallus crustose, grey, thin, K-, C-, P-. Apothecia without a thalline margin, sessile, slightly constricted, up to 1 mm diam., with orange, K+ red disk. Apothecial margin thin, smooth, yellow to orange-yellow, K+ red, C-. Ascospores hyaline, ellipsoid, polar-diblastic, 8 per ascus, 9-15 x 5-8 micron. Septum 3-5 micron long. Pycnidia immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid.
Note: a holarctic early colonizer of calciferous substrata, found on the top of isolated calcareous boulders and on mortar walls in urban environments.

85 Spores 1-celled, not polar-diblastic ..... ***Protoblastenia rupestris*** (Scop.) J. Steiner
Thallus crustose, grey to dirty grey-brown or grey-green, K-, C-, KC-, P-. Apothecia frequent, without a thalline margin, immersed, not constricted, up to 0.5 mm diam. Apothecial disk dirty orange, convex, smooth, K+ red. Margin indistinct. Epihymenium orange, K+ red, with a layer of crystals. Subhymenium colourless to yellowish. Paraphyses anastomosing, ramified, slightly thickened above, adglutinated. Asci bitunicate. Ascospores 1-celled, hyaline, ellipsoid, thin-walled, 8 per ascus, 8-17 x 5-8 micron. Photobiont chlorococcoid.
Note: a common and ecologically wide-ranging species, most frequent on faces of calciferous rocks wetted by rain, and near the ground; an early colonizer of several substrata, from mortar-cement to basic siliceous pebbles, often found in urban environments.

86 Spores 2-celled ..... ***Catillaria chalybeia*** (Borrer) A. Massal. v. ***chalybeia***
Thallus crustose, beige to more usually dark olivaceous to blackish or dark grey-brown, matt or slightly glossy, K-, P-. Prothallus black. Apothecia without a thalline margin, up to 1 mm diam. Apothecial disk black; margin black. Epithecium dark-brown to green black. Hymenium K-, N+ red, colourless or usually pale blue-green, at least in the lower part. Hypothecium dark brown, K-. Paraphyses simple or rarely forked, with dark-brown cap. Ascospores hyaline, 8 per ascus, 7.5-15 x 2-5 micron. Conidia 1.8-3.5 x 0.5-0.8 micron. Photobiont chlorococcoid.
Note: a holarctic, subtropical to arctic species, found on a wide range of siliceous substrata, incl. roofing tiles and brick, and even on gypsum, in sheltered situations and also on periodically inundated rocks; common both in natural and urban areas, esp. on walls (e.g. present within the urban area of Rome).

86! Spores more than 2-celled **87**

86 Spores 1-celled **89**

87 Thallus K+ red ..... ***Diplotomma chlorophaeum*** (Leight.) Szatala
Thallus crustose, white, K+ red, C-, KC-, P+ orange. Apothecia without a thalline margin, up to 1.5 mm diam., with black, often white-pruinose disk. Ascospores 4- to many celled, not hyaline, submuriform, 8 per ascus, (14,5) 18,5 (27,5) x (7) 10 (12,5) micron. Photobiont chlorococcoid. False thalline margin sometimes present.
Note: a temperate, perhaps holarctic early colonizer of basic siliceous rocks and roofing tiles; overlooked, and certainly more widespread.

87 Thallus K- **88**

88 Thallus white. Spores pigmented, (2-) 4-celled ..... ***Diplotomma epipolium*** auct. non (Ach.) Arnold
Thallus crustose, white, K-, C-, KC-, P-. Apothecia without a thalline margin, up to 1.5 mm diam., with black, often white-pruinose disk. Ascospores (2-) 4-celled, not hyaline, 8 per ascus, (40) 55 (70) x (10) 17 (25) micron. Photobiont chlorococcoid. False thalline margin sometimes present.
Note: a mainly temperate species of exposed calcareous rocks.

88 Thallus greyish-green. Spores hyaline, 4-8-celled ..... ***Scoliciosporum umbrinum*** (Ach.) Arnold v. ***umbrinum***
Thallus crustose, greyish-green, K-, C-, KC-, P-. Apothecia frequent, without a thalline margin, sessile. Apothecial disk brown to blackish, convex, K-, C-, KC-, P-. Margin indistinct. Epihymenium greenish, K-, C-, P-, KC-. Ascospores 4-8-celled, hyaline, sigmoid, with cells of equal size, curved, 8 per ascus, (15) 20-30 (40) x 2-3 micron. Photobiont chlorococcoid.
Note: an ecologically wide-ranging, probably holarctic species, also present in urban environments; sometimes parasitic on other lichens (esp. when on siliceous rocks).

89 More than 32 spores per ascus **90**

89 8 spores per ascus **92**

90 Apothecial disk smooth. Asci I+ blue. Paraphyses simple ..... ***Sarcogyne regularis*** Körb v. ***regularis***
Thallus crustose, white to grey. Apothecia without a thalline margin, (0.3) 0.4-1.5 (2) mm diam. Apothecial disk red-brown to black, plane. Margin black, pruinose, white-grey. Epithecium brownish, well developed. Hypothecium colourless. Paraphyses simple. Asci clavate, I+ blue. Ascospores hyaline, not ornamented, 100-200 per ascus, 3-6 x 1.5-2 micron. Photobiont chlorococcoid.
Note: a vary variable holarctic-subcosmopolitan species which badly needs revision based on molecular data. It is common both in urban environments (e.g. on mortar walls) and in natural situations, mostly in lichen-poor stands.

90 Apothecial disk wrinkled. Asci I-. Paraphyses ramified and anastomosing **91**

91 Ascomata sessile ..... ***Polysporina simplex*** (Davies) Vězda
Thallus crustose. Apothecia rounded, without a thalline margin, sessile, 0.3-0.8 mm diam. Hymenium J+ yellow changing to red. Paraphyses anastomosing, ramified. Ascospores 1-celled, hyaline, narrowly ellipsoid, 200 per ascus, 3-5.5 (6) x 1-1.8 (2) micron. Photobiont chlorococcoid.
Note: a holarctic early colonizer of small cracks of siliceous, sometimes base-rich or slightly calciferous rocks.

91 Ascomata immersed ..... ***Polysporina lapponica*** (Schaer.) Degel.
Thallus crustose, brown, thin, areolate. Apothecia rounded, without a thalline margin, immersed, (0.2) 0.3-0.5 (1) mm diam. Hymenium J+ yellow changing to red. Paraphyses anastomosing, ramified. Asci clavate. Ascospores 1-celled, hyaline, narrowly ellipsoid, 200 per ascus, 3.5-5.5 x 1.5-2.5 (3) micron. Photobiont chlorococcoid.
Note: a widespread, mainly temperate to southern boreal-montane, probably holarctic species, found on base rich, slightly calciferous siliceous rocks, often on walls or on faces near the ground; certainly much more widespread in the north. This species develops its own thallus after initially commencing as a parasite on *Acarospora*, *Buellia*, *Candelariella* or *Lecanora*.

92 Thallus K+ yellow. Asci *Lecanora*-type **93**

92 Thallus K-. Asci not *Lecanora*-type **95**

93 Subhymenium dark, K+ orange to brownish-orange ..... ***Lecidella carpathica*** Körb
Thallus crustose, whitish to pale whitish grey, areolate, K+ yellow, C-. Areolae convex, verrucose, contiguous. Apothecia frequent, without a thalline margin, sessile, strongly constricted, up to 1 mm diam. Apothecial disk black, shiny. Margin thin, black. Hymenium 55-70 micron tall. Epihymenium bluish green to grey-blue, K-, C-. Subhymenium bright red brown. Paraphyses simple, slightly thickened above, free. Margin (section) greenish to blackish blue at edge, brownish within. Asci clavate, *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, thick-walled, 8 per ascus, 8-17 x 5-9 micron. Pycnidia dark, immersed. Conidia filiform. Photobiont chlorococcoid.
Note: a widespread holarctic lichen with a broad altitudinal and latitudinal range, found on base-rich rocks

wetted by rain in exposed situations; in the Apennines and in Southern Italy not uncommon on the top of calcareous boulders; it often starts the life-cycle on other crustose lichens.

93 Subhymenium pale to colourless, K- **94**

94 Apothecial margin (section) dark brown throughout, opaque. Epihymenium greenish black to brownish ..... ***Lecidella anomaloides*** (A. Massal.) Hertel & H. Kilias

Thallus crustose, grey to greenish grey, thin, granulose, K+ yellow, C-. Apothecia frequent, without a thalline margin, sessile, strongly constricted, up to 1 mm diam. Apothecial disk black. Margin thin, black. Hymenium 70-80 micron tall. Epihymenium greenish black to brownish, K-, C-. Subhymenium pale brown to colourless. Apothecial margin (section) uniformly dark brown, opaque. Paraphyses simple, slightly thickened above, free. Asci clavate, *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, thick-walled, 8 per ascus, 7-15 x 5-9 micron. Pycnidia dark, immersed. Conidia filiform. Photobiont chlorococcoid.

Note: on steeply inclined to slightly underhanging, hard, base-rich or weakly calciferous siliceous rocks.

94 Apothecial margin (section) blue-green to brownish at edge, pale and transparent within. Epihymenium brown to purplish brown ..... ***Lecidella stigmatea*** (Ach.) Hertel & Leuckert

Thallus crustose, white to dirty grey-green, thin, K+ yellow, C-, P-. Apothecia frequent, without a thalline margin, sessile, strongly constricted, up to 1.5 mm diam. Apothecial disk black. Margin thin, black. Hymenium 60-80 micron tall. Epihymenium brown to purplish brown, K-, C-. Subhymenium pale brown to colourless. Apothecial margin (section) with blue-green to brownish edge, colourless within. Paraphyses simple, slightly thickened above, free. Asci clavate, *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, thick-walled, 8 per ascus, 10-20 x 5-10 micron. Pycnidia dark, immersed. Conidia filiform. Photobiont chlorococcoid.

Note: a widespread holarctic species, found on base-rich and calciferous siliceous rocks; a variable and ecologically wide-ranging lichen, often found in managed habitats, esp. on sandstone walls, and sometimes starting the life-cycle on other crustose lichens.

95 Apothecial margin (section) dark brown throughout. Spores broadly ellipsoid. Asci *Porpidia*-type ... . ***Porpidia cinereoatra*** (Ach.) Hertel & Knoph

Thallus crustose, dirty creamish whitish or ash grey, thick, areolate. Prothallus black. Medulla K-, C-, P-, J-. Apothecia rounded, without a thalline margin, 0.3-2 mm diam., with black disk, white pruinose. Hymenium 70-110 micron tall. Asci *Porpidia*-type. Ascospores 1-celled, broadly ellipsoid, not ornamented, 8 per ascus, 12-22 (24) x (5) 6-10 (11) micron. Photobiont chlorococcoid.

Note: on siliceous rocks wetted by rain, esp. low boulders and large pebbles in rainly-humid areas.

95 Apothecial margin (section) blue-green or dark brown at edge, pale and transparent within. Spores narrowly ellipsoid. Asci *Lecidea*-type **96**

96 Apothecia arising singly. Thallus C+ red. Medulla J- ..... ***Lecidea fuscoatra*** (L.) Ach.

Thallus crustose, grey to grey-brown, areolate, K-, C+ red, KC-, P-. Medulla UV+ white. Apothecia frequent, without a thalline margin, sessile, 0.5-2 (3) mm diam., with black disk, white pruinose. Epihymenium brownish, K-. Hymenium K-, C-, KC-, P-. Paraphyses with dark cap. Margin (section) brownish at edge. Asci *Lecidea*-type, clavate. Ascospores 1 (2)-celled, hyaline, narrowly ellipsoid, 8 per ascus, (7) 9-14 (17) x (3.5) 4-7 (10) micron. Pycnidia dark, immersed. Photobiont chlorococcoid. Apothecia arising singly.

Note: a mainly temperate, widespread, extremely variable lichen, found of faces wetted by rain, occurring on a wide variety of substrata, from base-rich siliceous rocks to brick and roofing tiles; in the South the degree of morphological variation is surprising.

96 Apothecia arising between the areoles and often compacted together with angular margins. Thallus C-. Medulla J+ ..... ***Lecidea lapicida*** (Ach.) Ach. v. ***lapicida***

Thallus crustose, whitish to grey, areolate, K-, C-, KC-, P-. Medulla J+ blue, UV+ white. Apothecia frequent, without a thalline margin, sessile, (0.2) 0.5-1.2 (1.8) mm diam. Apothecial disk black. Epihymenium brownish, K-. Hymenium K-, C-, KC-, P-. Paraphyses with dark cap. Margin (section) brownish at edge, K+ yellow. Asci *Lecidea*-type, clavate. Ascospores 1 (2)-celled, hyaline, narrowly ellipsoid, 8 per ascus, (8) 10-15 (16) x (3.5) 4-7 (10) micron. Pycnidia dark, immersed. Photobiont chlorococcoid. Apothecia arising between the areoles, often compacted together with angular margins.

Note: a circumpolar, arctic-alpine to boreal-montane and cool-temperate species with a broad ecological range, found on hard, acid siliceous rocks, mostly in exposed, windy situations.

97 Thallus with radiating marginal lobes **98**

97 Thallus without marginal lobes **100**

98 Thallus K+ red, pruinose at the periphery ..... ***Lobothallia radiosa*** (Hoffm.) Hafellner

Thallus crustose, grey, with radiating marginal lobes, orbicular, areolate, K+ red, C-, KC-, P-, pruinose at the periphery. Lobes 0.5-1 mm wide, elongate, contiguous, adpressed to the substratum. Edge entire. Medulla J-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 1 mm diam. Apothecial disk brown to black, plane, smooth. Margin indistinct, thin. Epihymenium greenish brown, K-, C-, P-, KC-. Subhymenium colourless. Paraphyses anastomosing, simple, adglutinated. Ascospores 1-celled, hyaline, broadly ellipsoid, thin-walled, 8 per ascus, 10-15 x 6-9 micron. Pycnidia immersed. Photobiont chlorococcoid. Algal layer under the hymenium present.

Note: a widespread holarctic lichen with a very wide altitudinal and latitudinal range, and with correspondingly broad ecological requirements, found on a wide variety of substrata, including basic siliceous rocks, limestone, dolomite, more rarely brick.

98 Thallus K-. Pruina diffuse **99**

99 Thallus white to pale yellowish, KC- ..... ***Lecanora albescens*** (Hoffm.) Branth & Rostr.

Thallus crustose, white to pale yellowish, with more or less evident radiating marginal lobes, orbicular, areolate, granulose, K-, C-, KC-, P-. Pruina diffuse. Apothecia frequent, lecanorine, sessile. Apothecial disk brownish, C-. Margin crenulate, pruinose, pale, from grey to white. Epihymenium pale grey above, brownish below. Asci *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, (7) 11 (16) x (3) 5-6 micron. Photobiont chlorococcoid. Thallus not pulvinate, generally larger than 1 cm.

Note: a holarctic, widespread lichen, found on a wide variety of calciferous or base-rich substrata, incl. mortar, brick, roofing tiles, walls, also in large urban areas.

99 Thallus greenish, KC+ yellowish ..... ***Lecanora muralis*** (Schreb.) Rabenh. ssp. ***muralis***

Thallus crustose, greenish, with radiating marginal lobes, orbicular, K-, C-, KC+ yellowish, P-. Pruina diffuse. Lobes 0.5-1 mm wide, flattened. Apothecia lecanorine, sessile. Apothecial disk brownish. Margin greenish white, paler than disk. Asci *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 8-14 x 3-7 micron. Photobiont chlorococcoid. Thallus up to 10 cm diam.

Note: a widespread, polymorphic, holarctic lichen, found on siliceous and calcareous rocks, roofing tiles, brick, also occurring inside large conurbations.

100 Thallus K+ yellow changing to red ..... ***Aspicilia cinerea*** (L.) Körb

Thallus crustose, dark grey, orbicular, areolate, K+ yellow changing to red, C-, KC-, P-. Areolae angular, flattened, smooth, contiguous. Medulla K+ yellow changing to red, C-, KC-, P-, J-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 2 mm diam. Apothecial disk black, plane, smooth. Margin indistinct, thin. Epihymenium greenish, K-, C-, P-, N+ green, KC-. Subhymenium colourless. Paraphyses anastomosing, simple, adglutinated. Asci clavate. Ascospores 1-celled, hyaline, ellipsoid, thin-walled, 8 per ascus, 11-22 x 6-13 micron. Pycnidia immersed. Photobiont chlorococcoid.

Note: on more or less basic siliceous rocks wetted by rain.

100! Thallus K+ yellow **101**

100 Thallus K- **102**

101 Thallus whitish to pale grey. Apothecia with brown disk and whitish to pale grey margin .... ***Lecanora campestris*** (Schaer.) Hue

Thallus crustose, whitish to pale grey, thin, granulose, K+ yellow, C-, P-. Apothecia frequent, lecanorine, sessile, strongly constricted, 0.5-1 mm diam. Apothecial disk brown, plane, C-, P-. Margin smooth, whitish to pale grey, K+ yellow, C-, KC-, P-, small. Epihymenium brownish. Subhymenium colourless. Paraphyses slightly thickened above. Asci *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 10-15 x 6-8 micron. Pycnidia dark, immersed. Photobiont chlorococcoid.

Note: a widespread holarctic lichen, found mostly on basic siliceous rocks, esp. hard sandstone, often on small stones, or faces not far from the ground; calcicolous forms are frequent in the south.

101 Thallus greenish yellow. Apothecia with greenish yellow disk and greenish margin .... ***Lecanora polytropa*** (Hoffm.) Rabenh. v. ***polytropa***

Thallus crustose, greenish yellow, thin, K+ yellow, C-, KC+ yellow, P-. Apothecia frequent, lecanorine, sessile, up to 2 mm diam. Apothecial disk greenish yellow, plane. Margin greenish, K+ yellow, KC+ yellow, P-. Asci *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 9-14 x 5-6 micron. Photobiont chlorococcoid.

Note: a cool-temperate to arctic-alpine, circumpolar, ecologically wide-ranging lichen, found on siliceous rocks wetted by rain; more common in the Alps.

102 Apothecial disk black **103**

102 Apothecial disk of another colour **105**

103 On siliceous substrata. Spores 6-8 per ascus ..... ***Aspicilia caesiocinerea*** (Malbr.) Arnold

Thallus crustose, bluish to brownish, rather dark grey, thick, orbicular, areolate, K-, C-, KC-, P-. Areolae angular, flattened, smooth, contiguous. Medulla K-, C-, KC-, P-, J-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 1 mm diam. Apothecial disk black, plane, smooth. Margin indistinct,

thin, equal with thallus, K-. Epihymenium greenish, K-, C-, P-, N+ green, KC-. Subhymenium colourless. Paraphyses anastomosing, simple, adglutinated. Asci clavate. Ascospores 1-celled, hyaline, ellipsoid, thin-walled, 6-8 per ascus, 14-30 x 7-16 micron. Pycnidia immersed. Conidia filiform. Photobiont chlorococcoid. Conidia 6-12 x 1 micron.
Note: on siliceous rocks wetted by rain.

103 On calcareous substrata. Spores 4 per ascus **104**

104 Thallus cracked-areolate, N- ..... ***Aspicilia calcarea*** (L.) Mudd v. ***calcarea***
Thallus crustose, white, orbicular, areolate, farinose, K-, C-, KC-, P-, N-. Areolae angular, flattened, smooth, contiguous, adpressed to the substratum. Medulla K-, C-, KC-, P-, J-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 1 mm diam. Apothecial disk black, sometimes pruinose, smooth. Margin indistinct, thin, K-. Epihymenium greenish, K-, C-, KC-, P-, N+ green. Subhymenium colourless. Paraphyses anastomosing, simple, adglutinated. Asci cylindrical. Ascospores 1-celled, hyaline, subglobose, thin-walled, 4 per ascus, 18-34 x 13-29 micron. Pycnidia immersed. Conidia bacilliform. Photobiont chlorococcoid.
Note: a mainly mediterranean to mild-temperate species, found on limestone and dolomite, sometimes also on other calciferous substrata; absent only from heavily disturbed habitats (but some stunted specimens even grow, on ancient monuments, in the center of Rome), sometimes reaching beyond treeline, esp. in the Apennines.

104 Thallus of scattered, rounded areolae, N+ green .....
..... ***Aspicilia contorta*** (Hoffm.) Kremp v. ***hoffmanniana*** S. Ekman & Fröberg
Thallus crustose, grey to brownish grey, thin, orbicular, areolate, K-, C-, KC-, P-, N+ green. Areolae rounded, flattened, smooth, more or less scattered. Medulla K-, C-, KC-, P-, J-. Apothecia frequent, lecanorine, semi-immersed, not constricted, up to 1 mm diam., mostly 1 per areola. Apothecial disk black, sometimes pruinose, concave, smooth. Margin indistinct, thin, K-. Epihymenium greenish, K-, C-, KC-, P-, N+ green. Subhymenium colourless. Paraphyses anastomosing, simple, adglutinated. Asci cylindrical. Ascospores 1-celled, hyaline, subglobose, thin-walled, 4 per ascus, 18-34 x 13-29 micron. Pycnidia immersed. Conidia bacilliform. Photobiont chlorococcoid.
Note: an early colonizer of a wide variety of calciferous or base-rich substrata, from limestone and dolomite to brick, roofing tiles and mortar walls; one of the most frequent Aspicilia in Italy.

105 Apothecial disk yellow **106**

105 Apothecial disk not yellow **107**

106 Apothecial disk K+ red. Thallus C-. Spores 2-celled ..... ***Caloplaca lactea*** (A. Massal.) Zahlbr.
Thallus crustose, not visible, thin, endosubstratic, K-, C-, P-. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 0.5 mm diam., generally sparse. Apothecial disk yellow, plane, K+ red, C-, P-. Margin thick, smooth, yellow. Epihymenium orange, K+ red. Subhymenium colourless. Paraphyses not anastomosing, simple, distinctly thickened above. Asci clavate. Ascospores 2-celled, hyaline, narrowly ellipsoid, polar-diblastic, 8 per ascus, 15-22 x 6-8 micron. Septum 1-3 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid.
Note: a mainly temperate species, an early colonizer of small calcareous pebbles in open habitats (e.g. stony ground in dry grasslands).

106 Apothecial disk K-. Thallus C+ orange. Spores 1-celled .....
..... ***Candelariella aurella*** (Hoffm.) Zahlbr.
Thallus crustose, yellow, thin, K-, C+ orange, KC-, P-. Apothecia frequent, lecanorine, sessile, up to 1.5 mm diam. Apothecial disk yellow, plane, K-. Margin thin, yellow, K-. Epihymenium yellow, K-. Hymenium J+ violet. Subhymenium colourless. Ascospores 1-celled, hyaline, oblong-obtuse, 8 per ascus, 10-18 x 4-7 micron. Photobiont chlorococcoid.
Note: a holarctic, subtropical to arctic-alpine, almost cosmopolitan species, found on a wide variety of calciferous substrata, from limestone and dolomite to mortar, asbestos-cement and concrete, exceptionally on eutrophicated and dusty lignum and bark. At all elevations, but specimens with a thin grey thallus are most frequent in urban environments below 1000 m.

107 Spores 1-celled **108**

107 Spores 2-celled **111**

108 Thallus C-. Asci *Lecanora*-type **109**

108 Thallus C+ red. Asci *Trapelia*-type **110**

109 Thallus granular or incospicuous, KC+ orange ..... ***Lecanora dispersa*** (Pers.) Sommerf.
Thallus crustose, white to pale yellowish, granulose, K-, C-, KC+ orange, P-. Pruina diffuse. Apothecia frequent, lecanorine, sessile. Apothecial disk brownish, C-. Margin crenulate, pruinose, pale, from grey to white. Epihymenium pale grey above, brownish below. Asci *Lecanora*-type. Ascospores 1-celled, hyaline,

ellipsoid, 8 per ascus, (7) 8.5-14 x (3) 4-7 micron. Photobiont chlorococcoid. Thallus not pulvinate, generally larger than 1 cm.
Note: most frequent in urban environments (e.g. on monuments, mortar walls, asbestos-cement); records from natural habitats and from upland areas refer to other species, esp. to *L. flotowiana*.

109 Thallus of well developed areolae, KC- ..... ***Lecanora albescens*** (Hoffm.) Branth & Rostr.
Thallus crustose, white to pale yellowish, with more or less evident radiating marginal lobes, orbicular, areolate, K-, C-, KC-, P-. Pruina diffuse. Apothecia frequent, lecanorine, sessile. Apothecial disk brownish, C-. Margin crenulate, pruinose, pale, from grey to white. Epihymenium pale grey above, brownish below. Asci *Lecanora*-type. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, (7) 11 (16) x (3) 5-6 micron.
Photobiont chlorococcoid. Thallus not pulvinate, generally larger than 1 cm.
Note: a holarctic, widespread lichen, found on a wide variety of calciferous or base-rich substrata, incl. mortar, brick, roofing tiles, walls, also in large urban areas.

110 Thallus crustose, more or less cracked. Areolae not overlapping .....
..... ***Trapelia coarctata*** (Sm.) M. Choisy
Thallus crustose, whitish, pale grey to pinkish-grey, thin, continuous to cracked, sometimes with a whitish prothallus, K-, C+ red, KC+ red, P-, UV+ bluish white. Apothecia frequent, lecanorine, rounded at least when young, sessile, up to 0.8 mm diam. (usually less); immature apothecia frequent, appearing as white dots on the thallus. Disk pinkish-grey to pale or dark reddish-brown. Proper margin concolourous with disk, surrounded by a thin, paler thalline margin in young apothecia. Paraphyses thin, anastomosing, densely ramified, not apically thickened. Asci *Trapelia*-type, clavate-cylindrical, thin-walled. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 15-25 x 7-13 micron. Photobiont chlorococcoid. With gyrophoric acid.
Note: a widespread holarctic lichen, an early coloniser of siliceous pebbles near the soil, sometimes on bare clayey soil, with a wide altitudinal and latitudinal range; rare, and mostly Tyrrhenian, in the eu-Mediterranean belt.

110 Thallus effigurate or subsquamulose. Areolae often overlapping .....
..... ***Trapelia involuta*** (Taylor) Hertel
Thallus effigurate or subsquamulose, whitish, pale grey to pale pinkish, thin, areolate, K-, C+ red, KC+ red, P-. Areolae often overlapping. Apothecia frequent, rounded, lecanorine, sessile, up to 0.8 mm diam. Apothecial disk rose-pink to red-brown. Margin concolour with disk, surrounded by a paler thalline margin forming a halo-like rim. Paraphyses anastomosing, ramified, not apically thickened. Asci *Trapelia*-type. Ascospores 1-celled, hyaline, ellipsoid, 8 per ascus, 15-25 x 7-13 micron. Photobiont chlorococcoid. With gyrophoric acid.
Note: on basic siliceous rocks, roofing tiles, brick walls, mainly Tyrrhenian.

111 Apothecial disk K-. Spores not polar-diblastic, 12-16 per ascus ..... ***Lecania erysibe*** (Ach.) Mudd
Thallus crustose, grey, thin, continuous, granulose, K-, C-, KC-, P-. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 0.5 mm diam. Apothecial disk pale brown, convex. Margin thin, whitish. Epihymenium K-, C-, P-, KC-. Paraphyses simple, slightly thickened above. Ascospores 2-celled, hyaline, ellipsoid, 12-16 per ascus, 9-15 x 3-5 micron. Photobiont chlorococcoid.
Note: a mainly temperate lichen, found on calcareous substrata, often on mortar, concrete and brick walls; in the past often confused with other species.

111 Apothecial disk K+ red. Spores polar-diblastic, 8 per ascus **112**

112 Apothecial disk orange to reddish-orange. Septum 2-3 micron long. Spores narrowly ellipsoid .....
..... ***Caloplaca arenaria*** (Pers.) Müll. Arg.
Thallus crustose, grey, thick, areolate, K-, C-, P-. Areolae flattened, contiguous. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 0.5 mm diam. Apothecial disk orange to reddish orange, plane, K+ red, C-, P-. Margin smooth, orange. Epihymenium orange, K+ red. Subhymenium colourless. Paraphyses not anastomosing, simple, distinctly thickened above. Asci clavate. Ascospores 2-celled, hyaline, narrowly ellipsoid, polar-diblastic, 8 per ascus, 12-15 x 4.5-6.5 micron. Septum 2-3 micron long. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid.
Note: a holarctic lichen found on calciferous siliceous rocks, incl. walls, often overgrowing other crustose lichens; a heterogeneous taxon in need of revision.

112 Apothecial disk rusty red. Septum 4-7 micron long. Spores ellipsoid .....
..... ***Caloplaca crenularia*** (With.) J. R. Laundon
Thallus crustose, grey to dark grey, areolate, K-. Areolae angular, flattened, contiguous, adpressed to the substratum. Apothecia frequent, lecanorine, sessile, slightly constricted, up to 1.5 mm diam. Apothecial disk rusty red, plane, K+ red. Margin thin, smooth, concolorous with disk, K+ red. Epihymenium orange,

K+ red. Subhymenium colourless. Ascospores hyaline, ellipsoid, polar-diblastic, 8 per ascus, 12-17 x 7-10 micron. Pycnidia orange-yellow, immersed. Conidia ellipsoid, 1-celled. Photobiont chlorococcoid. Septum 4-7 micron long.
Note: a temperate to subtropical species, found on a wide variety of siliceous rocks, on horizontal to weakly inclined faces; very heterogeneous, and in need of revision.

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References

CASTELLO M., 2001 - Studi lichenologici in Italia Nord-orientale. VIII: La diversità lichenica nell'area periurbana del M. Valerio (Trieste, Friuli-Venezia Giulia). *Gortania*, 23: 59-77.

CLAUZADE G. & ROUX C., 1985 - Likenoj de okcidenta Europo. Ilustrita determinlibro. *Bull. Soc. Bot. Centre-Ouest*, Royan, 7 (n.s.), p. 893.

NIMIS P.L., 2003 - Checklist of the Lichens of Italy 3.0. *University of Trieste, Dept. of Biology*, IN3.0/2 (http://dbiodbs.univ.trieste.it/).

NIMIS P.L. & MARTELLOS S., 2002 - ITALIC - The information system on Italian lichens. *Bibl. Lichenol.*, 82: 271-283.

NIMIS P.L. & MARTELLOS, S., 2003 - A second checklist of the lichens of Italy. With a thesaurus of synonyms. *Museo Regionale di Scienze Naturali, Saint-Pierre-Valle d'Aosta*, Aosta, Monografie 4, p. 192.

NIMIS P.L. & MARTELLOS S., 2004 - Keys to the lichens of Italy. I. Terricolous species. *Ed. Goliardiche*, Trieste, in stampa.

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