Selected saxicolous species of the genus *Caloplaca* (licheniused fungae) occurring in the Czech Republic.

containing

Detailed descriptions of 29 species

&

Key to the saxicolous *Caloplaca* species occurring or potentially occurring in the Czech Republic

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2004
Motto:

"Houby jsou produktem díva vymýšleným jen proto, aby narušil harmonii ostatní přírody a přiváděl do rozpaků a zoufalství mykology. V této magické říši není hranic mezi poznaným a nepoznaným, světlo se zde přímo dotýká tmy. Vydali jste se na cestu poznávání, nikoli poznání, na cestu nesrošlanou, která se houpá pod nohama a vede poutníka k radosti a harmonii zrovna tak jistě jako k chmurám a rozčarování. Je vám dáno pracovat, není vám dáno svou práci dokončit."

S. Vaillant (1669-1723) in Botanicon Parisiense.
Annotation

29 saxicolous species of the genus *Caloplaca* were selected for the detailed study. These species are characterised by complete diagnosis, ecology, distribution in the Czech Republic and colour photographs. Taxonomic and nomenclatural notes and illustrations of specific features are added in many cases.

Key to the saxicolous *Caloplaca* species occurring or potentially occurring in the Czech Republic, that contains 46 species, has been created.

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I declare that I have written this study by myself, just with the help of the used references.

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In České Budějovice, 9. 1. 2004

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[Signature]
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1. Introduction

The genus *Caloplaca* has not been sufficiently studied in the Czech Republic. Common species have been very little reported or haven’t yet been known from the Republic. Many taxa have been also misunderstood. Therefore, I decided to work taxonomically 29 saticolous *Caloplaca* species and gather the most records of these as possible. From this work has resulted also the key to the 46 saxicolous *Caloplaca* occurring or potentially occurring in the Czech Republic.

1.1. Description of the genus *Caloplaca* Th. Fr.

Morphological and anatomical terminology follows the chapter 1.3.

The genus *Caloplaca* is more or less separated by the apothecial margin consisting of true and excipulum, asci of *Teloschistes* type, polariloculate colourless spores, bacilliform to oblong single con content of anthraquinones.

*Diagnosis:* Thallus with yellow, orange or red tinge containing anthraquinon pigm upper cortex, or with white, grey, brown or black tinge with or without cont anthraquinones. In some species thallus indistinct or endolithic (fig. 2.4B). Cortex ab present, para-plectenchymatous. Epinecral layer or crystalline pruina present in some Algal layer continuous or discontinuous, para-plectenchymatous or plectenchymatous. cells including in the genus *Trebouxiav* (Chlorophyceae). Medulla sometimes dev mostly loose, plectenchymatous.

Apothecia with yellow, orange or red tinge containing anthraquinon pigme ephymenium, or blackish with or without greyish crystalline pruina and with or v content of anthraquinones. Hypothecium usually colourless, rarely greyish in cross-s with or without oil-drops. Hymenium colourless or rarely deformed asci and some para are filled or covered by yellow (brownish) crystals of anthraquinones. Ephymenium c with anthraquinon-crystals, greyish-yellow, yellow, orange or brownish in cross-s Excipulum usually consisting of true excipulum (without algae) and thalline excipul 1.1A. Asci usually 8-spored, *Teloschistes*-type (amyloid structures dyeing with IKI are on fig. 1.1B). Ascospores colourless, usually 2-cellular, polariloculate, rarely uniloculato species usually included in the genus *Fulgensia* or 4-loculate (fig. 1.1C). Hamat consisting of various types of paraphyses. Paraphyses apically or sub-apically branched branched, usually more or less anastomosed, flexuose or straight and broadened in tips broadened (fig. 1.1D).

Pycnidia immersed, inoscpicuous unchambered or distinct and chambered, in par species partially elevated. Conidiophores single or branched and anastomosed, consis more or less isodiamicet cells. Conidiogenous cells isodiamicet, elongated, long-triang bottle-shaped. Conidia single, bacilliform to oblong (fig. 1.1E).

1.2. The genus *Caloplaca* in the light of molecular biology

Recent molecular research has found out, that the closely related genera *Cal Fulgensia* and *Xanthoria*, based on morphological characters, does not agree wel phylogeny (Gaya et al. 2003). Their results (fig. 1.2) are based on 62 sequences of r ribosomal DNA, internal transcribed spacer (ITS).

Authors reported, that *Caloplaca*, *Fulgensia* and *Xanthoria* form together two mai lineages. First one contains lobate *Caloplaca* species (sect. *Gasparina*), whole sp genyen *Xanthoria*, *Fulgensia schistitii* and surprisingly *Caloplaca pyreceae* (usually kn
Fig. 1.1. **Genus Caloplaca**, characteristic features. A, Vertical section through an apothecium, showing ombinated apothecial margin, consisting of true and thalline excipulum (a, hymenium; b, true excipulum; c, hypothecium; d, thalline excipulum); B, *Teloschistes*-type of ascus, showing structures of apical aparatus; C, spores (a-c, polariloculate spores; a, thin ellipsoid; b, ellipsoidal; c, citriform; d, rare, -loculate spore); D, Tips of paraphyses (a, straight, not broadened in tip; b, flexuose; c, straight, submoniliiform; d, apically branched; e, sub-apically branched; f, branched and anastomosed - simplified); E, Structures inside of pycnidia (a, conidiogenous cells with attached conidia; b, shapes of conidia).
Fig. 1.2. Relationship among selected *Caloplaca*, *Fulgensia* and *Xanthoria* species, based on internal transcribed spacer (ITS) unambiguously aligned sites only. One of the five equally most likely trees generated by maximum likelihood search. All internodes present in the strict consensus of these five trees are highlighted with thicker branches. Numbers above each internode represent posterior probabilities $\geq 50\%$. One asterisk indicates scores $\geq 95\%$, and two asterisks show scores $> 99\%$. 

\[ f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-m)^2}{2\sigma^2}} \]
younger synonym to *C. holocarpa*). Second lineage contains the other *Caloplaca* species and most of *Fulgensia* species. The first group, containing type for genus *Xanthoria* (*X. parietina*) seems to be fairly homogenous. Therefore, authors propose to combine whole *Caloplaca* species of this lineage and *Fulgensia sheistidii* into the genus *Xanthoria*. The second group, containing the type of genus *Caloplaca* (*C. cerina*) is too heterogenous to make any taxonomic conclusions without further study.

In this context, I should rename the title of my study from “Selected saxicolous species of the genus *Caloplaca*...” to “Selected saxicolous species of the genera *Caloplaca* and *Xanthoria*...”

1.3. Anatomical and morphological structures used in determination (their development and variability)

This chapter gives the list of anatomical and morphological structures in alphabetical order. Structures within apothecia and within thallus are mentioned separately. Description of development and variability is added in some structures.

**Apothecium** (sexually originated, disc-shaped fruiting body). The general term **Ascocarp** (fructifying body) is sometimes used instead of apothecium. Great variability in size, shape and colour within the genus *Caloplaca* is apparent. These characters are usually taxonomically important. Some ways of apothecial development are shown (figs. 2.1, 2.2).

**Ascus** (vertical arranged, cudgel-like or oval structure occurring in hymenium, containing ascospores; fig. 1.1B). Size of asci has particular importance in taxonomy. Shape of asci seems to be non-significant for determination.

**Ephymenium** (upper part of hymenium; space between tops of asci and paraphyses tips).

- It is characteristically coloured (e.g. yellow-orange by anthraquinon-crystals) and some chemical reactions (with K and C) are bonded with this layer.

**Excipulum** (apothecial margin) consists of **thalline excipulum** (outer margin containing algae) and **true excipulum** (inner margin, without algal cells). Thalline / true excipulum ratio is useful distinctive character. One of these partial structures can be characteristically absent in some species. However, thalline / true excipulum ratio is strongly dependent on development of apothecia in some species (fig. 2.1). True excipulum is usually more apparent in young apothecia, thalline margin prevails in older apothecia.

Anatomical structure of true excipulum is also taxonomically useful character. Two basic types are distinguished: **plectenchymatous** (consisting of fibrilous cells) and **para-plectenchymatous** (consisting of more or less isodiametric cells).

**Hamathecium** (set of paraphyses).

**Hymenium** (asci-producing layer, fig. 1.1A) consists of paraphyses and asci. Height of hymenium is used in determination, but it is strongly variable within some species. It depends on development - young apothecia have usually lower hymenium. In a single apothecium is sometimes lower hymenium in margins then in centre.

**Hypothecium** (space occurring under the hymenium, it is delimited by thalline tissues from the bottom).

**Paraphyses** (vertically arranged, strile hyphae occurring in the hymenium and surrounding the asci; fig. 1.1D). Paraphyses are variously shaped within the genus *Caloplaca*. Variability in thickness, branching, anastomosing and broadening on the top is significant. Anyway, these characters are usually strongly variable within separate species. Therefore, several characteristic shapes of paraphyses are better to illustrate.
Spores (= Ascospores; sexually originated reproductive particles; fig. 1.1C). Size and shape of spores and septum-thickness (of ripe spores! – see in chapter of Methods) are characters mostly investigated. These characters are strongly variable among species, but usually conservative within separate species. Development of spores is illustrated (fig. 2.3).

Thallus (lichen body). Presence / absence, size, thickness, colour and shape are characters commonly used in taxonomy. Thallus seems to be more variable then apothecia. Basic types of thallus within the genus Caloplaca are endolytic (occurring beneath the surface of substrate, superficially more or less non-visible; fig. 2.4B), epiphytic (occurring on the substrate surface; fig. 2.4A), leprose (having the whole surface of thallus entirely sorediate without any cortex), granular (consisting of granules with cortex), crustose-areolate (crust-like, consisting of island-like portions separated from adjacent areoles), crustose-rimose (crust-like, irregularly cracked in all directions), squamulose (having small scales), sublobate (delimited by small, not elongated and never branched lobes) and lobate (usually orbicular, delimited by elongated and more or less branched marginal lobes).

Algal cells. Occuring in algal layer. Very rarely occur in apothecial structures, out of algal layer (fig. 2.2). Size of cells is investigated, but does not have significant taxonomic importance. Sizes of algal cells are always very variable within single sample. Also different samples of single species are occasionally abnormally different in observed algal sizes.

Algal layer (layer beneath cortex, containing algal cells). Thickness and continuity / discontinuity is investigated, but probably does not have significant taxonomic importance.

Conidia (= pycnospores, asexual spores produced in pycnidia; fig. 1.1E). Size of conidia has particular taxonomic importance.

Conidiogenous cells (conidia are produced on such cells; fig. 1.1E). Size and shape of cells have taxonomic importance.

Conidiophores (hyphae inside of pycnidia, consisting of more or less isodiametric cells, bearing conidiogenous cells). Shape of conidiophores (branched / non-branched or anastomosed / non-anastomosed) is sometimes used in taxonomy.

Cortex (outer layer of thallus, usually consisting of para-plectenchymatous cells and containing no algae). Presence / absence, thickness, size of cells and colour are very useful characters in taxonomy. Chemical reaction of thallus (with K and N) are bonded with upper cells of cortex. Cortex is usually not equally thick layer. Locally penetrates deeply among algal layer-tissue and on the contrary sporadically is very thin (fig. 2.4A).

Epinecral layer (extra-cellular layer occurring on thallus surface, consisting of dead remains of thalline cells in mixture with various crystals). Algae and cyanobacteria inhabiting thallus surface are not included in this term. Presence / absence and thickness of epinecral layer are investigated, but taxonomic importance is small.

Isidia (photobiont-containing protuberance of the cortex, which may be granular, warty, cylindrical or coralloid). Only several isidiate species belong to the genus Caloplaca. Size and shape are used in taxonomy.

Lobules (photobiont-containing protuberance of the cortex similar to isidia, but larger and lobe-shaped). Within the genus Caloplaca occurring only in C. xerica.

Medulla (the lower-most layer of thallus, occurring beneath the algal layer). Usually loose, plectenchymatous and variously thick. Presence / absence and thickness are occasionally investigated. Taxonomic importance is probably not significant.

Pruina (usually pale greyish or white crystalline layer on thallus surface). Commonly occurring within the genus Caloplaca, but only in particular species having taxonomic importance.
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characters types face of on the radiate (crust-rimose scales), usually of algal onomic e. Also observed y / distance. conidia hape of ic, cells, shed or s and are very bonded ntrates 2.4A). of dead bacteriaickness , warty, loplace.

g and Usually are mmonly tonomic

200μ

200μ

0.5mm

Fig. 2.1. Development of apothecia. A, Caloplaca xerica, development from apothecial primordium to old apothecium, true excipulum / thalline excipulum ratio distinctly changes during development; B, Caloplaca crenulatella, horizontal view is situated below vertical setions of particular stages, see the fenulate appearnce of thalline excipulum; C, Caloplaca arenaria, possible development of old apothecia. Single ascocarp is divided into several “daughter” apothecia.
Fig. 2.2. Three different apothecium structures in *Caloplaca flavovirescens*. A, Typical ascocarp with hymenium, hypothecium and true excipulum without algae (common); B, Ascocarp with isolated algal clusters in hypothecium and also in hymenium (rare); C, Ascocarp with large spots of small algal cells thin hymenium. Algal clusters are surrounded with true excipulum-like tissues. These structures are superficially distinct as small elevations in hymenium (rare).
Fig. 2.3. Ascospore development in the genus *Caloplaena*. a-e, young spores (septum not developed at first, then septum slightly indicated or developed, but canal between loculi still thick); f-j, ripe spores (spores bilocular, connected by thin canal); k,l, overripe spores (canal between loculi disappearing, loculi coming smaller); m-r, deformed spores (differing from normally developed spores in size and shape or number, size and shape of loculi; deformed spores occasionally coloured by anthraquinons).
Fig. 2A. Thallus structure of *Caloplaca teicholyta* and *C. marmorata*. A, vertical section through thallus of *C. teicholyta* (a, epinecrallayer; b, cortex; c, algal layer; d, medulla); B, horizontal view on dolytic thallus of *C. marmorata* after 50% HNO₃ application; C, fungal filament of *C. marmorata* in detail.
**Pycnidia** (asexual fruiting bodies, usually immersed in thallus, producing conidia). Pycnidia within the genus *Caloplaca* can be superficially distinct, large and chambered (with central cavity inside) or completely indistinct and unchambered. Relatively conservative structure, little variable within species. Size of pycnidia and colour of cortex around ostiulum (pycnidial opening) are investigated. Specific reactions with C and K are occasionally bonded with the cortex around ostiulum.

**Soralia** (structures creating on thallus surface; spots without cortex, where soredia are produced). Colour, shape and position on thallus are taxonomically important. Delimitation / non-delimitation of soralia (means, if the margin of soralia is distinct or inconspicuous) is useful character.

**Soredia** (non-corticate reproductive particules, ca 20-80μ in diameter, usually produced in soralia). Size of soredia is occasionally used in species taxonomy.
2. Material and methods

I have chosen 29 saxicolous species of the genus Caloplaca occurring in the Czech Republic for the detailed study. Some other species occurring in the Czech Republic, such as whole section Pyrenodesmia, some non-sorediate species of the section Gasparina and parasitic species C. magnitifs, were excluded.

Most of investigated samples have been collected by myself. They are deposited in herbarium of Faculty of Biological Sciences in České Budejovice (Herbarium Facultatis Biologicae Universitatis Bohemiae Meridionalis), not included in the Index Herbariorum. Other used samples were gained from herbaria GZU, PRM, PRC, S, W and private herbaria of Zdeněk Palice and David Svoboda.

I have seen the type material of some taxa. Types were gained from herbaria BM, GZU, H, PRM, UPS and W. Unfortunately I was not able to see some important types, e.g. Caloplaca arenaria, C. dolomitica, C. lamprocheila and C. furax.

Macroscopic characters of the samples, such as size and colour of apothecia, thalli, lobes, soralia, isidia, etc., were observed under the binocular lupe Olympus, SZH10. Most of microscopic characters were investigated under 1000x magnification by the microscope Olympus, BH-2. Only larger structures, such as thallus and cortex thickness and hymenium height, were observed under 100x or 400x magnification. Spore septums were measured in mature stage. Therefore, ascospores were observed after short-time heating. Most of young spores become "mature-like" after heating (Steiner et Peveling 1984). This procedure is especially important in fresh material. In the older samples (meaning tens or hundreds of years) it is not necessary, because the most of spores become "mature-like" after some time of deposition in herbarium. Most structures were studied in water, but shape and size of paraphyses and cells within exicum were investigated after 10% KOH application. Potassium hydroxide dissolves the crystals of anthraquinons and observed structures become easily seen. However, KOH application causes distinct magnification of cells. Spores were never observed after KOH application, because spore septums becomes abnormally thick.

Quantitative characters, such as sizes of ascospores, conidia, cortex cells, etc., were set from more than 60 measurements. 10 measurements were made in every sample. I have investigated at least 6 samples in each species. In two species, C. ochracea and C. ruderalis, I have not gathered sufficient number of specimens. Therefore, quantitative characters follow the mentioned references to taxonomy in these species. Quantitative characters are presented as the interval of measured values (numbers without brackets in the diagnoses of species). In some cases several out-standing values, occurring outside of the interval in less than 10% of total measurements, were measured (numbers in brackets). Measured values were rounded to the nearest 0.5μm, only sizes of conidia were rounded to the nearest 0.1μm.

I have not analysed secondary metabolites, but I have used colour chemical tests of anthraquinons and other substances, such as lecidea green, thallidima green and sedifolia grey. Following chemicals have been used: C (ca 5% KClO; detergent SAVO), I (Lugol’s solution - 0.5g iodine, 1.5g potassium iodine in 100ml distilled water), K (10% KOH) and N (50% HNO₃). Lacto-glycerol cotton blue was rarely used for easier observation of fungal cells.

Presence of carbonates in substrate was investigated with 50% HNO₃. Nitric acid was also used for decalcification by investigation of endolithic thalli.

The colour photographs I took by the digital camera Olympus, DP 10. The illustrations of anatomical structures I created in the program CorelDRAW, after the hand-made paintings.

3. Results

3.1. Key to the saxicolous Caloplaca species occurring or potentially occurring in the Czech Republic.

About the key: The key includes 46 saxicolous (or bricks, concrete, mortar and roofing-tiles inhabiting) species of Caloplaca. Except of the species already known from the Czech Republic, some potentially occurring species are included. Southern-most and Northern-most European species and some strictly alpine species are not included. The key is based partially on my own experiences and partially on available literature.

Synopsis:
1a ... Thallus epilithic, black, greyish or whitish, K- (or cortex K+ dirty violet, in cross-section observable) or thallus endolithic or indistinct .................................................. 2
1b ... Thallus yellowish, yellow, orange or red, always K+ violet-red .................................................. 28
2a ... Apothecia blackish or greyish-pruinose, K- (epithecium K- or K+ "dirty" violet in cross-section) or apothecia not developed .................................................. 3
2b ... Apothecia yellow, orange or red, K+ violet-red .................................................. 9
3a ... Strict parasites, never occurring free-living .................................................. 10
3b ... Free-living species, occasionally partially parasitic .................................................. 12
4a ... Septum of ripes spores thin, up to 4μm thick .................................................. 13
4b ... Septum of ripe spores thicker, more then 4μm thick .................................................. 18
5a ... Thallus crustose-areolate, crustose-rimose or subsquamulate, not orbicular, delimited by marginal lobes .................................................. 29
5b ... Thallus more or less orbicular, delimited by marginal lobes (sect. Gasparina) .................................................. 50
6a ... Thallus sorediate .................................................. 51
6b ... Thallus non-sorediate .................................................. 54
7a ... Thallus epilithic, black, greyish or whitish, K- (or cortex K+ dirty violet, in cross-section observable) or thallus endolithic or indistinct .................................................. 2
7b ... Thallus yellowish, yellow, orange or red, always K+ violet-red .................................................. 28
8a ... Apothecia blackish or greyish-pruinose, K- (epithecium K- or K+ "dirty" violet in cross-section) or apothecia not developed .................................................. 3
8b ... Apothecia yellow, orange or red, K+ violet-red .................................................. 9
9a ... Strict parasites, never occurring free-living .................................................. 10
9b ... Free-living species, occasionally partially parasitic .................................................. 12
10a ... Septum of ripe spores thin, up to 4μm thick .................................................. 13
10b ... Septum of ripe spores thicker, more then 4μm thick .................................................. 18
11a ... Thallus crustose-areolate, crustose-rimose or subsquamulate, not orbicular, delimited by marginal lobes .................................................. 29
11b ... Thallus more or less orbicular, delimited by marginal lobes (sect. Gasparina) .................................................. 50
12a ... Thallus sorediate .................................................. 51
12b ... Thallus non-sorediate .................................................. 54

Tests of sediment (Lugol's I) and N of fungal tests were set. I have derum, I's follow presented species. In 10% of undersed to striations aintings. (1992).
8a ... Thallus endolithic with whitish epiphitic prothallus. Usually occurring in shallow depressions in hard limestone. Apothecia very rare, black, grey-pruinose (sect. Pyrenodesmia). .................................................. C. erodens - not known from the Czech Republic so far

8b ... Thallus more or less epiphytic, leprose. Usually on flat surface of calcareous sandstone, bricks or roofing-tiles. Occasionally fertile, with reddish apothecia .................. C. albolutelescens

9a ... Strict parasites, never occurring free-living .................................................. 10

9b ... Free-living species, occasionally partially parasitic ........................................ 12

10a ... Apothecia red, usually convex, excipulum inconspicuous. Montane and alpine species, on Miriquidica nigripespa ................................................. C. magni-fili - not included in this work in this study

10b ... On Candelariella vitellina .......................................................... 11

11a ... With orange true excipulum, thallus indistinct. Similar to C. holocarpa. C. vitellinula - not known from the Czech Republic so far

11b ... With dark grey or black true excipulum, outer cells of true excipulum grey in cross-section, thallus sometimes present, consisting of small grey to brown areoles .................. C. grimmiae

12a ... Septum of ripe spores thin, up to 4μm thick .................................................. 13

12b ... Septum of ripe spores thicker, more then 4μm thick ..................................... 18

12c ... Spores 4-locular, thallus usually yellow, but rarely white and K - ............... C. ochracea

13a ... Thallus epiphytic or somewhat reduced or indistinct, but not endolithic ........ 14

13b ... Thallus more or less endolithic (fig. 2.4), ephymenium C- in cross-section (C. lactea group) .................................................. 17

14a ... Thallus sorediate, apothecia with strong persistent C+ dark violet reaction .......... 15

14b ... Thallus non-sorediate, apothecia with C- or slow indistinct C+ red reaction ...... 16

15a ... Thallus lobate, 100-300μm thick, covered by cortex, entirely sorediate in centre, apothecia usually with thallus-like grey outer apothecial margin .................. C. teicholyta

15b ... Thallus non-lobate, distinctly thinner, without cortex, leprose, apothecia with yellow or whitish pruinose outer margin ................................................. C. albolutelescens

16a ... Thallus indistinct (when present, then yellow), older apothecia often with yellow collar-shaped thalline margin (fig 2.1), spores (10-)11.5-28 x (3-)4-7.5μm in size, paraphyses tips widened to 7μm ................................................. C. crenulatella (mostly young specimens)

16b ... Thallus present or somewhat reduced (rarely completely indistinct), apothecia never with yellow collar-shaped outer margin, ascospores Ascospores (10-)12-18(-20) x 3-6(-7)μm in size, paraphyses tips widened to 4.5μm ................................................. C. arenaria (inclusive of C. subpurpurata)

17a ... Thallus often densely yellow dotted (around apothecial primordia and destroyed apothecial remains), apothecia more or less orange, spores (11-)12-14(-16) x 6-8.5μm in size ................................................. C. lactea

17b ... Thallus without yellow dots or yellow dots scattered, apothecia darker, orange-red, spores (13-)15-19 x 5-7μm in size ................................................. C. marmorata

18a ... True excipulum always indistinct, thallus sorediate or minutely isidiate ....... C. chlorina

(when thallus strongly isidiate, non-sorediate, then C. isidiigera, included in C. chlorina in this work)

18b ... True excipulum always present, sometimes more or less reduced .................. 19

19a ... True excipulum dark grey to black, in cross-section with grey outer cells ...... 20

19b ... True excipulum with yellow, orange or red tinge ........................................ 21

20a ... Thallus indistinct or consisting of scattered brown to grey areoles, always parasitic on Candelariella vitellina ................................................. C. grimmiae

20b ... Thallus free-living, distinct, crustose-rimose, pale to dark grey, often with distinct dark prothallus ................................................. C. aractina
<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21a</td>
<td>Thallus lobulate, isidiate or sorediate.</td>
</tr>
<tr>
<td>21b</td>
<td>Thallus non-isidiate, non-sorediate and without lobules.</td>
</tr>
<tr>
<td>22a</td>
<td>Thallus entirely sorediate in centre.</td>
</tr>
<tr>
<td>22b</td>
<td>Thallus lobulate, isidiate or with delimited soralia, apothecia often with crenulate thallus-like grey outer margin (fig 2.1).</td>
</tr>
<tr>
<td>23a</td>
<td>Thallus thin, often indistinct, usually with pale grey fibrillose prothallus, orange apothecia with paler excipulum changing to yellow when wet.</td>
</tr>
<tr>
<td>23b</td>
<td>Thallus usually thick and conspicuous, prothallus, when developed, black.</td>
</tr>
<tr>
<td>24a</td>
<td>Apothecia having paler excipulum, strongly changing colour when wet, pycnidia dark grey or indistinct, not red.</td>
</tr>
<tr>
<td>24b</td>
<td>Both apothecial disc and excipulum usually deep red, almost unchanging colour when wet. Pycnidia red, reacting K⁺ violet-red, C⁺ dull violet.</td>
</tr>
<tr>
<td>25a</td>
<td>Thallus usually thick, sublobate, pale to dark grey, apothecia up to 1mm in diameter, becoming waxy when wet, spores 13-15 x 8μm.</td>
</tr>
<tr>
<td>25b</td>
<td>Thallus thin, not sublobate, black, apothecia up to 0.5mm in diameter.</td>
</tr>
<tr>
<td>26a</td>
<td>Apothecia dark red to brownish. Excipulum often I⁺ blue, spores 8-12 x 7-7.5μm in size.</td>
</tr>
<tr>
<td>26b</td>
<td>Apothecial disc red, excipulum distinctly paler, shiny, I⁻, spores (10-)14-18 x 8-9μm.</td>
</tr>
<tr>
<td>27a</td>
<td>Thallus without cortex or cortex thin, up to 20μm thick, thick epineural layer often present, thalline excipulum present, alga always reaching upper excipulum, spores (12-)14-18 x 7-10μm in size.</td>
</tr>
<tr>
<td>27b</td>
<td>Thallus with distinct cortex, 7-30μm thick, thalline excipulum strongly reduced, algae mostly not present in excipulum.</td>
</tr>
<tr>
<td>28a</td>
<td>Thallus crustose-araleate, crustose-rimose or subsquamulose, not orbicular, delimited by marginal lobes.</td>
</tr>
<tr>
<td>28b</td>
<td>Thallus more or less orbicular, delimited by marginal lobes (sect. Gasparina).</td>
</tr>
<tr>
<td>29a</td>
<td>Thallus brown-red to orange-red, apothecia remain flat and immersed, true excipulum indistinct, spores small, 7.5-9.5 x 4-5μm.</td>
</tr>
<tr>
<td>29b</td>
<td>Thallus yellow to orange, rarer orange-red, mature apothecia more or less sessile, true excipulum more or less distinct.</td>
</tr>
<tr>
<td>30a</td>
<td>Thallus sorediate.</td>
</tr>
<tr>
<td>30b</td>
<td>Thallus non-sorediate, granular-isidiate or non-isidiate.</td>
</tr>
<tr>
<td>31a</td>
<td>Thallus areolate with distinct cortex, soralia delimited or thallus entirely broken into soredia, soredia rather para-plectenchymatous.</td>
</tr>
<tr>
<td>31b</td>
<td>Thallus leprose, entirely sorediate, soredia rather plectenchymatous, lichens never fertile.</td>
</tr>
<tr>
<td>32a</td>
<td>Thallus yellow or rarely orange, granular, areolate, sublobate or entirely broken into soredia, soralia marginal, lichens occasionally fertile.</td>
</tr>
<tr>
<td>32b</td>
<td>Thallus dull orange, rarely yellow-orange, areolate, sublobate or lobate and orbicular, never entirely broken into soredia, soralia delimited producing in centre of areoles, bright yellow.</td>
</tr>
<tr>
<td>33a</td>
<td>Thallus bright yellow, distinctly delimited to almost sublobate.</td>
</tr>
<tr>
<td>33b</td>
<td>Thallus beige, dull orange, brownish or greyish yellow, not distinctly delimited.</td>
</tr>
</tbody>
</table>
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48a ... True excipulum and lower hypothecium para-plectenchymatous, distinct black prothallus often developed. \textit{C. subsoluta}

48b ... Only outer part of true excipulum more or less para-plectenchymatous. \textit{C. saxicola}

49a ... Whitish or pale greyish fibrilose prothallus often present. Occurring on silicates in more or less damp situations. \textit{C. dolomiticola} s.l. (probably heterogenous, variable group; \textit{C. dalmatica}, \textit{C. placida}, \textit{C. schaereri} and \textit{C. velana} are included)

50a ... Thallus sorediate.

50b ... Thallus non-sorediate.

51a ... Thallus orange-red, small-sized, up to 10mm in diameter, soralia orange-red, soredia large, 50-80\,\mu m in diameter. \textit{C. proteus} - not known from the Czech Republic so far

51b ... Thallus yellow to orange, soralia yellow, soredia smaller.

52a ... Thallus yellow, rarely yellow-orange. Soralia usually boldly delimited, coloured as the thallus.

52b ... Thallus more or less orange. Soralia mostly well delimited, bright yellow.

53a ... Thallus never pruinose, marginal lobes often reduced, yellow to orange prothallus usually developed.

53b ... Outer parts of marginal lobes typically white pruinose. Therefore, thallus seems to be double-coloured, orange (rarely yellow) in centre and pale yellow in margins. Prothallus usually not developed.

54a ... Thallus isidiate in centre.

54b ... Thallus non-isidiate.

55a ... Septum of ripe spores thin, up to 4\,\mu m thick, thallus often pruinose. \textit{C. biatorina} - not included in this work

55b ... Septum of ripe spores more than 4\,\mu m thick.

56a ... Spores citriform (abnormally broadened around septum, fig 1.1C). Thallus large, often several centimeter in diameter. \textit{C. aurantia} group - not included in this work (\textit{C. aurantia} and \textit{C. flavescens} occurring in the Czech Republic)

56b ... Spores ellipsoid. Thallus smaller.

57a ... Thallus small-sized, usually up to 10mm in diameter, deep orange-red to brown-red, marginal lobes strongly convex.

57b ... Thallus usually larger, up to 2.5mm in diameter, yellow to orange, lobes slightly convex.

\textit{C. saxicola}
3.2. Saxicolous species of the genus Caloplaca occurring in the Czech Republic

About the composition: Each species is defined by its current name. Below the current name is situated a list of synonyms. Author and publication of each taxa is attached. In some taxa I have gained the information about type specimens, such as locality, date, collector and place of deposition. Types, that I have seen, are marked by “!”.

Diagnoses consist of descriptions of thallus, apothecia and pycnidia. Anatomical and morphological terms follow the chapter 1.3. Nomenclatural notes occur in species Caloplaca arenaria, C. aractina, C. dolomitica and C. teicholyta. Taxonomic notes contain the most characteristic features of each species and the comparison with similar species. Ecology and distribution concerns usually the area of the Czech Republic.

All the studied specimens are mentioned at the end of characterisation of each species. The records are described in order: locality, substrate, date, collector and place of deposition. Missing information are substituted by “?”. In the samples, that I have collected, the information about collector and place of deposition are not mentioned. These records are deposited in herbarium of Faculty of Biological Sciences in České Budějovice (Herbarium Facultatis Biologicae Universitatis Bohemiae Meridionalis - not included in the Index Herbariorum).


Bas.: Lecanora alboluteascens Nyl., Flora (Regensburg) 64: 177. 1881.
Type: Great Britain. Tyneside, Stocksfield, Northumberland, W. Johnson, 1887 (H-Nyl. 29845, holotype!)

Diagnosis: Thallus whitish, unregularly covered with clusters of (dark) grey soredia. Thallus very thin, plectenchymatous, with more or less leprose appearance. Soredia 15-30µm in diameter. Cortex not developed. Thallus K-, C-, I-, N-, only soredia slowly K+ “dirty” violet in microscopic slide. Algal layer discontinuous, para-plectenchymatous, consisting of small fungal cells, 4-6µm in diameter and algal cells 5-18µm in diameter.

Apothecia often not developed. Sometimes only young apothecia and yellowish primordia present. I have recorded specimens with ripe apothecia rarely. When apothecia present, then scattered (only rarely clustered), small, 0.1-1mm in diameter. Old apothecia occasionally becoming flexuose. Orange-red true excipulum more distinct in young apothecia, when thalline excipulum not yet developed. True excipulum plectenchymatous, consisting of anastomosed fibrillose cells. Yellowish or whitish pruinose thalline excipulum more prominent in old apothecia. Disc red or brown-red (rarely blackish).

Hypothecium colourless, without or with oil drops, ca 5-10µm in diameter. Hymenium 80-90µm high. Hamathecium of distinctively branched, (1.5-)2-2.5µm thick paraphyses. Paraphyses tips widened up to 4.5µm, 2-4 upper cells broadened. Ascis ca 75-80 x 20µm in size. Ascospores 16-26 x 8.5-11µm in size. Septum of ripe spores 2-3µm (<1/5 spore length). Apothecia C+ fast violet-red, K+ violet-red.

I have not found pycnidia. Photographs and illustrations: Figs. 3.1A, 3.1B.

Taxonomic notes: Easily distinguishable species, having greyish sorediate thallus without cortex, large spores and C+ violet apothecia. It was considered as a synonym to Caloplaca teicholyta in Purvis et al. (1992), but C. teicholyta differs in lobate, orbicular thallus with presence of thick cortex and in other features within apothecia. C. erodens, occurring in shallow depressions in hard limestone, has endolithic thallus with whitish epilithic prothallus. Moreover, apothecia are very rare present, black and grey-pruinose.

References to taxonomy: Wade 1965.
3.1A. Caloplaca albomaculata. A. Thallus with apothecia. B. C. apothecia (left) C. Apothecia in excised thallus.
g. 3.1B. *Caloplaca alboluteans*. A, ascospores (a-c, young spores; d, e, ripe spores; f, overripe spore; i, deformed spores, often brown coloured); B, paraphyses tips.
Ecology: Mostly recorded on men-made substrata, e.g. old weathered brick walls. Among natural substrata it prefers soft calcareous sandstones. I have never found it on hard limestones.


Distribution: Probably rare throughout the Czech Republic on specific artificial substrata, but I have gained lack of data that support it. It occurs naturally in the area of Cretaceous basin. It seems to be rather common in the valley of Jizera river, north of Mladá Boleslav. Altitudinal maximum: 280m a. s. l., Krivoklát (Central Bohemia).

Specimens seen: Central Bohemia. Beroun, Krivoklát, in the village near the castle, 50°02'10"N, 13°52'30"E, bricks in the old wall, 23.3.2003.

2. Caloplaca aractina (Fr.) Häyrén, Meddel. Soc. pro Fauna et Flora Fenn. 40: 158. 1914.


Caloplaca viridirufa (Ach.) Zahlbr., Cat. Lich. Univ. 7: 198. 1931.


Caloplaca conglomerata (Bagl.) Jatta, Sylloge Lich. Ital.: 255. 1900.


Diagnosis: Thallus dark grey to pale grey, typically delimited by large areas of glazed grey to black prothallus. Thallus large (often more cm in diameter), usually thin, crustose-rimose, with coarse surface. Areoles up to 1.2mm in diameter. Thallus K-,-C-, cortex in cross-section slowly K+ blue-violet.
Cortex colourless with greyish outer cells, unequally thick, 20-50\(\mu\)m. Cortex cells para-plectenchymatous, 3.5-5.5\(\mu\)m in diameter. Epinecral layer up to 15\(\mu\)m thick. Algal layer para-plectenchymatous, algal cells 6-15\(\mu\)m in diameter.

Apothecia scattered to numerous, small, 0.1-0.4mm in diameter. Thalline excipulum of the same colour as thallus, or darker, having thick para-plectenchymatous cortex, sometimes covered with dark epinecral layer. True excipulum typically black, para-plectenchymatous, consisting of slightly elongated cells. Outer cells grey in cross-section. Disc variable in coloration, brown-orange, red-brown but also black (darker coloration probably positively correlates with light intensity on localities).

Hypothecium colourless to dark brown-red in thicker cross-sections, para-plectenchymatous, sometimes consisting of vertically arranged chains of cells. Hymenium 60-70\(\mu\)m high. Hamathecium of 1.5-2\(\mu\)m thick paraphyses, often branched and spasmodically anastomosed. Paraphyses tips widened to 4.5 (7.5)\(\mu\)m, 2-4 upper cells broadened. Ascospores (7.5-)9-12.5(-14) x 4-7(-8.5)\(\mu\)m in size. Septum of ripe spores 3-7\(\mu\)m (1/3-1/2 spore lenght). Apothecia C- (epiphymenum occasionally weekly and slowly C+ orange-red), disc K+ violet-red, excipulum cortex K+ slowly "dirty" violet-blue. Excipulum and hypothecium I-.

Pycnidia commonly found, immersed in thallus surface, with blackish cortex around ostiolum. Wall of pycnidia K+ blue-violet in cross-section. Conidiogenous cells ca. 4-5\(\mu\)m in diameter. Conidia bacilliform, 4.5-7 x 1-2\(\mu\)m in size.

Photographs and illustrations: Figs. 3.2A, 3.2B.

Nomenclatural notes: The correct name for Caloplaca aractina should be C. viridirufa Ach. 1810. Acharius's description (Acharius 1810) is not specific enough, but there is cited one locality: "ad lapides schistosos Helvetiae. (leg.) Schleicher". The corresponding collection is small, partially destroyed piece of lichen, with only two apothecia that agree well with C. aractina.

Taxonomic notes: Easily distinguishable species, characterised by dark grey or black true excipulum, bacilliform conidia and typical glazed, dark grey prothallus. Caloplaca grimmiae having also black true excipulum is parasite, with minute aroclate thallus. Caloplaca chlorina differs for example in absence of true excipulum and in dark prothallus. Caloplaca xerica differs in size of conidia and in having isidia-like structures and soredia. Caloplaca atroflava and C. scotoplasca with similar thallus strongly differ in morphology of excipulum.


Ecology: Species typical for sunny, more or less south-facing silicate rocks in warmer parts of the Czech Republic. On such localities it becomes often dominant. Sometimes it is surprisingly found in damp situations (e.g. shaded north-facing rocks). Substrates are variable – e.g. basalt, gneiss, granite and schist. It is occasionally recorded on stones in old walls, mostly ruin walls. Small number of species occurs in C. aractina communities.

Associated lichen species: Buellia alboatra, Caloplaca demissa, C. holocarpa, C. saxicola, Candelariella vitellina, Lecanora dispersa.

Distribution: This species is restricted to rocks in warmer and dryer climate. Three distribution centres occur in the Czech Republic - the river valleys in South-western Moravia (rivers Dyje, Jihlava, Oslava, Rokytňa and Svrata), river valleys in Central Bohemia (rivers Berounka, Sázava, Vltava) and rocky hills in České středoohří Mts. (Northern Bohemia). Altitudinal maximum: 470m a. s. l. (the “Koštál” hill in České středoohří Mts.).

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Fig. 3.2A. Caloplaca aractina. A, Thallus
th apothecia; B, Apothecia in detail; C,
thallus delimited by dark glossy prothallus;
Prothallus in detail.
Fig. 3.2B. *Caloplaca aractina*. A, vertical section through an apothecium, showing paraectenochymatous true excipulum with grey upper cells; tissues in hypothecium are vertically arranged; conidiogenous cells; C, conidiospores; D, ascospores (a,b, young spores; c-e, ripe spores; f, deformed ore); F, paraphyses tips.
Specimens seen: **Central Bohemia.** Beroun, Roztoky, rocks "Na andělů", 1 km SW of the village, WSW exp., alt. 250m, 50°01'10"N, 13°51'40"E, base-rich vertical schist rock, 1.6.2003; Beroun, Zbečno, Račice, rocks in Berounka valley, alt. 250-300 m, 50°01'40"N, 13°55'30"E, S-faced schist rock, 14.8.2003; Hlásná Třebáň, rocks in the Berounka river, alt. 220m, schist, 10.6.1933, Suza (PRM 631129, in collection of C. subsolata); Hořovice, Točník, ruin of castle Žebrák, alt. 350m, 49°53'20"N, 13°53'10"E, quartzose sandstone in the NE-oriented wall, 31.5.2003; Milín, Solnice, rocks on the left side of Vltava river, 1 km NE of the village, S exp., alt.: 300-400 m, 49°37'35"N, 14°12'20"E, well lit, (slightly lime-rich) vertical face of the silicate rock, 6.12.2002; Rakovník, Skřívaň, the rock "Valachov", 1 km SE from the village, in the valley of Týmerský potok brook, SW exp., 50°01'N, 13°46'30"E, around sulphate and carbonate layers in bazalt rock, 21.10.2002; Rakovník, Skřívaň, the rock "Valachov", 1 km SE from the village, in the valley of Týmerský potok brook, SW exp., 50°01'N, 13°46'30"E, base-enriched bazaltic rock, 16.9.2002; Skryje, Týfov, the ruin of medieval castle Týfov, 1 km S from the village, 49°58'30"N, 13°47'30"E, south facing base-rich silicate rock under the wall of the castle, 17.9.2001.

**Northern Bohemia.** Lovosice, Třebenice, ruin of castle Košťál, 2 km N of the village, alt. 470 m, 50°31'25"N, 13°35'10"E, bazaltic, S-oriented rock beneath the castle, 9.5.2003.

**Southern Bohemia.** Písek, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26'20"N, 14°11'40"E, very rare on the walls of a castle, 4.8.2003.

**Western Bohemia.** Radnice, Bohy, ruin of the castle Krašov in Berounka river valley, alt. 300 m, 49°57'N, 13°39'53"E, schist stone in wall of ruin, 14.9.2003.

**Southern Moravia.** Ivančice, Biskoupky, serpentinite rock, alt. 210m, 10.3.1958, A. Vězda (Vězda: Lich. Sel. Exs. 206); Třebíč, Mohelno, Vězda (Vězda: Lich. Sel. Exs. 348); Třebíč, Mohelno, rocky steppe on the left side of the river Jihlava, alt. 300m, on serpentinite, form with black apothecia, 1932, Suza (PRM 697206, in collection of C. subsolata); Znojmo, Nový Hrádek, rock above Dyje river, alt. 350m, schist, 29.3.1932, Suza (PRM 631113, in collection of C. subsolata).

**Austria.** Niederösterreich. Tielachmündung, on amphybolitic rock, 1893, J. Baumgartner (W, sub C. viridisula); Oberösterreich. Stein. schust rock, alt. 400m, ?, J. Baumgartner (W, Zahlbr.: Krypt. Exs., 46).

**France.** Pyrénées orient., Foras-Réal, 1872, Nylander (H-Nyl 30249, sub C. viridisula).

**Germany.** Wüttemberg. Lorch "ad Lorch", ?, Nylander (H-Nyl 30240, 30241).

**Hungary.** Divény, on silicate, ?, A. Zahlbruckner (W, sub C. fuscoatra); St. Lejörgy, 24.3.1901, J. Baumgartner (W, sub C. fuscoatra).


**Sweden.** Bohuslän, Laka, Valla, Tjörn, on maritime rocks, 1920, Magnusson (W).

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*Patellaria lamprocheila* DC., Lam. te DC., Flore de Francaise, ed. 3, 2: 357. 1805. (Syn.: *Caloplaca lamprocheila* (DC) Flagg., Revue Mycol. 10: 130. 1888.).


*Type: Sweden. Bohuslän, Jörlanda, Rannekär, on shady rock below a hill, 24.5.1939, G. Degelius (UPS, isotypus).*


*Type: Sweden. Bohuslän, Stenkyrkja, Bäck, 24.7.1937, H. Magnusson (UPS, holotype).*
Caloplaca caesiorufa sensu Suza et sensu Zahlbruckner.

Caloplaca scotopolaca auct. Austr. (not C. scotopolaca (Nyl.) H.Magn.).

**Diagnosis:** Thallus dark grey to pale grey, not delimited by prothallus. Thallus sometimes indistinct (*C. arenaria* in sense of recent authors), usually thin, crustose-rimose, with coarse to flat surface. Cortex in cross-section colourless or with more or less greyish spots, 10-20μm thick. Cortex cells para-plectenchymatous, 4-6μm in diameter. Epinecral layer up to 16μm thick. Algal cells 4.5-16μm in diameter. Thallus K-, C-, only cortex in cross-section slowly K+ blue-violet.

Apothecia scattered to clustered, 0.1-1.1mm in diameter. Old apothecia occasionally becoming flexuose and in some cases splitting into many small apothecia. Excipulum ca 0.05mm thick, usually paler than disc, yellow-orange to orange-red. Thalline excipulum rarely surrounded by grey thalline margin. Development of true excipulum depending on apothecium age (in young apothecia usually more prominent), plectenchymatous, composed of fibrils cells that are broader and shorter at outer edge of excipulum. Disc variable in coloration, from to red, old apothecia sometimes blackish. Paler apothecia typically found in thalli from localities.

Hypothecium colourless, occasionally with crystals. Hymenium 60-110μm high. Hamathecium of 1.5-2.5μm thick paraphyses, often branched and sparsingly anastomosed. Tips of paraphyses widened to 4.5μm, 1-5 upper cells broadened. Ascos pores (10-)12-18(-20) x 3-6(-7)μm in size. Septum of ripe spores 2-4μm wide (1/4 spore length). Apothecia C+/dull red (epihymenium often slowly and permanent C+ violet-red), K+ violet-red.

Pycnidia rarely found, immersed in thallus surface, with the same or darker coloured cortex around ostiolum. Wall of pycnidia K+ distinctly blue-violet in cross-section. Conidia bacilliform to oblong, 0.7-1.4 x 3-3.5μm in size.

**Photographs and illustrations:** Figs. 2.1C, 3.3A, 3.3B.

**Nomenclatural notes:** The correct name for this lichen is probably not *Caloplaca arenaria*, although it is used by most recent authors (Clauzade et Roux 1985, Nimis 1993, Purvis et al. 1992, Wirth 1995). The description of *C. arenaria* (see nomenclatural notes under *C. teicholylta*) does not agree well with this taxon, but rather with *C. teicholyta* or *C. albotestsens*.

Therefore, *C. lamprocheila* is probably the correct name as used by older authors (e.g. Magnusson 1944, Wade 1965). The description of *C. lamprocheila* (Lamarck,de; De Candolle 1805) runs as follows: “Ce lichen ressemble beaucoup a la patellaire ferrugineuse; mais il croit sur les rochers au lieu de naitre sur les écorces; sa croute est épaisse, fendillé, jaunatre ou cendrée dans...” (“This lichen resembles *Caloplaca ferruginea* in many characters, but it grows on rocks, not on bark; its cortex is rough, rimose, yellowish or ash-grey...”). This incomplete description is not in conflict with the taxon currently known as *C. arenaria*, but is perhaps closer to e.g. *C. crenularia*.

**Taxonomic notes:** Easily distinguishable species, characterised by its narrow and long spores and thin septum, plectenchymatous excipulum and blue-violet K+ reaction of thallus cortex. *C. subpalilida* (=*C. oxfordensis*), traditionally considered as a separate species, does not anatomically and morphologically differ from *C. arenaria*. It was distinguished from *C. arenaria* by the presence of thallus and the paler and smaller apothecia. These characters show continuous variation between “arenaria” and “subpalilida” types. Moreover, thallus development depends strongly on substrate. Specimens with well-developed thalli occur on smooth substrata like schist and phyllite. Therefore, I consider *C. subpalilida* as junior synonym of the taxon currently known as *C. arenaria*. 
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Veronis et al. under *C.
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**Fig. 3.3A. Caloplaca arenaria.** A, Thallus with apothecia; B, Apothecia in detail; C, Thallus indistinct, apothecia directly on substrate; D, Thallus restricted to slits in substrate; E, Old crenulate apothecia; F, apothecia with grey outer excipulum (rare).
Fig. 3.3B. *Caloplaca arenaria*. A, ascospores (a-d, young spores; e-m, ripe spores; n, overripe spore); B, paraphyses tips; C, two extreme types of conidiospores.
Other similar species, such as *C. crenularia*, *C. "pseudocrenularia"*, *C. holocarpa* and *C. scotoplaca*, differ easily in thick spores with broader septa. *Caloplaca caesiorufa* (Ach.) Zahlbr. in Zahlbruckner's and also Suza's collections is in fact *C. arenaria*. See more about this problem under *C. caesiorufa* (in chapter Refused species).


Ecology: Species typical for nutrient-rich habitats (e.g. bird perching places) on different substrates. I have never found it on carbonates. It seems to prefer base-enriched silicates (e.g. amphybolit, basalt, gneiss, phyllit, schist, serpentinit). Most records are from natural rocks, where it usually grows on warm and sunny spots (mostly south-facing rocks). Some records are from agricultural landscape, where it grows on boulders within the fields and meadows, together with nitrophilous lichens.


Distribution: Probably occurring throughout the Czech Republic. Significantly more common in warmer areas at lower altitude. Commonly found on rocks in river valleys. Records in mountains are rare, always from sheltered and relatively warm microhabitats. Altitudinal maximum: Hrubý Jeseník Mts., "Velká kotlina" corrie, ca 1100m a.s.l. (Moravia), Blanský les Mts., Mt. Křeť, 1080m a.s.l. (Bohemia). In the Austrian Alps it occurs at altitudes up to ca 1900m a.s.l.

Specimens seen: **Central Bohemia.** Beroun, Karlištěn, Budíčany, on basaltic rock, alt. 220-230m, 6.11.2002, D. Svoboda (herb. D. Svoboda, no. 366, sub C. subpollidita); Beroun, Karlištěn, Budíčany, on basaltic rock, alt. 220-230m, 6.11.2002, D. Svoboda (herb. D. Svoboda, no. 340); Beroun, Křivokláter, near Fürstembergs statue, 50°02'10"N, 13°52'30"E, concrete, 23.3.2003; Beroun, Křivokláter, protected area "Brdárka", rocks 2 km NE of the village, alt. 300m, 50°03'03"N, 13°53'40"E, base-rich schist rock, 23.3.2003; Beroun, Zbečno, Račice, rocks in Berounka valley, alt. 250-300 m, 50°01'40"N, 13°55'30"E, S-faced schist rock, 14.8.2003; Jilešov u Prahy, the Sázava valley, S-SSW exposed rock above the river, few hundred metres E from the Žampach point, alt. 260m, sunny lime-rich schistaceous rock, 31.3.2001, Z. Palice, O. Pexa et D. Svoboda (herb. Z. Palice); Křivokláter, Měštečko, the rock in the valley of Rakovnický potok brook, 1 km NW from the town, 50°03'20"N, 13°50'50"E, base-rich silicate rock, 26.1.2002; Milín, Solenice, rocks on the left side of Vltava river, 1 km NE of the village, S exp., alt. 300-400 m., 49°37'35"N, 14°12'20"E, well lit, lime-rich and nutrient-rich rock, 6.12.2002; Rakovník, Skřívráž, the rock "Valachov", 1 km SE from the village, in the valley of Tytěřský potok brook, SW exp., 50°01'00"N, 13°46'30"E, nutrient-rich silite rock, together with *Amandinea punctata*, *Candelariella vitellina* and *Physcia dubia*, 16.9.2002, Rakovník, Skřívráž, the rock "Valachov", 1 km SE from the village, in the valley of Tytěřský potok brook, SW exp., 50°01'00"N, 13°46'30"E, alight silite rock, 16.9.2002; Skryje, Týřovice, the ruin of medieval castle Tyřov, 1 km S from the village, 49°58'30"N, 13°47'30"E, south facing base-rich silicate rock under the wall of the castle, 17.9.2001.

**Southern Bohemia.** České Budějovice, Kamenny Újezd, rocks under the ruin of a castle Kotek (Maškovec), 2 km W of the village, S exp., alt. 420-440 m., 48°54'05"N, 14°24'20"E, base enriched gneiss rock, 17.11.2002; Český Krumlov, rock on the top of the Mt. Křeť, alt.: 1080 m, exp.: S, 48°52'27"N, 14°17'10"E, vertical rock, influenced by the bird excrements?, 16.11.2002; Český Krumlov, Staré Dobrovice, protected area "Kalamandra", in the village, alt. 530 m, exp. S, 48°49'15"N, 14°17'00"E, nutrient rich gneiss rock, influenced by birds excrements, 8.11.2002; Český Krumlov, protected area "Vysenšké kopce", 48°49'20"N, 14°17'40"E, amphibolite rock, 15.3.2002; Husinec, Lažště, Dvory, rocks 1 km S from the village, 49°02'00"N, 13°57'05"E, base-rich gneiss rock, 1.2.2002; Husinec, Výrov, stone bush nearby the village, 49°03'00"N, 13°59'50"E, gneiss stone, in community of nitrophilous lichens (*Amandinea punctata*), 10.3.2002; Křiš, Březovík, protected area "Ptačí stěna" 2 km E from the village, silicate rock, 25.4.2001; Milevsko, Kovařov, flat stones in meadow, slightly elevated the soil, 16.9.2003; Milevsko, Sobědraž, flat
stone surface slightly elevated above the soil, 12.6.2003; Čížek, the rocks on the left side of the Otava river, near the sewage disposal plant of the town, 49°19'10"N, 14°09'00"E, veathered, seminatural silicate rock, 6.8.2002; Písek, Hádníště, the rock on the left side of Otava river, 1 km W from the village, 49°17'50"N, 14°06'30"E, base-rich silicate, 4.9.2002; Čížek, Zvíkovské Podhradí, the castle Zvícov, alt. 360 m, 49°26'20"N, 14°11'40"E, S-faced rocks beneath the castle, 4.8.2003; Prachatice, Vitézovice, ruin of medieval castle Osule, 1 km W of the village, alt. 640 m, 49°02'55"N, 14°04'E, gneiss stones in wall of ruin, 12.4.2003; Strahaný, Doubledy, rocks on thiright side of Malše river, 0.5 km E from the village, 48°35'45"N, 14°30'40"E, gneiss rock, 1.2.2002; Vacov, Žár, the rock in the valley of the Spáňka river SE from the village, sunny base-rich silicate rock, 7.7.2001; Zábřeh, Krutušín, locality Zábředská skála rock, 1 km SE from the village, 49°00'50"A, 13°55'30"E, gneiss stones in the stone debris, 5.5.2002.

Western Bohemia. Karlovy Vary, Andělská Hora, ruin of medieval castle N of the village, alt. 700 m, 50°12'20"N, 12°58'E, basaltic, S-oriented rock, 21.3.2003; Radnice, Bohy, ruin of the castle Krašov in Berounka river valley, alt. 300 m, 49°57"N, 13°35'30"E, S-facing, sunny schist rock under the ruin, 14.9.2003; Sušice, Nové Městečko, rocks on the left side of Otava river 1 km N of the village, SE exp., alt. 510-550 m, 49°11'10"N, 13°29'30"E, 49°11'10"N, 13°29'30"E, on nutrient rich gneiss rock, in the upper part of the rock, with Amandinea punctata, 4.1.2003; Sušice, Nové Městečko, rocks on the left side of Otava river 1 km N of the village, SE exp., alt. 510-550 m, 49°11'10"N, 13°29'30"E, on nutrient rich gneiss rock, near the road, 4.1.2003; Sušice, Kašperské Hory, the Kašperk castle ruin, alt. 860 m, 6.5.1995. Z. Palic (herb. Z. Palic).


Southern Moravia. Ivančice, Biskupy, in Jihlava river valley, alt. 260m, on granulit, 16.4.1973, J. Poelt, A. Vězda (GZU); Náměšť n. Oslavou, Vaneč, in Oslava river valley, alt. 330m, 1919, Suza (PRM, sub Calopla caesiorufa); Tišnov, Ostrov, in Libočovka river valley, alt. ca 420m, 1927, Suza (PRM, sub Calopla caesiorufa); Tišnov, Rojetín, in Libočovka river valley, alt. ca 420m, 1927, Suza (PRM, sub Calopla caesiorufa); Znojmo, rock above Dyje river, alt. 210m, granite, alt. 250m, 1929, Suza (PRM, sub Calopla caesiorufa); Znojmo, rock above Dyje river, alt. 210m, granite, with C. subsoluta, 2.5.1992, Suza (PRM 631124, in the collection of C. subsoluta).


Italy. Sardegna. Núoro, Genargento, alt. 1230-1300m, 5.5.1986, H.Mayrhofer (GZU, sub C. crenularia).

Norway. West Norway, Gravvinens, schist rock, alt. 350m, 1945, J.J. Havaas (PRM).


Spain. Barcelona, Sierra de Montseny, alt. 1200-1300m, 28.5.1983, N. Mayrhofer (GZU); Barcelona, Sierra de Montseny, alt. ca 1500m, 28.5.1983, N. Mayrhofer (GZU).


Ukraine. Vilhoritat Mts., Onkovec u Užhorodu, alt. 180m, 1930, Nádvorník (PRM).


Type: Switzerland [Helvetia] (H-Ach. 1157D, lectotype)

Gasparina cirrochroa (Ach.) Stein


Diagnosis: Thallus orange, orbicular, delimited by well-developed thin marginal lobes, ca 0.2-0.5mm wide, rounded and forked, shallowly convex. Thallus areolate in centre, but in larger thalli (more than ca 1cm in diameter) central parts dying off and only contiguous lobes present. Outer parts of lobes typically white pruinose. Thallus sorediate in centre. Soralia bright yellow. Soredia ca 30-40µm in diameter. Prothallus not developed. Thallus K+ violet, C-, N-.

Apothecia and pycnidia not found in Czech material. For any details see Navaro-Rosines et Roux (1994).

Photographs: Fig. 3.4A.

Taxonomic notes: Species is characterised by thin and branched lobes, bright yellow soralia and white pruinose outer parts of thallus. Caloplace obliterans can be somewhat similar, when its marginal lobes are developed. Anyway, it differs in never pruinose thallus and in having yellow prothallus. Caloplace proteus has small, orange-red and non-pruinose thallus, with orange soralia producing larger soredia (50-80µm in diameter). Caloplace decipiens has somewhat broader lobes and poorly delimited soralia of the same colour as thallus.


Ecology: Species more or less restricted to calcareous substrata. Mainly occurring on limestone rocks, occasionally inhabits also lime-rich silicates, e.g. basalt. Rarely recorded also on concrete. Usually found in shaded situation.

Associated lichen species: Caloplace citrina, C. chrysodetha, C. flavescens, C. xantholyta
Distribution: Common in areas with large limestone outcrops. Rare in small spots of calcareous substrata (e.g. dispersed occurrence of crystalline limestone) and on basaltic outcrops, e.g. in “Křivoklátská páhorkatina” upland. Altitudinal maximum: 560m a. s. l., in Blanice river valley, near Lažiště (Southern Bohemia).


Southern Bohemia. Český Krumlov, protected area "Vyšenské kopc", concrete wall of the bridge, 21.5.2001; Lažiště, Dvory, rocks 1 km S from the village, 49°02'00"N, 13°57'05"E, crystalline limestone, 17.6.2001.

Southern Moravia. Mikulov, Svatý kopec hill, 0.3 km east from the town, 48°48'30"N, 16°39'05"E, shaded limestone rock, 24.2.2002.


Bas.: Verrucaria citrina Hoffm., Deutschl. Fl. 198. 1796.
Type: Sweden, „Svecia“. (H- Ach, 1243 A, neotype selected by Nordin 1972)


Type: Austria. Stria, Feldbach, Riegersburg, alt. 400m, andesitic rock, 22.9.1990, Kantvilas, Mayrhofer, Vězda (W, isotypus).

Leconora flavocitra Nyl., Flora. 69: 461. 1886.


Diagnosis: Thallus yellow-green, yellow, yellow-orange to orange, very variable, areolate with thick convex areoles (type flavocitra), crustose continuous with few soralia, crustose-rimose, granular with granules up to 90μm in diameter or fully broken into soralia. Soralia rather para-plectenchymatous, always present (only initial stages without soralia), usually marginal, at edges of areoles or in thalline rims. Soralia rarely present below areoles. Soredia (20-)25-35(-50)μm in diameter. Prothallus not apparent or whitish on smooth substrata in shaded situation. Thallus variably thick, 40-300μm (thickest in flavocitra type). Cortex 10-32μm thick, para-plectenchymatous. Algal cells 6-16μm in diameter. Medulla loose, plectenchymatous. Thallus C-, N-, I-, K+ violet-red.

Apothecia occasionally present, ca 0.3-0.7mm in diameter. Disc dark to pale orange. True excipulum 30-125μm thick. Thalline excipulum coloured as thallus, sometimes broken into soralia.

Hypothecium colourless. Hymenium 55-70μm high. Hamathecium consisting of 1-1.5μm thick flexuose, richly branched and anastomosed paraphyses. Tips of paraphyses usually elongated, slightly swollen, up to 5μm. Ascospores often deformed, ellipsoid, (8-)9-12(-15) x 4-6(-7)μm in size. Septum (3-)4-6μm wide. Apothecia C-, N-, K+ violet-red.

Pycnidia immersed, with orange cortex (darker than thallus) around ostiolums. Conidia 3.7 x 0.7μm in size.

Photographs and illustrations: Figs. 3.5A, 3.5B.
spots of basaltic a.s. 1., in alt. 250m, the village, 21.5.2001; 6.6.2001.

25°E, shaded 20.7.2003;

M. Mayrhofer,

Nyl. 29196,

H. Sorg. Soc. Linn. 86Jacq.).

Soralia, areolate a, crustose-dia. Soralia (ia), usuallyoles. Soredia substrata in Cortex 10-

uella loose, range. True broken into

of 1-1.5μm vesicles usually 9-12(-15) x

. Conidia 3-

3.4A. Caloplaca cirrochroa. A, Thallus

bright yellow soralia; B, Thallus in

tail; C, Pale thallus from shaded situation.
g. 3.5A. *Caloplaca citrina*. A, Thin thallus with scattered soralia; B, Thallus with distinct white prothallus; C, Thick areoles with marginal soralia; D, Thallus splitted into large granular soredia; E, Two morphotypes of *citrina*, first with orange granular soredia (left), second with yellow fine soredia (right); F, Sorediate thallus in detail.
Fig. 3.5B. *Caloplaca citrina*. A, ascospores (a-f, young spores; g-i, ripe spores; j-m, overripe spores; n-r, deformed spores); B, paraphyses tips.
**Taxonomic notes:** Species characterised by its yellow to orange sorediate never lobate thallus. Great variability occurs within *C. citrina*. Several extreme forms considered as the separate species by some authors (e.g. more or less granular var. *arcis* or convex-areolate to sublobate var. *flavocitrina*). However, they are put into *C. citrina* in this work, because I have found many intermediate specimens. Anyway, it is often difficult to distinguish real intermediate forms, because typical *C. citrina* and "*C. flavocitrina*" often grow together.

Many similar species can be confused with *C. citrina*. *C. granulosa* has more or less lobate thallus with rather isidiate surface without soralia, but this taxon is very similar to *C. citrina* var. *arcis*. Some coastal species, such as *C. flavogranulosa*, *C. littorea* are granular, without soralia. Their occurrence is probably restricted to coastal area. *C. chrysodetha* and *C. xantholyta* differ in colour, powdery surface that is never covered by cortex. Their granular soredia are also different (powdery, plectenchymatous).


**Ecology:** Species inhabits plenty of substrata (rocks, wood and bark), but never occurring on acid rocks. Corticolous and lichenicolous forms seem to be rare throughout the Czech Republic. I have only once collected *C. citrina* on bark and never on wood. Common records come from more or less base-rich and often nutrient-enriched (nitrophilous) natural rocks (calcareous or non-calcareous). This species strongly expands onto artificial substrates, as mortar, concrete, bricks or roofing-tiles.


**Distribution:** Common throughout the Czech Republic.


Eastern Bohemia. Náchod, Česká Slalice, Babiččino údolí valley, 0.5 km N of town, alt. 300 m, 50°23'58"N, 16°02'42"E, overhanging calcareous rock (cretaceous marl), 20.4.2001, Halda, Palice (herb. Palice, 5484).

Southern Bohemia. Brloh, Kuklov, in the village, 48°55'30"N, 14°11'0"E, calcareous coat of the wall, 7.2.2002; České Budějovice, in the town, mortar on E-oriented wall, 9.4.2003; České Budějovice, Krmenze, rocky outcrops S of the town, alt. 510m, 48°54'15"N, 14°18'40"E, on S-exposed serpentinite outcrop, 8.11.2003; Český Krumlov, lookout tower on the top of Mt. Křel’ alt.: 1080 m, W exp., 48°52'2"N, 14°17'10"E , old mortar on the tower, 8.11.2003; Český Krumlov, Staré Dobré, protected area "Kalamandra", approximately 1 km from the village, old wall built of the crystalline limestone and silicate stone, without concrete, 22.10.2001, M. Bartoš, Hrubčová n. V., Parkarec, the ruin Karlův hrádek 2 km S from the village, 49°06'35"N, 14°27'43"E, silicate stones in the wall of the ruin, 1.3.2002; Husinec, Výrov, in the village, alt. 520m, 49°03'00"N, 13°59'50"E, gneissic stone in N-facing wall, 7.4.2002; Krmenze, the graveyard N from the town, 48°54'30"N, 14°18'20"E, concrete on the old wall, 7.2.2002; Lažiště, Zábrdí, rocks 0.5 km SE from the village, 49°01'30"N, 13°56'45"E, base-rich silicate rock, 17.6.2001; Písek, in the town, alt. 370m,
Verrucaria
14°04'E,
9°26'20''N,
1 km W of
Zár, the
Vímperk,
11.6.2003;
base-rich
t. 700 m,
Krásov in
Sedlec, the
boulder,

Wien 60:

Caloplaca

um thick.
Granules
diameter.
. Yellow
colour as
granules.
in size.
tomosed. .2 x 6µm

Fig. 3.6A. Caloplaca coronata. A, Thallus
with apothecia; B, Apothecia in detail; C,
Orange prothallus in detail.
49°18′20″N, 14°09′E, W-oriented, lime-enriched gneissic outcrops under town walls, with Verrucaria macrostoma f. furfuracea, 15.5.2003; Písek, Mirovice, "Neretvský lom" quarry, 49°30′30″N, 14°04′E, limestone rock, 26.8.2003; Písek, Zvěkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26′20″N, 14°11′40″E, bark of Acer platanoides, 4.8.2003; Prachatice, Vítějovice, ruin of the castle "Osoule", 1 km W of the village, alt. 640 m, 49°03′N, 14°04′E, base-rich gneissic stones in walls, 17.5.2003; Vacov, Žár, the rock in the valley of the Spulka river SE from the village, base-rich silicate rock, 7.7.2001; Vímek, Onšovice, near the "Spulka" river, alt. 590m, 49°06′10″N, 13°46′E, gneiss stones by the river, 11.6.2003; Zábřhat, Kralušín, locality Zábřhská skála rock, 1 km SE from the village, 49°00′50″A, 13°55′30″E, base-rich silicate rock, 16.6.2001.

Western Bohemia. Karlovy Vary, Andělská Hora, ruin of medieval castle N of the village, alt. 700 m, 50°12′20″N, 12°55′E, concrete in basaltic wall, 21.3.2003; Radnice, Bohy, ruin of the castle Krašov in Berounka river valley, alt. 300 m, 49°37′N, 13°35′30″E, schist stone in wall of ruin, 14.9.2003; Železná Ruda, Mt. Svaroh, the rest of building, on lime, 24.10.1996, Palice (herb. Palice).


Southern Moravia. Kyjov, Miletice, horizontal sides of bricks in the wall, 2.7.2003; Mikulov, Sedlec, the locality Skalky, 1.5 km SW from the village, 48°53′40″N, 16°40′30″E, terciery soft limestone boulder, 23.2.2002 (245, 255).


Bas.: Calopisima aurantiacum var. coronatum Kremp. ex Körb., Par. Lich.: 66. 1859. (Syn.: Caloplaca aurantiaca var. coronata (Kremp. ex Körb.) Jatta).

Diagnosis: Thallus yellow-orange to orange, consisting of granules, ca 80-120µm thick. Granules dispersed to tightly clustered and forming areoles 0.5-2mm in diameter. Granules covered with cortex, 8-26µm thick, consisting of isodiametric cells 2.5-6µm in diameter. Outer cells covered with orange-brown anthraquinon-crystals. Epinecral layer ca 3-9µm thick. Algal layer para-plectenchymatous, algal cells 6-15.5µm in diameter. Medulla, consisting of loose plectenchymatous tissues, present in areoles. Medullar hyphae ca 2.5µm thick. Yellow or orange prothallus occasionally developed. Thallus C-, N-, I-, K+ violet-red.

Apothecia rather rarely present, up to 1mm in diameter, sessile. Disc of the same colour as thallus or somewhat deeper orange. Excipulum orange, often covered with thalline granules. True excipulum present, plectenchymatous.


I have not recorded pycnidia.

Photographs: Fig. 3.5A.

Taxonomic notes: Species easily distinguishable due to its granular thallus. Granules typically minute. Apothecial margins covered with these granules are characteristic.

Some forms of Caloplaca citrina can be confused with C. coronata. C. citrina can also have granular-like thallus (unusual form), but its granules are smaller-sized and not covered with distinct cortex. Apothecia in C. citrina are rather broken into soralia than granular.

References to taxonomy: no references.
Ecology: Similar to *Caloplaca dolomitica*, but its occurrence restricted to calcareous substrata. Typical species of hard limestone outcrops. I do not know *C. coronata* from artificial substrata.

Distribution: Known occurrence restricted to Pavlovské vrchy hills and Moravský kras karst (Southern Moravia) and Český kras karst (Central Bohemia) within the Czech Republic. It will be probably recorded in other areas with limestone outcrops.


*Southern Moravia.* Brno, Hády, 14.3.?, Suza; Moravský kras karst, valley of Punkva brook, rock near “Skalský mlýn” water-mill, alt. 400m, calcareous rock, 13.4.1963, A. Vězda (Vězda: Lich. Sel. Exs. 192); Moravský kras karst, calcareous rocks above “Skalský mlýn” water-mill, 28.4.1920, Suza; Mikulov, Sedlec, the locality Skalky, 1.5 km SW from the village, 48°53′40″N, 16°40′30″E, terricyf soft limestone boulder, 23.2.2002; Pavlov, Kletnice, the locality “Soutěška” 2 km N from the village Pavlov, Kletnice, the locality “Soutěška” 2 km N from the village, limestone rock, 12.10.2001.


Type: England. Isle of Wight, May 1794, Withering (BM, lectotype !)


*Caloplaca festiva* (Fr.) Zw., Flora 47: 85. 1864.


Diagnosis: Thallus gray to pale gray, crustose-areolate to crustose-rimose, variably thick. Black, fibrillos prothallus occasionally developed, often occurring on the border with other thalli. Cortex colourless, 7-30μm thick, consisting of para-plectenchymatous cells, 5.5-7.5μm in diameter. Algal cells 8-13μm in diameter. Thallus C-, K-; cortex in cross-section C-,K-.

Apothecia normally scattered, not clustered, 0.2-1mm in diameter. Thalline excipulum typically aborted, or restricted to the base of apothecia. True excipulum dark red to dark orange-red, not changing color when wet. Disc orange-red to dark red.

Hypothecium colourless or often brownish in lower and lateral parts. Hymenium 70-80μm high, asci 50-55 × 15μm in size. Hamathecium of 1-2μm thick paraphyses heavily branched and anastomosed. Tips of paraphyses not or only slightly widened (up to 3μm), resembling *Caloplaca ferruginea*. Ascospores (10-)12-14.5 × 7-8(-9)μm in size. Septum of ripe spores 4-5.5μm. Apothecia K+ violet-red. Excipulum C+ (unusual fast, distinct and persistent reaction to dark violet). Disc C-.
Pycnidia frequent, dark red, elevated spots in thallus surface, chambered, 100-200μm in diameter, K+, C+ dark violet. Conidiogenous cells isodiametric, 4-7μm in diameter. Conidia narrowly ellipsoidal, 3-3.8 x 1μm in size.

Photographs and illustrations: Figs. 3.7A, 3.7B.

Taxonomic notes: Species from Caloplaca ferruginea group. Probably three different species in Europe are included in this name. First, the northern and north-western group with darker thallus, smaller spores and thinner septa (C. crenularia in my sense). Second, rather South-European group with larger spores (ca 14-16μm long) and wider septa (6-8μm). Both “types” differ from third, non-described Caloplaca “pseudocrenularia” in absence of algae in excipulum and having distinct cortex (glazed thallus surface). Corticulous Caloplaca ferruginea differs in having larger spores and not rimose thallus.

From other species differs C. crenularia in having dark red pycnidia.

Ecology: Growing on siliceous rocks, in dark and damp situations. The only three records from the Czech Republic occurring on vertical sides of phyllitic/schistose or basaltic rocks, in humid subalpine climate (about 1300m a.s.l.).

Associated lichen species: Not sufficiently known.

Distribution: Lichen with oceanic character of distribution. Common in North-western Europe (e.g. Great Britain). I know only three records from the Czech Republic. They are situated in Hrubý Jeseník Mts. (Moravia) and Krkonoše Mts. (Bohemia). It was also recorded on the Polish side of Krkonoše Mts. Altitudinal maximum: about 1300m (all the localities in Krkonoše Mts. and Hrubý Jeseník Mts.).


Poland. Polish Western Sudetes, Karkonosze Mountains, Mały Snieżny kocioł (distr. Jelenia Góra), ca 1300m alt., on vertical sunny wall of basalt, 6.10.1976, J. Nowak (GZU).


Bas.: Lecanora crenulatella Nyl., Flora (Regensburg) 69: 461. 1886.


Caloplaca lactea f. aestimabilis (Arnold) Lettau, Hedwigia 52: 238. 1912. (Bas.: Gyalolechia lactes f. aestimabilis Arnold, Flora 67: 257. 1884.).

Type: Germany. Bayern, Oberbayern, Fränkischer Jura, quarry in Weinbergshofe at Treuchtlingen, sandstone, 8.5.1870, F. Arnold (M, herb. F. Arnold).
0-200μm in diameter. Conidia are different in size within the group, with most commonly measured at 8-8μm). Both genera of algae in *Caloplaca* species are recorded from three records of dolomitic rocks, in ortho- and ortho-western rocks. They are also recorded at localities in Křivoklát, Karlov, alt. 786 m, Vysoká hora (schistose rock, ZU). Along the road W of the bay "Ankaran" on Palice (herb. Z. Óra), ca 1300m above sea level.

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Martindale (H. W. Beauchamp). 3.7A. *Caloplaca crenularia*. A, Thallus in apothecia; B, Apothecia in more detail; C, Apothecium in detail with C+ violetpurple excipulum; D, Red pycnidia (white arrows) and apothecial primordia (black arrow).
Fig. 3.7B. *Caloplaca crenularia*. A, vertical section through an apothecium, showing absence of thaline excipulum and dark coloured layer (occasionally developed) surrounding hypothecium; B, ascospores (a, young spore; b-e, ripe spores; f, overripe spore; g, deformed spore); C, paraphyses tips.
Caloplaca lactea f. aurata (Harm.) Zahlbr., Cat. Lichenogr. Univ. 7: 151. 1931. (Bas.: Lecanora lactea f. aurata Harm., Lich. de France 5: 862. 1913.).

Type: France. Loir-et-Cher, Bearegard, 27.9.1892, J. Harmand (ANGUC).


Type: Bohemia centr., Loděnice, diabas, 1931, Z. Černohorský (PRM, 785536, herb. M. Servit!).

Type: France, Haute-Loire, St-Privat-d’Allier, 600m, 6.9.1954, G. Clauzade (MARSSJ, herb. B. de Lesd., holotypos).

Type: France. Alpes-Maritimes, Biot, 5m, above basalt, 6.4.1954, R. Prin (MARSSJ, herb. B. de Lesd.).

Type: Italy. Liguria. Stazzano presso Serravalle, P. Ferrari (MOD?).

**Diagnosis:** Thallus yellow, indistinct or crustose-areolate, consisting of dispersed to clustered areoles (0.2-1.5mm in diameter), rarely subquamulose, strongly variable in development. Cortex poorly developed, consisting of 1-4 rows of isodiametric cells, 3-6μm in diameter. Epinecral layer 0-30μm thick. Algal layer para-plectenchymatous, consisting of algal cells 7-23μm in diameter and fungal cells 3-6μm in diameter. Colourless crystals sometimes present in spots within algal layer. Medulla poorly developed. Thallus K+ violet-red.

Apothecia usually present, scattered or clustered, 0.2-1mm in diameter. Disc and true excipulum orange, changing to yellow-green when wet. True excipulum somewhat paler than disc, well developed in young apothecia, more or less reduced in older ascocarps. Thalline excipulum indistinct in young apothecia. In the older apothecia becoming conspicuous, superficially observable as the yellow “collar” surrounding apothecium.

Hypothecium colourless. Hymenium 50-110μm high, ascii 45-90 x 6-28μm in size. Hamathecium consisting of 2-2.3μm thick paraphyses, sparsingly branched. Tips of paraphyses distinctly widened at tips (up to 7μm), usually 2-3 upper cells swollen. Ascospores narrowly ellipsoid, very variable in length, (10-)11.5-28 x (3-)4-7.5μm in size. Septum of ripe spores 1.5-2μm. Deformed spores occasionally having allantoid shape and abnormal length (up to 35μm). 3-celled spores sometimes found. Apothecia C+ (slow, but persistent red-violet reaction) or C-, K+ violet-red.

**Photographs and illustrations:** Figs. 2.1B, 3.8A, 3.8B.

**Taxonomic notes:** Rather polymorphic species from *Caloplaca lactea* group. It is variable in hymenium height, length of ascospores and development of thallus and apothecia. However, presence of “apothecial collar”, shape of ascospores and septum thickness are less variable characteristic features.

Most species of *Caloplaca lactea* group differ in absence of yellow thallus. However, *Caloplaca aquensis* and *C. ferrarii* are hardly distinguishable from *C. crenulatella*, when its
thallus is badly developed. C. aquensis has more prominent true excipulum in ripe apothecia and broader spores with thicker septa. C. ferraria should have thinner true excipulum and spores with slightly thinner septa. I do not believe in such minute distinctive features. I have seen lectotype of C. ferraria var. pura (W 152621), which should be placed to C. crenulatella according to my observation.

Caloplaca arenaria differs in usually deeper coloured (ferrugineous) apothecia, excipular anatomy and also in absence of yellow thallus. C. dolomitica can be habitually also similar, but differs in small spores with thick septa. Mediterranean species C. interfulgens differs in more distinct thallus, consisting of larger areoles, 0.5-4mm in diameter.


Ecology: Growing on lime-rich siliceous and calcareous rocks, on horizontal as well as vertical rock-faces. More frequently occurring in sunny situations. It is very common on artificial substrata (concrete, mortar and asphalt). Its ecology is similar to Caloplaca xerica that has however lower ecological amplitude and usually is less abundant on localities.


Distribution: Common species throughout the Czech Republic on artificial substrata. Rarer occurs in natural habitats. It is restricted to the areas with calcareous or other base-rich rock-outcrops (e.g. Český kras and Moravský kras carstns, České středoohoří Mts. and “Křivoklátská pahorkatina” upland).


Southern Bohemia. České Budějovice, in the town, alt. 390 m., 48°58’41”N, 14°27’30”E, on concrete wall, 20.1.2003; České Budějovice, in the town, alt. 390 m., 48°58’41”N, 14°27’31”E, on concrete wall, 9.4.2003; České Budějovice, the park "Stromovka", alt. 390 m., 48°58’20”N, 14°27’30”E, on concrete wall, 14.1.2003; České Budějovice, Křemže, rocky outcrops S of the town, alt. 510m, 48°54’15”N, 14°18’40”E, on S-exposed serpentinite outcrop, 8.11.2003; Husinec, on concrete, 23.5.2003; Husinec, Těšovice, in the village, concrete, with Candelariella aurella, 23.5.2003; Písek, in the town, concrete, 15.5.2003; Písek, Mirovice, "Nerezský lom" quarry, 49°30’30”N, 14°04’E, limestone rock, 26.8.2003; Písek, Protivín, Čačák, 49°12’10”N, 14°13’40”E, concrete, 3.5.2003; Písek, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26’20”N,
Fig. 3.8A. *Caloplaca crenulatella*. A, Areolate thallus with apothecia; B, Older apothecia with crenulate margin; C, Apothecia in detail; D, Young apothecia with indistinct thalline excipulum.
Fig. 3.8B. *Caloplaca crenulatella*. A, vertical section through a typical apothecium, showing thalline excipulum which forms yellow-coloured "collar" around orange true excipulum; B, ascospores (a,b, young spores; c-g, ripe spores; h, overripe spore; i-m, deformed spores); C, paraphyses tips.
14°11'40"E, on the walls of a castle, 4.8.2003; Vodňany, Čiřenice, on the railway station, on concrete wall, 14.4.2003.

**Western Bohemia.** Karlovy Vary, Andělská Hora, in the village, alt. ca 620m, 50°12'20"N, 12°58'E, concrete wall, 21.3.2003.

**Southern Moravia.** Mikulov, Sedlec, the locality Skalky, 1.5 km SW from the village, 48°53'40"N, 16°40'30"E, tertiery soft limestone boulder, 23.2.2002; Mikulov, Svatý kopeček hill, 0.3 km east from the town, 48°48'30"N, 16°39'05"E, hard limestone boulder, 24.2.2002; Kroměříž, the castle Buchlov, sandstone rock, 5.7.2003; Kýjov, Milotice, horizontal sides of bricks in the wall, 2.7.2003; Vyškov, airport, asphalt, 3.7.2003; Vyškov, airport, vertical concrete plate, 3.7.2003.


**Bas. Physcia decipiens** Arnold, Flora 50: 562. 1867.

**Type:** Germany. Bayern. Eichstätt, auf Dachplatten-Schienen einer alten Mauern zu Eichstätt, 1863, Arnold (Arnold, Lich. Exs., no. 222b; M, holotype).

**Syn.:** *Gasparrinia decipiens* (Arnold) Syd.

**Diagnosis:** Thallus yellow to yellow-orange, sometimes white pruinose, usually orbicular, 1-2cm in diameter, with 1-2.5mm long marginal lobes. Marginal lobes convex, distinctly branched, 0.2-0.5mm wide. Occasionally found indistinctly lobed specimens, e.g. in competition of several thalli. Thallus areolate and sorediate in centre. Delimited soralia producing on areoles marginally at first. Older soralia expanding, covering whole areoles and becoming non-delimited. Prothallus not developed or inconspicuous, fibrilous. Thallus variably, 100-250µm thick. Cortex para-plectenchymatous consisting of cells 4-8µm in diameter. Algal layer continuous. Medulla loose, plectenchymatous. Thallus K+ violet-red, cortex and medulla C-, N-, I-.

Apothecia only occasionally present, often badly developed with tumide margin, sessile, ca 0.4-1mm in diameter. Disc darker orange than thallus. Excipulum of the same colour as thallus. True excipulum rather reduced in mature apothecia. Hypothecium colourless. Hymenium 55-85µm high. Asci 40-60 x 7.5-16µm in size. Hamatheciun consisting of 1-2µm thick single or branched paraphyses. Tips of paraphyses broadened, with 1-2 upper swollen cells. Ascospores 12.5-15.5 x 5.5-7µm in size. Septum 1.5-3µm wide. Apothecia N-, C-, K+ violet-red.

I have not seen pycnidia.

**Photographs:** Fig. 3.9A.

**Taxonomic notes:** Species characterised by its orbicular, lobate and rarely fertile thallus, producing soralia in centre. It is clear taxon, hardly confused. Other lobate sorediate species, such as *C. cirrochroa* and *C. proteus* have more subtle thallus, with other coloration. Juvenile sterile forms of *C. saxicola* are often hardly distinguishable from this species, but mature thalli are clear. *C. citrina* (mostly sublobate typ. *flavocitrina*) can be also similar to forms of *C. decipiens* with worse developed marginal lobes.


**Ecology:** Similar to *Caloplaca teicholyta*. It is common on calcareous rocks (various limestones, calcareous sandstones), rarely on non-calcareous, but always lime-enriched rocks (mostly basalts). Sometimes occurring on other non-calcareous rocks when situated under lime-rich walls, e.g. under ruin walls. This species commonly expands onto artificial substrates (mostly concrete).

Distribution: Common throughout the Czech Republic.

Specimens seen: Central Bohemia. Beroun, Krivoklát, in the village, 50°02′10"N, 13°52′30"E, schistaceous stone in the wall, 23.3.2003; Beroun, Lištice, on diabasic rock, alt. 260m, 2.1.2003, D. Svoboda (herb. Svoboda); Beroun, Srbsko, on the hill "Na Závěrce" near Berounka river, calcareous rock, alt. 240m, 10.8.2002, D. Svoboda (herb. Svoboda); Beroun, Srbsko, near Barrandova jeskyně cave, calcareous rock, alt. 240m, 23.10.2002, D. Svoboda (herb. Svoboda); Praha, Nová Ves, "Prokopské údolí" valley, on the "Hradčí" hill, calcareous rock, alt. 310m, 15.9.1999, D. Svoboda (herb. Svoboda); Rakovník, Kalubice, in the village, alt. 370m, 50°03′N, 13°49′40"E, mortar, 31.5.2003; Skryje, Ťýrovice, the ruin of medieval castle Ťýrov, 1 km S from the village, 49°58′30"N, 13°47′30", south facing base-rich silicate rock under the wall of the castle, 17.9.2001.


Southern Bohemia. Písek, in the town, alt. 370m, 49°18′20"N, 14°09′E, W-oriented, lime-enriched gneissic outcrops under town walls, 15.5.2003; Písek, Mirovice, "Nerestský lom" quarry, 49°30′30"N, 14°04′E, limestone rock, 26.8.2003; Písek, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m., 49°26′20"N, 14°11′40"E, on the walls of a castle, 4.8.2003.


Placodium demissum Körb. ex Flotow, Parerga lichenologica. p. 55. 1859.

Syn.: Lecanora demissa (Körb. ex Flotow) Zahlbr. 1898.; Parmelia demissa (Körb. ex Flotow) Zwackh.

Diagnosis: Thallus crustose, orbicular, olivaceous brown to brown or greyish to white pruinose, ca 2-6mm in diameter, 100-160μm thick. Thallus rimose in centre, always delimited with flat or slightly convex marginal lobes, shortly but richly branched, 0.2-0.4mm broad, 0.5-2mm long. Coarse soralia produced in the centre of the thallus. Cortex developed, para-plectenchymatous, variously thick, 20-70μm. Cortex cells 3-8μm in diameter, inner cells colourless, outer cells brownish to greyish. Algal layer para-plectenchymatous, more or less continual, algal cells 6-14μm in diameter. Thallus and cortex in section K-, N-.

Apothecia never seen. Sometimes asccarps of other lichen species, as Buellia alboatra and Lecanora dispersa occur on thallus of C. demissa and seemingly belong to it.

Pycnidia indistinct, unchambered. Conidiogenous cells "bottle-like" with (1-)3-5μm long protrusions, conidia bacilliform 3.5-5 x 0.8-1μm in size (for illustrations of conidia and conidiophores see Arup et Grube 1999, fig. 5).
Fig. 3.9A. *Caloplaca decipiens*. A, Thallus with soralia in central part; B, Young thallus so far without soralia; C, Central part of older thallus; D, Apothecia; E, Apothecial primordia and young apothecia.
Fig. 3.10A. *Caloplaca demissa*. A, Non-pruinose thallus; B, Greyish thallus with pruina; C, Thallus with apothecia of *Buellia alboatra*; D, Thalline lobes in detail.
Photographs: Fig. 3.10A.

Taxonomic notes: Species characterised by a small lobate orbicular thallus, brownish or greyish pruinose, K- (also cortex in section). This distinct species can be hardly confused with other taxa. Caloplaca peliophylla occurring in North America has somewhat similar sublobate thallus, but it is non-sorediate and normally fertile. Caloplaca teicholyta is often sterile, but differs e.g. in significantly larger, thicker thallus and thinner cortex K+ "dirty" violet.

Some lobate species of Lecanora (sect. Placodium) are also usually fertile and differ strongly in pycnidial structures - long, never isodiametric cells of conidiophores and thread-like conidia (Arup et Grube 1999). Hyperphyscia adglutinata has similar sorediate and only occasionally fertile thallus, which is however thinner, flat, never convex, tightly pressed onto a substrate.

Ecology: This species is typical for sunny overhanging rocks or vertical rock-faces of non-calcareous, but more or less basic and nutrient rich rocks (e.g. andesite, basalt, gneiss, granite, schist, some conglomerates and sandstones). On well-lit, mostly south-facing rocks it forms large colonies that bland together. Occasionally it forms a dominant of lichen community almost without other competitors. There are two ecotypes. First, heavily greyish pruinose (var. caesiella) is common in dryer, more or less sunny and base-enriched habitats. Second, brownish and non-pruinose is typical for habitats occasionally wet from rain and usually less base-enriched. C. demissa has been very rarely found on artificial substrates, mostly on stones in ruin walls.

Associated lichen species: Acarospora praeruptorum, Amandinea punctata, Buellia alboatra, Caloplaca aractina, C. arenaria, C. flavovirescens, C. irrubescens, Hyperphyscia adglutinata, Lepraria rigidula, Lecanora dispera, Lecidella anomaloidea, L. stigmata, L. viridans, Phaeophyscia nigricans, Ph. orbicularis, Physcia dimidiata, Ph. dubia, Rhinodina zwackhiana, Verrucaria nigrescens, Xanthoria fallax.

Distribution: This species is restricted to natural rocks in warmer and dryer climate. The distribution pattern is similar to Caloplaca aractina and C. subsolata, but it is wider - it increases to higher altitudes. Number of localities and abundance on localities distinctly increases from higher to lower altitudes. There are three distribution centres in the Czech Republic, such as the river valleys in South-western Moravia (rivers Bityška, Dyje, Jevíšovka, Jihlava, Loučka, Osłava, Rokytína, Svitava, Svratka and Želetavka), river valleys in Central Bohemia (rivers Berounka, Lužnice, Otava, Sázava, Vltava and more isolated localities on rivers Blanice, Chrudimka, Litavka, Malše, Ploučnice and Spulka) and rocky hills in České středohoří Mts. (Northern Bohemia). Isolated localities are situated usually on rocky hills under the ruin walls (e.g. Andělská hora, Košťálov and Žebrař). Altitudinal maximum: 700m a. s. l. on Andělská hora hill in Doupovské hory Mts. (Western Bohemia).


Specimens seen: Central Bohemia. Beroun, Rostoky u Křivoklátu, rocks "Na andělu", 1 km SW of the village, WSW exp., alt. 250m, 50°01'10"N, 13°51'40"E, base-rich vertical schist rock, 1.6.2003; Beroun, Zdice, S-facing rock on W edge of town, alt. 300 m, 49°54'30"N, 13°58'20"E, sunny rock of basalt (diabas), 11.9.2003; Hofovice, Točník, ruin of the castle Točník, 1 km NE of the village, alt. 430 m, 49°53'50"N, 13°53'30"E, base-rich, S oriented rock beneath the castle, 10.5.2003; Křivokláta, Městečko, the rock in the valley of Rakovnický potok brook, 1 km NW from the town, 50°03'20"N, 13°50'50"E, base-rich basaltic rock, 26.1.2002; Milín, Solenice, rocks on the left side of Vltava river, 1 km NE of the village, S exp., alt. 300-400 m, 49°37'35"N, 14°12'20"E, acid and base-rich rocks, vertical plates and under overhangs, 6.12.2002; Příbram, Jince, Rejkovice, schist rocks on the left side of "Litavka" river, E exp., alt. 390m, 49°49'N, 13°58'30"E, overhangs and vertical plates of alight schist rock, 13.6.2003; Rakovník, Křížvá, the rock "Valachov", 1 km SE from the village, in the valley of Tyterský potok brook, SW exp., 50°01'N, 13°46'30"E,

Distribution: Occurrence on artificial substrata seems to be rare throughout the Czech Republic. Such occurrence is dependent on the distribution of old, weathered brick walls. Natural distribution is more or less restricted to the limestone areas, where this species complex commonly occurs. Altitudinal maximum: 430m, the castle Točník in the Central Bohemia (Slovakia: 1350m, Mt. Klak in South-western part of Malá Fatra Mts.).


Northern Moravia. Nový Jičín, Stramberk, the hill “Kotouč”, alt. 400m, calcareous rock, 1920, Suza (PRM 580887, sub Caloplaca aurantia ca var. diffacta).

Southern Moravia. Kroměříž, the castle Buchlov, sandstone rock, 5.7.2003; Kyjov, Milotice, horizontal sides of bricks in the wall, 2.7.2003; Mikulov, between Svátý kopec hill and the limestone quarry, 1 km E of the town, SE exp., 48°48’40”N, 16°39’20”E, hard limestone boulder, 21.8.2002; Mikulov, “Svatá hora” hill, alt. 350m, calcareous rock, 1915, Suza (PRM 580849, sub C. placida).


Germany. Baden-Württemberg. Schwäbische Alb Mts., Heidenheim, Bartholoni, alt. 610m, dolomite rock with sandy impurities, 18.11.1986, Muhl, Poelt (GZU); Kelheim an der Donau, Altmühl, limestone rock, alt. 380m, 14.3.1953, Schröppel (GZU).

Hungaria. Fiume, calcareous rock, col. J. Schuler (A. Zahlbr., Kryptogamae exsiccateae, no. 2369, sub C. placida var. difracta); Pest, Kistéény, calcareous rock, alt. 220m, 1914, G. Timkó (Flora Hung. Exs., no. 720, sub Caloplaca flavivirescens).


Switzerland. Kanton Argüa, Baden, Läger, alt. 720-800m, limestone, 29.5.1978, Mayrhofer (GZU).

**Fig. 3.11A. Caloplaca dolomitica.** A, Thallus with apothecia; B, Areolate thallus, only young apothecia present; C, Thallus affected by grazing of snails, only apothecial primordia present.
Fig. 3.11B. *Caloplaca dolomitica*. A, ascospores (a-e, ripe spores; f, overripe spore; g,h, deformed spores); B, paraphyses tips.


*? Lecanora erythrella* (Ach.) Kieff. (Syn.: *Caloplasca erythrella* (Ach.) Ach.).

**Diagnosis:** Thallus greyish, green-yellow or yellowish, never deep yellow. Thallus crustose-areolate to rimose, often deformed by grazing of snails. Prothallus mostly not present. Thallus C-, I-, N-, K+ more or less violet-red (greyish thalli K+ only in spots, cortex in section dark violet).

Cortex colourless in lower part, dirty yellow in upper part, (10-)15-30(-40) \(\mu\)m thick. Consisting of para-plectenchymatous tissue, with cells 3-6\(\mu\)m in diameter. Epinecral layer +/- continual, maximally 15\(\mu\)m thick. Algal layer continuous or discontinuous, para-plectenchymatous. Fungal cells 3-5(-7)\(\mu\)m, algal cells 6-15\(\mu\)m in diameter.

Apothecia 0.2-1.1\(\mu\)m in diameter, dark to pale orange, strongly contrasting with pale thallus. True excipulum of the same colour as disc or somewhat paler, plectenchymatous, with elongated cells, 3-6\(\mu\)m thick. Outer cells becoming rather isodiametric (distinct after KOH application), 3-6\(\mu\)m in diameter. True excipulum partially reduced in old apothecia. Thalline excipulum orange, covered by 10-30\(\mu\)m thick cortex. Occasionally, in older apothecia, outer greyish (or yellowish) thalline margin can be present.

Hypothecium colourless, plectenchymatous. Some isolated groups of algae can be found in hypothecium and also in hymenium (fig. 2.2). I have never found this character in other species, but it seems to be frequent within this taxon. Hymenium 55-90\(\mu\)m high, asci 40-70 x 12-16\(\mu\)m in size. Hamathecium consisting of 1.5-2\(\mu\)m thick paraphyses, rarely or often branched and anastomosed. Paraphyses tips swollen to 4.5\(\mu\)m, 1-4 upper cells broadened. Ascospores 12-17(-18) x 6-8(-10)\(\mu\)m. Septum of ripe spores 4-5\(\mu\)m, ca 1/3 of sp. length. Apothecia C-, N-, K+ violet-red.

Pycnidia not seen.

**Photographs:** Fig. 3.12A.

**Taxonomic notes:** Species significantly characterised by untypical yellowish to greyish thallus. Therefore, orange apothecia strongly contrast with thallus. This character shares *Caloplasca flavovirens* with *C. flavorubescens*. Some authors consider these taxa as a single species, but there are some differences. *C. flavorubescens* growing exclusively on bark has continual thallus (not rimose or areolate) and larger apothecia (to 3\(\mu\)m in diameter).

*Caloplasca dolomititica* differs mostly in thallus colour. Other distinctive characters are typically oily hypothecium, para-plectenchymatous true excipulum, hymenium with yellow-orange crystals (anthraquinone crystals fill old and deformed asci and cover some paraphyses to lower part of hymenium), smaller spores and less broadened paraphyses. *C. subsoluta* differs easily in having para-plectenchymatous hypothecium and true excipulum. *C. crenulatella* differs clearly in spores.

**References to taxonomy:** Laundon 1976, Purvis et al. 1992, Wade 1965.

**Ecology:** Species characteristic for slightly lime-rich silicates (e.g. calcareous schist or gneiss) and superficially more or less decalcified carbonates. Typical species in areas, where some acid silicate formations fade into the calcareous formations. Rarely occurring on concrete.

**Distribution:** Not sufficiently known.
Specimens seen: Southern Bohemia. České Budějovice, Kamenný Újezd, rocks under the ruin of a castle Kotek (Maškovc), 2 km W of the village, S exp., alt. 420-440 m, 48°54'05"N, 14°24'20"E, base-enriched gneissose rock, 17.11.2002; Písek, Zvichovská Podhradí, the castle Zvichov, alt. 360 m, 49°26'20"N, 14°11'40"E, horizontal side of concrete wall, 4.8.2003.


Bas.: Lecanora grimmiae Nyl., Flora 69: 97. 1886.

Type: Caucas, Aru Kosch in valle Baksan, 1885, Lojka (H-Nyl. 30079, holotype).

Calopla ca congestivars (Nyl.) Zahbr., Cat. Lich. 7: 110. 1931.

Bas.: Lecanora congestivars Nyl., Flora (Regensburg) 66: 100. 1883.


Type: Yugoslavia. Serbia. Rtanji-Gebirge, ?, Zimmermann (?).

Diagnosis: Thallus parasitic on Candelariella vitellina, restricted to thalline excipulum and area below apothecium (to 200µm thick) or present, areolate, consisting of convex brown to grey areoles, that are usually squeezed among C. vitellina granules. Prothallus not seen. Paraplectenchymatous cortex colourless in inner part, outer cells brownish, 20-30µm thick. Algal layer continuous, rather para-plectenchymatous, algal cells 6-12µm in diameter. Thallus K-.

Cortex K+/- slowly slightly "dirty" violet in cross-section.

Apothecia 0.3-1.2mm in diameter, disc deep orange-red to deep red. True excipulum grey, brown or blackish, usually darker than thallus (brownish outer cells in section), plectenchymatous, with elongated cells, in KOH 4-5µm thick. Thaline excipulum present, more distinct in older apothecia.

Hypothecium colourless. Hymenium 50-70(-80)µm high, asci 40-50 x 10-14µm in size. Hamathecium of 1.5-2µm thick paraphyses, richly subapicaly and apically branched and often anastomosed. Paraphyses tips not broadened or widened up to 4µm, 2-4 upper cells broadened. Ascospores small 10-12(-14) x 6-8µm in size. Septum of ripe spores 3-4µm thick.

Apothecia C-, disc K+ violet-red.

Pycnidia not seen.

Photographs: Figs. 3.13A.

Taxonomic notes: Species always parasitic on Candelariella vitellina, characteristic with minute and only occasionally present brown to grey thallus and with dark red apothecia having dark true excipulum.
Fig. 3.12A. *Caloplaca flavovirescens*. A, Yellowish thallus with apothecia; B, Thallus in detail; C, Greyish thallus, almost without yellow tinge.
Fig. 3.13A. Caloplaca grimmae. A, Thallus indistinct, parasitic on Candelariella vitellina; B, Apothecium overgrown by C. vitellina lobes; C, Apothecium in detail.
Caloplaca vitellinaria is also parasite on C. vitellinulla, but it has completely different appearance, very similar to Caloplaca holocarpa. C. aractina having dark red apothecia and blackish true excipulum differs among others in distinct, non-parasitic thallus.

References to taxonomy: Wetmore 1996.

Ecology: Occurring as a parasite on Candelariella vitellina on non-calcareous rocks in xero-thermic habitats. Typical species of rocky steppes on warm slopes in river valleys. In contrast of its host it is rather rare species, restricted to specific habitats.


Distribution: This species is restricted to natural rocky outcrops in warmer and dryer climate. There are three distribution centres in the Czech Republic, such as the river valleys in South-western Moravia (rivers Dyje, Jižlava, Oslava and Rokytá), river valleys in Central Bohemia (rivers Berounka and Vltava) and rocky hills in České středohoří Mts. (Northern Bohemia). Altitudinal maximum: ca 500m in České středohoří Mts (Northern Bohemia).

References to distribution in the Czech Republic: Suza 1942, 1947.


Southern Moravia. Dalešice, Mohelná, locality Mohelná badcová step S from the village, southern slope, 49°06'30"N, 16°11'10"E, on the thallus of Candelariella vitellina, serpentine/sunny slope, 17.5.2002; Dalešice, Mohelná (Věžda: Lišch. Sel. Exs. 49, sub C. congestris); Ivančice, Hrubštejn, serpentinite rock, 5.8.1956, A. Věžda (Věžda: Lišch. Boh. Exs. 59);


Portugal. Serra do Estrela, Manteigas, the glacial valley near the village, sunny granite stones and rocks (on Candelariella vitellina), 8.7.2002.


Bas.: Verrucaria obliterta = holocarpa Hoffm., Deutsch. Flora: 179. 1796. (Syn. Lichen holocarpus (Hoffm. ex Ach.) Ehrh. ex Ach., Lichenogr. Suec. Prodr.: 73. 1798., Callopsis aureantia var. holocarpum (Hoffm. ex Ach.) Körb.).


Caloplaca pyracea var. rivulorum (Eitner) Kutík 1923.

Diagnosis: Thallus usually indistinct, whitish or grey, continually changing into whitish fibrous prothallus. Prothallus typically developed only on smooth substrates. Thallus occasionally seems to be yellowish due to apothecial primordia covered with yellow cortex. Yellow pigmentation (K+ violet) rarely expands around primordia and apothecia. Thallus is more distinct on smooth substrate. Cortex not developed or inconspicuous around apothecia, very thin, colourless. Algal cells 5.5-15.5µm in diameter.

Apothecia usually abundant, yellow-orange to orange, 0.2-0.6mm in diameter. True excipulum more or less developed, plecenchymatous, with fibrillose cells. Thalline excipulum is always present. In the corticolous specimens outer grey apothecial margin occasionally
present around thalline excipulum. Excipulum usually paler than disc, yellow to yellow-orange. Wet apothecia change colour into pale yellow.

Hypothecium colourless. Hamathecium 60-70μm high, asci 50-60 x 13-16μm in size. Hamathecium of ca 1.5μm thick paraphyses, branched and anastomosed. Paraphyses tips widened up to 6μm, mostly 2-4 upper cells broadened. Ascospores (8.5)-9-15 x 6-8μm in size. Septum of ripe spores 3.5-6.5μm thick. Apothecia C- (epihymenium C+ slowly red), K+ violet-red.

Pycnidia not seen. 

Photographs and illustrations: Figs. 3.14A, 3.14B.

Taxonomic notes: Relatively monomorphic species, characterised by small, thick spores, with broad septa and by heavily broadened paraphyses tips. There are huge differences in substrate preferences within this species and that was the reason to describe several "ekospecies". Caloplaca thuringiaca Sochting et Stordeur is muscicolous, restricted to warm and dry habitats in lower altitudes, C. saxfragarum Poelt, C. schoeferi Poelt and C. tirolensis Zahlbr. are muscicolous, restricted to alpine habitats, but without any satisfied morphological features. C. vitellinaria is parasitic species on Candelariella vitellina morphologically almost identical with C. holocarpa (it is very different from C. grimmiae, definitely not its synonymum, as suggested by Wetmore 1996). C. lithophila H. Magn. is saxicolous, differentiated only in having oil cells in paraphyses. There are probably many other described taxa, based on substrate ecology throughout the world. The situation is obviously far from being fully understood. Caloplaca vitellinula is another problematic species, that probably does not exist and contains abnormal specimens of C. holocarpa and C. saxicola (see chapter Caloplaca vitellinula for the details).

Caloplaca crenularia (and other species from "ferruginea" group) differs e.g. in character of hamathecium. Caloplaca arenaria has narrow spores with thin septa. Caloplaca ceracea differs in having typical thick subsquamous thallus.


Ecology: Species growing on the broad spectrum of substrates. There are saxicolous, corticolous, lichicolous, muscicolous and also coprophilous ecotypes. Muscicolous and lichicolous types are considered as different species (see taxonomic notes). Saxicolous types prefer variable nutrient-rich substrates. They occur on calcareous rocks but more common on silicate rocks (e.g. basalt, gneiss, granite and schist). Among artificial substrates C. holocarpa inhabits calcareous or non-calcareous stones in the walls (typical species for ruin walls), concrete and also old iron materials (e.g. old agricultural machines).

I have seen one interesting record of C. holocarpa on dung of rabbit Oricolagus caniculus in arid conditions of the Hungarian pusztá (Vézda 1975).


Distribution: Probably common throughout the Czech Republic. Known altitudinal max.: 1080m on the Mt. Klet' (Southern Bohemia/Blansky les Mts.). True altitudinal maximum is located probably higher.
Fig. 3.14A. *Caloplaca holocarpa*. A, Thallus on smooth substrate with distinct whitish prothallus; B, Yellow thallus is not typical, but occasionally present; C, Apothecia somewhat similar to that of *C. Cremulatella*. 
Fig. 3.14B. *Caloplaca holocarpa*. A, vertical section through a thallus with three apothecial primordia, cortex around primordia is covered with orange crystals (black dots), normal thallus is not yellow colored and much more thinner (on sides); B, ascospores (a-c, ripe spores; d, overripe spore); C, paraphyses tips.
Diagnosis: Thallus dark to pale grey or green-grey, crustose-rimose, often covered by small, globose to coralloid isidia, up to 0.1mm in diameter, that easily split into soredia. Soredia 20-80μm in diameter. Forms inhabiting limestone (C. isidiigera type) have larger isidia and do not produce any soredia. Some morphotypes, usually occurring in damp situations, do not produce isidia and have flat areoles, that easily breaking up into soralia at edges. Prothallus rare, black, only seen on smooth quartzite crystals. Cortex colourless or slightly greyish, thin, up to 20μm thick. Cortex cells para-plectenchymatous, 4-8μm in diameter. Algal layer para-plectenchymatous, algal cells 6-16μm in diameter. Thallus K-, but cortex and soredia slowly K+ blue-violet in cross-section.

It occurs often almost sterile. Apothecia occasionally present, scattered to clustered, 0.2-1mm (to 1.5mm in corticolous forms) in diameter. Thalline exciple of the same colour as thallus or slightly paler, occasionally covered by isidia, or broken into soralia. True excipulum inconspicuous. Disc yellow, orange, brown-orange to brown.

Hymenium colourless. Hymenium 60-75μm high. Ascii 40-55μm high. Hamathecium consisting of 1.5-2μm thick paraphyses, poorly branched. Tips of paraphyses widened to 4.5μm, mostly 2-4 upper cells broadened. Ascospores 10-18 x 5-8μm in size. Septum of ripe spores 4-6μm thick, ca 1/3 of spore length. Disc of apothecia C- (epihymenium in cross-section also C-), K+ violet-red.

Pycnidia scattered in thallus surface, somewhat darker than thallus. Wall of pycnidia slightly greyish in cross-section, K+ blue-violet. Conidiogenous cells more or less isodiametric, 5-6μm in diameter. Conidia narrowly ellipsoid, ca 3-3.5 x 1μm in size.

Photographs and illustrations: Figs. 3.15A, 3.15B.

Taxonomic notes: Rather polymorphic species, strongly variable in thallus. There are non-isidiate to heavily isidiate, non-sorediate to strongly sorediate individuals. But some features are conservative, e.g. absence of true excipulum and K+ “dirty” violet reaction of thallus. Leaded-grey, heavily isidiate, non-sorediate and entirely calcicolous lichens were described by Vězda as Caloplaca isidiigera from high altitudes of Nízké Tatry Mts. (Slovakia). Although Wetmore (1997) has incorporated this taxon into C. chlorina, it seems to be very different from typical collections of C. chlorina. Anyway, typical calcicolous Vězda’s Caloplaca isidiigera has not been found in the Czech Republic yet.

Caloplaca aractina differs in the blackish true excipulum and distinct dark prothallus. Caloplaca xerica differs among others in presence of true excipulum, that continues beneath hypothecium. I do not understand to the relation between C. chlorina and C. cerina. However, C. cerina is non-sorediate, having K- cortex and usually is recorded on mosses and plant debris. C. virescens, occurring on bark, has smaller, narrowly ellipsoid spores with thin septa (1/4 sp. length).


Ecology: This species inhabits broad spectrum of substrates. It occurs on nutrient-rich bark of deciduous trees (e.g. Acer, Quercus), where it prefers bases of tree trunks. C. chlorina also grows on nutrient-rich silicate rocks and stones, e.g. basalt, gneiss and schist. Rarely occurring on limestone (C. isidiigera type). Commonly recorded on artificial substrates, as horizontal-facing bricks and roofing-tiles. It expands also on concrete, but only in neighbourhood of silicate stones. It prefers damp and shaded habitats, occasionally growing near the water.

Fig. 3.15A. *Caloplaca chlorina.* A, Grey-green thallus, typical in damp situations; B, Thallus with apothecia; C, Apothecia in detail.
Fig. 3.15B. *Caloplaca chlorina*. A, vertical section through an apothecium, showing absence of true excipulum; B, conidiogenous cells with conidia; C, ascospores (a-d, young spores; e-h, ripe spores); D, paraphyses tips, the first type is the most common.
**Distribution:** Probably occurring throughout the Czech Republic, but not enough records gained. Altitudinal maximum: 1180 m a.s.l., Šumava Mts. (Southern Bohemia), on Populus trunks.

**Specimens seen:**
- **Central Bohemia.** Beroun, Křivoklát, in the village near the castle, 50°02′10″N, 13°52′30″E, nutrient-rich rock under the castle, with C. holocarpa, 23.3.2003; Rakovník, Kalubice, in the village, alt. 370m, 50°03′N, 13°49′40″E, silicate stone (schist), 12.9.2003.
- **Southern Bohemia.** Husinec, Výrov, in the village, alt. 520m, 49°03′00″N, 13°59′50″E, gneissic stones in garden, 4.9.2003; Husinec, Výrov, in the village, alt. 520m, 49°03′00″N, 13°59′50″E, gneissic stone in N-facing wall, 5.6.2003; Kvidla, Horská Kvidla (Šumava Mts.), 49°02′N, 13°35′E, bark of Populus, alt. 1065-1070m, 22.10.2003, Palice (Herb. Z. Palice, no. 8160); Písek, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26′20″N, 14°11′40″E, bark of Acer platanoides, 4.8.2003; Vimperk, Onšovice, near the “Spulka” river, alt. 590m, 49°06′10″N, 13°46′E, gneiss stones by the river, 11.6.2003.
- **Western Bohemia.** Karlovy Vary, Andělská Hora, ruin of medieval castle N of the village, alt. 700 m, 50°12′20″N, 12°58′E, basaltic, S-oriented rock beneath the castle, 21.3.2003.
- **Southern Moravia.** Kroměříž, the castle Buchlov, stones (sandstone) in the wall, also on concrete, in shaded situation, 5.7.2003; Kjov, Milotice, horizontal sides of bricks in the wall, 2.7.2003; Oslavan, in Oslava river valley, gneiss rock, 6.8.1919, Suza (PRM); Tišnov, Doubravník, in Svratka river valley, gneiss, 1921, Suza (PRM); Velká nad Veličkou, Vápenky, locality of Kamenná bouda, 3 km NE from the village, the old oak on the bifurcation, 48°53′30″N, 17°39′30″E, bark of old Quercus, 29.5.2002.

**Bulgaria.** Haskovo, Madžarovo, by the river Arda, 41°40′N, 25°50′E, bark of old Quercus, 29.10.2002.


Type: Finland. Turkku Pori, Särkisalo, Kaukasalo, on calcareous stone, 18.8.1920, Vainio (TUR, lectotype).


**Diagnosis:** Thallus leprose and plechtenchymatous, dull orange, brownish to greyish yellow on the surface and creme to yellowish inside. Consisting of powdery globose granules, ca 0.1 mm in diameter, occasionally having short hairs on the surface. Well developed thallus producing thick areolate, superficially leprose crust. Thallus effuse, not distinctly delimited, K+ violet, C-.

Apothecia and pycnidia not seen.

**Photographs:** Fig. 3.16A.

**Taxonomic notes:** Easily distinguishable monomorphic species, characteristic with dull orange, brownish to greyish yellow powdery thallus, K+ violet. *Caloplaça citrina* differs in having areoles with para-plechtenchymatous cortical layer and in colour and shape of soredia, that are more or less yellow and smoother. *C. saxnolyta* differs in bright yellow thallus and in distinctly delimited, occasionally sublobate thallus. Leprose species from other genera have different colour and K- reaction.


**Ecology:** Species inhabits shaded, but more of less dry overhanging rocks or vertical rock-faces in limestones or other lime-rich stones (calcareous sandstones and mudstones). Rarely growing also on concrete.
Associated lichen species: Caloplaca cirrochroa, C. citrina, C. dolomitica, C. xantholyta.

Distribution: Probably common in most of karst areas in the Czech Republic, but I have gained insufficient number of records. This species has been probably often confused with C. citrina.

Specimens seen: Central Bohemia. Beroun, Srbsko, locality “Na Závěrce”, alt. 240m, calcareous stone, 2.5.2001, D. Svoboda (herb. D. Svoboda);


Bas.: Lecanora inconnexa Nyl., Flora (Regensburg) 66: 100. 1883.
Type: France. Supra saxa dolomitica prope Monspelium, 1853, Nylander (H-Nyl. 29575, holotype!)

Type: Italy. Sardinia. Distr. Nuoro, Punta Palai, Catena della Margine, dry brook bank, on Aspicilia cf. contorta, 24.7.1985, Nimmis, Poelt (GZU, holotype!)

Caloplaca tenuatula ssp. inconnexa

? Caloplaca inconnexa var. verrucariarum

Diagnosis: Thallus yellow to yellow-orange, often resembling Candelariella vitellina, crustose-arclate, with irregular short marginal lobes (thallus never orbicular). Areoles ca 0.2-0.6mm in diameter, marginal lobes often larger, to 1.5mm thick. Thallus thick with curled areoles. Prothallus usually not developed, if present, then pale yellow to whitish. Thallus C-, K+ violet-red.

Cortex colourless, covering by yellow-orange crystals, 10-25µm thick, with several rows of isodiametric cells. Epinecral layer not continual, thin. Algal cells 7-22µm in diameter, gathered around with isodiametric fungal cells, 3-5.5µm in diameter.

Apothecial disc orange to orange-red, 0.2-1mm in diameter. True excipulum orange, paler than disc consisting of long branched and anastomosed plectenchymatous cells, 2-4µm thick. Thalline excipulum more distinct in older apothecia, yellow, “collar-shaped” (such as in C. crenulatella).

Hypothecium colourless, occasionally with oil-drops. Hymenium 65-80µm high, asci 50-60 x 10-20µm in size. Hamathecium consisting of 1.5-2µm thick, flexuose and branched paraphyses. Paraphyses tips slightly swollen to 3.5µm, mostly only 2 upper cells broadened. Ascospores broadly ellipsoid, (8-)10-14(-15) x (4-)5-10µm in size. Septum of ripe spores 4-7µm thick, ca 1/2 of sp. length. Loculi of spores sometimes characteristically K+ violet-red. Apothecia C- (epihymenium sometimes C+ slowly reddish in section), K+ violet-red.

Pycnidia chambered, superficially indistinct, 100-150µm in diameter, of the same colour as thallus. Conidiogenous cells oblong to long, obtuse triangular, 4-5 x 5-7µm in diameter. Conidia narrowly ellipsoid, 3-3.8µm x 1-1.5µm in size.

Photographs: Fig. 3.17A.
Fig. 3.16A. *Caloplaca chrysodetha* and *Caloplaca xantholyta*. A, B, Thallus of *Caloplaca chrysodetha*; C, D, Sharply delimited Thallus of *Caloplaca xantholyta*.
Fig. 3.17A. Caloplaca “inconnexa”. A, Thallus parasited on Acarospora cervina; B, Thallus in detail; C, Distinctly lobate thallus; D, Young thallus, probably not parasitic.
Taxonomic notes: Type of Caloplaca inconnexa does not agree well with "Caloplaca inconnexa" occurring in the Central Europe. Although anatomy does not significantly differ, morphology seems to be dissimilar. All the type-like samples from the Western Europe that I have seen had mostly not parasitic thallus consisting of small scattered squamules. Such characters agree with Nylander's description (Nylander 1883). The central European samples of "Caloplaca inconnexa" are mostly parasitic and have rather compact-areolate or sublobate thallus. I am not able to decide, if the discussed morphotypes are geographical or ecological variants of single species or two separate species.

Caloplaca inconnexa differs from relative species in having parasitic, usually sublobate thallus, resembling Candelariella vitellina.

Taxon C. inconnexa var. verrucariarum differs from typical C. inconnexa in having thin thallus without marginal lobes, lower hymenium, ca 45-55μm and producing smaller spores. Real taxonomic value of this taxon is not clear to me.

Caloplaca dolomitica differs in non-lobate or indistinctly lobate thallus, smaller spores, excipulum consisting of isodiametric cells and longer conidia. Deformed asci and paraphyses are often covered and filled by crystals of anthraquinones.

Alpine species Caloplaca cacuminum differs in more minute thallus often restricted to cracks in the rocks, small and thin spores (ca 8-10 x 4μm) with thin septa (1-2μm), lower hymenium and broader paraphyses tips.

Parasitic species Caloplaca oasis and C. polycarpa are rather similar to C. dolomitica s.l. Both differ in non-lobate, rather minute thallus and para-plectenchymatous excipulum (more information under C. dolomitica).


Ecology: Species restricted to limestones and calcareous sandstones in the Central Europe, but in the Mediterranean also found on silicates. It is parasitic species, typically growing on Acarospora cervina (then tightly growing around Acarospora areoles) and Aspicilia sp div. (var. nesodes). Rarer hosts are Lecanora muralis and Lobothallia radioa. Caloplaca inconnexa very rarely occurs also free-living.

Distribution: Rather mediterranean species. Only three times recorded from "Pavlovske vrchy" hills (south of Brno) and two-times from Eastern Bohemia within the Czech Republic. Perhaps in will be found also in some other areas with calcareous outcrops. Known altitudinal max. ca 360m on Svaty kopecek hill near Mikulov (Slovakia: 980m, Mt. Zniev, SW part of Malá Fatra Mts.).

Specimens seen: Eastern Bohemia, Úpice (distir. Trutnov), on calcareous sandstone, 1911, 1912, Kufák (PRM 580611, 580616, sub Caloplaca auranticus).

Southern Moravia. Mikulov, Sedlec, the locality Skalky, 1,5 km SW from the village, 48°53'40"N, 16°40'30"E, terciery soft limestone boulder, 23.2.2002; Mikulov, Sedlec, the locality Skalky, 1,5 km SW from the village, 48°53'40"N, 16°40'30"E, hard limestone boulder, partly parasitized on Lecanora muralis, 23.2.2002; Mikulov, Svatý kopeček hill, 0,3 km east from the town, 48° 48'30"N, 16°39'05"E, parasited on thallii of Acarospora cervina, 24.2.2002.

Austria. Niederösterreich. Themalpen, Frauenstein bei Mödling, S-facing dry slopes with dolomite outcrops, alt. 300-320m, 14.7.1984, Mayrhofer, Poelt (GZU 92-84, 113-84).


Italy. Marettino (Isolé Élégdi), on limestone, parasitic on Aspicilia viridescens, 27.3.1991, Poelt (GZU); Sardinia. Cagliari, Pula, Nora, granite rocks near the coast, 18.7.1985, Nimis, Poelt (GZU, var. nesodes); Sardinia. Cagliari, Burcei, on granite, alt. 670m, 19.7.1985, Nimis, Poelt (GZU, var. nesodes); Sardinia. Genargento Ms., Mt. Arbu, calcareous schist, alt. 1250m, 17.7.1987, Poelt (GZU); Sardinia. Monte Albo Ms., Cantoniera di St. Anna, Punta Cupetti, on limestone, alt. 900m, 25.7.1985, Poelt, Nimis (GZU).

Slovakia. Malé Karpaty Ms., Flavecké Podhradie, Pohanská, alt. 300-400m, dry slope with limestone outcrops. 29.6.1993, Pišt, Poelt (GZU 11-94); Martin, Kláštor p. Znievom, mt. Zniev, alt. ca 980 m, sunny limestone rock, often parasitic on Acaerospora cervina, 23.7.2003.

Serbia. Montenegro. Prokletije Ms., Debojacku Krs, limestone, alt. 1600-2000m, 14.7.1974, Poelt (GZU 212 – three samples);

Tunis. Bou Salem, Thibar, alt. 470m, calcareous rock, 12.4.1968, Poelt (GZU).


Bas.: Callospis lutecoldium var. lacteum Massal., Schedul. Critic. 7: 133. 1856.

Type: Italy, Venetto, Verona, ad saxa neocomiana in ventosis oppidi Tregnago (Viacara, Gualla, etc.), leg. A. Massalongo, A. Massalongo, Lich. Italic Ex. 236 (M).


Diagnosis: Thallus endolithic or restricted to substrate cavities, white and yellow dotted. Yellow dots represent epilithic thallus spots around abundant apothecial primordia and destroyed apothecia. Thallus consisting of loose, plectenchymatous tissue with ca 3-4μm thick cells. Algal layer discontinuous. Algal cells 6-18μm in diameter. Thallus K- (yellow dots K+ violet red), C-, N-, I-.

Apothecial primordia partially immersed in substrate, yellow, K+ violet, mature ascocarps sessile. Apothecia scattered or clustered, 0.15-0.4mm in diameter. Disc orange to orange-red. True excipulum well developed, paler then disc, yellow-orange to orange, rarely in mature apothecia somewhat reduced. Tissues of true excipulum plectenchymatous.


Photographs and illustrations: Figs. 3.18A, 3.18B.

Taxonomic notes: Species belonging to Caloplaca lactea group. There are rather minute and not clear distinctive characters within this group. This taxon is characterised by endolithic thallus, small and rather pale orange apothecia, plectenchymatous excipulum, small spores with thin septa and usually branched paraphyses. Thallus is characteristically yellow dotted around apothecial primordia and destroyed apothecia.

Inside of this group C. lacteoides and C. marmorata are the most similar species. C. marmorata differs in larger spores, darker, usually deep red apothecia and thallus that is almost without yellow dots. C. lacteoides has partially para-plectenchymatous excipulum and single, not branched paraphyses. Whitish forms of Caloplaca ochracea are superficially similar, but differ in 4-loculate spores.

References to taxonomy: Clauzade et Roux 1985, Navaro-Rosines et Hladun 1996.

Ecology: Similar to Caloplaca ochracea and C. marmorata. Typical species for hard limestone outcrops. It does not probably occur on artificial substrata.
**Fig. 3.18A.** *Caloplaca lactea*. A, Thallus with apothecia; B, Apothecia in detail; C, Apothecia in detail and small apothecial primordia (yellow-orange dots).
Fig. 3.18B. *Caloplaca lactea*. A, ascospores (a, young spore; b-e, ripe spores; f,g, deformed spores); B, paraphyses tips.
Pycnidia not seen.

*Photographs and illustrations*: Figs. 2.4B, 3.19A, 3.19B.

*Taxonomic notes*: Species belonging to *Caloplaca lactea* group. There are rather minute and not clear distinctive characters within this group. This taxon is characterised by endolithic thallus, small and dark apothecia, plechtenchymatous true excipulum, large spores with thin septa and usually branched paraphyses.

*C. lactea* and *C. lacteoides* are the most similar species. *C. lactea* differs in paler apothecia, usually yellow dotted thallus and smaller spores. *C. lacteoides* has partially para-plechtenchymatous true excipulum and single, not branched paraphyses.


*Ecology*: Similar to *Caloplaca lactea*. Typical species for hard limestone outcrops. It does not probably occur on artificial substrata.

*Distribution*: This species seems to be more common than relative *C. lactea*. Known occurrence in the Czech Republic is restricted to “Český kras” karst (Central Bohemia) and “Pavlovské vrchy” hills (Southern Moravia). It will be probably recorded in some other areas with limestone outcrops.


**Southern Moravia**: Mikulov, between Svatý kopeček hill and the limestone quarry, 1 km east from the town, SE exp., 48°48'40"N, 16°39'20"E, hard limestone boulder, 21.8.2002; Mikulov, Svatý kopeček hill, 0,3 km east from the town, 48°48'30"N, 16°39'05"E, hard limestone boulder, 24.2.2002.


**Slovakia**: Nitra, Vršatec, “Vršatecká bradlá” island hills, alt. 650 m, 49°04'N, 18°09'E, limestone, 20.7.2003.


*Bas.: Placodium obliterans* Nyl., Flora (Regensburg) 57: 7. 1874.


*Diagnosis*: Thallus deep orange, of scattered areoles or crustose-areolate to crustose-rimose, sorediate. Sometimes marginal lobes present and then thallus more or less orbicular. Areoles usually small, up to 0.5mm in diameter, marginal lobes to 1mm long. Areoles flat to convex, 40-120μm thick. Soralia rare to common, usually well delimited, occurring in centre of thallus, bright yellow. Soredia ca 30-40μm in diameter. Cortex 10-40μm thick. Algal layer discontinuous. Medulla distinct, thick. Yellow to pale orange prothallus usually present. Thallus K+ violet, C-, N-.

Apothecia and pycnidia not found in the Czech material.

*Photographs*: Fig. 3.20A.
Fig. 3.19A. *Caloplaca marmorata*. A, B, Indistinct endolitic thallus with apothecia; C, Apothecium in detail.
Fig. 3.19B. *Caloplaca marmorata*. A, ascospores (a, b, young spores; c, ripe spore; d, overripe spore; e, deformed spore); B, paraphyses tips, the last type with more branches is rather rare.
Fig. 3.20A. *Caloplaca obliterans*. A, Thallus with yellow-orange prothallus; B, Thallus with indistinct lobes; C, Small thallus with two soralia in central part (arrows).
Taxonomic notes: Species resembling Caloplaca cirrhochoa. However, C. cirrhochoa has typically developed marginal lobes, orbicuar appearance and often pruinose surface. Caloplaca proteus is also similar, but has larger orange soredia, 50-80µm in diameter, and strongly orbicular character. Some morphotypes of Caloplaca citrina are very similar, but have usually yellow, never deep orange, thallus. Moreover, soralia of C. citrina are produced in the centre as well as on margins of thallus and marginal lobes are never developed.


Ecology: Species inhabits overhanging mineral-rich silicate rocks (e.g. schist, porphyre) or vertical rock-faces in the mountains.


Distribution: Rare in the mountains. Known only from Hrubý Jeseník Mts. (Northern Moravia) and Krkonoše Mts. (Northern Bohemia). Altitudinal maximum: 1260m in Jeseníky Mts., altitudinal minimum: ca 1150m in Krkonoše Mts.


Austria. Steiermark. Niedere Tauern, Triebener Tauern, Trieben, alt. 1700m, mineral-rich silicate, J. Hafeliner, 15.8.2000 (GZU); Steiermark. Ostalpen, Gurktaler Alpen, S-exp. rock, alt. 1800-2000m, 18.6.1978, J. Poelt (GZU); Steiermark. Schackauer Tauern, Schönbenëtöre, alt. 2080m, silicate overhang, 5.9.1975, J. Poelt (GZU); Steiermark. Schladmingen Tauern, Schladming, alt. 1230m, 18.8.1991, J. Poelt (GZU);


Bas.: Lecidea ochracea (Schaer., Nat. Anz. 2: 11. 1818. (Syn.: Blastenia ochracea (Schaer.) Trevis).

Lecanora tetraschistica Nyl., Flora (Regensburg) 57: 307. 1874.

Type: (H-Nyl. 29602, lectotype selected here!)


Apothecia scattered to clustered, up to 0.5mm in diameter. Young apothecia partially immersed, but mature ascocarps sessile. Disc dark to pale orange. Excipulum yellow-orange to orange, paler than disc. True excipulum usually well developed, consisting of almost isodiametric outer cells (3.5-5.5µm in diameter) and elongated inner cells, ca. 2.5µm thick. Rarely, in mature apothecia, true excipulum somewhat reduced.

Hypothecium colourless, sometimes with oil-drops. Hymenium 65-95µm high. Asci 50-65 x 7-12µm in size. Hamatheicum of 1-2µm thick paraphyses, occasionally branched. Paraphyses tips swollen in tips up to 4.5µm, 1-3(-5) upper cells swollen. Young ascospores with wide and long canal between two end loculi (about 1/2 spore length). Mature ascospores
becoming 4-loculate, 12-15.5 x 4.5-7μm. Two inner loculi become distinctly thinner in K. Apothecia C-, N-, K+ violet-red.

Pycnidia not seen.

*Photographs and illustrations*: Figs. 3.21A, 3.21B.

*Taxonomic notes*: Species easily characterised by 4-loculate ripe spores. Thin, film-like, yellow or yellow dotted thallus is useful field character.

Some morphotypes of *Caloplaca ochracea* with whitish thallus can be confused with *C. lactea* and other species of *C. lactea* group, that have only 2-loculate spores. The forms of *C. ochracea* with strong yellow tinge are similar with some species of *C. dolomitica* group, such as *C. schaereri*, having also 2-loculate spores. Most similar to *C. ochracea* is mediterranean species *C. subochracea* (occurring also in Slovakia – Palice, non-published), that has polariloculate spores with thick septa (about 1/2 spore length), never becoming 4-loculate.


*Ecology*: Similar to *Caloplaca lactea*. Typical species for hard limestone outcrops. It does not probably occur on artificial substrata.

*Distribution*: Known occurrence in the Czech Republic is restricted to Pavlovské vrchy hills (Southern Moravia). It will be probably recorded in other areas with limestone outcrops.

*Specimen seen*: **Southern Moravia.** Mikulov, Svatý kopeček hill, 0.3 km east from the town, 48° 48'30"N, 16°39'05"E, half-shaded limestone rock, 24.2.2002; Mikulov, Pavlovské vrchy hills, calcareous rock, 24.10.1920, Suza (PRM).

**Slovakia.** Ilava, Červený Kámeň, limestone island hill above the village, limestone, 20.7.2003.

22. *Caloplaca “pseudocrenularia”*

*Diagnosis*: Thallus blackish or dark to pale grey, distinctly mat, crustose-rimose, variably thick. Black, fibrilous prothallus rarely developed. Cortex usually not developed, rarely thin, up to 20μm thick, para-plectenchymatous. Epineural layer often present, max. 25(-40)μm thick. Algal cells 4-18μm in diameter. Thallus C-, K-, Cortex and epineural layer in cross-section C-, K-.

Apothecia scattered or clustered, 0.2-1.5mm in diameter. True excipulum reduced to hyphal strands, 20-50μm thick, consisting of thin elongated cells. Thalline excipulum typically distinct, orange-red, almost of the same colour as the disc. Grey outer margin often surrounding excipulum. Excipular tissue distinct also under hypothecium, where it separates thecial and thalline structures. Disc orange-red to dark red.

Hypothecium colourless, often with oil-drops. Hymenium 80-90μm high, asci 60-70 x 14-19μm in size. Hamathecium of 1-2μm thick paraphyses heavily branched and also anastomosed. Tips of paraphyses not or only slightly widened (to 3μm), resembling *Caloplaca ferruginea*. Ascospores (12-)14-18 x 7-10μm in size. Septum of ripe spores 5-8μm wide. Apothecia K+ violet-red. Excipulum C+ dark violet (unusually fast, distinct and persistent reaction), disc C-.

Pycnidia frequent, large and chambered, dark red, elevated spots in thallus surface, 100-200μm in diameter, K+, C+ dark violet. Conidiogenous cells isodiametric, slightly elongated
Fig. 3.21A. *Caloplaca ochracea*. A, Yellowish thallus with apothecia; B, Thallus delimited by black prothallus; C, Whitish thallus with apothecia.
Fig. 3.21B. Caloplaca ochracea. A, ascospores (a-d, young spores; e-g, ripe spores; h, probably deformed spore); B, paraphyses tips.
Fig. 3.22A. *Caloplaca "pseudocrenularia"*. A, B, Thallus with apothecia; C, Apothecia without outer grey edge; D, Apothecia with outer grey edge; E, Apothecia in detail, algal cells in excipulum are visible in section (arrow); F, Thallus in detail, red pycnidia are visible (arrows).
Fig. 3.22B. *Caloplaca* "pseudocrenularia". A, vertical section through an apothecium, showing plectenchymatous true excipulum consisting of thin cells (cca 2μ). This excipular tissue continues beneath hypothecium and occasionally expands with strands into algal layer. There is high density of algae in thalline excipulum, cortex of excipulum is thin and discontinuous; B, conidia and conidiogenous cells; C, ascospores (a-e, young spores; f, ripe spore); D, contours of strongly branched and anastomosed paraphyses that are not broadened in tips.
or long triangular, 3-7 μm in diameter. Conidia bacilliform to narrowly ellipsoid, 3-5.5 x 0.5-1.2 μm in size.

Photographs and illustrations: Figs. 3.22A, 3.22B.

Taxonomic notes: Non-described species or strongly specific ecotype within Caloplaca ferruginea group. Its collections were traditionally placed into Caloplaca crenularia. However, typical C. crenularia differs in having smaller spores, with thinner septa, presence of distinct cortex and absence of algae in excipulum. There are also huge differences in ecology and distribution. Caloplaca ferruginea has glazing, smooth, usually not rimose, whitish thallus. It is considered as strictly corticolous species, but probably is closer related to C. “pseudocrenularia”, than C. crenularia. Caloplaca ceracea differs in having dark pycnidia with C and K negative reactions. Moreover, it has sub-squamulous thallus and apothecia becoming waxy when wet.

Ecology: Growing on base-rich siliceous rocks (mostly dark and rough volcanites as andesitic and basaltic pyroclastics) in sunny and dry habitats. It occurs mostly on south-facing rocks.


Distribution: Lichen with continental character of distribution. According to my knowledges it occurs in the South and South-eastern Europe (from Spain to Greece). It is known from the warmest areas of the Czech Republic and Slovakia. I have revised only several Suza’s collections from the rocks following lower reach of Berounka river (Central Bohemia) and one South Moravian record. It is probably a rare species.

Specimens seen: Central Bohemia. Beroun, Řevnice, in Berounka river valley, on diabasic rocks, alt. 250-280 m, 1933, Suza (PRM 631055, sub C. ferruginea); Praha, Černošice, ?Budčany, in Berounka river valley, alt. 220 m, 1933, Suza (PRM 631063, sub C. ferruginea) Praha, Chuchle, diabasic rocks, alt. 180-200 m, 1.2. 1921, Suza (PRM 631062).

Southern Moravia. Dalešice, Mohelno, in Jihlavka river valley, alt. 300 m, on serpentine rocks, ?, Suza (PRM 631052, sub C. ferruginea).


Italy. Liguria, Savona, Alassio, phyllitic rock, 4.1974, M. Steiner (GZU); Sicily, Catania, Mt. Etna, by the road from Nicolosi to Rifugio Sapienza, alt. 950 m, on lava-stream from the year 1910, 28.5.1988, J. Poelt (GZU).

Slovakia. Detvianská Polana Mts., Zolná, alt. 400 m, andesitic conglomerates, 22.8.1959, A. Vězda (Lich. Sel. Exs. 145); Krupina, Cerovo, "Sokoli skalá" rock near the castle Cabrad in Litava river valley, sandstone of volcanic material, 26.7.2003; Krupina, Cerovo, ruin of the castle Cabrad in Litava river valley, andesitic boulders under dry and hot conditions, 26.7.2003; Zvolen, in Neresnica river valley, on andesitic rocks, alt. 300-400 m, 1933, Suza (PRM 631064, sub C. ferruginea).

Spain. distr. Tarragona, Sierra de Prades, near the road between Monasterio de Poblet and Prades, alt. 900 m, on silicate in woodland of Quercus pyrenaica (GZU).

Srba. Vranje, Pljačkovica, NW of the town Vranje, ca 850 m, 7.7.1977, H. Mayerhofer et J. Poelt (GZU); Vranje, Pljačkovica, NW of the town Vranje, 800-900 m, 7.7.1977, H. Mayerhofer (GZU); Zlatibor Mts., between Titovo Uzice and Nova Varos, ca 24 km S of Cajetina (between Dobroselica and Draglica), alt. 880-900 m, Serpentinit rock, 13.7.1974, J. Poelt (GZU).

Type: Switzerland. coll. Schleicher (H-Ach. 1044, holotype).


*Diagnosis:* Thallus orange-red to brown-red, typically crustose rimose, with sharp areoles, ca 0.2-0.4 mm in diameter. Thallus thin, with smooth surface. Dirty yellow to orange prothallus is occasionally developed. Thallus C-, K+ violet-red.

Cortex colourless, covered with orange-red crystals, 15-40 μm thick, with several rows of isodiametric cells, 4.5-8 μm in diameter. Algal layer continual para-plectenchymatous, algal cells 6-20 μm in diameter.

Apothecial disc red to red-brown, very small, 0.05-0.2(-0.3) mm in diameter. Apothecia permanently immersed in thallus, never becoming sessile. Disc flat or slightly concave, never convex. True excipulum not developed. Thaline excipulum 15-75 μm thick, separated by thin cortex from neighbouring thalline tissues (fig....).

Hypothecium colourless. Hymenium low, 40-50 μm high, asci small 30-37 x 9-11 μm in size. Hamatheicum of 1.5-2 μm thick paraphyses, slightly branched. Paraphyses tips widened to 4.5 μm, mostly 2-4 upper cells broadened (occasionally submonilliform). Ascospores very small, 7.5-9.5 μm x 4.5 μm in size. Septum of ripe spores 2.5-4 μm, ca 1/3 to 1/2 of spore length. Apothecia C- (in section also), K+ violet-red.

Pycnidia small and indistinct, of the same colour as thallus. Conidiogenous cells globose to pyriform, 4-6.5 μm in diameter. Conidia narrowly ellipsoid, (2.3-)3-3.8 μm x 0.7-1.2 μm in size.

*Photographs and illustrations:* Figs. 3.23A, 3.23B.

*Taxonomic notes:* Clearly delimited species, having immersed flat apothecia without true excipulum. Small spores and low hypothecium are also characteristic.

*References to taxonomy:* Wetmore 1999.

*Ecology:* Species restricted to xero-thermic habitats in river valleys. It occurs on vertical faces of base-rich to neutral silicate rocks. Not known from anthropogenic substrates. No accompanied species or only several species occur together with *Calopla ca rubelliana*.

*Associated lichen species:* *Calopla ca demissa*, *Physcia dimidiata*, *Ph. dubia*.

*Distribution:* Very rare mediterranean species with several localities in the Central Europe. It occurs in Czech and Moravian thermophyticum only. Several historical localities are situated in Central Bohemia, where I have recently recorded the species on two localities in the Berounka river valley, near the villages Skryje and Zbečno in extremely xero-thermic habitat. Within the Moravian thermophyticum only one locality is known – the rock in the Jihlava river valley, near Ivančice (cf. Suza 1947, Vězda 1998). Altitudinal maximum: 300 m, under the ruin of the castle Týrov, near Skryje (Central Bohemia).
Fig. 3.23A. *Caloplaca rubeliana*. A, General view on thallus; B, C, Crustose-rimose thallus with apothecia; D, Apothecia that remain flat and immersed in detail.
Fig. 3.23B. Caloplaca rubelliana. A, vertical section through a typically immersed apothecium, showing absence of true excipulum; B, ascospores (a-c, young spores; d, ripe spore; e, deformed spore); C, paraphyses tips; D, part of conidiophore with two upper conidiogenous cells; conidiogenous cells with attached conidia.
Specimens seen: Central Bohemia. Beroun, Zbečno, Račice, rocks in Berounka valley, alt. 250-300 m, 50°00'40"N, 13°55'30"E, S-faced schist rock, 14.8.2003; Praha, Liběčice, Vltava river valley, on schist, alt. ca 200m, 17.10.1934, Suza (PRM); Revnice, Hájská Trebaň, in Berounka river valley, on schist, alt. 250-280m, ?, Suza (PRM); Skryje, Týřovice, the ruin of medieval castle Týřov, 1 km S from the village, alt. 300m, 49°58'30"N, 13°47'30"E, base-rich silicate rock, 16.9.2001.

Southern Moravia. Ivančice, Biskoupky, in Jihlava river valley, granulitic rock, alt. 270m, 4.5.1931, Suza (PRM); Ivančice, Biskoupky, in Jihlava river valley, granulitic rock, alt. 230m, 23.7.1931, Suza (PRM).


Bas.: Lecanora aurantiaca var. ruderum Malbr., Luich. Norm. exs. no. 322. 1873.

Type: France. Seine-Infrérieure, Rouen, Quevilly, on the mortar of calcareous walls, ?, Malbranche (UPS, lectotype).


Placodium decipiens var. camboricum Labr., Lich.-Herb. exs. no. 90. 1879. (nomen nudum, art. 32)

"Type": England. Cambridgeshire, on Walls of Milton Church and other churches in Cambridgeshire, ?, Labaralester (BM).

Caloplastra incrustans H. Olivier, Revue Botanique, Courrensian 10: 625. 1892.

Type: France, (H, herb. Acharius).

Diagnosis: Thallus granular or areolate with mostly convex areoles, delimited or obscurely delimited, yellow, often white pruinose, never producing soralia. Prothallus not apparent. Cortex 20-30(-40)µm thick, para-plectenchymatous, of 1-2 rows of large cells (12-20µm in diameter), covering by thick pruina. Algal layer para-plectenchymatous, algal cells 6-18µm in diameter. Medulla loose, plectenchymatous. Thallus C-, N-, K+ violet-red.

Apothecia scattered to clustered, up to 1.5mm in diameter. Young apothecia partially immersed, with the disc below the orbicular tumid margin, but mature ascoecars sessile. Disc dark to pale orange, occasionally pruinose. Thalline excipulum ca 0.2mm thick, yellow, occasionally pruinose. True excipulum 25-120µm thick, deep yellow, pruinose or non-pruinose, slightly darker than the thalline excipulum. Consisting of oblong outer cells, ca 5-6 x 3-4µm in size.


Photographs: Fig. 3.24A.

Taxonomic notes: Species characterised by yellowish, never orange, pruinose thallus consisting of irregular shaped convex areoles or granules (easily visible after removing of pruina, e.g. after 50% HNO3 application). Moreover, apothecia of C. ruderum are immersed at first nad never becoming convex. Thalline excipulum is characteristically yellow.

It was confused with many other taxa, such as C. crenulatella, C. decipiens, C. flavovirescens and C. saxicola. However, C. crenulatella differs in non-pruinose thallus,
spores with thin septa and in the collar-shaped thalline margin. *C. decipiens* has sorediate, lobate and more or less orbicular thallus. *C. flavovirescens* has non-pruinose thallus and orange apothecial margin. *C. saxicola* differs in more or less lobate, orbicular thallus and in usually convex older apothecia with yellow to orange margins. Anyway, within the variability of *C. saxicola* are some non-lobate forms, that strongly resemble *C. ruderum*.


Ecology: Species with specific ecology. Probably no records from natural rock outcrops are known (Laundon 1976). It inhabits soft limestone and mortar on the old walls, but it is entirely absent on hard limestones. Laundon considers the species as calcicolous, photophilous and probably nitrophilous.

Distribution: Probably rare lichen, generally restricted to mortar on old walls. All two records from the Czech Republic come from remains of calcareous mortar on ruins of church and chapel. It is probably lack of suitable substrates within the Czech Republic.

Specimens seen: Southern Bohemia. České Budějovice, Dubní, Habři, the locality Haječky, 1 km W of the village, 48°58′50″N, 14°19′20″E, mortar on the wall of church, 12.3.2002; Lhenice, Směděč, the old chapel 0.3 km SW of the village, 48°55′55″N, 14°09′00″, calcareous mortar on the wall, 7.2.2002.


Type: Sweden. (H-herb. Acharius, neotype selected by Nordin 1972)

*Lecanora nuorum* (Hoffm.) Ach.

*Parmelia nuorum* (Hoffm.) Ach.

*Amphiloma nuorum* (Hoffm.) Körb. (Syn.: *Amphiloma nuorum* var. *miniatum* (Hoffm) Körb.; *Amphiloma nuorum* var. *vulgare* Körb.).

*Caloplaca nuorum* (Hoffm.) Th. Fr. (Syn.: *Caloplaca nuorum* var. *corticicola* (Nyl.) Zahlbr.; *Caloplaca nuorum* var. *major* Th. Fr.; *Caloplaca nuorum* var. *obliterascens* (Nyl.) Serv.; *Caloplaca nuorum* var. *pulvinata* (A. Massal.) Jatta).

*Gasparinia nuorum* (Hoffm.) Tornab. (Syn.: *Gasparinia nuorum* var. *lobulata* (Flörke) Syd.; *Gasparinia nuorum* var. *major* Stein; *Gasparinia nuorum* var. *miniatata* (Hoffm.) Stein).

*Lecanora miniatata* (Hoffm.) Ach.

*Caloplaca tegularis* auct. (Syn.: *Caloplaca nuorum* ssp. *tegularis* auct.; *Gasparinia tegularis* auct.)

*Caloplaca pusilla* (A. Massal.) Zahlbr.

Diagnosis: Thallus yellow-orange, orange to orange-red, sometimes pruinose (mostly on calcareous substrata), usually orbicular, delimited with 0.5-1(-2)mm long marginal lobes, mostly up to 1cm in diameter (rarely to 2.5cm). Marginal lobes convex, shortly branched, 0.1-0.5mm wide. Thallus areolate in centre. Commonly found (mostly in shaded habitats) forms completely without marginal lobes, with thin rimose to areolate thallus (var. *obliterascens*). Prothallus inconspicuous or distinct, fibrillose, whitish or yellowish (usually in non-lobate forms). Thallus 100-300μm thick, in non-lobate forms often <100μm thick. Cortex 15-30μm thick, para-plctenchymatous. Algal layer continuous. Algal cells 9-18μm. Medulla dense or loose, plctenchymatous. Thallus K+ violet-red, thallus and medulla C-, N-, I-.

Apothecia scattered to clustered, occurring in centre of thallus, ca 0.3-1mm in diameter. Disc yellow-orange to dark orange, usually somewhat darker than excipulum and thallus. True excipulum often reduced to thin stripe around hymenium, consisting of more or less
Fig. 3.24A. *Caloplaca ruderum*. A, General view on thallus; B, Thallus with apothecia; C, Apothecia with typical yellow edge in detail.
Fig. 3.25A. *Caloplaca saxicola*. A, Pruinose thallus typical for calcareous substrata; B-D, Various thallus shapes from non-calcareous substrata; E, Poorly developed thallus without distinct marginal lobes; F, Typical form growing in damp situations completely without marginal lobes.
isodiometric outer cells that become more elongated in the inner part. Apothecial margins
coloured as thallus.

Hypothecium colourless, sometimes with oil-drops. Hymenium 40-85μm high. Ascii 40-60
x 7.5-16μm in size. Hamathecium consisting of very variable, 1-2μm thick, flexuose,
branched and anastomosed paraphyses. Tips of paraphyses up to 7μm broadened, with 1-4
upper swollen cells. Ascosporas 10-14 x 3.5-8μm in size. Septum 2.5-6μm wide. Apothecia
N-, C- (epihymenium slowly and persistently C+ (violet) red in section), K+ violet-red.

I have not seen pycnidia. However, pycnidia not visible on surface, conidia bacilliform, 2-
3 x 0.8-1μm in size (Wade 1965, Wetmore 1998).

Photographs: Fig. 3.25A.

/ Taxonomic notes: Species characterised by orbicular lobate thallus, richly fertile. More
problematic are the crustose, non-lobate forms, that are strongly distributed in specific
habitats. These forms clearly belong to C. saxicola, because intermediate sublobate specimens
are often found. Non-lobate forms are usually fertile. Therefore, most of these forms were
collected as C. vitellinula. For the details see under C. vitellinula in the capture “excluded
taxa”.

Typical lobate forms can be confused with few taxa. Caloplaca decipiens and C. proteus
produce soralia. C. auranitia and C. flavescens have larger thalli and broad citrifrom spores
(tumide around septum). C. arnoldi differs in deep red or red-brown minute thallus (mostly
less then 1cm in diameter). C. biatorina is superficially very similar, but has always pruinose
thallus of specific colour (strange orange tinge, somewhat to rose). Moreover, the ripe spores
of C. biatorina have thin septa.

1998.

Ecology: Species occurs on calcareous (various types of limestone) as well as non-
calcareous substrata (e.g. basalt, gneiss and schist), but the substrate should be somewhat
base-enriched. Never found on typical acid rocks. This species strongly expands onto some
artificial substrata, such as building stones and concrete. Non-lobate forms of C. saxicola
often occur on shaded lime-rich silicate stones in old walls and castle ruins.

Associated lichen species: Amandinea punctata, Buellia alboatra, Caloplaca albolute,
cens, C. auranitia, C. citrina, C. cremulatella, C. cyrrochroa, C. decipiens, C. demissa, C.
dolomitica, C. flavescens, C. holocarpa, C. teicholyta, Candelariella aurella, C. vitellina,
Lecanora albescens, L. dispersa, L. hagenii sensu Wirth 1995, L. muralis, Lepraria rigidula,
Lecidella stigmatia, Phaeophyscia nigricans, P. orbicularis, Physcia caesia, Polyspora
symplex, Rhizocarpon distinctum, Sarcogyne regularis, Staurothele frustulenta, Toninia
lobulata, Verrucaria. nigrescens, Xanthoria elegans.

Distribution: Common throughout the Czech Republic.

Specimens seen: Central Bohemia. Beroun, Srbsko, locality “Na Závěrce”, in Berounka river
valley, limestone, 2.5.2001, (herb. D. Svoboda); Beroun, Srbsko, “Tomáškův lom” quarry, on
mortar, 24.10.2003, D. Svoboda (herb. D. Svoboda); Beroun, Srbsko, Vechtovka, calcareous
rock, 25.4.2001, D. Svoboda (herb. D. Svoboda, sub C. chrysoidea); Beroun, Sedlec, in the
valley of Kačák brook, on diabas, 6.1.2001, D. Svoboda (herb. D. Svoboda, sub C. chrysoidea);
Holovice, Točník, ruin of the castle Točník, 1 km NE of the village, alt. 430m,
49°53′30″N, 13°53′30″E, base-rich, S oriented hornfels rock beneath the castle, with C. citrina, C. decipiens,
10.5.2003 (1123, 1119); Holovice, Točník, ruin of castle Zebřík, alt. 350m, 49°53′20″N, 13°51′10″E,
concrete in the wall of ruin, 31.5.2003; Skryje, Týpovice, the ruin of medieval castle Týpov, 1 km S from
the village, 49°58′30″N, 13°47′30″, south facing base-rich silicate rock under the wall of the castle, 17.9.2001.

Southern Bohemia. Dubné, Habří, the locality Háječky, 1 km W from the village, 48°58′30″N, 14°19′20″E,
gneiss stone in the wall, 12.3.2002; Husinec, Vývoj, stone walls in the village, 49°03′00″N, 13°59′50″E,
gneiss rock, var. oblitterascens, 10.3.2002 (369, 375); Husinec, Výrov, stone walls in the village, 49°03′00″N, 13°59′50″E, gneiss rock, not var. oblitterascens, 10.3.2002; Kremsč, Trisov, rocks ca 200 m A from the ruin of the castle Dvčí kámen, 48°53′30″N, 14°21′30″E, silicate rock, having reduced thallus, 16.5.2002; Písek, Zvíkovské Podhradí, the castle Zvíkove, alt. 360 m, 49°26′20″N, 14°11′40″E, on the walls of a castle, 4.8.2003; Pohorská Ves, Pohorí na Šumavě, alt. 910 m, 48°35′20″N, 14°41′30″E, weathered granite next to the road, 12.5.2002; Prachatice, Vítězovice, ruin of the castle "Osule", 1 km W of the village, alt. 640m, 49°03′N, 14°04′E, base-rich gneiss stones in walls, 17.5.2003; Záblatí, Kratušín, locality Záhradská skála rock, 1 km SE from the village, 49°00′50″A, 13°55′30″E, base-rich medium-lit overhanging silicate/carbonate rock, 16.6.2001 (325, 1226, 1227).

Western Bohemia. Karlový Vary, Andělská Hora, ruin of medieval castle N of the village, alt. 700m, 50°12′20″N, 12°58′E, basaltic stones in S-oriented wall, 21.3.2003; Radnice, Bohy, ruin of the castle Krášov in Berouna river valley, alt. 300 m, 49°57′N, 13°35′30″E, schist stone in wall of ruin, 14.9.2003.


Southern Moravia. Mikulov, Sedlec, the locality Skalky, 1.5 km SW from the village, 48°53′40″N, 16°40′30″E, terrícier soft limestone boulder, 23.2.2002; Náměšť nad Oslavou, in Chvojnice river valley, alt. ca 300m, on gneiss, 14.3.?, Suza (PRM, sub C. vitellinula); Pavlov, Klentnice, the locality "Soutěška" 2 km N from the village, Pavlov, Klentnice, the locality "Soutěška" 2 km N from the village, limestone rock, 13.10.2001; Třebíč, gneiss rocks close to the town, alt. 400m, 1911, Suza (PRM, 631262, sub Caloplaca tegularis).

Slovakia. Vihorlat, Nevicke Podhradie, alt. 220m, 20.6.1931, Nádvorník (PRM, 697311, sub Caloplaca tegularis).


Bas.: Lecanora murorum * subsulata Nyl., Flora (Regensburg) 56: 197. 1873.
Type: France?. Prope Collioure Julii 1872. (H-Nyl. 30453a).


Type: USA. Arizona. (Pima Co.), Tuscon, Station I,northward facing basalt, 2.500 ft. (762 m), March, 1908, J.C. Blumer (W).


Caloplaca americana (Malme) Zahlbr., Cat. Lich. Univ. 7: 64. 1930.

Type: USA. New Mexico. (San Miguel Co.?), Las Vegas, 12. Nov. 1925, Bro. Aect (Mich.).

Diagnosis: Thallus usually orange, paler (up to yellow) in shaded situation, dull orange to orange-red in extremely lit habitats. Thallus crustose-areolate first, usually crustose-rimose later and occasionally squamulose. Thallus often delimited by the black prothallus, that is much more developed on smooth substrate. Specimens from the rough stones (e.g. grit sandstone) commonly having no prothallus. Thallus C-, K+ violet-red.
Fig. 3.26A. *Caloplaca subsolata*. A, General view on thallus delimited by black prothallus; B, C, Crustose-rimose thallus with apothecia; D, Heavily sublobate thallus (rather rare).
Fig. 3.26B. *Caloplaca subsoluta*. A, vertical section through an apothecium, showing paraphlegetrenchymatous true excipulum and hypothecium; B, ascospores (a-d, young spores; e,f, ripe spores; g, overripe spor; h, deformed spor); C, paraphyses tips.
Cortex colourless, unequally, 10-45μm thick, with cuttings into the algal layer. Cortex cells para-plectenchymatous, 3-7(-10)μm in diameter. Epinecral layer 4-10μm thick, yellow-orange. Algal layer para-plectenchymatous. Algal cells 5-16μm in diameter.

Apothecia usually present, of the same colour as thallus or deeper coloured, 0.1-0.6(-1.1)mm in diameter. True excipulum more or less developed, para-plectenchymatous, consisting of the cells about 5μm in diameter (fungal cells often somewhat elongated in lower excipulum). Thalline excipulum always present.

Hypothecium colourless, para-plectenchymatous in lower part. Hymenium 50-60μm high, asci 40-50 x 14μm in size. Hamathecium of 1-2μm thick, branched and anastomosed paraphyses. Paraphyses tips widened to 4(-6)μm, mostly 3-4 upper cells broadened. Ascospores 9-12.5(-14.5) x 5.5-8.5μm in size. Larger spores, more than 12.5μm long commonly found in samples from shaded habitats. Septum of ripe spores 3-4μm thick. Apothecia C-, K+ violet-red.

Pycnidia scattered in thallus surface, indistinct, of the same colour as thallus. Conidia narrowly ellipsoid, 3-3.8 x 1-1.5.

Photographs and illustrations: Figs. 3.26A, 3.26B.

Taxonomic notes: Easily recognising species, having para-plectenchymatous tissues in true excipulum and in the lower hypothecium. Dark prothallus and C- reaction of apothecia are also significant.

Similar species are Caloplaca flavovirescens, C. ruderum and C. dolomitica, but all of them have absence of para-plectenchymatous tissues in hypothecium and absence of black prothallus. Some reduced forms of C. saxicola (e.g. var. obliterascens) are also superficially similar, but their anatomy of apothecia does not agree with C. subsoluta.


Ecology: Species typical for sunny overhanging rocks or vertical (more rarely horizontal) rock-faces of non-calcareous, but more or less base- and nutrient-enriched rocks (e.g. andesite, basalt, diorite, gneiss, granite, schist, some conglomerates and sandstones). On well-lit, mostly south-facing rocks it forms large colonies, that blend together, but usually it is not dominant of lichen communities. I have not found C. subsoluta on artificial substrates, such as concrete, bricks and mortar so far.

Associated lichen species: Aspicilia contorta, Caloplaca aractina, C. demissa, C. grimmiae, Candelariella vitellina, Lecanora muralis, Physcia dubia, Rhizocarpon disporum, Xanthoria falcata.

Distribution: This species is restricted to natural rocks in warmer and dryer climate. Number of localities and abundance on localities distinctly increases from higher to lower altitudes. There are three distribution centres in the Czech Republic, such as rocks in the river valleys in the South-western Moravia (rivers Dyje, Jihlava, Oslava, Rokytá and Svratka), rocks in the river valleys in Central Bohemia (rivers Berounka, Sázava, Vltava) and rocky hills in the České středohoří Mts. (Northern Bohemia). Altitudinal maximum: 450-500m (the "Velký Lovos" hill in the České středohoří Mts. and rocks in the Blanice river valley in the Southern Bohemia).


Specimens seen: Central Bohemia. Beroun, Hlásná Třebáň, rocks in the Berounka river, alt. 220m, schist, 10.6.1933, Suza (PRM); Beroun, Křivokláš, protected area "Brdartka", rocks 2 km NE of the village, alt. 300m, 50°03'N, 13°53'40"E, base-rich schist rock, 23.3.2003; Beroun, Zbečno, Račice, rocks in Berounka valley, alt. 250-300 m, 50°01'40"N, 13°55'30"E, S-faced schist rock, 14.8.2003; Beroun, Zdice, S-facing
Fig. 3.27A. *Caloplaca teicholyta*. A, Thallus without apothecia (common); B, Thallus with apothecia (very rare); C, Thallus with apothecia in detail; D, Apothecia in more detail.
rock on W edge of town, alt. 300 m, 49°54'30"N, 13°58'20"E, S-faced rocks beneath the castle, 4.8.2003; Hlásná Třebáň, rocks in the Berounka river, alt. 250-280m, schist, 10.6.1933, Suza (PRM); Milín, Solenice, rocks on the left side of Vltava river, 1 km NE of the village, S exp., alt. 300-400m, 49°37'35"N, 14°12'20"E, well/medium-lit, lime-rich rock, 6.12.2002; Praha-Radotín, diabas, 19.9.1920, Hiltizer (PRM); Rakovník, Křišťanův, the rock "Valachov", 1 km SE from the village, in the valley of Tyterský potok brook, SW exp., 50'06"N, 13°46'30"E, alight spilitic rock, 16.9.2002; Revitice, Hlásná Třebáň, rocks above Berounka river, alt. 250-280m, diabas?, 10.8.1933, Suza (PRM); Skryje, Týřovice, the ruin of medieval castle Týřov, 1 km S from the village, 49°58'30"N, 13°47'30", south facing base-rich silicate rock under the wall of the castl, 17.9.2001; Stěchovice, locality "Svatojánské prudy" in valley of Vltava river, alt. 220m, schist rock, 8.10.1934, Suza (PRM).

**Eastern Bohemia:** Chrast, Vratěbův Kostelec, diorit, 1913, Kutšák (PRM).

**Northern Bohemia:** Litoměřice, Třebenice, rock beneath ruin of castle Košťálov, alt. 400-450m, basalt, 2.5.1936, Suza; Lovosice, on the hill "Veľký Lovoš", 450-500m, basaltic rock, 4.5.1938, Suza (PRM).

**Southern Bohemia:** České Budějovice, Kamenný Újezd, rocks under the ruin of a castle Kotek (Mařkovce), 2 km W of the village, S exp., alt. 420-440 m, 48°54'05"N, 14°24'20"E, base enriched gneiss rock, vertical side, 17.11.2002; Český Krumlov, Staré Dobrkovice, protected area "Kalamba", in the village, alt. 530 m, exp. S, 48°49'15"N, 14°17'00"E, vertical side of base-rich gneissous rock, 8.11.2002; Lažňště, Dvory, rocks 1 km S from the village, 49°02'00"N, 13°57'05"E, light terrace on the silicate rock, 5.8.2002; Písek, Zvěkovské Podhradí, the castle Zvěkov, alt. 360 m, 49°26'20"N, 14°11'40"E, S-faced rocks beneath the castle, 4.8.2003; Velešíň, Hrachový Hory, the ruin of the medieval castle Velešíň, 48°50'00"N, 14°28'45"E, gneiss rock, 7.3.2002.

**Western Bohemia:** Radnice, Bohý, ruin of the castle Krásův in Berounka river valley, alt. 300m, 49°57'N, 13°35'30"E, S-facing, sunny schist rock, 14.9.2003.

**Southern Moravia:** Bískupice, rocks above Jaroměřiška river, alt. 370m, serpentinit, 6.1929, Suza (PRM); Hrubšice, rocks in valley of Jihláva river, alt. 230m, serpentinit, 5.8.1919, Suza (PRM); Ivaněnice, Bískupky, on the serpentine rocks, 5.8.1936, A. Vězda (Vězda: Lich. Bohem. Exs. 206); Brno, Veverská Bytýška, rocks above Svatka river, alt. 340-350m, congolomates, 5.12.1926, Suza (PRM); Budkovice, rocks above Rokytná river, alt. 270m, granit, 14.11.1928, Suza (PRM); Moravský Krumlov, near the hill Tábor, alt. 250-300m, rock of basic congolomates, 19.5.1996, Gruna, Polace; Náměšť n. Oslavou, rain "Ketovický hrad", rocks above Oslava river, alt. 350m, gneiss, 1921, Suza (PRM); Třebíč, Mobelná, rocky steppe on the left side of the river Jihláva, serpentinit, 1932, Suza (PRM); Znojmo, rock above Dyje river, alt. 210m, granit, 2.5.1920, Suza (PRM); Znojmo, Nový Hrádek, rock above Dyje river, alt. 350m, schist, 29.3.1932, Suza (PRM).


**Slovakia.** Filakovo, Hajnáčka, rocks beneath the hill 441m, basalt?, 17.5.1933, Suza; Kováčov (Southern Slovakia), rocks above Dunaj river, alt. 150m, andesitic sediments, 9.7.1929, Suza (PRM); Krupina, Cerovo, ruin of the castle Čabraď in Litava river valley, andesitic congolomates, 26.7.2003; Prešov, rocks above village Pintice, alt. 300-400m, andesitic, 4.8.1938, Suza (PRM); Prievidza, Podhradie pri Prievidzí, on ruin, alt. 550-600m, andesitic rock, 8.1930, Suza (PRM); Spišská Nová Ves, Primovice, Sv. Ondřej, alt. 650m, basaltic rock, 15.7.1930, Suza (PRM); Zvolen, rocks in the "Neresnica" valley, 300-400m, 16.5.1933, Suza (PRM).

### 27. Caloplaca teicholyta


**Syn.:** Placodium teicholytum (Ach.) DC.; Blastenia teicholyta (Ach.) Bausch; Caloplaca arenaria var. teicholyta (Ach.).


**Blastenia erythrocarpa Pers.**

**Caloplaca erythrocarpa (Pers.) Zwackh 1862.**

**Caloplaca calicaceae** Cretz, Lich. Rom. Ex., No. 78., 1939.
Fig. 3.27B. *Caloplaca teicholyta*. A, ascospores (a-c, young spores; d, ripe spore; e, overripe spore; f-j, deformed spores); B, paraphyses tips.
Type: Romania. Distr. Caliacra, Cap-Caliacra, alt. 5-10 m, 24.4.1938, P. Crețeziu (W, isotypus!).

**Diagnosis:** Thallus greyish to white, in centre covered with clusters of grey soredia. Thallus usually thick (100-300μm), more or less orbicular with marginal lobes. Sometimes only partially lobate, rarely lobes completely reduced. Cortex developed, para-plectenchymatous, variously thick, 0-25μm. Algal layer para-plectenchymatous. Algal cells 6-17μm. Thallus C-, I-. Cortex and soredia slowly K+ "dirty" violet and N+ dull violet in cross-section.

Apothecia rarely developed. When present, then usually abundant, up to 1mm in diameter. Old apothecia occasionally becoming flexuose. Orange-red, plectenchymatous true excipulum is more distinct in young apothecia. Thalline excipulum coloured as thallus, strongly developed in older apothecia, 100-120μm thick. Disc deep orange-red.

Hypothecium colourless, without oil drops. Hymenium 110-130μm high. Asci ca 75-85 x 10-16μm in size. Hamathecium consisting of flexuose, distinctly branched and anastomosed, 1.5-2.5μm thick paraphyses. Tips of paraphyses widened to 4.5μm, 1-5 upper cells broadened. Ascospores (11-)14-16 x 6-10μm in size. Septum of ripe spores 2-3μm. Apothecia C+ fast violet-red, K+ violet-red.

Pycnidia somewhat darker than thallus. Conidiogenous cells often long obtuse triangular, 6-8.5 x 3-4μm. Conidia bacilliform to ellipsoid, 3.5-3.8 x 1-2.3μm in size, sometimes having short appendix in place of previous attachment to conidiogenous cell.

**Photographs and illustrations:** Figs. 2.4A, 3.27A, 3.27B.

**Nomenclatural notes:** *Lichen caesiorumcus* Schrader, Spicil. Fl. Germ. 1: 80. 1784. (not Acharius 1798) is the first name for *Caloplaca teicholyta* in sense of Zahlbruckner (Zahlbruckner 1931). However, Magnusson (Magnusson 1944) suggests, that nobody has really studied the type material.

Some classical and also recent authors used *Caloplaca arenaria* as a correct name for the taxon currently known as *C. teicholyta* (e.g. Vězda 1966, Wade 1965). But most recent authors use *C. arenaria* as a correct name for another taxon - *C. lamprocheila* (DC.) Flag. 1888. Anyway, the Persoon's description runs as follows: "*crusta leprosa pulverulenta, caesia; scutellis croceo-rubis. Semper hancce speciem ad lapidem arenarum, friabile, ferrugineum, inveni. Crusta parca unc. 1-1,5 lata inaequalis. Scutella planiusculae, subrigosae, margine demum pallescunt*" ("thallus leprose, dusty, grey; apothecia yellow-red. Species always found on weathered ?ferruginous sandstone. Thallus scanty 1-1.5 inches (in diameter), unequally broad. Apothecia flat, sub-wrinkled (when old?), apothecial margin fade, when older"). In my opinion, this description agrees well with *Caloplaca albolutescens* (dusty, scanty thallus), but it is also not in conflict with the taxon currently known as *C. teicholyta*. The investigation of type material seems to be necessary.

*Caloplaca caliacrae* Crețeziu 1939, is considered in this work as a junior synonym of the taxon currently known as *C. teicholyta*.

**Taxonomic notes:** Species characterised by greyish or whitish orbicular and lobate thallus, sorediata in centre. Moreover, K+, N+ "dirty" violet reaction of cortex is distinct in cross-section.

Most similar species is probably *Caloplaca lallavei* that has clearly delimited thick thallus, entirely areolate, but never lobate. It is often richly fertile. *Caloplaca albolutescens* significantly differs in non-lobate, completely leprose thallus, without cortex. Thalline excipulum is yellow or white pruinose, but never thallus-like grey, as in *C. teicholyta*.

Ecology: Common on calcareous rocks (hard and soft limestone, calcareous sandstone). Rarely found on non-calcareous, but always lime-enriched rocks (e.g. basalt). Sometimes occurring on non-calcareous rocks, when situated under lime-rich walls, e.g. under the ruin walls. This species commonly expands onto artificial substrates, such as concrete, bricks and roofing-tiles.


Distribution: Common throughout the Czech Republic.


Northern Bohemia. Bakov n. Jizerou, railway station, alt. 220 m, 50°28′30″N, 14°25′30″E, calcareous sandstone rock, SE exp., 23.4.2003 (1052, 1055); Lovosice, Trébenice, ruin of castle Koštál, 2 km N of the village, alt. 470m, 50°29′30″N, 13°59′10″E, basaltic, S-facing rock beneath the castle, with Caloplaca chlorina, C. demissa, C. decipiens, X. elegans, 9.5.2003; Lovosice, Trébenice, Vlastislav, ruin of castle Skalka, alt. 300m, 50°30′N, 13°58′E, mortar and sunny, basaltic rock, 9.5.2003 (1143, 1144, 1145).

Southern Bohemia. České Budějovice, Křemže, rocky outcrops S of the town, alt. 510m, 48°54′15″N, 14°18′40″E, on S-exp. serpentinite outcrop, with Aspicilia contorta, Staurotheca frustulenta, 8.11.2003; Písek, in the town, concrete, 15.5.2003; Písek, Protivín, Čečínky, 49°12′10″N, 14°13′40″E, horizontally facing concrete, 3.5.2003; Písek, Zvíkovské Podhradi, the castle Zvíkov, alt. 360m, 49°26′20″N, 14°11′40″E, on the walls of a castle, 4.8.2003; Straňany, Doubleby, eastern edge of the village, walls behind the church, 48°53′40″N, 14°30′20″E, horizontal concrete side of the wall, 7.3.2002.

Southern Moravia. Dolní Věstonice, Pavlov, ruin of the castle Divč hrad, 1 km W from the village, limestone rock, 12.10.2001; Mikulov, chateau on the hill in the town, 48°48′30″N, 16°38′20″E, concrete surface of the brick-wall, 24.2.2002; Mikulov, Sedlec, the locality Skalky, 1.5 km SW from the village, 48°53′40″N, 16°40′30″E, tertiary soft limestone boulder, 23.2.2002; Kyjov, Milotice, horizontal sides of bricks in the wall, 2.7.2003.


Bas.: Lecanora xantholyta Nyl., Flora (Jena) 62: 361. 1879.
   Type: Wales. Caernarvonshire, Llandudno, Great Orme’s Head, on limestone, ?, Holmes (H-Nyl., no. 30400, holotype!).


Leproplaca xantholyta (Nyl.) Hue, Revue Botanique, Courrens 6: 148. 1887.

   Type: Italy (? dist. Verona), calcareous rocks, ?Mazzalongo, Anzi op. cit. no. 542 A (BM).

Diagnosis: Thallus bright yellow, leprose and plecenchymatous, more or less orbicular. Clearly delimited, occasionally with distinct marginal lobes. Surface powdery or consisting of granules. Cortex never developed. Soredia similar to *C. chrysodeta*, sometimes having short hairs on surface. Medulla whitish, occasionally exposed. Marginal lobes flat or slightly convex. Thallus K+ violet, C-. Apothecia and pycnidia not found.

Photographs: Fig. 3.16A.


Ecology: Species inhabits shaded, but more or less dry overhanging rocks or vertical rock-faces in limestones or other lime-rich stones (calcareous sandstones and mudstones). Rarely growing also on concrete. Often together with *C. chrysodeta*, but *C. xantholyta* is obviously rarer.

Associated lichen species: *Caloplaca chrysodeta*, *C. cirrochroa*, *C. citrina*.

Distribution: Rare, but probably present in most of karst areas in the Czech Republic. It occurs surely in Český Kras karst (Kocourková, personal communication). Unfortunately I have gathered woeful number of records.


Type: Austria. Vintschgau, Südtirol, Südseitige trockene gneisshänge am Eingang in das Schlanders, June, 1966, Poelt 12073 (GZU, holotype).

*Caloplaca furax* Egea et Llimona, Collectanea botanica 14: 266. 1983.

Type: Spain. Cañada del Conejo dicto, ad pedem Sierra del Relumbar, prope Bienservida (Albacete), 350m s.m., ad saxa schistosa metamorphica paulo inclinata (MURC lichenotheca No. 3039).


Type: Italy. Bocche di Cattaro, Devesite near Castelnuovo, alt. 600-700m, on limestone, 1902, J. Baumgartner (W, holotype).

Diagnosis: Thallus dark to pale gray, often whitish pruinose, crustose areolate, with outer areoles often enlarged into squamules. Squamules are better developed at the parasitic forms (type *C. furax*). Thallius often delimited by fibrillose black prothallus. Dark isidia, lobules and soralia are produced. When such structures covering whole thalline surface, then thallus becoming black. Some morphotypes on artificial substrata have more reduced thallus. Thallus K-, C-, only cortex and soredia slowly K+ blue-violet and N+ dull violet in cross-section.
Cortex colourless with greyish outer cells, unequally thick, up to 30µm. Cortex cells paraphyloclenchymatous, 4-4.5µm in diameter. Soredia 20-50µm in diameter. Algal layer paraphyloclenchymatous, algal cells 7.5-23µm in diameter.

Apothecia rare, scattered or numerous and clustered, 0.2-1mm in diameter. True excipulum orange, whitish or yellowish pruinose in outer part (in young apothecia often whole excipulum pruinose). True excipulum plectenchymatous, continuing into thin but distinct layer beneath hypothecium. Thalline excipulum of the same colour as thallus, occasionally white pruinose. Inner and outer excipulum ratio heavily fluctuates and depends on the ascocarp development (fig. 2.1A). Disc orange, dark orange to brown.

Hypothecium colourless, often with oil-drops. Hymenium 75-120µm high, asci 55-95 x 11-18µm in size. Hamathecium consisting of 1.5-2µm thick, branched and slightly anastomosed paraphyses. Paraphyses tips widened to 4.5µm, mostly 2-3 upper cells broadened. Ascospores (8-)-11-14.5(-16) x 6-10.5µm in size. Septum of ripe spores 4-6µm thick. Apothecia C- (epihymenium weekly and slowly C+ orange-red), K+ violet-red.

Pycnidia chambered, scattered in thallus surface, to 200µm in diameter, somewhat darker then thallus. Wall of pycnidia grey in section, K+ blue-violet. Conidia narrowly ellipsoid, (2.5)-3-4.6 x (0.7-)1-1.5µm in size.

Photographs and illustrations: Figs. 2.1A, 3.28A, 3.28B.

Taxonomic notes: Species with great variability in thallus and also in colour and morphology of apothecia. The less variable, characteristic features are presence of isidia-like structures and soralia, K+ blue-violet cortex and continual excipular tissue beneath apothecia. Caloplaca furax represents squamulose and sublobate forms of this species. Therefore, it has been used as a synonym in this work.

Caloplaca areolata differs from typical forms of C. xerica in absence of isidia and soralia. However anatomy and morphology of apothecia agrees well with C. xerica. Moreover I have several times observed lobules on thalli of C. areolata. Possibly is C. areolata calcicolous morphotype of C. xerica.

Caloplaca chlorina differs in more minute thallus and in absence of true excipulum.

Ecology: This species usually inhabits horizontal rock faces. Overhanging rocks or vertical rock-faces are rarely inhabited, with the exception of mountain localities, where is C. xerica often restricted to the lit and sheltered overhanging rocks.

Common substrates are non-calcareous, but more or less base- and nutrient-enriched rocks (mostly basalt, andesite, schist, calcareous conglomerates and sandstones). Samples from limestone, that agree rather with Caloplaca areolata, have not been recorded in the Czech Republic. It prefers well-lit conditions and has week claims on moisture (generally, specimens from dryer habitats are more pruinose). C. xerica is mostly free-living, but occasionally partially parasitic, mostly on Aspicilia sp. Its ecology is similar to Caloplaca crenulatella. Both lichens commonly occur together on artificial substrates, such as concrete and asphalt. Most records came from such habitats, where they dominate among other lichens.


Distribution: Probably common species throughout the Czech Republic on artificial substrates. It expands on such substrata probably recently, because juvenile, week developed thalli are frequently found. It has been found more often in warmer regions (in lower
Fig. 3.28A. *Caloplaca xerica*. A, Thallus delimited by dark grey prothallus; B, Heavily pruinose thallus producing soralia (dark grey); C, Thallus with marginal lobes parasitic on *Aspicilia*; D, Thallus with young apothecia; E, Apothecia without distinct outer greyish margin; F, Dark apothecia with grey outer margin (rare).
Fig. 3.28B. *Caloplaca xerica*. A, vertical section through an apothecium, showing plectenchymatous true excipulum consisting of elongated cells; plectenchymatous tissue surrounds hypothecium at the bottom; B, ascospores (a-c, young spores; d-h, ripe spores; i-j, overripe spores; k, deformed spore); C, paraphyses tips.
altitudes) on natural substrates ("Křivoklátská pahorkatina" upland, Moravian pathhills of "Českomoravská vrchovina" upland, České středohoří Mts. and Čihřy Mts.). Outstanding record comes from Hrubý Jeseník Mts., "Velká kotlina" corrie (Northern Moravia). This occurrence in 1190m a.s.l. is also altitudinal maximum.

**Specimens seen:** Central Bohemia. Beroun, Hostim, beneath the hill Hradiště, on weathered carbonate stone, alt. 290m, D. Svoboda (herb. D. Svoboda, in collection of Caloplaca dolomitica, no. 485); Hořovice, Točník, ruin of the castle Točník, 1 km NE of the village, alt. 430 m, 49°53'30"N, 13°53'30"E, base-rich, S oriented hornfels rock beneath the castle, with C. citrina, C. decipiens, 10.5.2003; Příbram, Jince, in the village, asphalt in the pathway, 31.5.2003; Příbram, Jince, "Jinecké Hřebeny" hills, alt. 700 m, concrete on roof of military building, 10.9.2003; Rakovník, Pustovětý, in the village, 50°03'20"N, 13°49'10"E, horizontal concrete plate, 31.5.2003; Beroun, Zdeš, S-facing rock on W edge of town, alt. 300 m, 49°54'30"N, 13°58'20"E, sunny rock of basalt (diabas), 11.9.2003; Hořovice, Točník, in the village, 340m, 49°53'20"N, 13°53'10"E, horizontal plate of concrete, 31.5.2003; Rakovník, Kalubice, in the village, alt. 370m, 50°03'3N, 13°49'40"E, mortar, 12.9.2003.

**Northern Bohemia.** Lovosice, Třebenice, ruin of castle Košťál, 2 km N of the village, alt. 470 m, 50°29'30"N, 13°59'10"E, bazaltic, S-oriented rock beneath the castle, 9.5.2003.

**Southern Bohemia.** České Budějovice, Dubné, Záboří, in the village, horizontal plate of concrete, 6.6.2003; České Budějovice, the park "Stromovka", alt. 390 m, 48°58'20"N, 14°27'30"E, on concrete walls, 1.4.2003; Písek, Zvěkavské Podhradí, the castle Zvíkov, alt. 360 m, 49°26'20"N, 14°11'40"E, on the walls of a castle, 4.8.2003; Vodňany, Bavorov, small bridge S of the village, horizontal concrete plate, 4.6.2003.

**Western Bohemia.** Radnice, Bohý, ruin of the castle Krášov in Berounka river valley, alt. 300 m, 49°57'N, 13°35'30"E, S-facing, sunny schist rock under the ruin, 14.9.2003.

**Northern Moravia.** Jeseníky Mts., Vysoká hole Mt., NE part of Velký kotol corrie, "Beckho skála" rock-face, alt. 1190 m, 50°03'22"N, 17°14'20,5"E, dry overhanging SE-exposed schist/phyllitic rock, 23.9.2001, Z. Palice (herb. Z. Palice).

**Southern Moravia.** Kroměříž, the castle Buchlov, sunny sandstone rock, 5.7.2003; Kroměříž, the castle Buchlov, sunny sandstone rock, parasitic on Aspicilia (lobate typ. = Caloplaca furax), 5.7.2003; Kyjov, airport, asphalt, 1.7.2003; Vyškov, airport, asphalt, 3.7.2003; Vyškov, airport, vertical concrete plate, 3.7.2003.

**Austria.** Hohe Tauern, Virgental, alt. 1200-1300m, 1.9.1988, Poelt (GZU); Kärnten, Villach, S-exposed lime-rich rock, 650-700m, 10.2.1972, Poelt (GZU); Südtirol, Vintschgau, S-oriented dry rocky slopes, N of Schländers, 750-900m, on mica-schist, 18.10.1975, J. Hafellner (PRM); Südtirol, Vintschgau, Laatsch, alt. 1000m, SE-exposed rocks, 13.9.1970, Poelt (GZU); Südtirol, Vintschgau, Verran, on limestone, 5.9.1991, Poelt (GZU).

**Macedonia.** Titov Veles, Gradsko, on silicate, ?, Poelt (GZU).

**Slovakia.** Krupina, Cerovo, ruin of the castle Čabraď in Litava river valley, andesitic conglomerates, 26.7.2003.

**Spain.** Jaca, Candanchu, valley of the Rio de Canal Roya, alt. 1800m, 42°47'30"N, 0°28'W, under the overhang, base-rich conglomerates, northern exp., 13.7.2002.

**Switzerland.** Wallis, near the border with Germany, 10.9.1970, Poelt (GZU).
3.3. Refused species

Bas.: Lichen caesiorufus Ach. Prodr.: 45. 1798.

Magnusson (1944) considers the name Caloplaca caesiorufa as a “nomen confusum”. Lichen caesiorufus Ach. was not validly published, because it is a later homonym of Lichen caesiorufus Schroeder (1794), that is probably the oldest name for Caloplaca teicholyta. Therefore, Lichen caesiorufus Ach. should be rejected under the article 53 of Int. Code of Bot. Nom.

Anyway, I have studded the only two specimens of Lichen caesiorufus available in Acharius herbarium (H-Ach. 337, H-Ach. 338). Both contain specimens belonging to several related Caloplaca species (C. alboluteascens, C. arenaria, C. ceracea, C. crenularia and C. scotopla) collected in different countries. I have seen some other C. caesiorufa samples, mostly Poelt’s, Suza’s and Zahrluckner’s, that all belong to C. arenaria or C. ceracea.

Type: Italia. Liguria. Stazzano presso Serravalle, sopra i massi arenisi, coll. P. Ferrari (MOD?).

Caloplaca ferrarri was only once published from the Czech Republic, as Caloplaca ferrarii var. diabasicola Suza 1934, varieta novum (Type: Bohemia centr., Loděnice, diabas, 1931, Z. Černohorský [PRM, 785536, herb. M. Servit[1]]). However, C. ferrarrii var. diabasicola is in fact a junior synonym of Caloplaca crenulatella (cf. Navarro-Rosines et Hladun 1996).

Bas.: Lecanora scotopla Nyl., Flora (Regensburg) 59: 232. 1876.

The name Caloplaca scotopla is used as the correct name for C. caesiorufa in a Catalogue of Lichens of the Czech Republic (Vězda et Liška 1999). However, the real C. scotopla is North European species, having dark red to brownish apothecia, often I+ blue excipulum and spores 8-12 x 7-7.5μm in size. This taxon has not been published from the Czech Republic.

Type: Sweden. Bohuslän, Jörlanda, Ramnekar, on shady rock below a hill, 24.5.1939, G. Degelius (UPS, isotypus!)

C. subpallida, traditionally considered as a separate species, does not anatomically and morphologically differ from C. arenaria. It was distinguished from C. arenaria by the
presence of thallus and the paler and smaller apothecia. These characters show continuous variation between “arenaria” and “subpallida” types. Moreover, thallus development depends strongly on substrate. Specimens with well-developed thalli occur on smooth substrata like schist and phyllite. Therefore, I consider C. subpallida as junior synonym of the taxon currently known as C. arenaria.


Bas.: Lecanora vitellinula Nyl. in Flora (Regensburg) 57: 318. 1874.

This species was described by Nylander from the bark of Alnus. Subsequently, this epithet was used by many authors for saxicolous specimens – even by Nylander himself (Wade 1965). The diagnosis in Wade’s monography agrees well with the description of non-lobate form of Caloplaca saxicola. All the collections that I have seen are in reality either C. saxicola or C. holocarpa that can have occasionally yellowish thallus (see under C. holocarpa).

Although I have not seen the type, I don’t believe in this species. In my opinion it is something like a “dust-basket”, where extreme forms of C. holocarpa and C. saxicola are thrown away.
4. Discussion

4.1. Recent taxonomic research


4.2. Taxonomically unclear taxa

Some taxa presented in my study on species level are rather groups of species then single species. Such taxa are mostly Caloplaca citrina, C. crenularia and C. dolomitica. It is the subject of speculation, if such taxon contains one heteromorphic or more monomorphic species. Classical morphology will be probably impossible to resolve this problem, even in the future.

Investigation of lichen secondary metabolites is one way to help resolving the problem with unclear taxa. Anthraquinones are characteristic metabolites occurring within the genus Caloplaca. Seven specific anthraquinones were recognised within the genus Caloplaca by Santesson (Santesson 1970), using lichen mass spectrometry. Recently, 13 different anthraquinones (chlorinated 7-chloremodin and fragilin, non-chlorinated emodin and parietin and their oxidative forms) were recognised by Söchting (Söchting 2001). Söchting also divided the genus Caloplaca into eleven chemosyndromes. However, these chemosyndromes are too rough for separation of extremely similar morphotypes. On the other hand, newly described species, such as Caloplaca asserigena, are occasionally based on content of specific anthraquinones (Söchting et Fröberg 2003). Beside anthraquinones some other secondary metabolites were found, such as lecidea green, thallloidina green and sedifolia grey (Tretiach et al. 2003, Wetmore 1996). These substances are responsible for characteristic reaction with C, K, N and concentrated HCl in some species.

Molecular biology is the second way. Unfortunately, all the works dealing with Caloplaca were done on higher than species level. I know two meaningful works (Arup et Grube 1999, Gaya et al. 2003) in Caloplaca that solve problems on the level of genera. First one found that Lecanora demissa belongs to Caloplaca. The second study found out among others that the definitions of genera Caloplaca, Fulgensia and Xanthoria do not agree well with phylogeny. Molecular works on species level are within lichenology at the beginning. Such studies were made on species of several genera (cf. Grube et Kroken 2000), but I don’t know any work on Caloplaca. Requirement of many samples from the whole areal is partially responsible for a small number of molecular works on species level.

4.3. Hybridization

Most lichenologists do not believe in hybridization or do not speculate about it. No molecular work has been done on lichen hybridization yet (Grube, personal communication). However, I have found some intermediate individuals between Caloplaca chlorina and C. holocarpa and between C. crenulatella and C. holocarpa. In the first case, typical apothecia of C. holocarpa occur on typical thallus of C. chlorina. Possible explanation is, that fertile C.
holocarpa grows on sterile thallus of C. chlorina, but I have seen such phenomena several times and the occurrence of ascocarps never exceeded the thallus. In addition, some apothecia have had distinct outer grey margin – intermediate feature between mentioned species.

Potential hybrids between C. crenulatella and C. holocarpa are characterised by intermediate features within apothecia – spore size, thickness of spore septum, shape of paraphyses, presence of yellow collar-shaped thalline excipulum. I am not able to include such specimens into the variability of one of the mentioned species.

Molecular biology would be able to resolve the problem with hybridization, but sufficient number of samples is required.
5. Conclusions

29 saxicolous species of the genus *Caloplaca* were selected for the detailed study. These species are characterised by complete diagnosis, ecology, distribution in the Czech Republic and colour photographs. Taxonomic and nomenclatural notes and illustrations of specific features are added in many cases.

6 species presented in this work, such as *C. albotutescens*, *C. crenulatella*, *C. chrysdetha*, *C. inconnexa*, *C. “pseudocrenularia”* and *C. ruderaum* have not been mentioned from the Czech Republic so far (cf. Vězda et Liška 1999). 4 species, such as *C. caesiorufa*, *C. ferrari*, *C. scotopaca* and *C. vitellinula* are excluded from the lichen flora of the Czech Republic. These species names have been misunderstood in the Czech Republic and confused with other species. One, probably non-described species *C. “pseudocrenularia”* have been recorded in the Czech Republic. The characteristic features of *C. “pseudocrenularia”* are noted here in detail.

Key to the saxicolous *Caloplaca* species occurring or potentially occurring in the Czech Republic, that contains 46 species, has been created in this study.
6. References


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