Selected saxicolous species of the genus *Caloplaca* (lichenised 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 ďábla vymyšleným 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 neprošlapanou, 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.

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

Kondrát

In České Budějovice, 9. 1. 2004

Contents

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 w taxonomically 29 saxicolous *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 anthraquinons.

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 anthraquinons. 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-plecenchymatous or plectenchymatous. cells including in the genus *Trebouxia* (*Chlorophycae*). Medulla sometimes deve mostly loose, plectenchymatous.

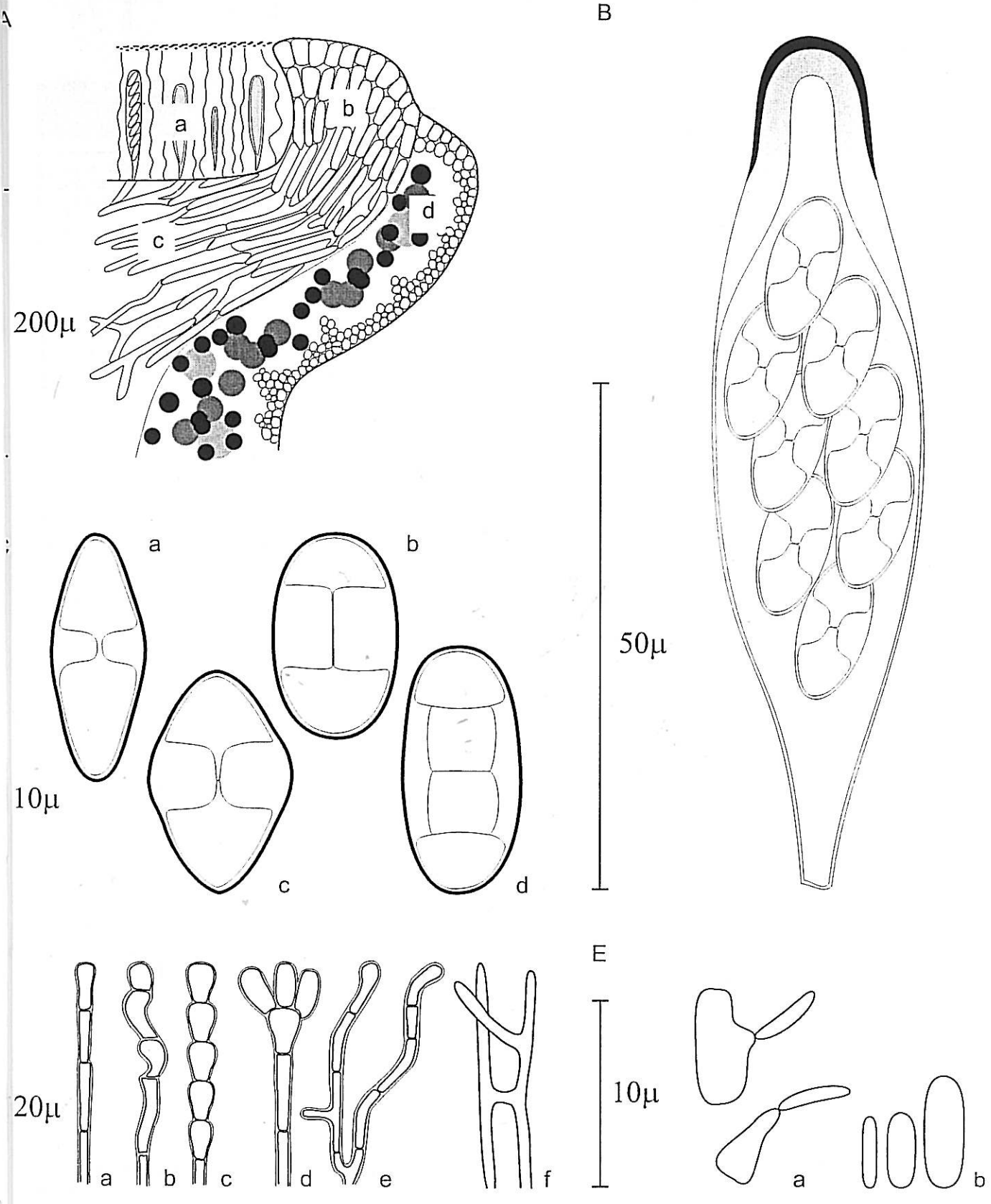
Apothecia with yellow, orange or red tinge containing anthraquinon pigme epihymenium, or blackish with or without greyish crystaline pruina and with or v content of anthraquinons. Hypothecium usually colourless, rarely greyish in cross-s with or without oil-drops. Hymenium colourless or rarely deformed asci and some para are filled or covered by yellow (brownish) crystals of anthraquinons. Epihymenium c with anthraquinon-crystals, greyish-yellow, yellow, orange or brownish in cross-s Excipulum usually consisting of true excipulum (without algae) and thalline excipulu 1.1A). Asci usually 8-spored, *Teloschistes*-type (amyloid structures dyeing with KI are on fig. 1.1B). Ascospores colourless, usually 2-cellular, polariloculate, rarely unicellula species usually included in the genus *Fulgensia*) or 4-loculate (fig. 1.1C). Hamath 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, incospicious unchambered or distinct and chambered, in pa species partially elevated. Conidiophores single or branched and anastomosed, consis more or less isodiametric cells. Conidiogenous cells isodiametric, 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 *Calo 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 spe genus *Xanthoria*, *Fulgensia schistidii* and surprisingly *Caloplaca pyracea* (usually kn



ig. 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; , hypothecium; d, thalline excipulum); B, *Teloschistes*-type of ascus, showing structures of apical aparat, bserving in Lugol's solution (black in the illustration = dark blue in real, greyish in the illustration = pale lue in real); C, spores (a-c, polariloculate spores; a, thin ellipsoid; b, ellipsoid; c, citriform; d, rare, -loculate spore); D, Tips of paraphyses (a, straight, not broadened in tip; b, flexuose; c, straight, ubmonilliform; d, apically branched; e, sub-apically branched; f, branched and anastomosed - simplified); , Structures inside of pycnidia (a, conidiogenous cells with attached conidia; b, shapes of conidia).

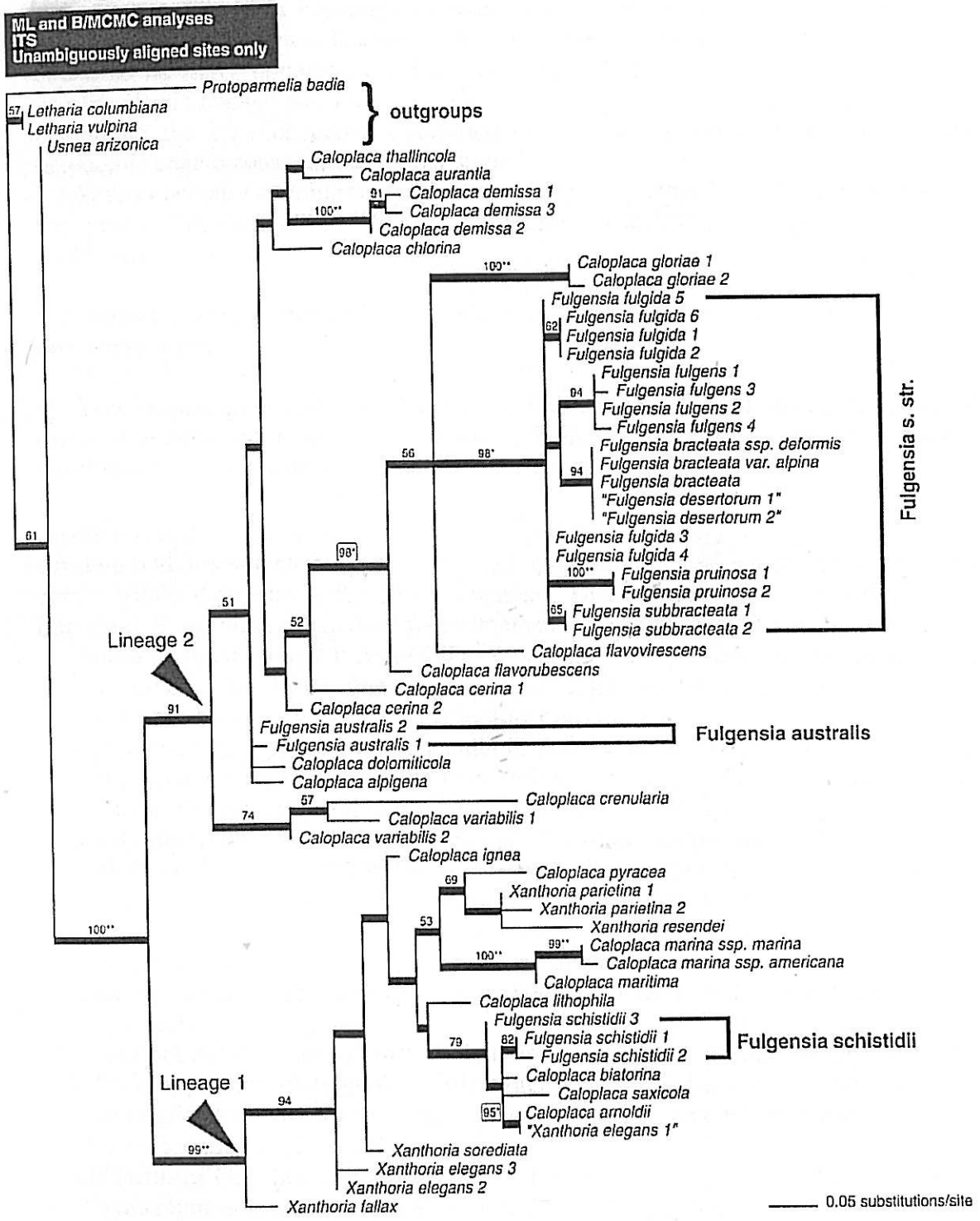


Fig. 1.2. **Relationship among selected *Caloplaca, Fulgensia* and *Xanthoria* species**, based on internal transcribed spacer (ITS) unambiguously aligned sites only. One of the five equally most likely trees generated by maximum likelihood search. All internodes present in the strict consensus of these five trees are highlighted with thicker branches. Numbers above each internode represent posterior probabilities ≥50%. One asterisk indicates scores ≥95%, and two asterisks show scores >99%.

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 shcistidii* 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** (fruiting 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.

Epihymenium (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 apothacia 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), **epilytic** (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).

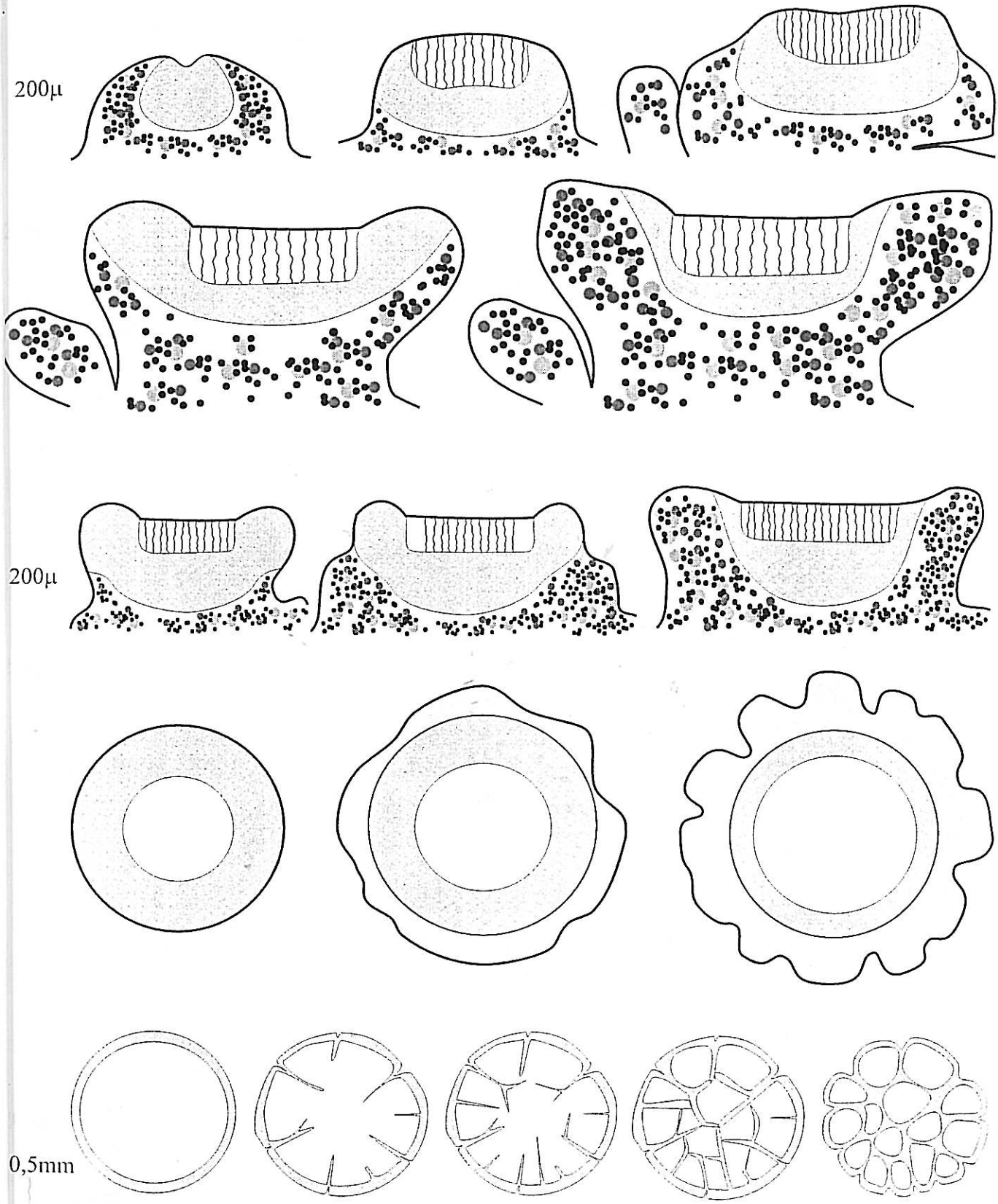
Epinecral layer (extra-cellular layer occurring on thallus surface, consisting of dead remains of thalline cells in mixture with various crystals). Algae and cyanobacteria inhabiting thallus surface are not included in this term. Presence / absence and thickness of epinecral layer are investigated, but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

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

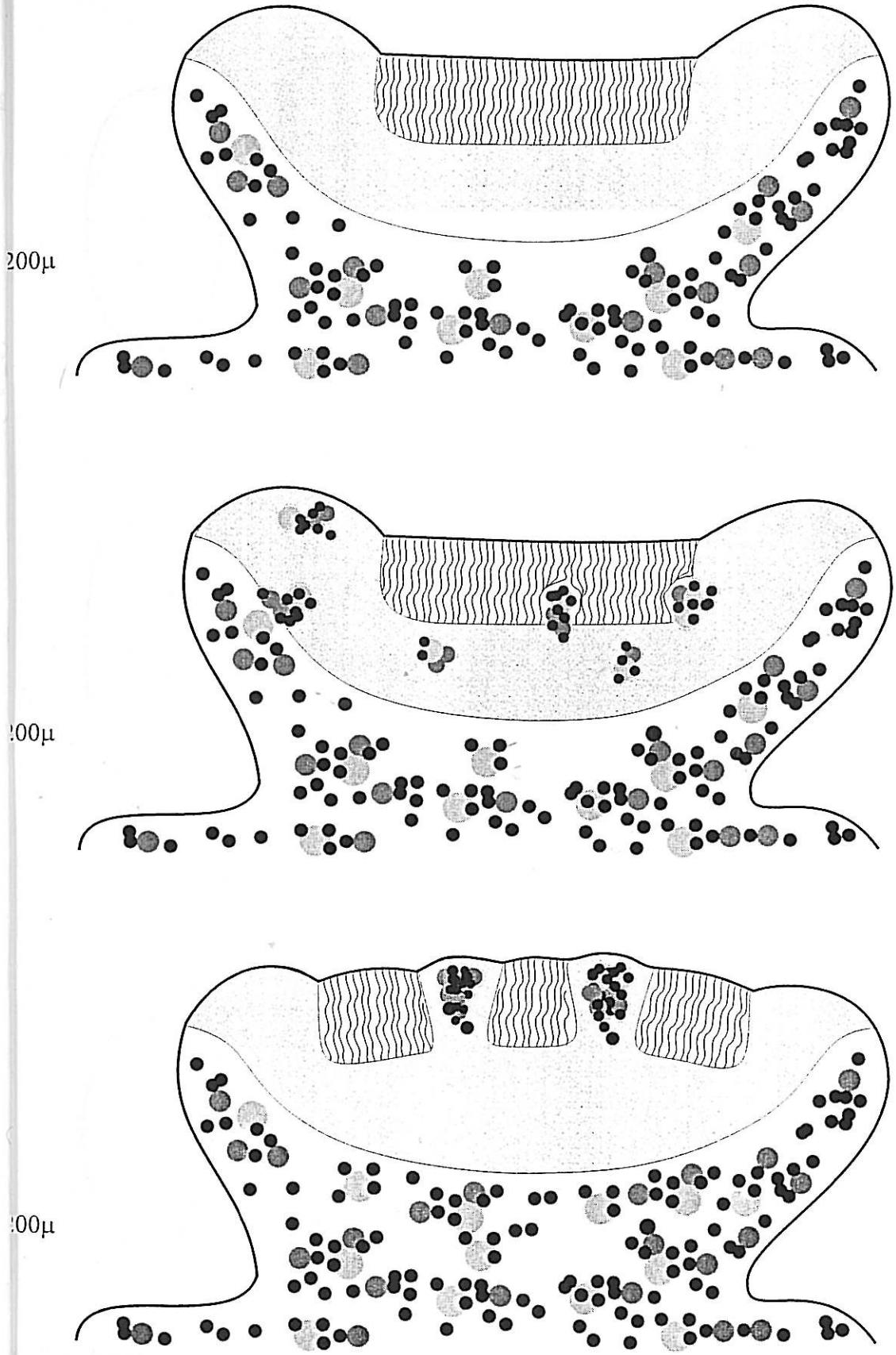
Lobules (photobiont-containing protuberance of the cortex similar to isidia, but larger and lobe-shaped). Within the genus *Caloplaca* occurring only in *C. xerica*.

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.

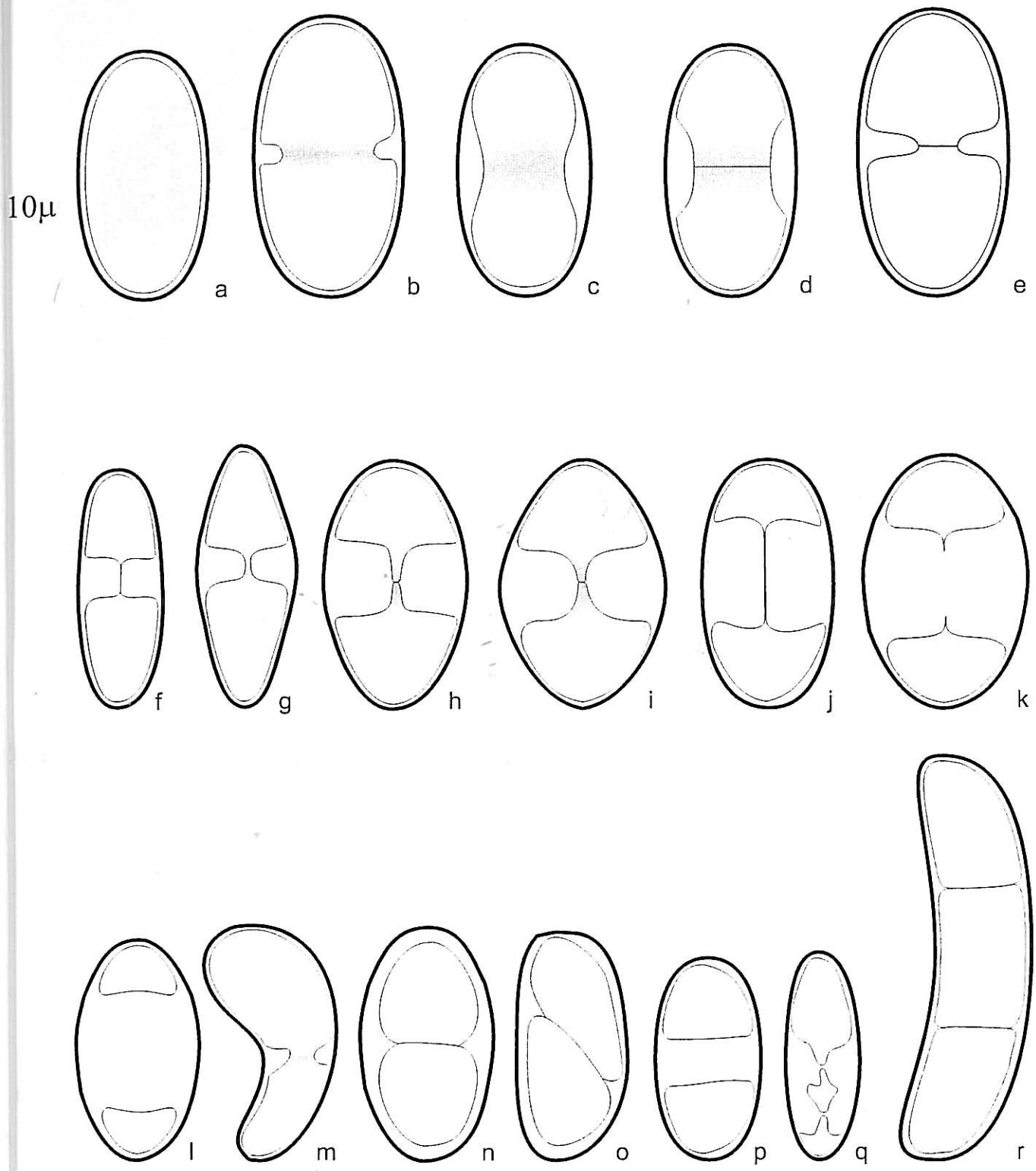
Pruina (usually pale greyish or white crystalline layer on thallus surface). Commonly occurring within the genus *Caloplaca*, but only in particular species having taxonomic importance.



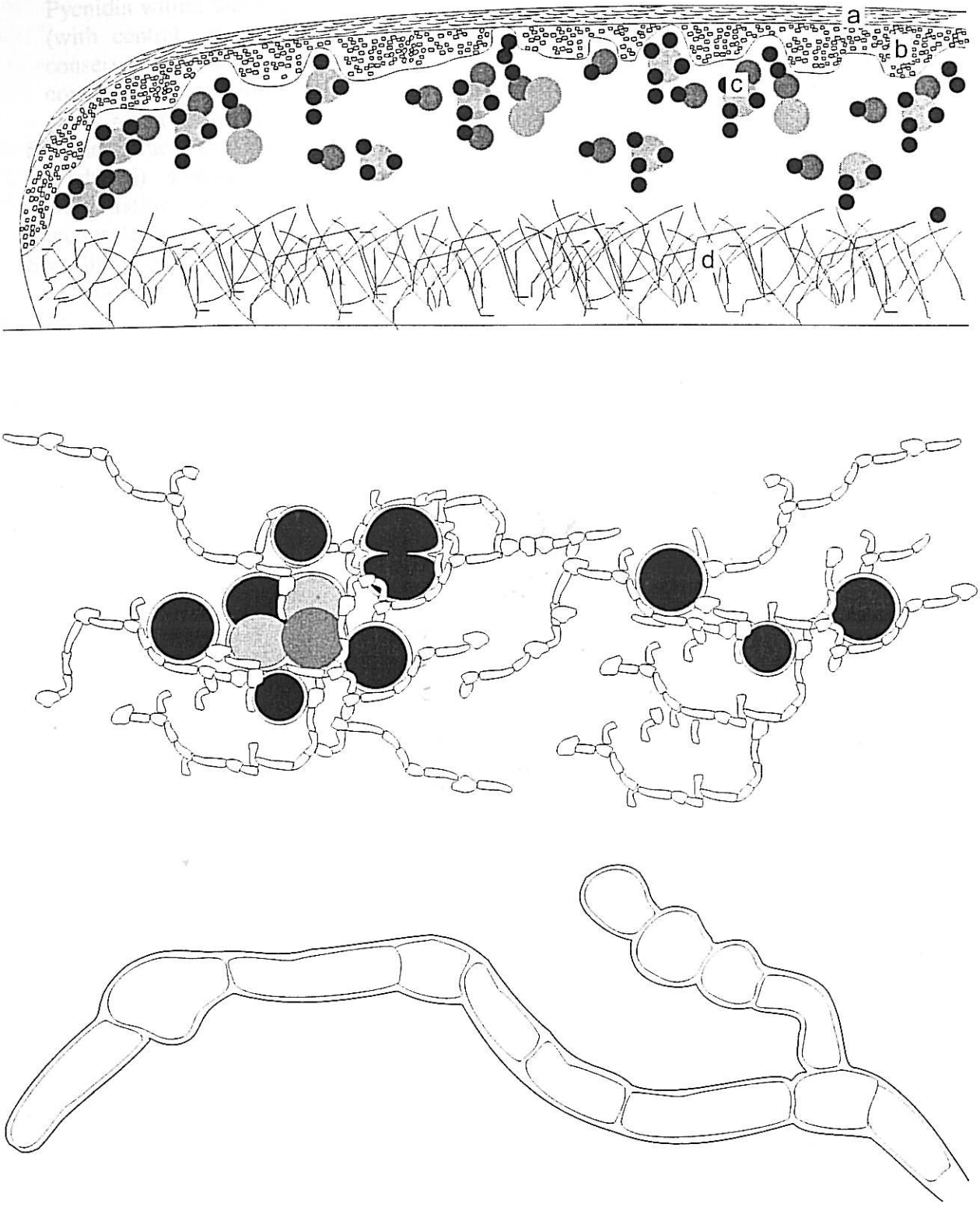
ig. 2.1. **Development of apothecia.** A, *Caloplaca xerica*, development from apothecial primordium to ld apothecium, true excipulum / thalline excipulum ratio distinctly changes during development; B, *aloplaca crenulatella*, horizontal view is situated below vertical setions of particular stages, see the renulate appearence of thalline excipulum; C, *Caloplaca arenaria*, posible development of old apothecia, ss ngle ascocarp is divided into several "daughter" apothecia.



g. 2.2. **Three different apothecium structures in *Caloplaca flavovirescens*.** A, Typical ascocarp with menium, hypothecium and true excipulum without algae (common); B, Ascocarp with isolated algal usters 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 perficialy distinct as small elevations in hymenium (rare).



g. 2.3. **Ascospore development in the genus *Caloplaca*.** a-e, young spores (septum not developed at st, then septum slighly indicated or developed, but canal between loculi still thick); f-j, ripe spores (spores lariloculate, 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).



g. 2.4. **Thallus structure of *Caloplaca teicholyta* and *C. marmorata*.** A, vertical section through hallus of *C. teicholyta* (a, epinecral layer; b, cortex; c, algal layer; d, medulla); B, horizontal view on dolytic thallus of *C. marmorata* after 50% HNO_3 aplication; C, fungal filament of *C. marmorata* 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 **ostiolum** (pycnidial opening) are investigated. Specific reactions with C and K are occasionally bonded with the cortex around ostiolum.

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. magni-filii*, were excluded.

Most of investigated samples have been collected by myself. They are deposited in herbarium of Faculty of Biological Sciences in České Budějovice (*Herbarium Facultatis Biologicae Universitatis Bohemiae Meridionalis*), not included in the Index Herbariorum. Other used samles 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. dolomiticola*, *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 excipulum 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 septum 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. ruderum*, 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, thalloidima green and sedifolia grey. Following chemicals have been used: C (ca 5% KClO; detergent SAVO), I (Lugol's sollution - 0.5g iodine, 1.5g potassium iodine in 100ml distilled water), K (10% KOH) and N (50% HNO_3). Lacto-glycerol cotton blue was rarely used for easier observation of fungal cells.

Presence of carbonates in substrate was investigated with 50% HNO_3. Nitric acid was also used for decalcification by investigation of endolithic thalli.

The colour photographes 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.

Anatomical and morphological terminology generally follows Purvis et al. (1992). Nomenclature (except of the genus *Caloplaca*) follows Vězda et Liška (1999).

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
9a ... Strict parasites, never occurring free-living..... 10
9b ... Free-living species, occasionally partially parasitic 12
12a ... Septum of ripe spores thin, up to 4µm thick..... 13
12b ... Septum of ripe spores thicker, more then 4µm thick..... 18
28a ... Thallus crustose-areolate, crustose-rimose or subsquamulose, not orbicular, delimited by marginal lobes 29
Thallus more or less orbicular, delimited by marginal lobes (sect. *Gasparina*)..... 50
50a ... Thallus sorediate..... 51
50b ... Thallus non-sorediate..... 54

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 ... Apothecia present, black or greyish (bluish) pruinose..... **sect. *Pyrenodesmia*** - not included in this work in this work (***C. alociza***, ***C. chalybea***, ***C. variabilis*** occurring in the Central Europe)
3b ... Apothecia absent..... 4
4a ... Thallus distinctly lobate, more or less orbicular, delimited by marginal lobes..... 5
4b ... Thallus crustose, without marginal lobes..... 6
5a ... Thallus up to 6mm in diameter, 100-160µm thick, cortex K- in cross-section, mostly with delimited soralia..... ***C. demissa***
5b ... Thallus larger, often more then 10mm in diameter, 100-300µm thick, cortex K+ "dirty" violet in cross-section, entirely sorediate in centre of thallus..... ***C. teicholyta***
6a ... Thallus sorediate, cortex K+ "dirty" blue-violet in cross-section..... 7
6b ... Thallus non-sorediate..... **juvenile lichens**, determination often imposible
7a ... Thallus minutely areolate, covered by cortex, with delimited soralia..... ***C. chlorina***
7b ... Thallus leprose or endolithic, in centre entirely sorediate, without cortex..... 8

8a ... Thallus endolithic with whitish epilithic prothallus. Usually occurring in shallow depresions 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 epilithic, leprose. Usually on flat surface of calcareous sandstone, bricks or roofing-tiles. Occasionally fertile, with reddish apothecia..... ***C. albolutescens***

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 nigrileprosa*..... ***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 epilithic or somewhat reduced or indistinct, but not endolithic.....14

13b ... Thallus more or less endolithic (fig. 2.4), epihymenium 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. albolutescens***

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. subpallida***)

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***

21a ... Thallus lobulate, isidiate or sorediate.....22
21b ... Thallus non-isidiate, non-sorediate and without lobules.....23
22a ... Thallus entirely sorediate in centre.....15
22b ... Thallus lobulate, isidiate or with delimited soralia, apothecia often with crenulate thallus-like grey outer margin (fig 2.1)..... ***C. xerica***
23a ... Thallus thin, often indistinct, usually with pale grey fibrilous prothallus, orange apothecia with paler excipulum changing to yellow when wet..... ***C. holocarpa***
23b ... Thallus usually thick and conspicuous, prothallus, when developed, black.....24
24a ... Apothecia having paler excipulum, strongly changing colour when wet, pycnidia dark grey or indistinct, not red.....25
24b... Both apothecial disc and excipulum usually deep red, almost unchanging colour when wet. Pycnidia red, reacting K+ violet-red, C+ dull violet.....27
25a ... Thallus usually thick, sublobate, pale to dark grey, apothecia up to 1mm in diameter, becomming waxy when wet, spores 13-15 x 8µm ..... ***C. ceracea*** - not known from the Czech Republic so far
25b ... Thallus thin, not sublobate, black, apothecia up to 0.5mm in diameter.....26
26a ... Apothecia dark red to brownish. Excipulum often I+ blue, spores 8-12 x 7-7.5µm in size..... ***C. scotoplaca*** - not known from the Czech Republic so far
26b ... Apothecial disc red, excipulum distinctly paler, shiny, I-, spores (10-)14-18 x 8-9µm ..... ***C. atroflava*** - not known from the Czech Republic so far
27a ... Thallus without cortex or cortex thin, up to 20µm thick, thick epinecral layer often present, thalline excipulum present, algae always reaching upper excipulum, spores (12-)14-18 x 7-10µm in size..... ***C. "pseudocrenularia"***
27b ... Thallus with distinct cortex, 7-30µm thick, thalline excipulum strongly reduced, algae mostly not present in excipulum..... ***C. crenularia***
28a ... Thallus crustose-areolate, crustose-rimose or subsquamulose, not orbicular, delimited by marginal lobes.....29
28b ... Thallus more or less orbicular, delimited by marginal lobes (sect. *Gasparina*).....50
29a ... Thallus brown-red to orange-red, apothecia remain flat and immersed, true excipulum indistinct, spores small, 7.5-9.5 x 4-5µm..... ***C. rubelliana***
29b ... Thallus yellow to orange, rarer orange-red, mature apothecia more or less sessile, true excipulum more or less distinct.....30
30a ... Thallus sorediate.....31
30b ... Thallus non-sorediate, granular-isidiate or non-isidiate.....34
31a ... Thallus areolate with distinct cortex, soralia delimited or thallus entirely broken into soredia, soredia rather para-plectenchymatous.....32
31b ... Thallus leprose, entirely sorediate, soredia rather plectenchymatous, lichens never fertile.....33
32a ... Thallus yellow or rarely orange, granular, areolate, sublobate or entirely broken into soredia, soralia marginal, lichens occasionally fertile..... ***C. citrina***
32b ... 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..... ***C. obliterans***
33a ... Thallus bright yellow, distinctly delimited to almost sublobate..... ***C. xantholyta***
33b ... Thallus beige, dull orange, brownish or greyish yellow, not distinctly delimited..... ***C. chrysodetha***

34a ... Thallus granular or isidiate, sometimes strongly greyish pruinose. Removing of pruina (e.g. by HNO_3) often necessary to see thallus structure.....**35**
34b ... Thallus non-isidiate, non-granular.....**36**
35a ... Thallus granular-isidiate, not pruinose, usually orange. Granules 80-120µm in diameter. Cells of cortex small, 2.5-6µm in diameter. Excipulum orange..... ***C. coronata***
35b ... Thallus granular-areolated, yellow to yellow-orange, white pruinose. Granules larger. Cells of cortex large, 12-20µm in diameter. Excipulum yellow, never orange..... ***C. ruderum***
36a ... Strict parasites, mostly not free-living.....**37**
36b ... Free-living species, occasionally partially parasitic.....**39**
37a ... Thallus large, thick, often sub-lobate, yellow. Similar to *Candelariella vitellina*. Mostly on *Acarospora cervina* and *Aspicilia* sp. div..... ***C. "inconnexa"***
37b ... Thallus minute, thin, not sub-lobate. Parasites on endolithic lichens.....**38**
38a Spores 10-14 x 6-7µm in size, paraphyses broadened to 5.5-7.5µm at tips, straight and not branched..... ***C. polycarpa*** - not known from the Czech Republic so far
38b Spores small 8-9 x 5.5-5.5µm in size, Paraphyses broadened to 4.5µm at tips, flexuose and branched, thallus delimited to the shallow rock depresions made by some endolithic lichens (e.g. genus *Bagliettoa* and *Verrucaria*)..... ***C. oasis*** - not known from the Czech Republic so far
39a ... Thallus yellowish to greyish, never deep yellow. When greyish, then with K+ dark violet reaction. Dull orange apothecia characteristically strongly contrasting with pale thallus..... ***C. flavovirescens***
39b ... Thallus deep yellow to orange.....**40**
40a ... Thallus sublobate or squamulose.....**41**
40b ... Thallus not squamulose or sublobate, but often distinctly delimited.....**43**
41a ... Thallus squamulose. True excipulum and lower hypothecium para-plectenchymatous, distinct black prothallus often developed..... ***C. subsoluta***
41b ... Thallus sublobate. Hypothecium not para-plectenchymatous, prothallus indistinct or pale.....**42**
42a ... Outer cells of true excipulum para-plectenchymatous, prothallus whitish when present. ..... ***C. saxicola***
42b ... True excipulum plectenchymatous throughout, prothallus usually not developed ..... ***C. inconnexa***
43a ... Ripe spores 4-loculate, thallus thin yellow or whitish..... ***C. ochracea***
43b ... Spores 2-loculate.....**44**
44a ... Ripe spores with thin septa, up to 4µm thick.....**45**
44b ... Ripe spores with broad septa, more than 4µm thick.....**46**
45a ... Thallus white endolithic, sometimes with K+ violet-red yellow spots around apothecial primordia and apothecial remains..... ***C. lactea***
45b ... Thallus epilithic, areolate, old apothecia with crenulate, yellow collar-like outer margin (fig. 2.2)..... ***C. crenulatella***
46a ... Thallus usually greyish, only occasionally with yellow spots around apothecia and apothecial primordia..... ***C. holocarpa*** - yellowish form usually known under *C. vitellinula*
46b ... Thallus yellow to orange, not greyish.....**47**
47a ... Thallus film-like thin yellow, without cortex, strongly resembling *C. ochracea*, but having 2-loculate spores with thick septa..... ***C. subochracea*** - not known from the Czech Republic so far
47b ... Thallus thicker, cortex developed.....**48**

48a ... True excipulum and lower hypothecium para-plectenchymatous, distinct black prothallus often developed..... ***C. subsoluta***
48b ... Only outer part of true excipulum more or less para-plectenchymatous.....**49**
49a ... Whitish or pale greyish fibrilous prothallus often present. Occuring on silicates in more or less damp situations..... ***C. saxicola*** - non-lobate form, known as *C. saxicola* var. *obliterascens* or *C. vitellinula*
49b ... Dark to pale prothallus occasionally developed, occuring on calcareous substrata and on bricks and roofing-tiles..... ***C. dolomiticola*** **s. l.** (probably heterogenous, variable group; ***C. dalmatica***, ***C. placida***, ***C. schaereri*** and ***C. velana*** are included)
50a ... Thallus sorediate.....**51**
50b ... Thallus non-sorediate.....**54**
51a ... Thallus orange-red, small-sized, up to 10mm in diameter, soralia orange-red, soredia large, 50-80µm in diameter..... ***C. proteus*** - not known from the Czech Republic so far
51b ... Thallus yellow to orange, soralia yellow, soredia smaller.....**52**
52a ... Thallus yellow, rarely yellow-orange. Soralia usually bedly delimited, coloured as the thallus..... ***C. decipiens***
52b ... Thallus more or less orange. Soralia mostly well delimited, bright yellow.....**53**
53a ... Thallus never pruinose, marginal lobes often reduced, yellow to orange prothallus usually developed..... ***C. obliterans***
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..... ***C. cirrochroa***
54a ... Thallus isidiate in centre..... ***C. granulosa*** - not included in this work
54b ... Thallus non-isidiate.....**55**
55a ... Septum of ripe spores thin, up to 4µm thick, thallus often pruinose..... ***C. biatorina*** - not included in this work
55b ... Septum of ripe spores more than 4µm thick.....**56**
56a ... Spores citriform (abnormaly broadened around septum, fig 1.1C), Thallus large, often several centimeter in diameter..... ***C. aurantia*** group - not included in this work (***C. aurantia*** and ***C. flavescens*** occurring in the Czech Republic)
56b ... Spores ellipsoid. Thallus smaller.....**57**
57a ... Thallus small-sized, usually up to 10mm in diameter, deep orange-red to brown-red, marginal lobes strongly convex..... ***C. arnoldi*** - not known from the Czech Republic so far
57b ... Thallus usually larger, up to 2.5mm in diameter, yellow to orange, lobes slightly convex..... ***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. dolomiticola* 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).

1. *Caloplaca albolutescens* (Nyl.) Oliv., Mém. Soc. Sci. Nat. Cherbourg 37: 127. 1909.

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

Diagnosis: Thallus whitish, unregulary 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 fibrilous 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. Asci 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 lenght). 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 depresions 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.

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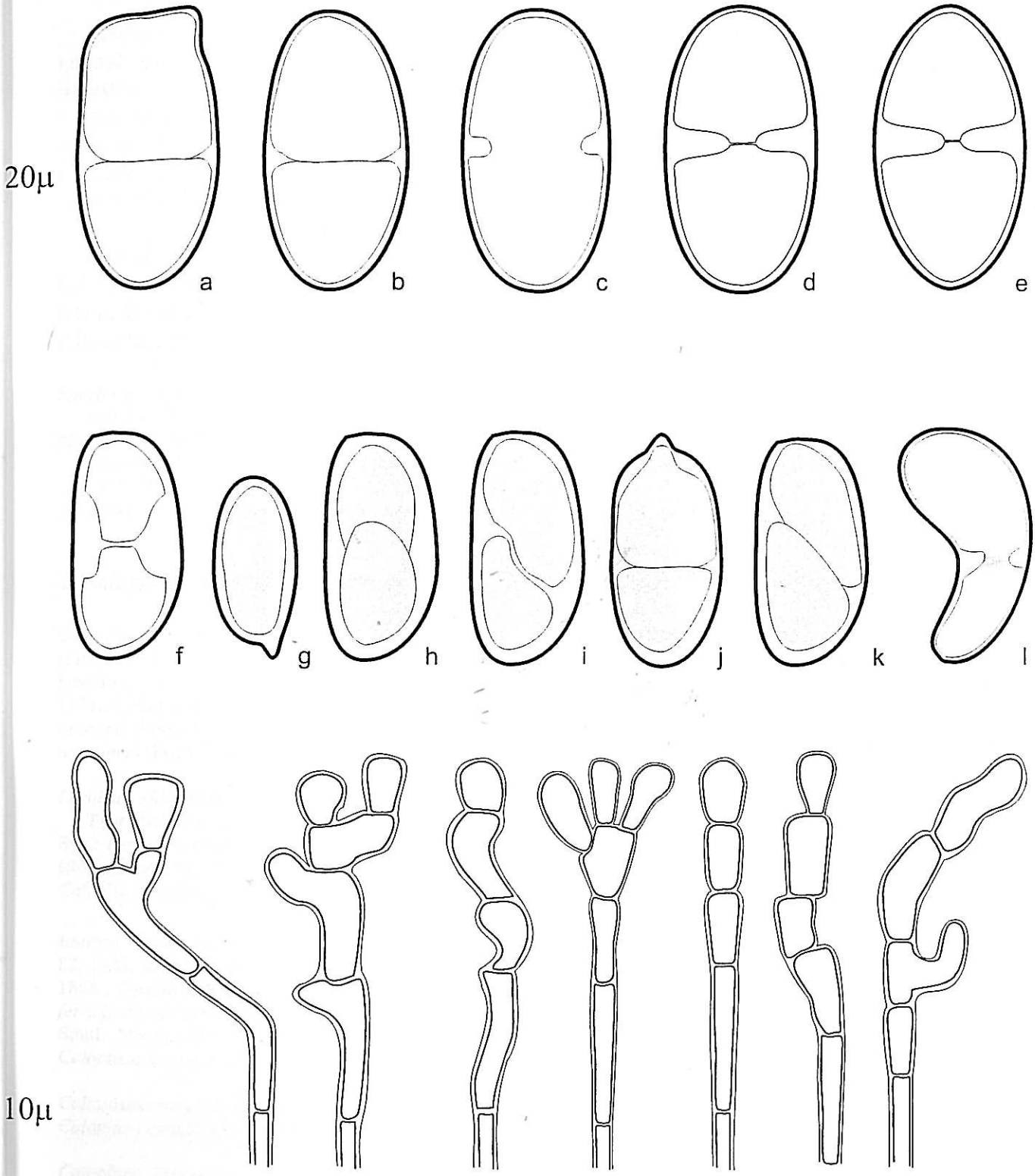
g. 3.1A. ***Caloplaca albolutescens.*** A, hallus with apothecia; B, *C. albolutescens* ght) as compared with similar, but distinctly bate *C. teicholyta* (left); C, Apothecia in tail.



g. 3.1B. ***Caloplaca albolutescens***. A, ascospores (a-c, young spores; d,e, ripe spores; f, overripe spore; l, 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.

Associated lichen species: Aspicilia contorta, Buellia alboatra, Caloplaca citrina, C. crenulatella, C. decipiens, C. dolomiticola, C. holocarpa, C. teicholyta, C. variabilis, Candelariella aurella, C. vitellina, Lecania erysibe, Lecanora dispersa, L. muralis, L. salina, Lobothalia radiosa, Phaeophyscia nigricans, P. orbicularis, Verrucaria nigrescens.

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., Křivoklát (Central Bohemia).

Specimens seen: **Central Bohemia.** Beroun, Křivoklát, in the village near the castle, 50°02'10"N, 13°52'30"E, bricks in the old wall, 23.3.2003.
Northern Bohemia. Bakov n. Jizerou, ruin of castle Zvířetice, alt. 250 m, 50°28'10"N, 14°25'10"E, calcareous sandstone boulders in walls, 23.4.2003; Bakov n. Jizerou, railway station, alt. 220 m., 50°28'30"N, 14°25'30"E, calcareous sandstone rock, SE exp., 23.4.2003.
Southern Moravia. Kyjov, Milotice, horizontal sides of bricks in the wall, 2.7.2003.

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

Bas.: *Parmelia aractina* Fries, Syst. Orb. Veget., pars. 1: 284. 1825. (Syn.: *Parmelia ferruginea* var. *aractina* (Fries) Fries, Lichenogr. Europ. Reform.: 173. 1831.; *Parmelia cerina* var. *aractina* (Fries) Fries, Summa Veget. Scandin., sect. 1: 108. 1846.; *Caloplaca cerina* var. *aractina* (Fries) Th.Fr., Lichenor. Scandin., vol. 1: 174. 1871.; *Callopisma cerinum* var. *aractinum* Jatta, Nuov. Giorn. Botan. Ital. 18: 94. 1886.; *Caloplaca chlorina* var. *aractina* (Fries) Oliv., Mémoir. Soc. Nation. Scienc. Natur. Cherbourg 37: 123. 1909.; *Placodium gilvum* var. *aractinum* (Fries) Kreyer, Acta horti Petropolit. 31: 325. 1913.).

Lecidea viridirufa Ach., Lich. Univ.: 204. 1810.
Type: Helvetia, ad lapides schistosos, ?, Shcleicher. (H, herb. Acharius 336!, lectotype selected here).
Syn.: *Lecanora viridirufa* (Ach.) Nyl., Flora (Regensburg) 59: 239. 1876.; *Callopisma viridirufum* Arn., Flora (Regensburg) 64: 313. 1881.; *Biatorina viridirufa* Hazs., Magy. Birod. Zuzmó-Flór.: 159. 1884.
Caloplaca viridirufa (Ach.) Zahlbr., Cat. Lich. Univ. 7: 198. 1931.

Biatora ferruginea var. *fuscoatra* Bayerhoffer, Uebersicht der Moose, Lebermoose und Flechten des Taunus: 82. 1849. (Syn.: *Lecanora ferruginea* var. *fuscoatra* (Bayer.) Nyl., Annal. Scienc. nat., bot., ser. 4, vol. 3: 161. 1855.; *Lecanora fuscoatra* (Bayer.) Nyl. (Bayerhoffer) Nyl., Flora (Regensburg) 55: 427. 1872.; *Caloplaca ferruginea* var. *fuscoatra* (Bayer.) Decuill., Bull. Soc. d'Etud. Angers 22: 223. 1893. *Placodium fuscoatrum* A.L. Smith, Monogr. Brit. Lich, vol. 1: 219. 1918.).
Caloplaca fuscoatra (Bayerhoffer) Zahlbr., Annal. Naturhist. Hofmuseums Wien 9: 131. 1894.

Callopisma conglomeratum Bagl., Nuov. Giorn. Botan. Ital.3: 243. 1871.
Caloplaca conglomerata (Bagl.) Jatta, Sylloge Lich. Ital.: 255. 1900.

Caloplaca ferruginea var. *obscura* Th. Fr., Lichenogr. Scandin. vol. 1: 183. 1871. (Syn.: *Callopisma ferrugineum* var. *obscurum* (Th. Fr.) Stein in Cohn, Kryptogam.-Flora von Schlesien, vol. 2: 119. 1879.).

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, 20-50μm. Cortex cells para-plectenchymatous, 3.5-5.5μm in diameter. Epinecral layer up to 15μm thick. Algal layer para-plectenchymatous, algal cells 6-15μm 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 60-70μm high. Hamathecium of 1.5-2μm thick paraphyses, often branched and sparsingly anastomosed. Paraphyses tips widened to 4.5 (7.5)μm, 2-4 upper cells broadened. Ascospores (7.5-)9-12.5(-14) x 4-7(-8,5)μm in size. Septum of ripe spores 3-7μm (1/3-1/2 spore lenght). Apothecia C- (epihymenium 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. 4-5μm in diameter. Conidia bacilliform, 4,5-7 x 1-2μm 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 areolate 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. scotoplaca* with similar thallus strongly differ in morphology of excipulum.

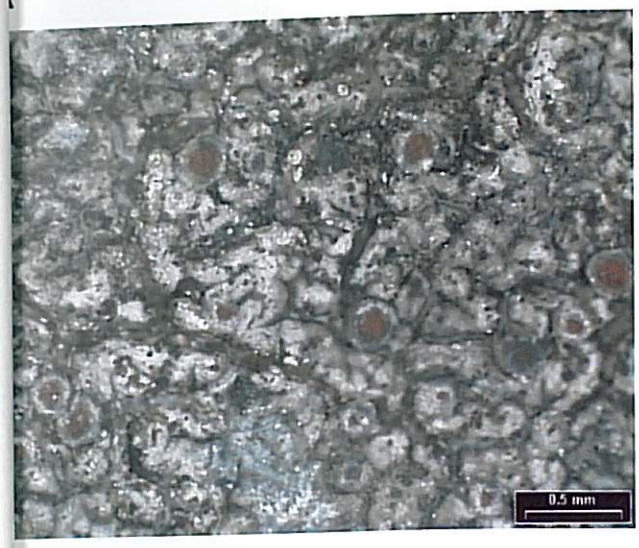
References to taxonomy: Purvis et al. 1992, Wetmore 1996, Wade 1965, Zahlbruckner 1902.

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, Rokytná and Svratka), river valleys in Central Bohemia (rivers Berounka, Sázava, Vltava) and rocky hills in České středohoří Mts. (Northern Bohemia). Altitudinal maximum: 470m a. s. l. (the "Košťál" hill in České středohoří Mts.).

Distribution maps: Suza 1942, 1947.



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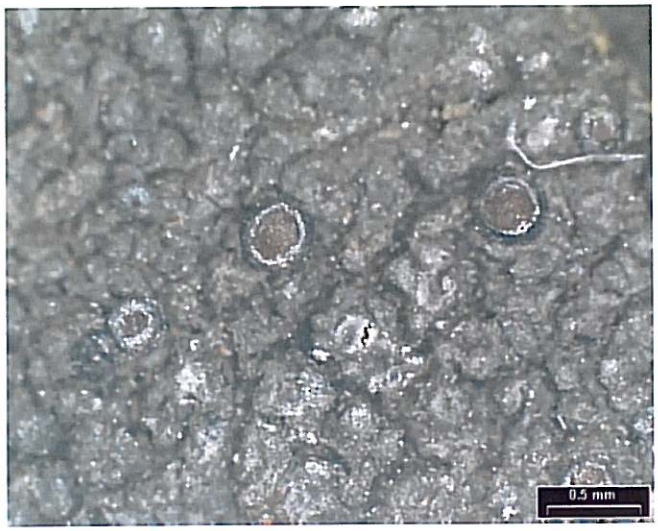

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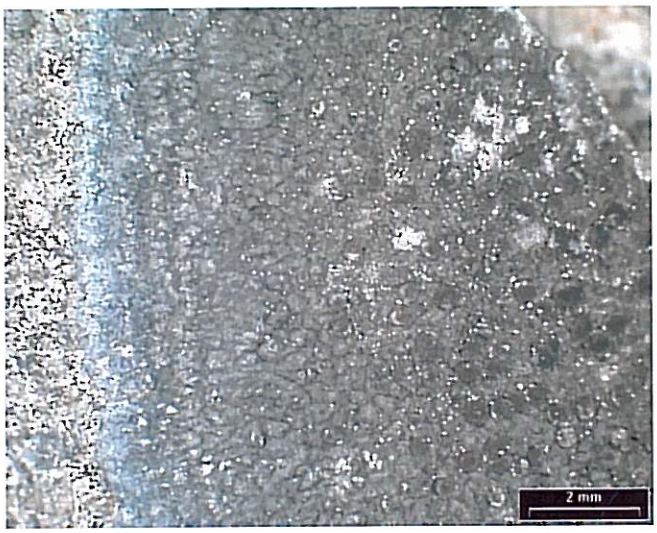

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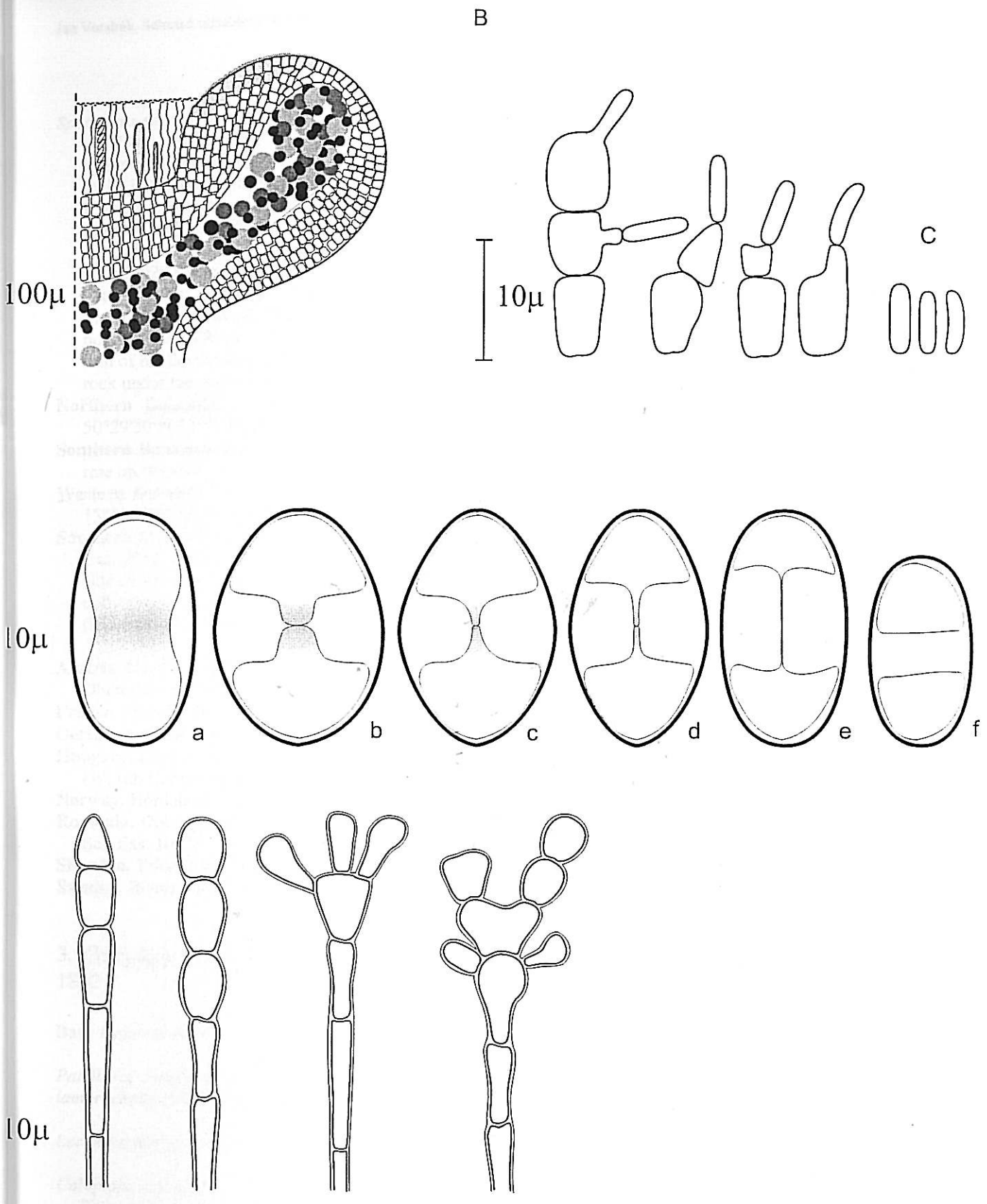
g. 3.2A. ***Caloplaca aractina.*** A, Thallus th apothecia; B, Apothecia in detail; C, allus delimited by dark glossy prothallus; Prothallus in detail.



g. 3.2B. ***Caloplaca aractina***. A, vertical section through an apothecium, showing para-ectenchymatous true excipulum with grey upper cells; tissues in hypothecium are verticaly 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 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, 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. subsoluta); 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, 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, (slightly lime-rich) vertical face of the silicate rock, 6.12.2002; Rakovník, Skřivaň, 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, around sulphate and carbonate layers in bazalt rock, 21.10.2002; Rakovník, Skřivaň, 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, base-enrichhed bazaltic rock, 16.9.2002; 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 castle, 17.9.2001.

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. 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°35'30"E, schist stone in wall of ruin, 14.9.2003.

Southern Moravia. Ivančice, Biskoupky, serpentinit 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 serpentine, form with black apothecia, 1932, Suza (PRM 697206, in collection of C. subsoluta); Znojmo, Nový Hrádek, rovk above Dyje river, alt. 350m, schist, 29.3.1932, Suza (PRM 631131, in collection of C. subsoluta).

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

France. Pyrenées orient., Forsa-Réal, 1872, Nylander (H-Nyl 30249, sub *C. viridirufa*).

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*).

Norway. Hordaland. Guldberg, phyllite, 22.8.1910, J.J. Havas (W, sub *C. fuscoatra*).

Romania. Dobrogea. Distr. Constanta, Mihai Viteam, alt. 1000m, schist rock, 12.7.1971, Vězda (Vězda: Lich. Sel. Exs. 1022).

Slovakia. Tribeč Mts., Jelenec (Gýmeš), on quarzite, 18.7.1973, Liška, Pišút (Pišút: Lich. Slov. Exs. 229).

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

3. *Caloplaca arenaria* (Pers.) Müll.Arg., Mém. Soc. Phys. et Hist. Natur. Genéve 16: 387. 1862.

Bas.: *Lichen arenarius* Pers., Neue Annal. der Botan.: 1: 27. 1794.

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

Lecanora ferruginascens Nyl., Flora (Regensburg) 55: 427. 1872.

Caloplaca oxfordensis Hedr., Mycol. 26: 162. 1934.
Type: U.S.A. Ohio. Bulter Co., near Oxford, 9.8. 1909, Fink (MICH, holotype).

Caloplaca subpallida H. Magn., Bot. Notis. 1945: 305. 1945.
Type: Sweden. Bohuslän, Jörlanda, Rannekär, on shady rock below a hill, 24.5.1939, G. Degelius (UPS, isotypus!).

Caloplaca scotoplaca f. *depauperata* H. Magn., Göteb. Kgl. Vet.–och Vitterh.-Samh. Handl. 6 Följden, Ser. B, 3(1): 55. 1944.
Type: Sweden. Bohuslän, Stenkyrka, Bäck, 24.7.1937, H. Magnusson (UPS, holotype).

Caloplaca caesiorufa sensu Suza et sensu Zahlbruckner.

Caloplaca scotoplaca auct. Austr. (not *C. scotoplaca* (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, 0.1-1mm 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 fibrilous cells that are broader and shorter at outer edge of excipulum. Disc variable in coloration, [illegible] to red, old apothecia sometimes blackish. Paler apothecia typically found in thalli from [illegible] 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. Ascospores (10-)12-18(-20) x 3-6(-7)µm in size. Septum of ripe spores 2-4µm wide (<1/4 spore lenght). 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 3-3.8µm 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. teicholyta*) does not agree well with this taxon, but rather with *C. teicholyta* or *C. albolutescens*.

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 licheu 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. subpallida* (=*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 "*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*.

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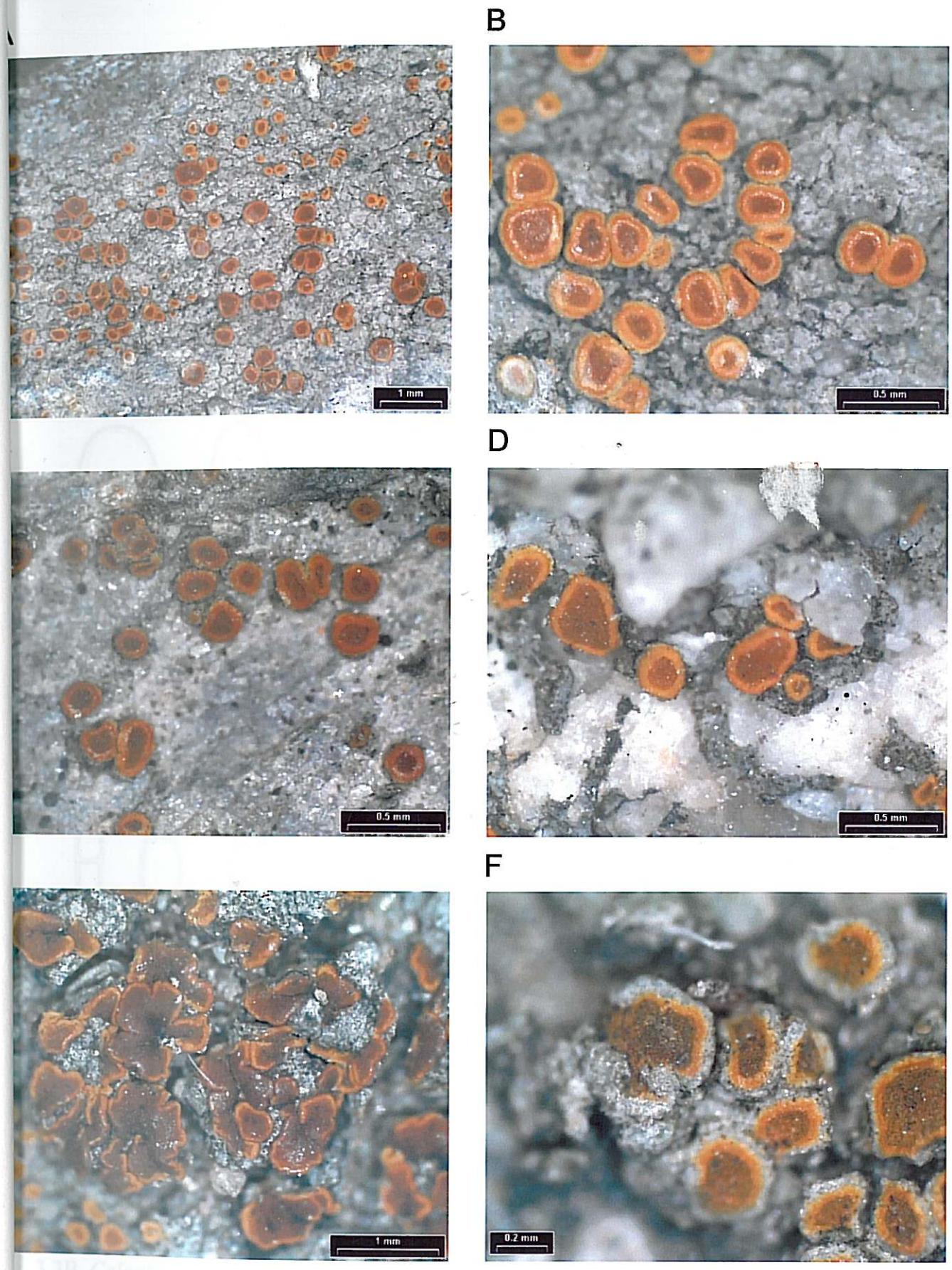
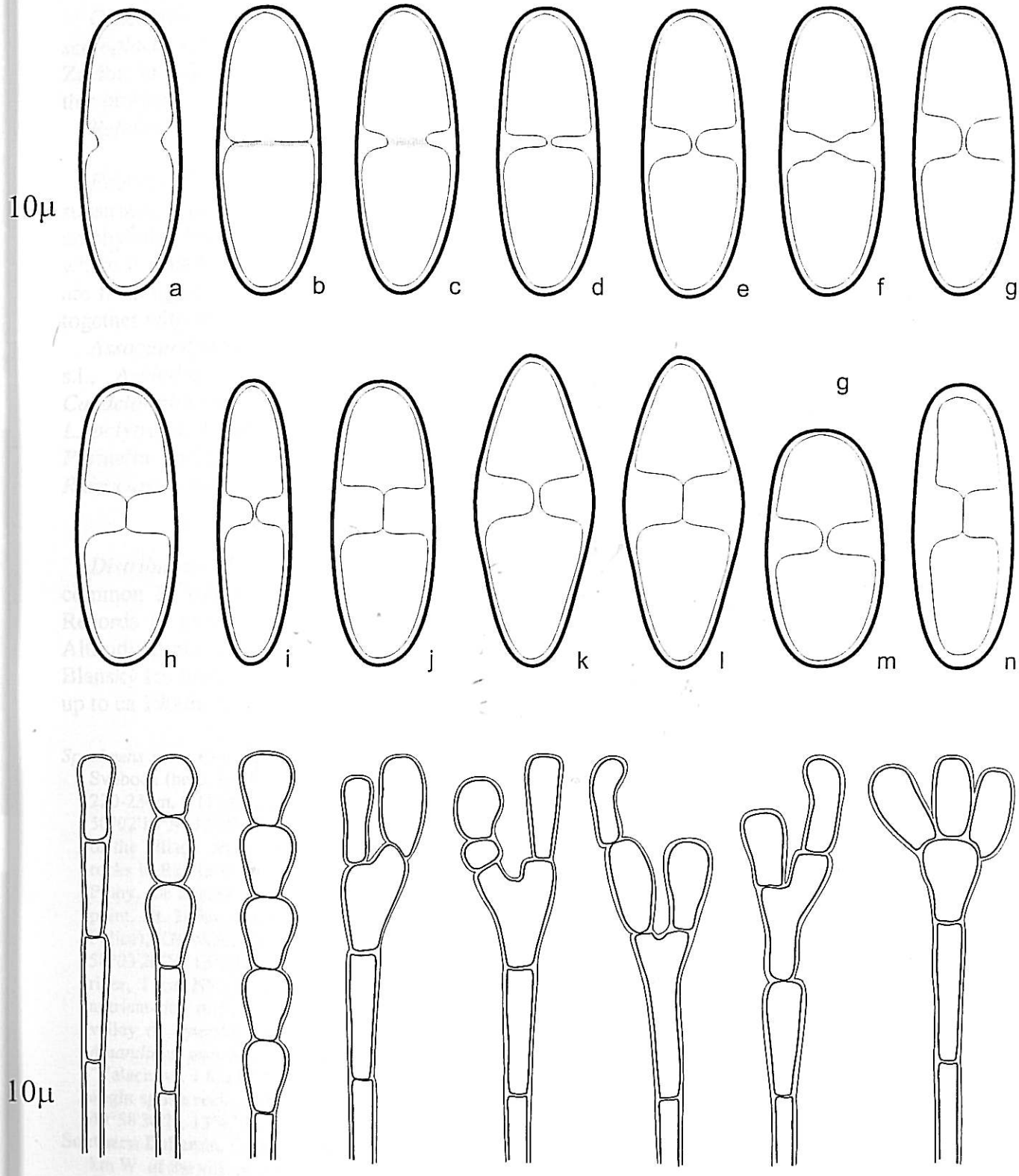


g. 3.3A. ***Caloplaca arenaria.*** A, Thallus with apothecia; B, Apothecia in detail; C, Thallus indistinct, ɔthecia directly on substrate; D, Thallus restricted to slits in substrare; E, Old crenulate apothecia; F, ɔthecia with grey outer excipulum (rare).



ig. 3.3B. ***Caloplaca arenaria***. A, ascospores (a-d, young spores; e-m, pe spores; n, overripe spore); B, paraphyses tips; C, two extreme apes 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).

References to taxonomy: Magnusson 1944, 1945, Wetmore 1996, Zahlbruckner 1902.

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 nitrophyllous lichens.

Associated lichen species: Acarospora fuscata, *A. smaragdula*, *Aspicilia caesio-cinerea* s.l., *Aspicilia contorta*, *Amandinea punctata*, *Buellia alboatra*, *Caloplaca demissa*, *Candelariella coralliza*, *C. vitellina*, *Diploschistes muscorum*, *Lecanora dispersa*, *L. muralis*, *L. polytropa*, *Lecidea fuscoatra*, *Lecidella carpatica*, *L. scabra*, *L. stigmatea*, *L. viridans*, *Parmelia pulla*, *Physcia caesia*, *P. dubia*, *Polysporina lapponica*, *Protoparmelia badia*, *Rhizocarpon distinctum*, *Rinodina oxidata*, *Trapelia involuta*, *T. obtegens*, *Xanthoria fallax*.

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. Kleť, 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, Karlštejn, Budňany, on basaltic rock, alt. 220-230m, 6.11.2002, D. Svoboda (herb. D. Svoboda, no. 366, sub *C. subpallida*); Beroun, Karlštejn, Budňany, on basaltic rock, alt. 220-230m, 6.11.2002, D. Svoboda (herb. D. Svoboda, no. 340); Beroun, Křivoklát, near Fürstembergs statue, 50°02'10"N, 13°52'30"E, concrete, 23.3.2003; Beroun, Křivoklát, 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; Jílové 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); Křivoklát, 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 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, Skřivaň, 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, nutrient-rich spilite rock, together with *Amandinea punctata*, *Candelariella vitellina* and *Physcia dubia*, 16.9.2002; Rakovník, Skřiváň, 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, alight spilite rock, 16.9.2002; Skryje, Týřovice, the ruin of medieval castle Týřov, 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, Kamenný 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. Kleť, alt.: 1080 m, exp.: S, 48°52'N, 14°17'10"E, vertical rock, influenced by the bird excrements?, 16.11.2002; Český Krumlov, Staré Dobrkovice, 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 "Vyšenské kopce", 48°49'20"N, 14°17'40"E, amphibolitic rock, 15.3.2002; Husinec, Lažiště, 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, stony balk nearby the village, 49°03'00"N, 13°59'50"E, gneiss stone, in community of nitrophillous lichens (Amandinea punctata), 10.3.2002; Ktiš, Březovík, protected area "Ptačí stěna" 2 km E from the village, silicate rock, 25.4.2001; Milevsko, Kovářov, flat stones in meadow, slightly elevated the soil, 16.9.2003; Milevsko, Sobědraž, flat

stone surface slightly elevated above the soil, 12.6.2003; Písek, the rocks on the left side of the Otava river, near the sewage disposall plant of the town, 49°19'10"N, 14°09'00"E, veathered, seminatural silicate rock, 6.8.2002; Písek, Hradiště, the rock on the left side of Otava river, 1 km W from the village, 49°17'50"N, 14°06'50"E, base-rich silicate, 4.9.2002; Písek, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26'20"N, 14°11'40"E, S-faced rocks beneath the castle, 4.8.2003; Prachatice, Vitějovice, 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; Straňany, Doudleby, rocks on theright side of Malše river, 0.5km E from the village, 48°53'45"N, 14°30'40"E, gneiss rock, 1.2.2002; Vacov, Žár, the rock in the valley of the Spůlka river SE from the village, sunny base-rich silicate rock, 7.7.2001; Záblatí, Kratušín, locality Zábrdská skála rock, 1 km SE from the village, 49°00'50"A, 13°55'30"E, gneiss rock, 5.5.2002; Záblatí, Kratušín, locality Zábrdská skála rock, 1 km SE from the village, 49°00'50"A, 13°55'30"E, gneiss stones in the stony 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, bazaltic, 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, nearby the road, 4.1.2003; Sušice, Kašperské Hory, the Kašperk castle ruin, alt. 860 m, 6.5.1995, Z. Palice (herb. Z. Palice).

Northern Moravia. Jeseníky Mts., locality Velká kotlina, sunny, base-rich slate rock, SEE exp., 23.9.2002, Z. Palice (herb. Z. Palice).

Southern Moravia. Ivančice, Biskupky, 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 *Caloplaca caesiorufa*); Tišnov, Ostrov, in Libochovka river valley, alt. ca 420m, 1927, Suza (PRM, sub *Caloplaca caesiorufa*); Tišnov, Rojetín, in Libochovka river valley, alt. ca 420m, 1927, Suza (PRM, sub *Caloplaca caesiorufa*); Znojmo, rock above Dyje river, alt. 210m, granite, alt. 250m, 1929, Suza (PRM, sub *Caloplaca caesiorufa*); Znojmo, rock above Dyje river, alt. 210m, granite, with *C. subsoluta*, 2.5.1920, Suza (PRM 631124, in the collection of *C. subsoluta*).

Austria. Burgenland. Oberwart, Bernstein, 5.11.1978, M. et H. Mayrhofer (GZU, sub *C. scotoplaca*); Burgenland. Günser Gebirge, Oberwart, 12.7.1990, J. Poelt (GZU, sub *C. scotoplaca*); Burgenland. Mittelburgenland, Bernstein, 10.6.1977, J. Hafellner (GZU, sub *C. scotoplaca*); Burgenland. Südburgenland, Güssing, 1.7.1990, J. Hafellner, W. Maurer (GZU, sub *C. scotoplaca*); Kärnten, Klagenfurt, Weidmanusdorf, 28.7.1881, Arnold (W, sub *Blastenia caesiorufa*); Niederösterreich. Krems a.d. Donnau, 1894, Baumgartner (W, sub *C. caesiorufa*); Niederösterreich. Donautal, Krumnussbaum, 7.4.1982, H. Wittmann (GZU, sub *C. scotoplaca*); Niederösterreich. Umlaufberg der Thaya, Hardegg, Merkersdorf, 27.5.1978, J. Poelt (GZU, sub *C. scotoplaca*); Oberösterreich, Arnsdorf, in Danubee river valley, on gneiss, alt. 700m, ?, J. Baumgartner (W, Zahlbr.: Krypt. Ex., 250), Steiermark. Fischbacher Alpen, Buchberg, 6.11.1988, J. Poelt (GZU, sub *C. scotoplaca*); Steiermark. Gurktaler Alpen, Murau, alt. 1700m, 18.6.1978, J. Poelt (GZU); Steiermark. Mittleres Murtal, Kraubath, 3.6.1977, J. Hafellner (GZU, sub *C. scotoplaca*); Steiermark. Murberge, Lind, Scheifling, alt. 780-800m, 1.5.1994, W. Obermayer (GZU); Steiermark. Mürztaler Alpen, St. Michael, 13.5.1999, J. Hafellner (GZU); Steiermark. Neumarkt, Gasthof Vetterl, alt. 900m, 13.9.1987, W. Obermayer (GZU); Steiermark. Niedere Taurern, Wölzer Tauern, Planneralpe, alt. ca 1900m, 22.7.1985, J. Hafellner (GZU); Steiermark. Österrechisches Hügelland, Feldbach, Gleichenbergdorf, 2.8.1993. B. Wieser (GZU); Steiermark. Österrechisches Hügelland, Feldbach, Gleichenberger Kogeln, 12.3.1994, B. Wieser (GZU); Steiermark. Österrechisches Hügelland, Bad Radkersburg, 12.3.1994, B. Wieser, J. Hafellner (GZU, sub. C. scotoplaca); Steiermark. Sausal-Gebirge, Leibnitz, 18.12.1988, J. Poelt (GZU); Steiermark. Seetaler Alpen, Perchau, alt. 1140m, 20.3.1987, W. Obermayer (GZU); Steiermark. Steierisches Randgebirge, Stubalpe, Hirschegg, 8.10.1989, J. Poelt (GZU, sub *C. scotoplaca*); Steiermark. Voitsberg, Teigitschgraben, 2.2.1994, H. Mayrhofer, E. Unger.

Germany. Niederbayern, Bayerisch-Böhmischer Wald, above Donau river, 1.9.1971, J. Poelt (GZU).

Great Britain. Scotland. Mid-Perth, Drummond Park, north side of Drummond Pond, alt. 45m, 1978, B.J. Coppins (GZU).

Greenland. Angmagssalik, 6.7.1985, E.S. Hansen (GZU); West Greenland, Disko Island, Godhavn, 29.7.1982, J. Poelt, H. Ullrich (GZU); West Greenland, Disko Island, Qeqertarssuaq, alt. 400m, 1987, P. Jacobsen (GZU).

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

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

Pakistan. Northwestern Himálaya, Gilgit, Jutial, alt. ca 1900m, 20.7.1991, J. Poelt (GZU).

Slovakia. Krupina, Cerovo, ruin of the castle Čabrad' in Litava river valley, andesitic boulders under dry and hot conditions, 26.7.2003; Krupina, Cerovo, "Sokolí skála" rock near the castle Čabrad' in Litava river walley, sandstone of volcanic material, 26.7.2003; Štiavnické vrchy Mts., natur. preserve "Kamenné more", alt. 330/490m, 1.7.1993, I.Pišút, J. Poelt.

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

Sweden. Bohuslän, Valla, Tjörn, under overhanging rock, 29.6.1920, H. Magnusson (W, sub *C. caesiorufa*, with *C.* cf. *scotoplaca*); Stockholm, Liljcholmen, 10.1889, G.O. Malme (S); Stockholm, Liljchholmen, 5.5.1889, G.O. Malme (S); Västmanland, Arboga, Laduberget, on sunny rocks, 10.9.1951, G. Kjellmert (S); Torne Lappmark. Jukkasjärvi, Jebrenjokk, on slightly calcareous slate, alt. 400m, 1919, H. Magnusson (W, Magn.: Lich. Sel. Scand. Ex., 373); Västmanland, Arboga, Nyby, 15.9.1950, G. Kjellmert (S).

Ukraine. Vihorlat Mts., Onkovce u Užhorodu, alt. 180m, 1930, Nádvorník (PRM).

USA. Minnesota. Yoyageurs NP., Headlight Island in Kabetogama Lake, 7.6.1978, C.M. Wetmore (GZU); Minnesota. Sugar Loaf Preserve along shore of Lake Superior (10 mi SW of Tofte). Along hillside NE of house on rock outcrops and in black spruce and white birch. 11.7.1995, C.M. Wetmore (S).

4. *Caloplaca cirrochroa* (Ach.) Th. Fr., Lich. Scand.: 171. 1871.

Bas.: *Lecanora cirrochroa* Ach., Syn. Lich.: 181. 1814.
Type: Switzerland [Helvetia] (H-Ach. 1157D, lectotype)

Gasparina cirrochroa (Ach.) Stein

Calplaca cirrochroa var. *obliterans* (Nyl.) Servít, Zpr. Kom. Přírod. Prozk. Moravy, sect. bot., Brno 6: 1-83. 1910.

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. *Caloplaca obliterans* can be somewhat similar, when its marginal lobes are developed. Anyway, it differs in never pruinose thallus and in having yellow prothallus. *Caloplaca proteus* has small, orange-red and non-pruinose thallus, with orange soralia producing larger soredia (50-80μm in diameter). *Caloplaca decipiens* has somewhat broader lobes and poorly delimited soralia of the same colour as thallus.

References to taxonomy: Navaro-Rosines et Roux 1994, Purvis et al. 1992, Wade 1965, Wetmore et Kärnefelt 1998.

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: Caloplaca 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 pahorkatina" upland. Altitudinal maximum: 560m a. s. l., in Blanice river valley, near Lažiště (Southern Bohemia).

Specimens seen: **Central Bohemia.** Beroun, Srbsko, Císařská rokle gorge, on calcareous rock, alt. 250m, 2.12.2002, D. Svoboda (herb. D. Svoboda); Skryje, Týřovice, Čertova skála rock, 2 km A from the village, 49°59'50"N, 13°47'30"E, shaded foot of the base-rich silicate rock, 18.9.2001.
Southern Bohemia. Český Krumlov, protected area "Vyšenské kopce", 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 kopeček hill, 0.3 km east from the town, 48° 48'30"N, 16°39'05"E, shaded limestone rock, 24.2.2002.

Slovakia. Ilava, Červený Kámeň, limestone island hill above the village, vertical side of limestone, 20.7.2003; Martin, Kláštor p. Znievom, Mt. Zniev, alt. ca 980m, vertical side of limestone rock, 23.7.2003.

5. *Caloplaca citrina* (Hoffm.) Th. Fr., Lich. Arct. 118. 1860.

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

Caloplaca citrina f. *erosa* B. de Lesd., Reserch. Lich. Dunkerque 127.1910
Type: France. Nord, Dunquerque, dunes pré le Phare, 3 Sept. 1909, B. de Lesdain (US, isotype).
Caloplaca citrina var. *arcis* Poelt et Vězda, Lich. Sel. Ex.: 2470. 1991.
Type: Austria. Stiria. Feldbach, Riegersburg, alt. 400m,andesitic rock, 22.9.1990, Kantvilas, Mayrhofer, Vězda (W, isotypus!).

Lecanora flavocitrina Nyl., Flora. 69: 461. 1886.
Type: „Anglia occidentali prope Staveley (Martindale)."Feb. 1886. J A M(artindale) (H- Nyl, 29196, holotype).
Caloplaca flavocitrina (Nyl.) Oliv., Mem. Soc. Nat. Sci. Nat. Cherbourg 37: 110. 1909.

Parmelia phlogina Ach., Meth. Lich. 180. 1803. (Syn.: *Lecanora phlogina* (Ach.) Nyl., Acta Soc. Linn. Bordeaux 21: 324. 1857.; *Caloplaca phlogina* (Ach.) Flagey, Mem. Soc. d´Emulat. Doubs 250. 1886.).

Diagnosis: Thallus yellow-green, yellow, yellow-orange to orange, very variable, areolate with thick convex areoles (type *flavocitrina*), crustose continual 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 *flavocitrina* 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 3-3.7 x 0.7µm in size.

Photographs and illustrations: Figs. 3.5A, 3.5B.

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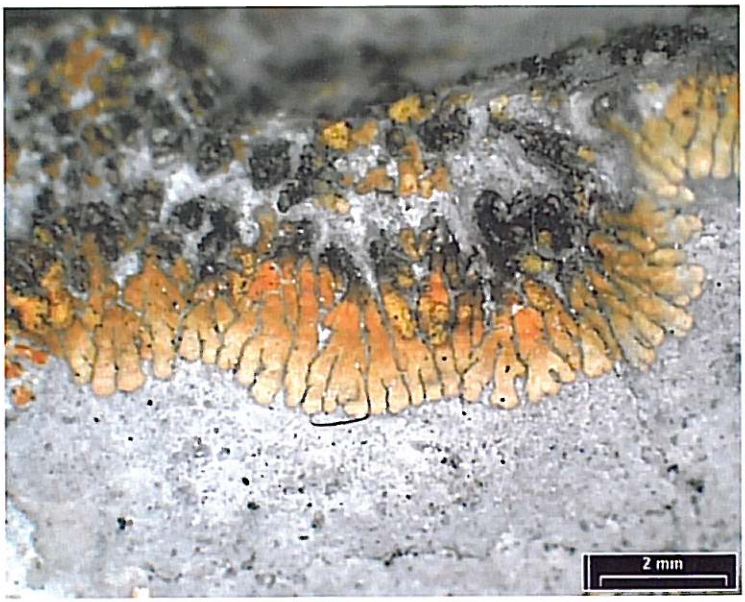

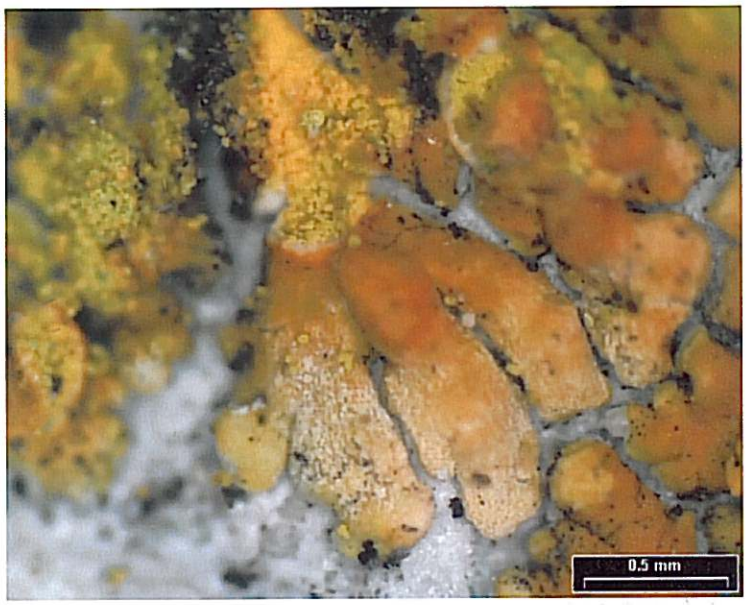

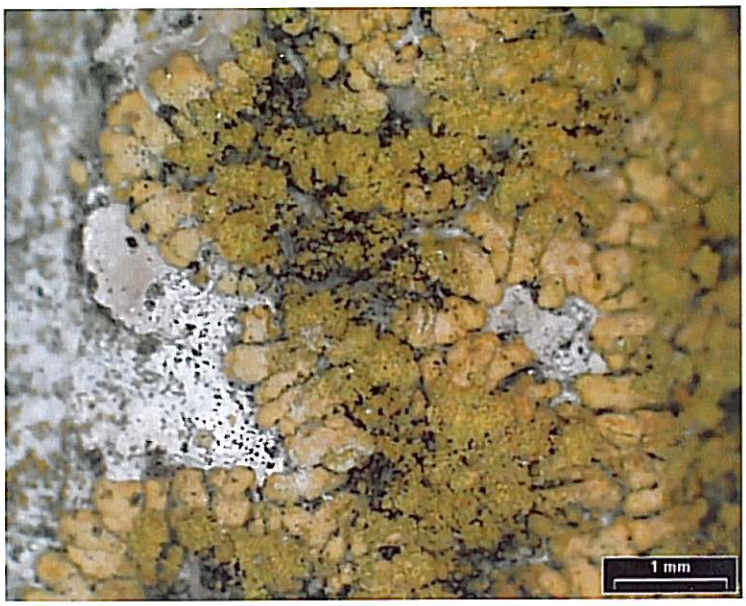

g. 3.4A. ***Caloplaca cirrochroa.*** A, Thallus
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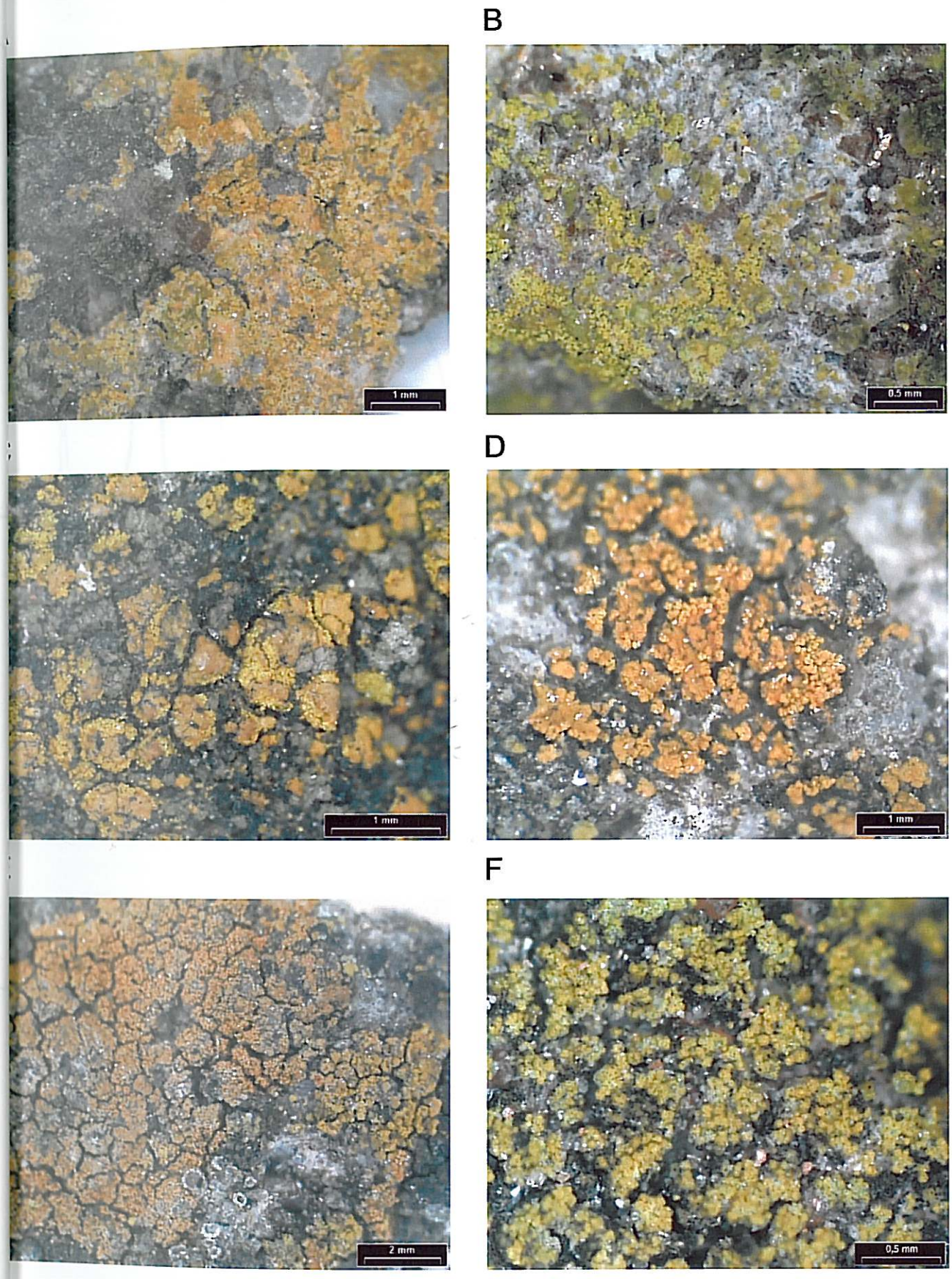

g. 3.5A. ***Caloplaca citrina.*** A, Thin thallus with scattered soralia; B, Thallus with distinct white prothallus; , Thick areoles with marginal soralia; D, Thallus splitted into large granular soredia; E, Two morphotypes of *citrina*, first with orange granular soredia (left), second with yellow fine soredia (right); F, Sorediate allus in detail.

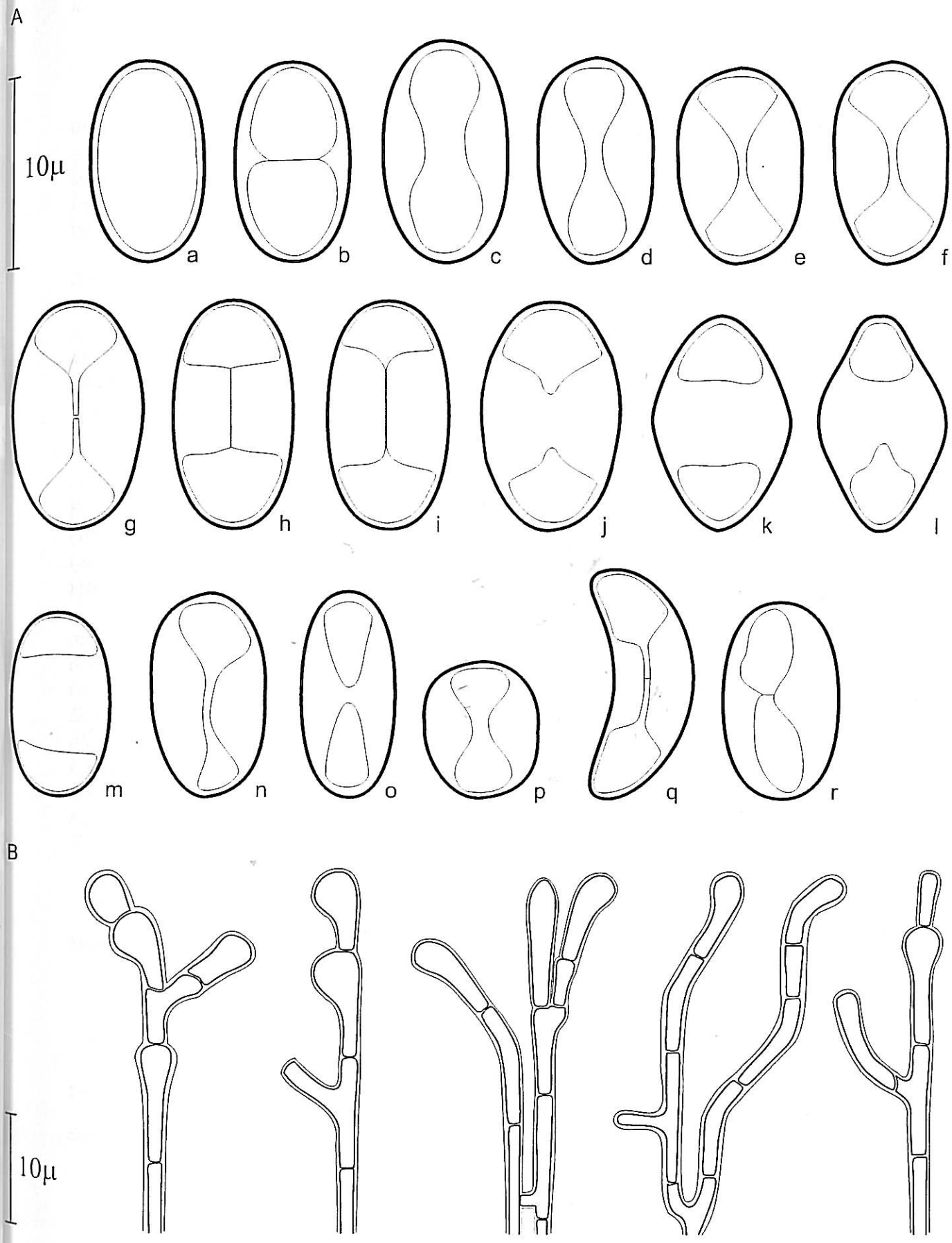

Fig. 3.5B. ***Caloplaca citrina***. A, ascospores (a-f, young spores; g-i, ripe spores; j-m, overripe spores; n-r, deformed spores); B, paraphyses tips.

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 sorales, 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).

References to taxonomy: Arup 2001, Purvis et al. 1992, Wade 1965, Wetmore 1993.

Ecology: Species inhabits plenty of substrata (rocks, wood and bark), but never occurring on acid rocks. Corticolous and lignicolous 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.

Associated lichen species: Aspicilia contorta, *A. cf. leprosescens*, *A. redescens*, *Caloplaca aurantia*, *C. chlorina*, *C. chrysodetha*, *C. crenulatella*, *C. cyrrochroa*, *C. decipiens*, *C. demissa*, *C. dolomiticola*, *C. flavescens*, *C. holocarpa*, *C. saxicola*, *C. subsoluta*, *C. teicholyta*, *C. xantholyta*, *C. xerica*, *Candelariella aurella*, *C. vitellina*, *Collema flaccidum*, *Dirina stenhammari*, *Diploicia canescens*, *Endocarpon pusillum*, *Lecania erisibe*, *Lecanora albescens*, *L. dispersa*, *L. garovaglii*, *L. hagenii* sensu Wirth 1995, *L. muralis*, *L. salina*, *Lecidella anomalloides*, *L. scabra*, *L. stigmatea*, *Lobothalia radiosa*, *Opegrapha calcarea*, *Phaeophyscia nigricans*, *P. orbicularis*, *Physcia caesia*, *P. dubia*, *Staurothele frustulenta*, *S. rufa*, *Verrucaria macrostoma*, *V. macrostoma* f. *furfuracea*, *V. muralis*, *V. nigrescens*, *Xanthoria elegans*, *X. fallax*.

Distribution: Common throughout the Czech Republic.

Specimens seen: **Central Bohemia.** Beroun, Křivoklát, Amalín, in the village, 50°02'10"N, 13°53'E, mortar, 23.3.2003; 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, Vechtrovka, calcareous rock, 25.4.2001, D. Svoboda (herb. D. Svoboda, sub C. chrysodeta); Beroun, Sedlec, in the valley of Kačák brook, on diabas, 6.1.2001, D. Svoboda (herb. D. Svoboda, sub C. chrysodeta); Rakovník, Skřivaň, 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, sulphate and carbonate layers, 16.9.2002.

Eastern Bohemia. Náchod, Česká Skalice, 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°55'50"N, 14°11'10"E , calcareous coat of the wall, 7.2.2002; České Budějovice, in the town, mortar on E-oriented wall, 9.4.2003; České Budějovice, Křemže, rocky outcrops S of the town, alt. 510m, 48°54'15"N, 14°18'40"E, on S-exp. serpentine outcrop, 8.11.2003; Český Krumlov, lookout tower on the top of Mt. Kleť, alt.: 1080 m, W exp., 48°52'N, 14°17'10"E , old mortar on the tower, 8.11.2003; Český Krumlov, Staré Dobrkovice, protected area "Kalamandra", approximately 1 km from the village, old wall built of the crystaline limestone and silicate stone, without concrete, 22.10.2001, M. Bartoš; Hluboká n. V., Purkarec, the ruin Karlův hrádek 2 km S from the village, 49°06'35"N, 14°27'45"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; Křemže, 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,

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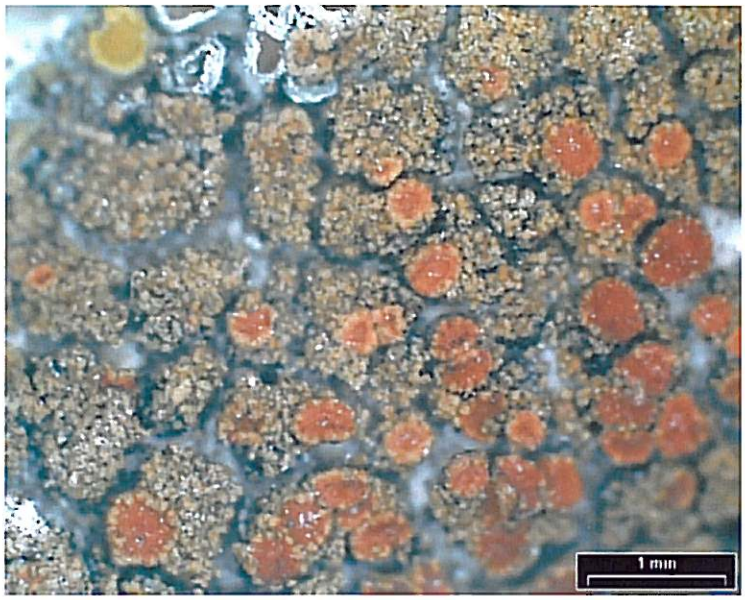

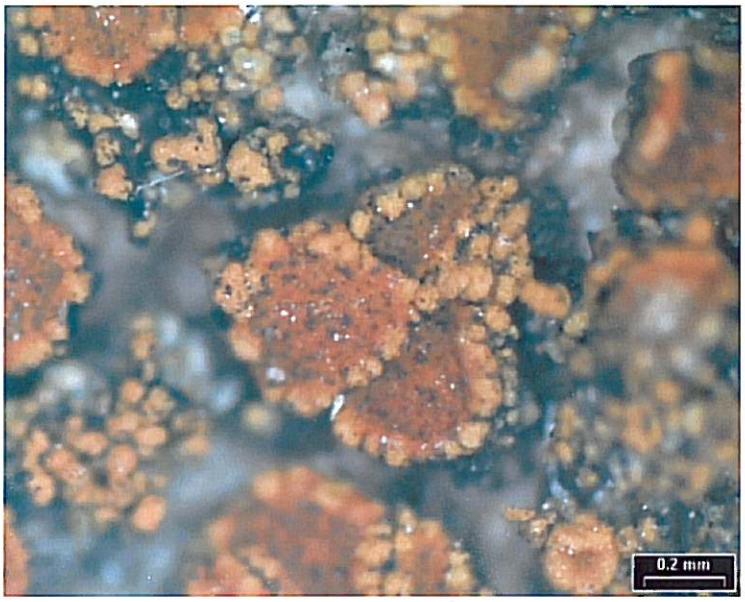

Fig. 3.6A. ***Caloplaca coronata.*** A, Thallus with apothecia; B, Apothecia in detail; C, Orange prothallus in detail.

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, "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, bark of *Acer platanoides*, 4.8.2003; Prachatice, Vitějovice, ruin of the castle "Osule", 1 km W of the village, alt. 640 m, 49°03'N, 14°04'E, base-rich gneisseous 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; Vimperk, Onšovice, near the "Spulka" river, alt. 590m, 49°06'10"N, 13°46'E, gneiss stones by the river, 11.6.2003; Záblatí, Kratušín, locality Zábrdská 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°58'E, concrete in basaltic wall, 21.3.2003; Radnice, Bohy, ruin of the castle Krašov in Berounka river valley, alt. 300 m, 49°57'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).

Northern Moravia. Jeseníky Mts., Vysoká hole Mt., Velký kotel corrie, "Němcův kámen" rock-face, alt. 1170-1180 m, schistose overhang, 10.6.2002, Z. Palice (herb. Palice 7015).

Southern Moravia. Kyjov, Milotice, 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).

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

6. *Caloplaca coronata* (Kremp. ex Körb.) J.Steiner, Verh. Zool. – Bot. Gesellsch. Wien 60: 71. 1919.

Bas.: *Callopisma 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 anthraqunon-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.

Hypothecium colourless. Hymenium 50-60μm high, asci 35-40 x 9-16μm in size. Hamathecium consisting of 1-2μm thick paraphyses, subapically branched and anastomosed. Paraphyses tips widened at tips to 5μm, 1-2 upper cells swollen. Ascospores ca 10-12 x 6μm in size. Apothecia C-, N-, K+ violet-red.

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 chatracteristic.

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 dolomiticola*, 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.

Specimens seen: **Central Bohemia.** Beroun, Srbsko, locality "Na závěrce", on calcareous rock, 2.5.2001, J. Kocourková, D. Svoboda (herb. D. Svoboda); Beroun, Kárlštejn, Velká hora hill, calcareous outcrops, alt. 400m, 1933, Suza (PRM); Beroun, Srbsko, Barrandova jeskyně cave, calcareous rock, 23.10.2002 (herb. D. Svoboda).

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, terciery soft limestone boulder, 23.2.2002; Pavlov, Klentnice, the locality "Soutěska" 2 km N from the villagePavlov, Klentnice, the locality "Soutěska" 2 km N from the village, limestone rock, 12.10.2001.

Slovakia. Ilava, Červený Kámeň, limestone island hill above the village, limestone, 20.7.2003; Nitra, Vršatec, "Vršatecká bradlá" island hills, limestone, 20.7.2003; Muráňská planina plateau: Mt. Kľak, S-slope, alt. 1250m, vertical calcareous rock, 11.5.1999, Guttová, Halda, Palice (herb. Palice, 2044).

7. *Caloplaca crenularia* (With.) J.R.Laundon, Lichenologist 16: 231. 1984.

Bas.: *Lichen crenularius* With., Arrang. Brit. Pl., ed. 3,4: 22 et 405. 1796.
Type: England. Isle of Wight, May 1794, Withering (BM, lectotype !)

Biatora ferruginea v. *festiva* Fr., Nov. Sched. crit.: 8. 1827. (Syn.: *Blastenia festiva* (Fr.) Mass., Monogr. Lich. blasteniosp.: 107. 1852.; *Lecanora ferruginea* v. *festiva* (Fr.) Nyl., Lich. Scand.: 143. 1861.; *Caloplaca ferruginea* v. *festiva* (Fr.) Th.Fr., Lich. Scand.: 183. 1871.; *Lecidea festiva* (Fr.) Hue, Nouv. Arch. Mus., Paris, ser. 5, 3: 169. 1913).

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

Lecidea Norrliniana Hue, Nouv. Arch. Mus., Paris, ser. 5, 3: 172. 1913.

Caloplaca Norrliniana (Hue) Zahlbr., Catal. Lich. 7: 160. 1931.

Diagnosis: Thallus gray to pale gray, crustose-areolate to crustose-rimose, variably thick. Black, fibrilous 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 colour 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 x 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 x 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 ellipsoid, 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). Corticolous *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.).

Specimens seen: **Northern Bohemia.** Krkonoše (Riesengebirge), "Malá sněžná rokle" glacial kettle, basaltic rock, alt. 1200-1300m, 1928, Suza (PRM).

Northern Moravia. Jeseníky Mts., Vysoká hole Mt., Velký kotel corrie, NE of community Karlov, alt. ca 1200m, on lime-enriched siliceous rock, 23.9.1994, Z. Palice (herb. Z. Palice); Jeseníky Mts., Vysoká hole Mt., Central part of Velký kotel corrie, a rock-face just above Šmarda wall, vertical phyllitic/schistose rock, alt. 1330-1340m, 10.6.2002, Z. Palice (herb. Z. Palice).

Germany. Oberbayern. Alpen, Eppau, locality "auf der Gleif", porphyrit rock, 4.1966, J. Poelt (GZU).

Great Britain. Scottland. Westerness; N side of Loch Sunart, 4-5 km W of Strontian, Woodland S of the road W of Woodend, alt. 0-40m, 14.6.1992, B. Coppins, P.W. James, J. Poelt (GZU).

Ireland. Co. Kerry, Kenmare, Quay (a point NNE of Cloonee village), rocks at SE coast of the bay "An Ribh?ar" [Kenmare river], 51°49'28"N, 9°44'24"W, alt. 3-5m a.s.l., 9.IX. 2003, J.Halda et Z.Palice (herb. Z. Palice).

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

8. *Caloplaca crenulatella* (Nyl.) Oliv., Mém. Soc. Sci. Nat. Cherbourg 37: 110. 1909.

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

Type: Great Britain. Kendal Staveley, Westmoreland, on calcareous rock, 2.1886, J.A. Martindale (H, Herb.-Nyl. No. 30215!).

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).

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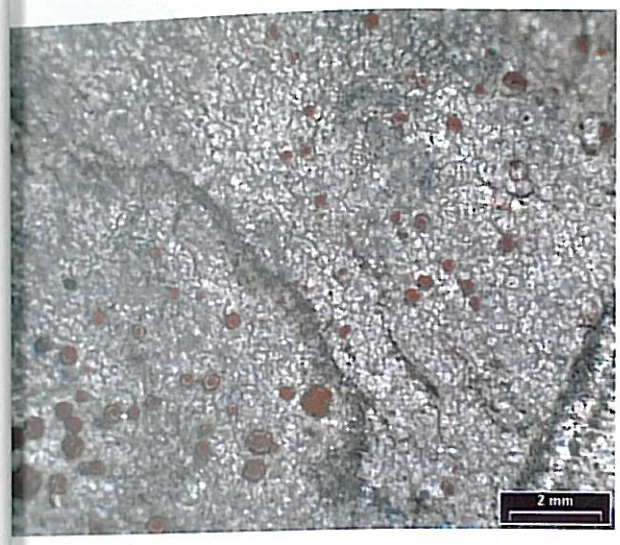

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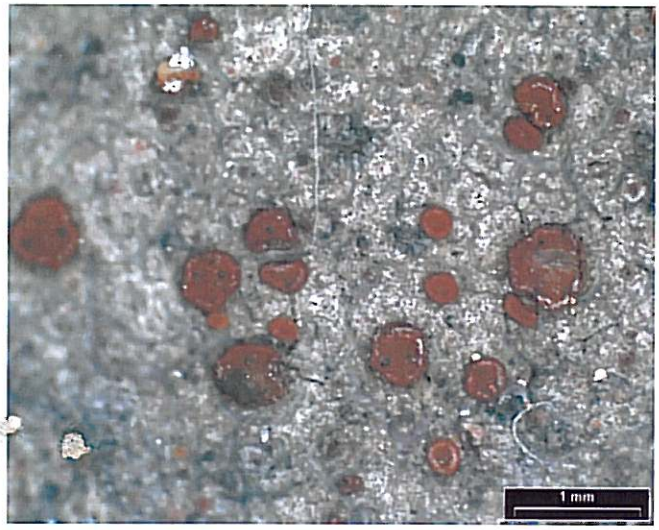

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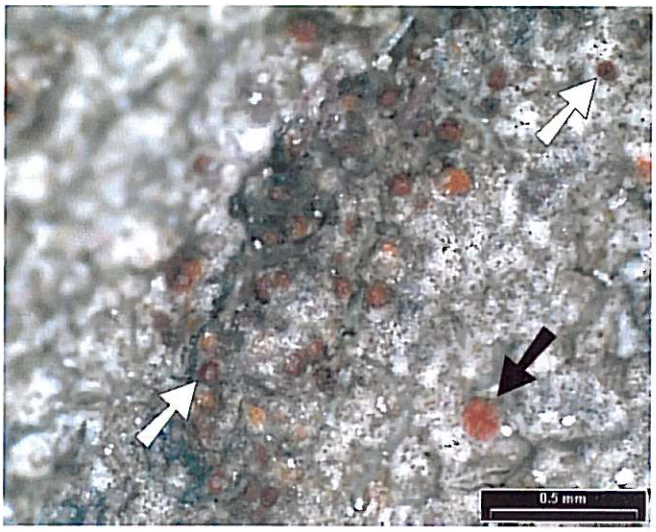


3.7A. ***Caloplaca crenularia.*** A, Thallus
apothecia; B, Apothecia in more detail;
Apothecium in detail with C+ violet-
oured excipulum; D, Red pycnidia (white
ows) and apothecial primordia (black
ow).

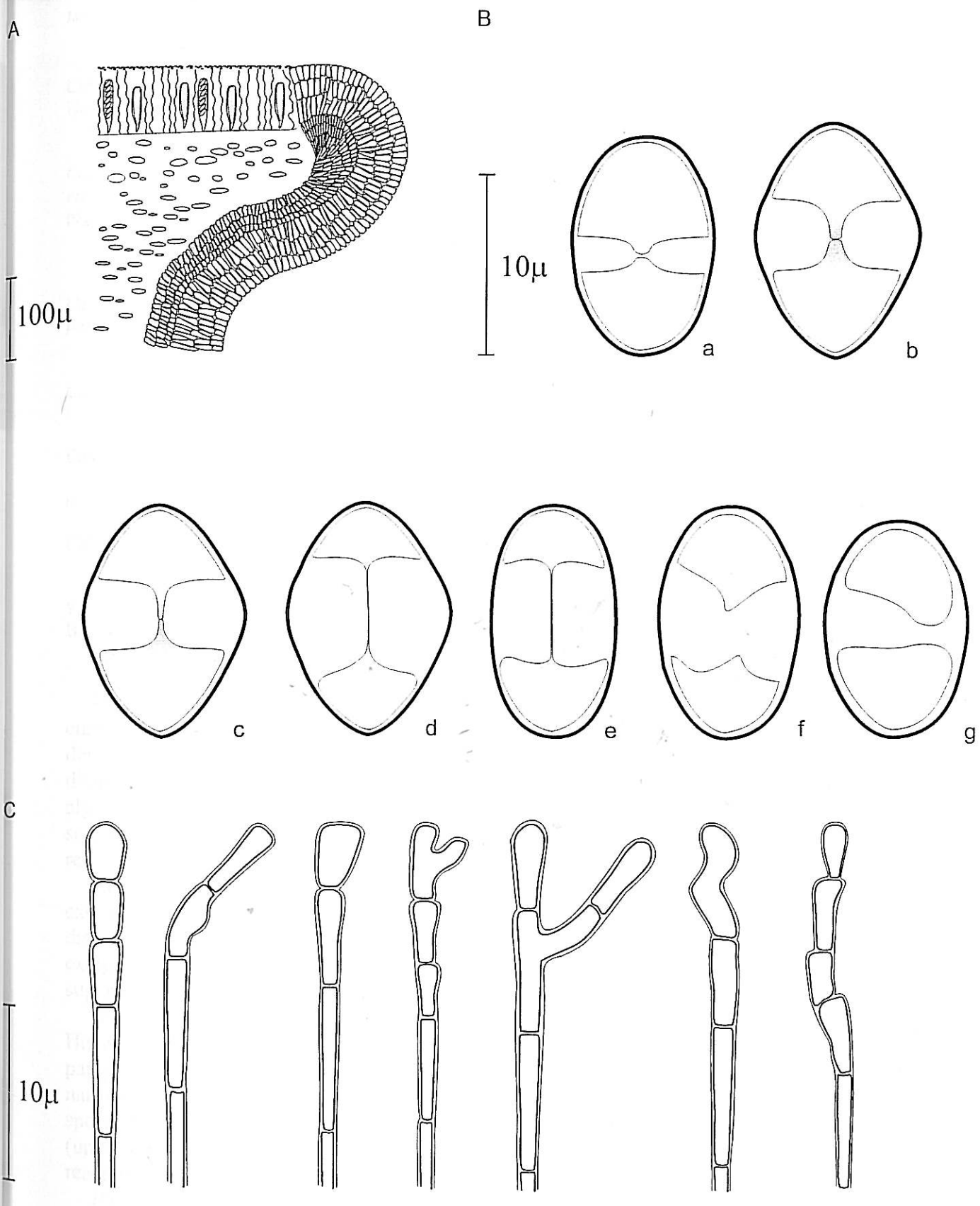


Fig. 3.7B. ***Caloplaca crenularia***. A, vertical section through an apothecium, showing absence of thaline excipulum and dark coloured layer (occasionally developed) surrounding hypothecium; B, ascospores (a, young spore; b-e, ripe spores; f, overripe spore; g, deformed spore); C, paraphyses tips.

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. Meurthe-et-Moselle, Pont-st-Vincent, 1888, J. Harmand (ANGUC).

Caloplaca lactea f. *ecrustacea* (Harm.) Zahlbr., Cat. Lichenogr. Univ. 7: 151. 1931. (Bas.: *Lecanora lactea* var. *erithrella* f. *ecrustacea*, Syn.: *Lecanora (Gyalolechia) lactea* f. *ecrustacea* (Harm.) Harm., Catal. Lich. Lorr., pag.: 275. 1894. and Lich. de France Crustacés, pag.: 862. 1913).
Type: France. Loir.-et-Cher, Bearegard, 27.9.1892, J. Harmand (ANGUC).

Caloplaca lactea f. *flavicunda* (Oliv.) Zahlbr., Cat. Lichenogr. Univ. 7: 151. 1931. (Bas.: *Caloplaca luteoalba* f. *flavicunda* Oliv., Flore Lich. Orne, 2: 141. 1884.
Type: France. Orne, Autheuil, mortar on walls, H. Olivier (H. Olivier, Lich. Exs. No. 228).

Caloplaca ferrarii var. *diabasicola* Servít et Černoh., Věstník Král. Čes. Spol. Nauk 2: 15. 1934.
Type: Bohemia centr., Loděnice, diabas, 1931, Z. Černohorský (PRM, 785536, herb. M. Servít!).

Caloplaca clauzadei B. de Lesd., Bull. Soc. Bot. France 102: 229. 1955.
Type: France, Haute-Loire, St.-Privat-d'Allier, 600m, 6.9.1954, G. Clauzade (MARSSJ, herb. B. de Lesd., holotypus).

Caloplaca prinii B. de Lesd., Bull. Soc. Bot. France 102, 229. 1955.
Type: France. Alpes-Maritimes, Biot, 5m, above basalt, 6.4.1954, R. Prin (MARSSJ, herb. B. de Lesd.).

? *Caloplaca ferrarii* (Bagl.) Jatta, Sylloge Lich. Ital.: 251. 1900.
Bas.: *Callopisma ferrarii* Bagl., Memmor. Accad. Scienc. Torino, ser. 2, 17: 406 and fig. 6. 1858.
Type: Italy. Liguria. Stazzano presso Serravalle, P. Ferrari (MOD?).

Diagnosis: Thallus yellow, indistinct or crustose-areolate, consisting of dispersed to clastered areoles (0.2-1.5mm in diameter), rarely subsquamulose, 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, asci 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 lenght, (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. ferrarii* 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. ferrarii* var. *pura* (W 15262!), 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. dolomiticola* 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.

References to taxonomy: Navarro-Rosines et Hladun 1996, Purvis et al. 1992.

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.

Associated lichen species: Aspicilia contorta, A. gibbosa, A. cf. leprosescens, A. redescens, Caloplaca citrina, C. decipiens, C. dolomiticola, C. holocarpa, C. subsoluta, C. teicholyta, C. xerica, Candelariella aurella, C. vitellina, Endocarpon pusillum, Lecania inundata, Lecanora dispersa, L. garovaglii, L. muralis, Lecania inundata, Lobothalia radiosa, Peltula euploca, Phaeophyscia nigricans, P. orbicularis, Staurothele frustulenta, S. rufa, Verrucaria nigrescens, Xanthoria elegans.

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 carsts, České středohoří Mts. and "Křivoklátská pahorkatina" upland).

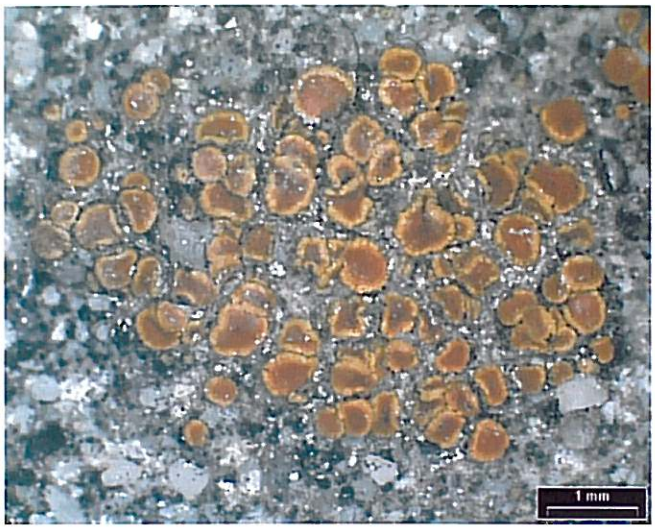
Specimens seen: **Central Bohemia.** Beroun, Homolák, calcareous rock, 1.8.2001, D. Svoboda (herb. D. Svoboda, sub Calplaca lactea); Beroun, Srbsko, locality "Císařská rokle", limestone rock, 13.11.2002, D. Svoboda (herb. D. Svoboda, sub Calplaca citrina); Beroun, Svatý Jan pod Skalou, basaltic rock, alt. 230m, 6.1.2001, D. Svoboda (herb. D. Svoboda, sub Caloplaca ferrari); Beroun, Roztoky u Křivoklátu, rocks "Na andělu", 1 km SW of the village, WSW exp., alt. 250m, 50°01'10"N, 13°51'40"E, horizontal concrete plate on the wall beneath the 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), with Staurothele frustulenta, 11.9.2003; Beroun, Křivoklát, Amalín, in the village, 50°02'10"N, 13°53'E, concrete, 23.3.2003; Hořovice, Točník, in the village, 340m, 49°53'20"N, 13°53'10"E, horizontal plate of concrete, 31.5.2003; 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, alcalic rock, 6.12.2002; Praha, Nová Ves, "Prokopské údolí" valley, calcareous rock, 15.9.1999, D. Svoboda (herb. D. Svoboda, sub Caloplaca holocarpa); Praha - Měcholupy, Křeslice, concrete, 14.4.1996, B. Gruna et Z. Palice (herb. Z. Palice); Příbram, Jince, in the village, asphalt in the pathway, 31.5.2003; Rakovník, Kalubice, in the village, alt. 370m, 50°03'N, 13°49'40"E, mortar, 12.9.2003.

Northern Bohemia. Bakov n. Jizerou, railway station, alt. 220 m., 50°28'30"N, 14°25'30"E, concrete, 23.4.2003; Bakov n. Jizerou, railway station, alt. 220 m., 50°28'30"N, 14°25'30"E, calcareous sandstone rock, SE exp., 23.4.2003; 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, 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 walls, 1.4.2003; České Budějovice, Křemže, rocky outcrops S of the town, alt. 510m, 48°54'15"N, 14°18'40"E, on S-exp. 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, "Nerestský lom" quarry, 49°30'30"N, 14°04'E, limestone rock, 26.8.2003; Písek, Protivín, Čačárky, 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,

A

B



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D

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.

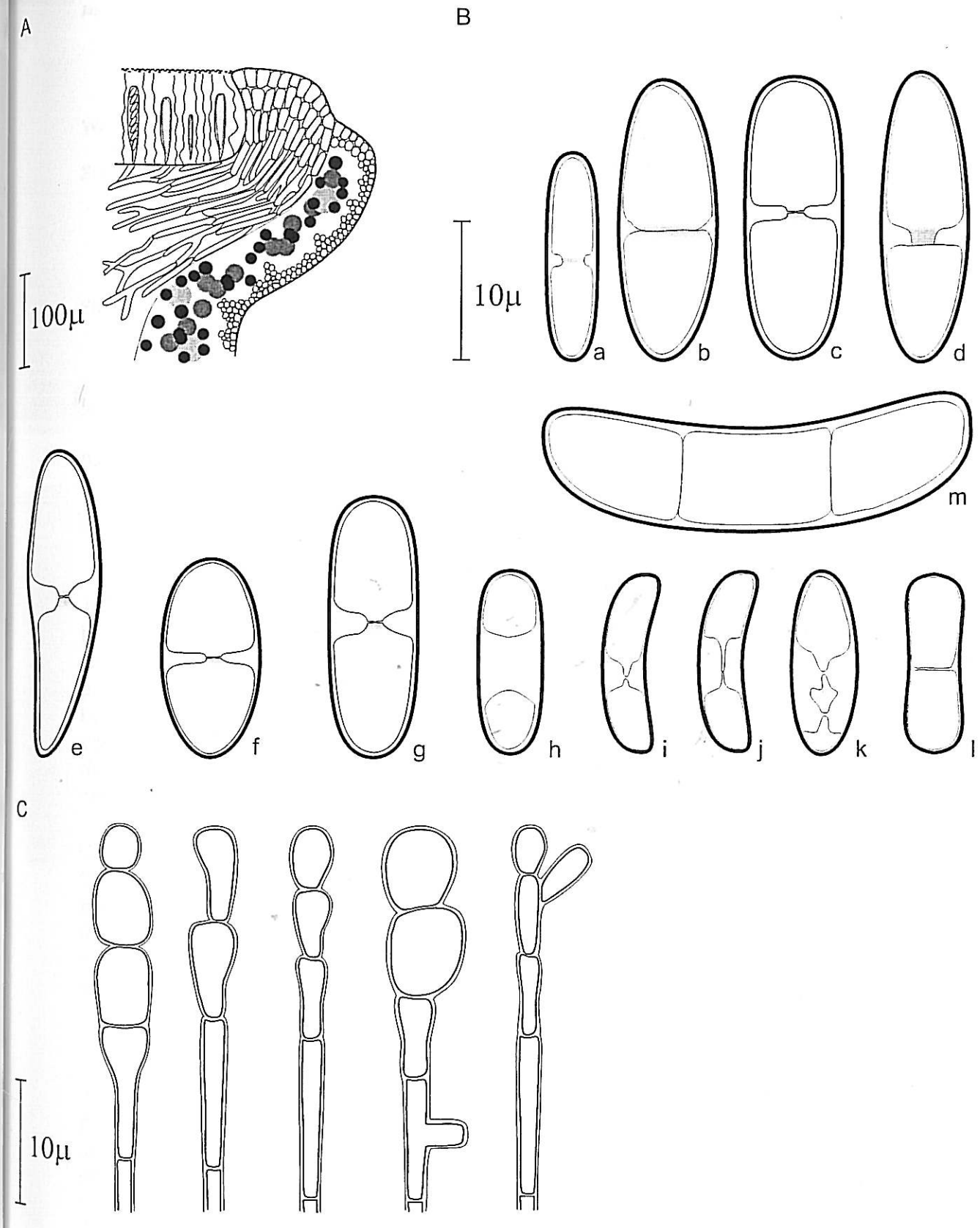


Fig. 3.8B. ***Caloplaca crenulatella***. A, vertical section through a typical apothecium, showing thalline excipulum which formes yellow-coloured "collar" around orange true excipulum ; B, ascospores (a,b, young spores; c-g, ripe spores; h, overripe spore; i-m, deformed spores); C, paraphyses tips.

14°11'40"E, on the walls of a castle, 4.8.2003; Vodňany, Číčenice, on the reilway 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, terciery 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; Kyjov, 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.

Slovakia. Krupina, Cerovo, ruin of the castle Čabraď in Litava river valley, andesitic conglomerates, 26.7.2003; Žilina, Súlov, "Súlovské skaly" rocks, calcareous conglomerates, 21.7.2003.

9. *Caloplaca decipiens* (Arnold) Blomb. et Forss., Points Förtecking 69. 1880.

Bas. *Physcia decipiens* Arnold, Flora 50: 562. 1867.
Type: Germany. Bayern. Eichstätt, auf Dachplatten-Schiefen 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-plctenchymatous 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. Hamathecium 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 subtile 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.

References to taxonomy: Purvis et al. 1992, Wade 1965, Wetmore 1998.

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).

Associated lichen species: Aspicilia contorta, A. cf. *leprosescens, Buellia alboatra, Caloplaca albolutescens, C. citrina, C. dolomiticola, C. holocarpa, C. saxicola, C. teicholyta, C. xerica, Candelariella aurella, C. medians, Endocarpon pusillum, Lecanora albescens, L. crenulata, L. dispersa, L. garovaglii, L. muralis, Lobothalia radiosa, Phaeophyscia nigricans, P. orbicularis, Rinodina gennari, Sarcogyne regularis, Staurothele frustulenta, S. rufa, Verrucaria macrostoma, V. macrostoma* f. *furfuracea, V. nigrescens, V. ochrostoma, Xanthoria elegans, X. papillifera.*

Distribution: Common throughout the Czech Republic.

Specimens seen: **Central Bohemia.** Beroun, Křivoklát, 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 "Hradiště" 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, 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 castle, 17.9.2001.

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; 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. 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.

Southern Moravia. Mikulov, chatteau on the hill in the town, 48°48'30"N, 16°38'20"E, concrete and south facing limestone rock, 24.2.2002.

Slovakia. Slovenský kras carst, "Plešivecká planina" flat, alt. ca 600m, 29.10.2002, D. Svoboda (herb. Svoboda).

10. *Caloplaca demissa* (Körb.) Arup et Brube, Lichenologist 31(5): 428. 1999.

Placodium demissum Körb. ex Flotow, Parerga lichenologica. p. 55. 1859.
Type: Germany. Lorch, Exs. Zw. L. 187 (UPS, lectotype selected by Arup et Grube, 1999).

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

? *Parmelia dendritica* var. *incusa* Flotow 1839.; *Lecanora incusa* (Flotow.) Wainio Természetr. Füzetek, XXII, 1899: 286.

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 ascocarps 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).

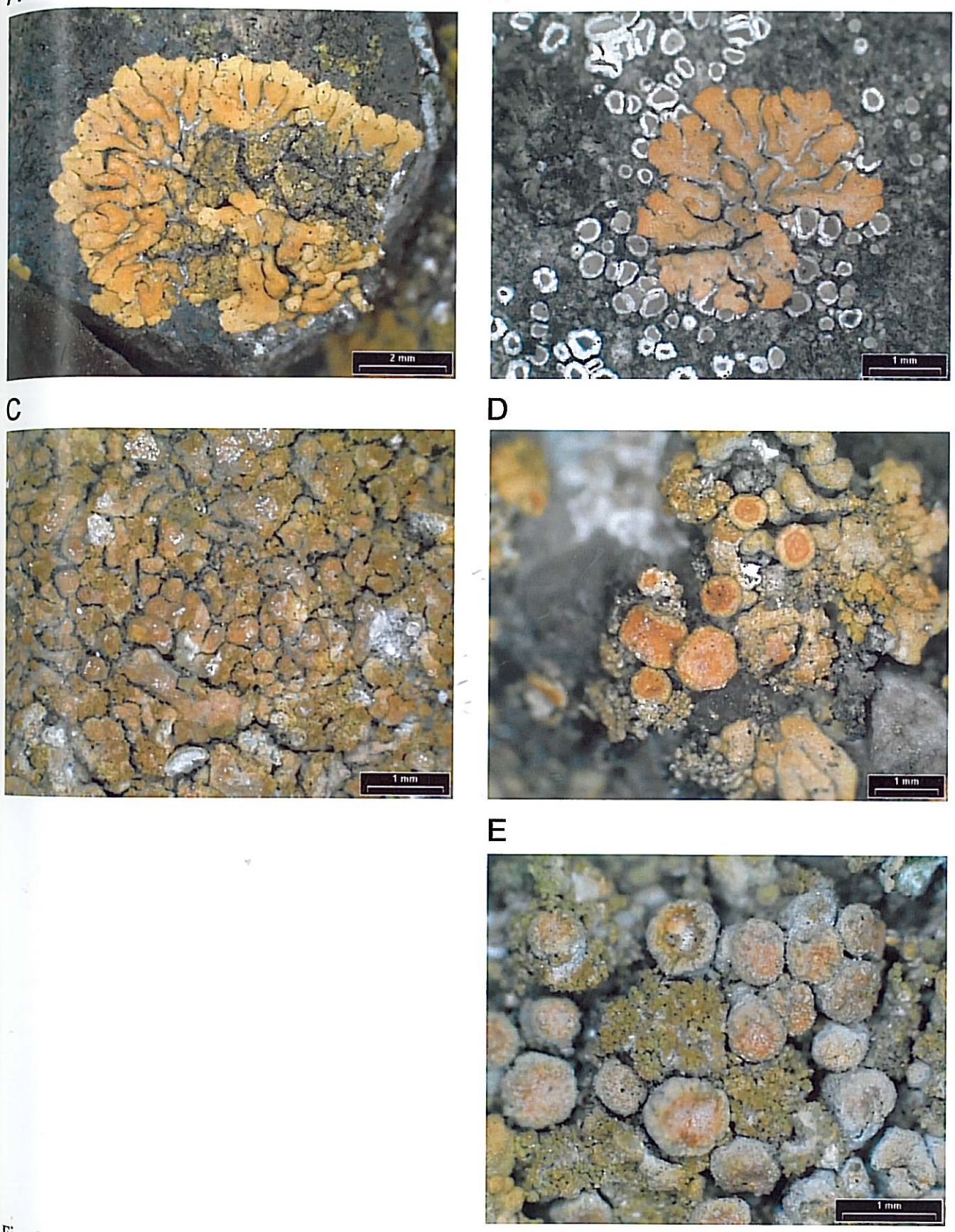


Fig. 3.9A. ***Caloplaca decipiens.*** A, Thallus with soralia in central part; B, Young thallus so far without soralia; C, Central part of older thallus; D, Apothecia; E, Apothecial primordia and young apothecia..

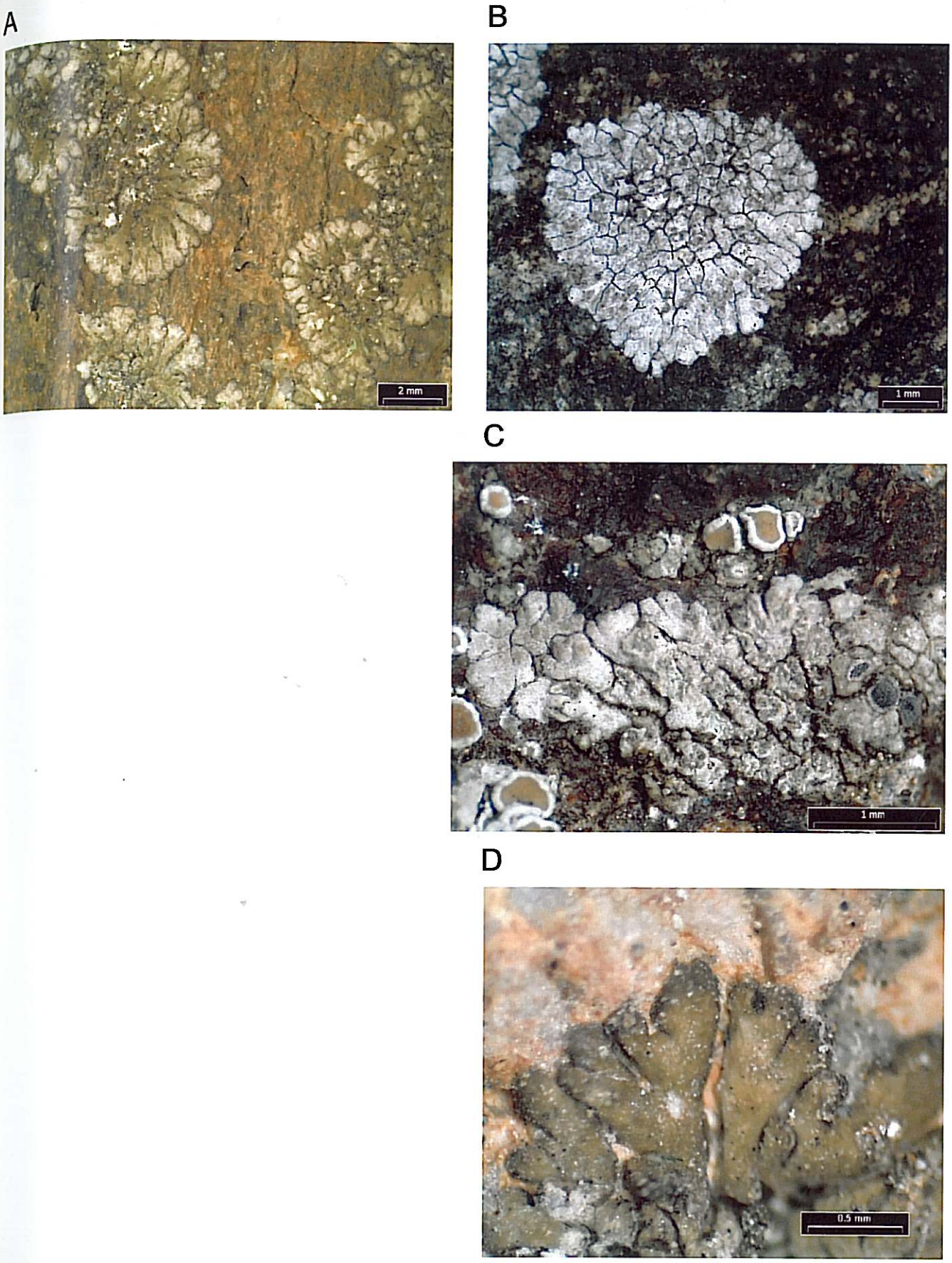


Fig. 3.10A. ***Caloplaca demissa.*** A, Non-pruinose thallus; B, Greyish thallus with pruina; C, Thallus with apothecia of *Buellia alboatra*; D, Thalline lobes in detail.

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 (eg. 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 dispersa, Lecidella anomaloides, L. stigmatea, L. viridans, Phaeophyscia nigricans, Ph. orbicularis, Physcia dimidiata, Ph. dubia, Rinodina 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. subsoluta*, 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 Bitýška, Dyje, Jevišovka, Jihlava, Loučka, Oslava, Rokytná, Svitava, Svratka and Želetavka), river valleys in Central Bohemia (rivers Berounka, Lužnice, Otava, Sázava, Vltava and more isolated localities on rivers Blanice, Chrudimka, Litávka, 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 Žebrák). Altitudinal maximum: 700m a. s. l. on Andělská hora hill in Doupovské hory Mts. (Western Bohemia).

Distribution maps: Suza 1942, 1947, Vondrák 2003.

Specimens seen: **Central Bohemia.** Beroun, Roztoky 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; 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 rock beneath the castle, 10.5.2003; Křivoklát, 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 "Litávka" river, E exp., alt. 390m, 49°49'N, 13°58'E, overhangs and vertical plates of alight schist rock, 13.6.2003; Rakovník, Skřiváň, 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,

Associated lichen species: Aspicilia contorta, A. calcarea, Buellia alboatra, Caloplaca albolutescens, C. citrina, C. coronata, C. crenulatella, C. decipiens, C. holocarpa, C. subsoluta, C. teicholyta, C. variabilis, C. xerica, Candelariella aurella, C. vitellina, Catapyrenium cinereum, Lecania erysibe, L. inundata, Lecanora dispersa, L. muralis, L. salina, Lobothalia radiosa, Peltula euploca, Phaeophyscia nigricans, P. orbicularis, Placynthium nigrum, Staurothele frustulenta, S. rufa, Verrucaria cf. *calciseda, C. nigrescens, Xanthoria elegans.*

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.).

Specimens seen: **Central Bohemia.** Beroun, in Berounka river valley, margin of old quarry, on carbonate stone, 19.1.2003, D. Svoboda (herb. D. Svoboda, no. 483, sub *C. irrubescens*); Beroun, Hostím, beneath the hill Hradiště, on weathered carbonate stone, alt. 290m, D. Svoboda (herb. D. Svoboda, no. 485, sub *C. irrubescens*); Beroun, Křivoklát, in the village near the castle, 50°02'10"N, 13°52'30"E, bricks in the old wall, 23.3.2003; Beroun, Srbsko, Barrandova jeskyně cave, calcareous rock, 23.10.2002, D. Svoboda (herb. D. Svoboda); Beroun, Srbsko, Barrandova jeskyně cave, calcareous rock, 23.10.2002, D. Svoboda (herb. D. Svoboda, sub *Caloplaca ruderum*); Beroun, Srbsko, Barrandova jeskyně cave, calcareous rock, 23.10.2002, D. Svoboda (herb. D. Svoboda, sub *Caloplaca flavovirescens*); Beroun, Srbsko, in the valley of Kačák brook, alt. 250m, on E-oriented calcareous rock, 13.10.2000, D. Svoboda (herb. D. Svoboda, sub *Caloplaca flavovirescens*); Beroun, Srbsko, locality "Na Závěrce", calcareous stone, 1.4.2001, D. Svoboda (herb. D. Svoboda); Beroun, Srbsko, locality "Na Závěrce", calcareous stone, 13.10.2000, D. Svoboda (herb. D. Svoboda, sub *C. flavovirescens*); Hořovice, Točník, ruin of the castle Točník, 1 km NE of the village, alt. 430 m, 49°53'30"N, 13°53'30"E, concrete at the base of the castle, well-lit, S-oriented slope, 10.5.2003; Praha, Modřany, 1921, Hilitzer (PRM 697169, sub. *C. flavovirescens*); Praha, Velká Chuchle, limestones above the village, 3.9.1919, ?Fejzka et Mayer (PRM 696855).

Northern Moravia. Nový Jičín, Štramberk, the hill "Kotouč", alt. 400m, calcareous rock, 1920, Suza (PRM 580887, sub *Caloplaca aurantiaca* var. *diffracta*).

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 Svatý kopeček 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 580894, sub *C. placida*).

France. Vaucluse. Saignon, alt. 500m, 24.4.1965, Clauzade, Lambinon, Vězda (W, Vězda: Lich. Sel. Ex., 424).

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

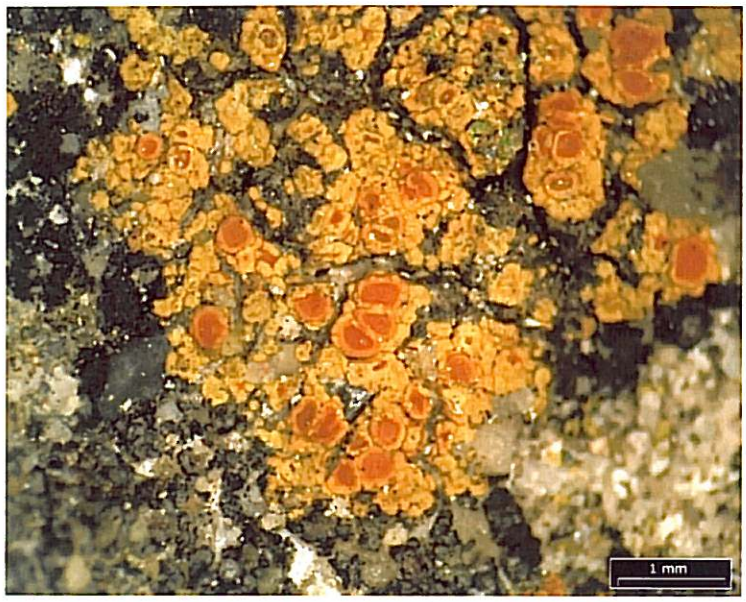
Hungaria. Fiume, calcareous rock, col. J. Schuler (A. Zahlbr., Kryptogamae exsiccatae, no. 2369, sub *C. placida* var. *difracta*); Pest, Kistétény, calcareous rock, alt. 220m, 1914, G. Timkó (Flora Hung. Exs., no. 720, sub *Caloplaca flavovirescens*).

Italy. Südtirol, Dolomiten Mts., Passo di Rolle, S-facing calcareous rock, alt. 2000-2200m, 23.10.1976, J. Hafellner (GZU).

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

Slovakia. Ilava, Červený Kámeň, limestone island hill above the village, limestone, 20.7.2003; Malá Fatra mts., Rájec, Fačkovo, mt. Klak, alt. 1350m, limestone, with Caloplaca variabilis, 22.7.2003; Považská Bystrica, Manínská tiesňava gorge, S-faced limestone rock, 19.8.1986, Poelt (GZU 68-86), Mayrhofer (GZU 68-86); Nitra, Tríbeč Mts., S-exposed steppe slope on Mt. Zobor, limestone, 30.6.1993, Pišút, Poelt (GZU); Vysoké Tatry Mts., Belanské Tatry Mts., Bujačí, calcareous rock, alt. 1800-1850m, 15.8.1958, A. Vězda (Vězda: Lich. Bohem. Exs. 232); Žilina, Súlov, "Súlovské skaly" rocks, calcareous conglomerates, 21.7.2003; Žilina, Súlov, "Súlovské skaly" rocks, calcareous conglomerates N of the village Súlov, 19.4.1986, Hafellner (GZU).

A



B

C

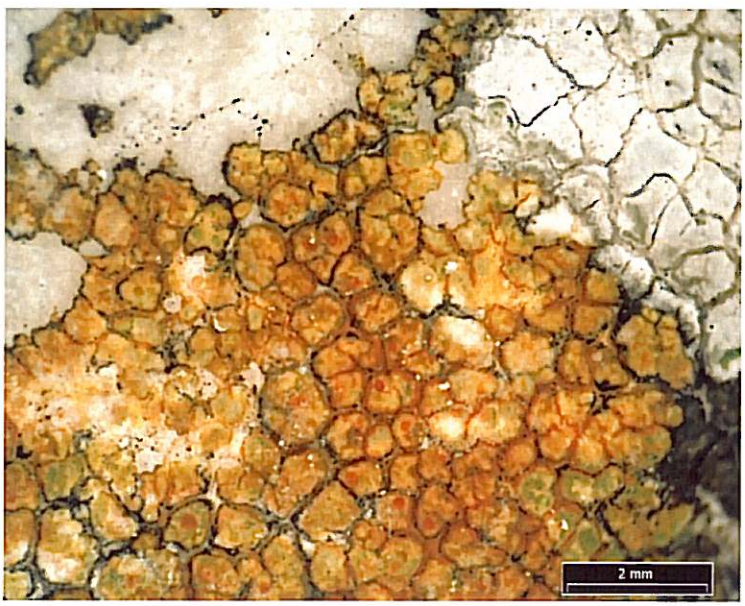


Fig. 3.11A. ***Caloplaca dolomiticola.*** A, Thallus with apothecia; B, Areolate thallus, only young apothecia present; C, Thallus affected by grazing of snails, only apothecial primordia present.

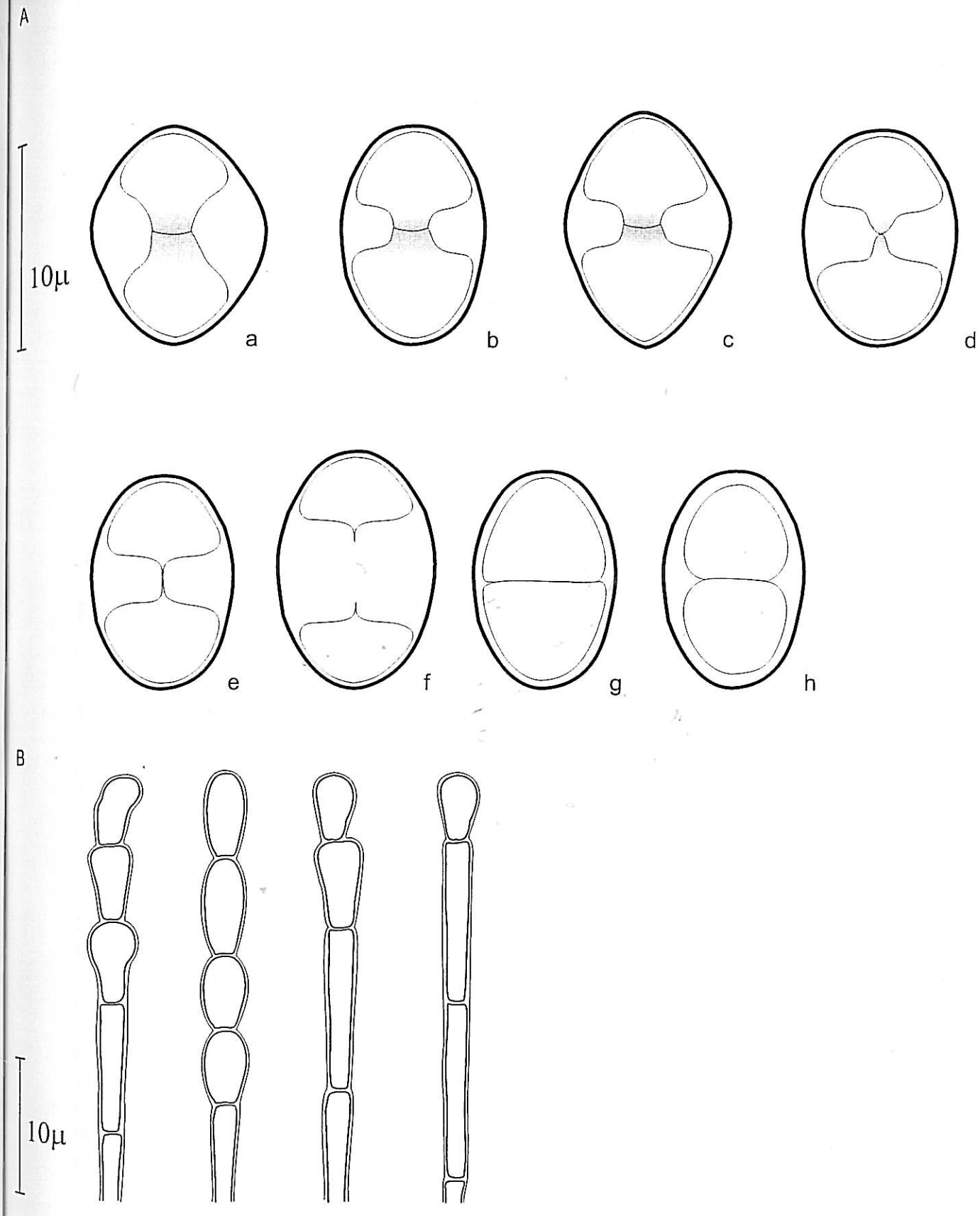


Fig. 3.11B. ***Caloplaca dolomiticola***. A, ascospores (a-e, ripe spores; f, overripe spore; g,h, deformed spores); B, paraphyses tips.

12. *Caloplaca flavovirescens* (Wulf.) Della Torre et Sarnth., Flecht. Tirol: 180. 1902.

Bas.: *Lichen flavovirescens* Wulf., Schriften Ges. Naturf. Freunde Berlin 8: 122. 1787. (Syn.: *Callopisma aurantiaca* var. *flavovirescens* (Wulf.) A. Massal.; *Caloplaca aurantiaca* var. *flavovirescens* (Wulf.) Th. Fr., Nova Acta R. Soc. Sc. Upsal. ser 3 3: 219. 1861.).

? *Lecanora erythrella* (Ach.) Kieff. (Syn.: *Caloplaca 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)µm thick. Consisting of para-plectenchymatous tissue, with cells 3-6µm in diameter. Epinecral layer +/- continual, maximally 15µm thick. Algal layer continuous or discontinuous, para-plectenchymatous. Fungal cells 3-5(-7)µm, algal cells 6-15µm in diameter.

Apothecia 0.2-1.1mm 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, 3-6µm thick. Outer cells becoming rather isodiametric (distinct after KOH aplication), 3-6µm in diameter. True excipulum partially reduced in old apothecia. Thaline excipulum orange, covered by 10-30µm 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 55-90µm high, asci 40-70 x 12-16µm in size. Hamathecium consisting of 1.5-2µm thick paraphyses, rarely or often branched and anastomosed. Paraphyses tips swollen to 4.5µm, 1-4 upper cells broadened. Ascospores 12-17(-18) x 6-8(-10)µm. Septum of ripe spores 4-5µm, 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 *Caloplaca flavovirescens* 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 3mm in diameter).

Caloplaca dolomiticola differs mostly in thallus colour. Other distinctive characters are typically oily hypothecium, para-plectenchymatous true excipulum, hymenium with yellow-orange crystals (anthraquinon 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 decalcificated 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 (Maškovec), 2 km W of the village, S exp., alt. 420-440 m, 48°54'05"N, 14°24'20"E, base-enriched gneisseous rock, 17.11.2002; Písek, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26'20"N, 14°11'40"E, horizontal side of concrete wall, 4.8.2003.

Austria. Tirol. Hohe Tauern, Gruben, Stein, near the remote buildings "Sudettendeutsche Hütten", alt. 1800m, schist, 31.7.1988, Horáková, Vězda (Vězda: Lich. Sel. Exs. 2294).
France. Bosses-Alpes, Limans, near Moulin de Pagnon, sandstone stones in steppose slope, alt. 600m, 18.4.1965, Clauzade, Lambinon, Vězda (Vězda: Lich. Sel. Exs. 373).
Poland. Polish Western Beskids. Beskid Niski Mts., Rymanov, Wisloczek, alt. 525m, horizontal-face of sandstone ground plates of burnt house on sunny N-facing slope above streem, 27.10.1974, J. Nowak (Nowak: Lich. Pol. Mer. exs., no. 196).
Slovakia. Ilava, Červený Kámeň, limestone island hill above the village, shaded limestone boulders near the river, 20.7.2003; Muránská planina plateau, Mt. Cigánka, xero-thermic SSE-SE slope, on half-shaded limestone rock, 15.5.2002, Guttová, Halda, Palice (Herb. Z. Palice, no. 6115); Vysoké Tatry Mts., Belanské Tatry Mts., "Holubiho dolina" valley, calcareous rock, alt. 1500m, 25.8.1958, A. Vězda (Vězda: Lich. Bohem. Exs. 233).

13. *Caloplaca grimmiae* (Nyl.) H. Olivier, Mém. Soc. Sc. Nat. Cherbourg 37: 119. 1909.

Bas.: *Lecanora grimmiae* Nyl., Flora 69: 97. 1886.
Type: Caucas, Arau Kosch in valle Baksan, 1885, Lojka (H-Nyl. 30079, holotype).

Caloplaca congrediens (Nyl.) Zahlbr., Cat. Lich. 7: 110. 1931.
Bas.: *Lecanora congrediens* Nyl., Flora (Regensburg) 66: 100. 1883.

Caloplaca consociata J. Steiner, Sitzber. Akad. Wiss. Wien 62: 127. 1898.
Type: Yugoslavia. Serbia. Rtanj-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. Para-plectenchymatous 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 apicaly 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.

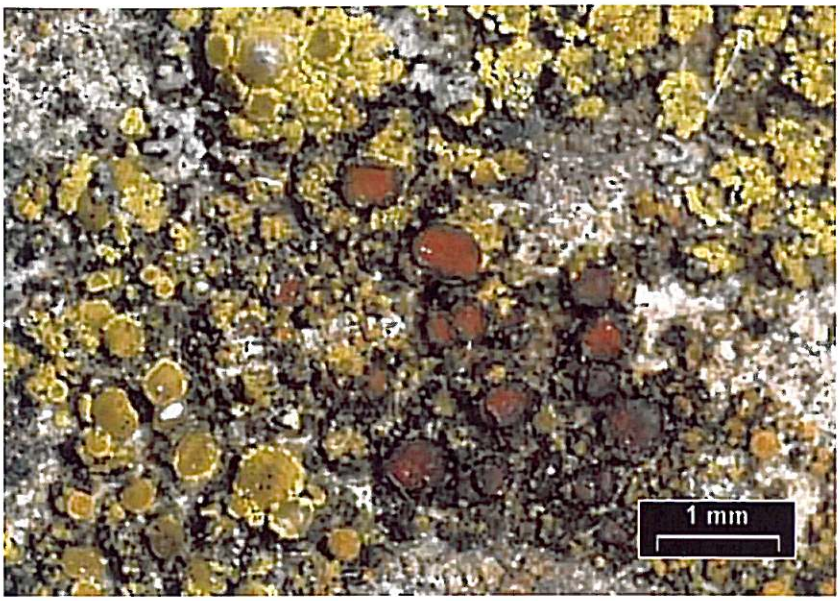
A

B

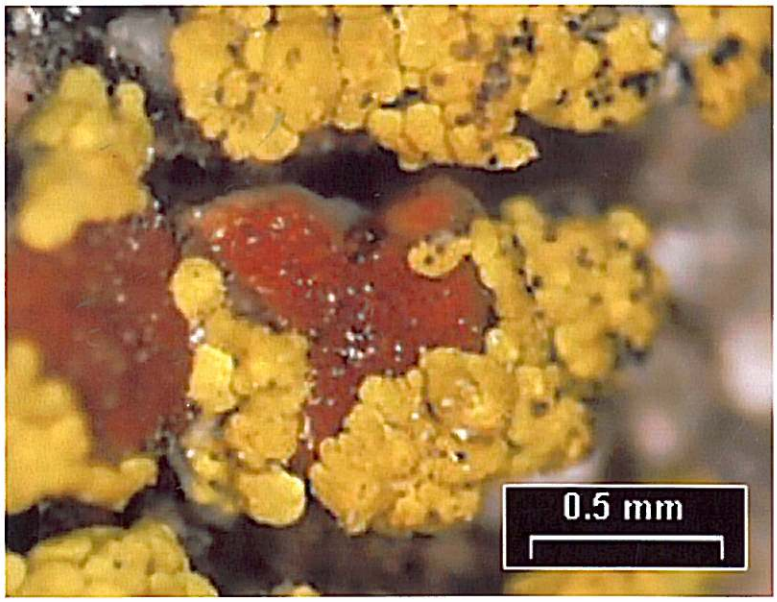
C

Fig. 3.12A. ***Caloplaca flavovirescens.*** A, Yellowish thallus with apothecia; B, Thallus in detail; C, Greyish thallus, almost without yellow tinge.

A



B



C

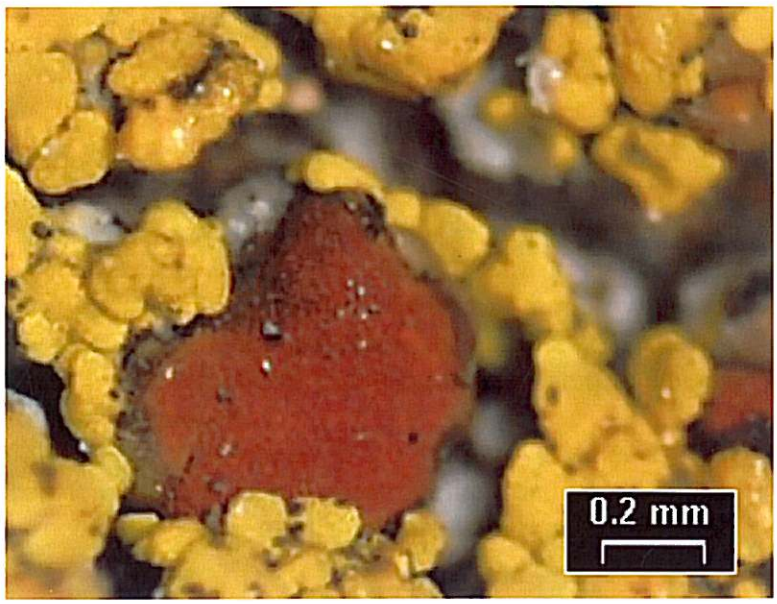


Fig. 3.13A. ***Caloplaca grimmiae.*** A, Thallus indistinct, parasitic on *Candelariella vitellina*; B, Apothecium overgrown by *C. vitellina* lobes; C, Apothecium in detail.

Caloplaca vitellinaria is also parasite on *C. vitellinulla*, but it has completely different appearence, 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.

Associated lichen species: Aspicilia caesio-cinerea, A. contorta, Candelariella vitellina, Lecanora garovaglii, L. muralis, Parmelia conspersa, P. pulla, P. somlöensis, Physcia dubia.

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, Jihlava, Oslava and Rokytná), 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.

Specimens seen: **Central Bohemia.** Central Bohemia, Praha-Radotín, diabas, 19.9.1920, Hilitzer (PRM 697288, in collection of *C. subsoluta*).

Southern Moravia. Dalešice, Mohhelno, locality Mohelenská hadcová step S from the village, southern slope, 49°06'30"N, 16°11'10"E, on the thalus of *Candelariella vitellina*, serpentinit / sunny slope, 17.5.2002; Dalešice, Mohhelno (Vězda: Lich. Sel. Exs. 49, sub *C. congrediens*); Ivančice, Hrubšice, serpentinite rock, 5.8.1956, A. Vězda (Vězda: Lich. Boh. Exs. 59);

Bulgaria. Eastern Rodopi, Haskovo, Madžarovo, by the river Arda, 41°40'N, 25°50'E, on the sunny volcanic rock, parazit on *Candelariella vitellina*, 27.10.2002.

Portugal. Serra do Estrela, Manteigas, the glaciar valley near tne willage, sunny granite stones and rocks (on *Candelariella vitellina*), 8.7.2002.

Slovakia. Krupina, Cerovo, ruin of the castle Čabraď in Litava river walley, andesitic conglomerates, on *Candelariella vitellina*, 26.7.2003.

14. *Caloplaca holocarpa* (Hoffm. ex Ach.) A.E. Wade, Lichenologist 3: 11. 1965.

Bas. : *Verrucaria oblittera* * *holocarpa* Hoffm., Deutsch. Flora: 179. 1796. (Syn. *Lichen holocarpus* (Hoffm. ex Ach.) Ehrh. ex Ach., Lichenogr. Suec. Prodrom.: 73. 1798., *Callopisma aurantiacum* var. *holocarpum* (Hoffm. ex Ach.) Körb.).

Caloplaca pyracea (Ach.) Th.Fr. (Syn. *Lecidea pyracea* (Ach.) Schultz, Prodrom. Flor. Stargard.: 381. 1806., *Callopisma pyraceum* (Ach.) Stein).

Caloplaca pyracea var. *rivulorum* (Eitner) Kuťák 1923.

Diagnosis: Thallus usually indistinct, whitish or grey, continually changing into whitish fibrilous prothallus. Prothallus ypically 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, plectenchymatous, with fibrilous 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. Hymenium 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 monomorfic 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. saxifragarum* Poelt, *C. schoeferi* Poelt and *C. tiroliensis* Zahlbr. are muscicolous, restricted to alpine habitats, but without any satisfied morfological features. *C. vitellinaria* is parasitic species on *Candelariella vitellina* morfologically 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 subsquamulose thallus.

References to taxonomy: Purvis et al. 1992, Søchting et Stordeur 2001, Wade 1965.

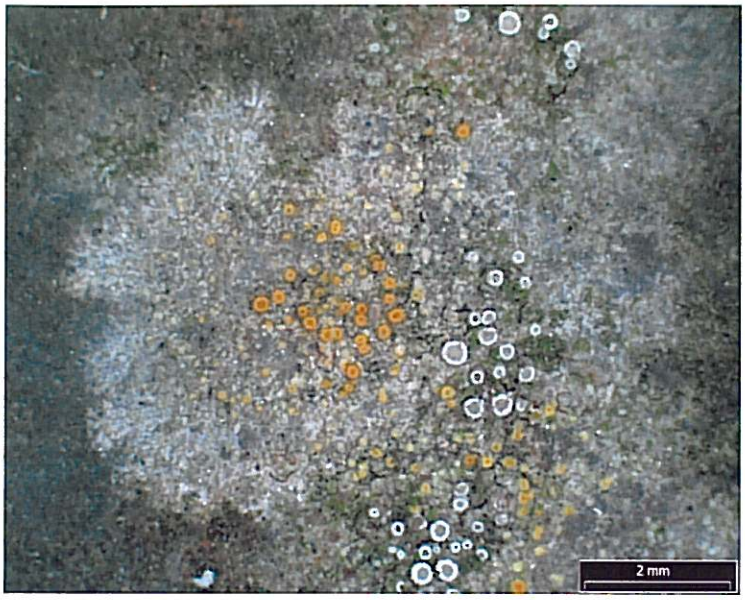
Ecology: Species growing on the broad spectrum of substrates. There are saxicolous, corticolous, lignicolous, muscicolous and also coprophilous ecotypes. Muscicolous and lignicolous types are considered as different species (see taxonomic notes). Saxicolous types prefer variable nutrient-rich substrates. 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 dungs of rabbit *Orictolagus caniculus* in arid conditions of the Hungarian puszta (Vězda 1975).

Associated lichen species: Acarospora fuscata, Amandinea punctata, Aspicilia caesia, A. moenium, Buellia alboatra, Caloplaca aractina, C. arenaria, C. citrina, C. chlorina, C. saxicola, Candelariella vitellina, Lecania erysibe, Lecanora dispersa, L. intricata, L. muralis, L. polytropa, L. salina, Lecidea fuscoatra, L. sarcogynoides, Lecidella anomalloides, L. stigmatea, Leptogium cf. *teretiusculum, Parmelia conspersa, Phaeophyscia nigricans, Ph. orbicularis, Physcia dubia, Polysporina simplex, Ramalina pollinaria, Rhizocarpon distinctum, Sarcogyne regularis, Tephromela atra, Xanthoria elegans.*

Distribution: Probably common throughout the Czech Republic. Known altitudinal max.: 1080m on the Mt. Kleť (Southern Bohemia/Blanský les Mts.). True altitudinal maximum is located probably higher.

A



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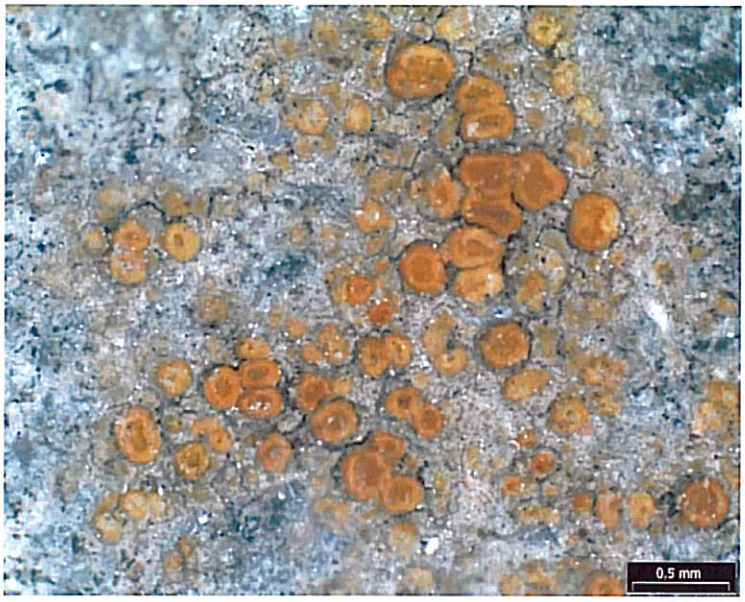

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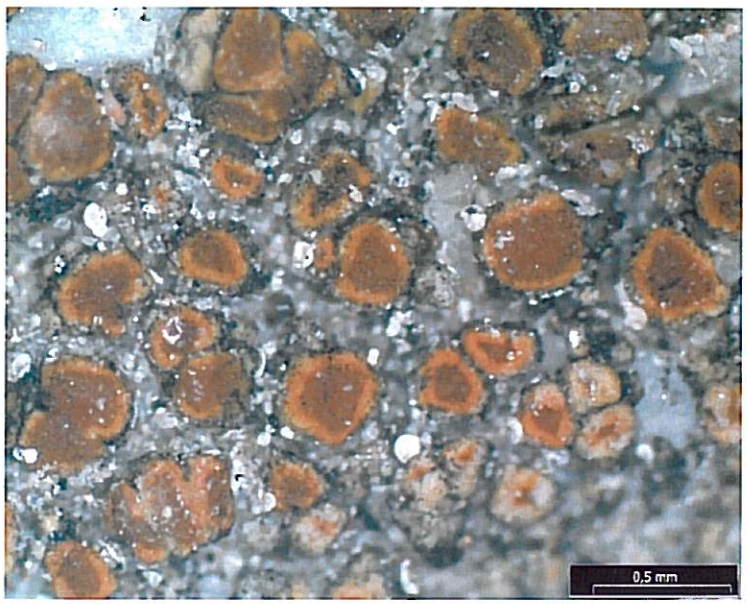


Fig. 3.14A. ***Caloplaca holocarpa.*** A, Thallus on smooth substrate with distinct whitish prothallus; B, Yellow thallus is not typical, but occasionally present; C, Apothecia somewhat similar to that of *C. Crenulatella.*

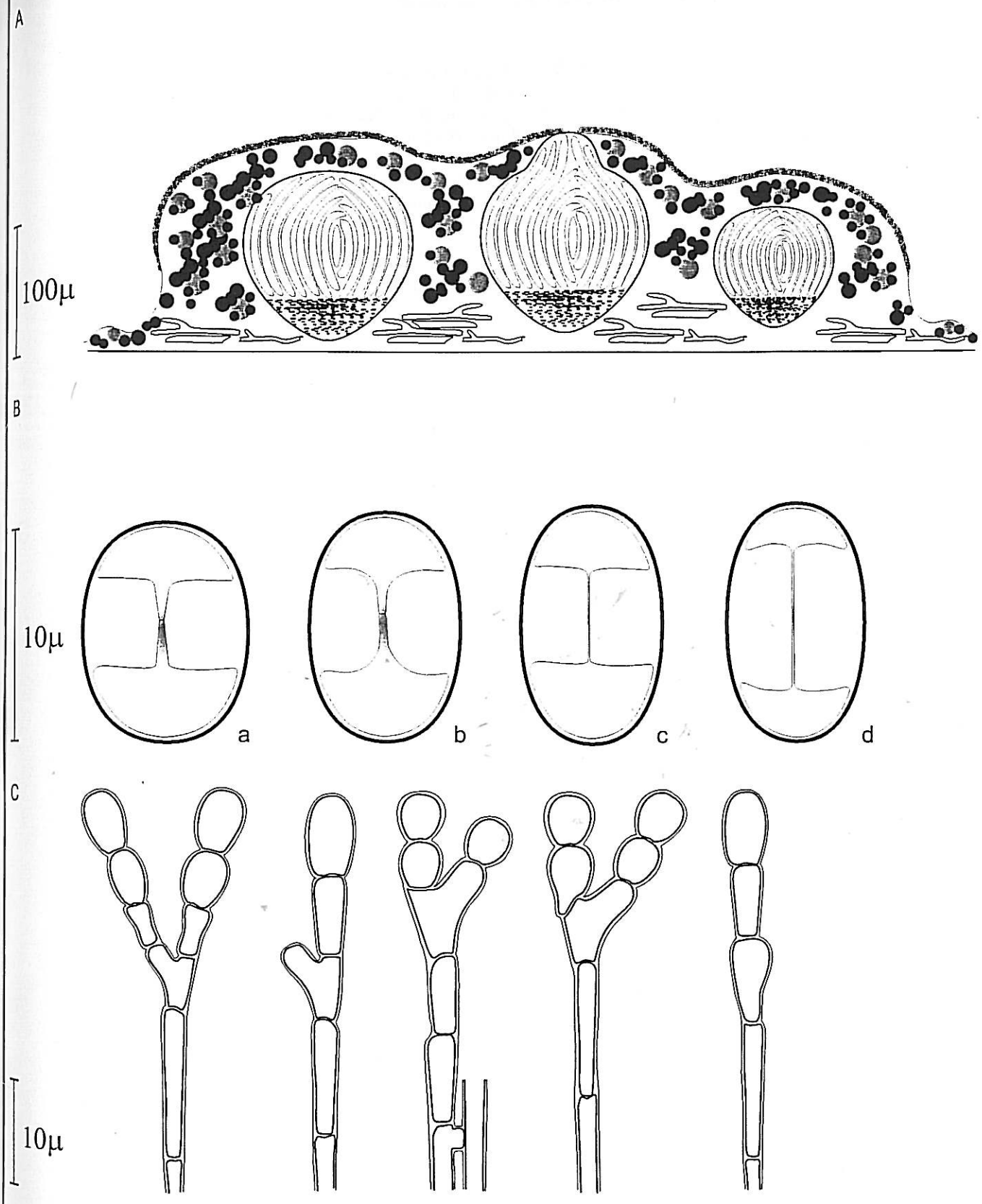


Fig. 3.14B. ***Caloplaca holocarpa***. A, vertical section through a thallus with three apothecial primordia, cortex around primordia is covered with orange crystals (black dots), normal thallus is not yellow colored and much more thinner (on sides); B, ascospores (a-c, ripe spores; d, overripe spore); 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-,C-, 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 excipulum 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.

Hypothecium colourless. Hymenium 60-75μm high. Asci 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 diametre. 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.

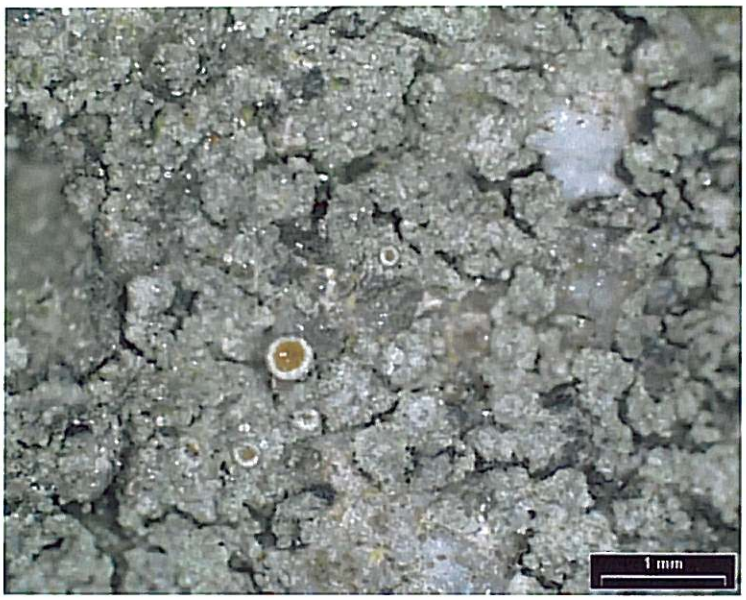
Caloplaca aractina differs in the blackish true excipulum and distinct dark prothallus. *Caloplaca xerica* differs among others in presence of true excipulum, that continues beneath hypothecium. I do not understand to the relation between *C. chlorina* and *C. cerina*. However, *C. cerina* is non-sorediate, 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).

References to taxonomy: Purvis et al. 1992, Vězda 1978, Wetmore 1996, 1997.

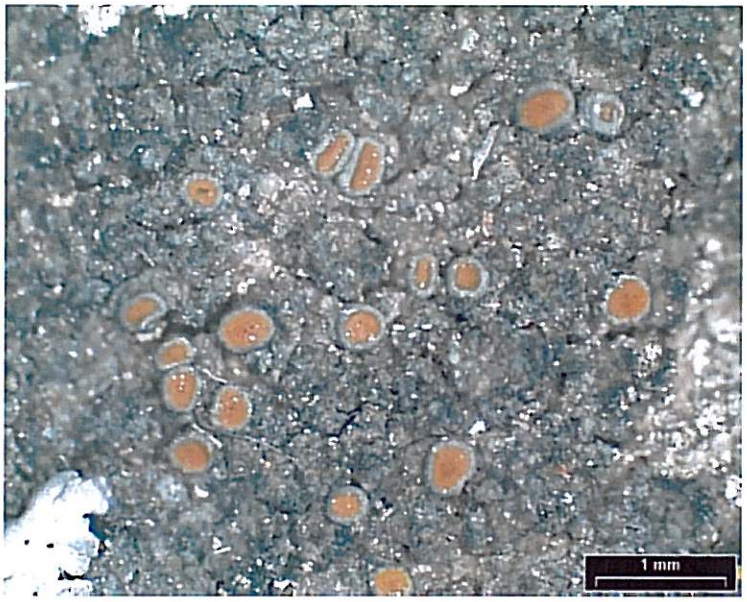
Ecology: This species inhabits broad spectrum of substrates. It occurs on nutrient-rich bark of deciduous trees (e.g. *Acer*, *Quercus*), where it prefers bases of tree trunks. *C. chlorina* also grows on nutrient-rich silicate rocks and stones, e.g. basalt, gneiss and schist. Rarely occurring on limestone (*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.

Associated lichen species: Aspicilia caesia, Bacidia rivularis, B. viridifarinosa, Caloplaca citrina, C. holocarpa, Candelariella vitellina, Collema flaccidum, Lecania erisibe, Lecanora hagenii sensu Wirth 1995, *L. muralis, L. salina, Lecidella anomalloides, Parmelia conspersa, Physcia dubia, Verrucaria nigrescens, V. praetermissa.*

A



B



C

Fig. 3.15A. ***Caloplaca chlorina.*** A, Grey-green thallus, typical in damp situations; B, Thallus with apothecia; C, Apothecia in detail.

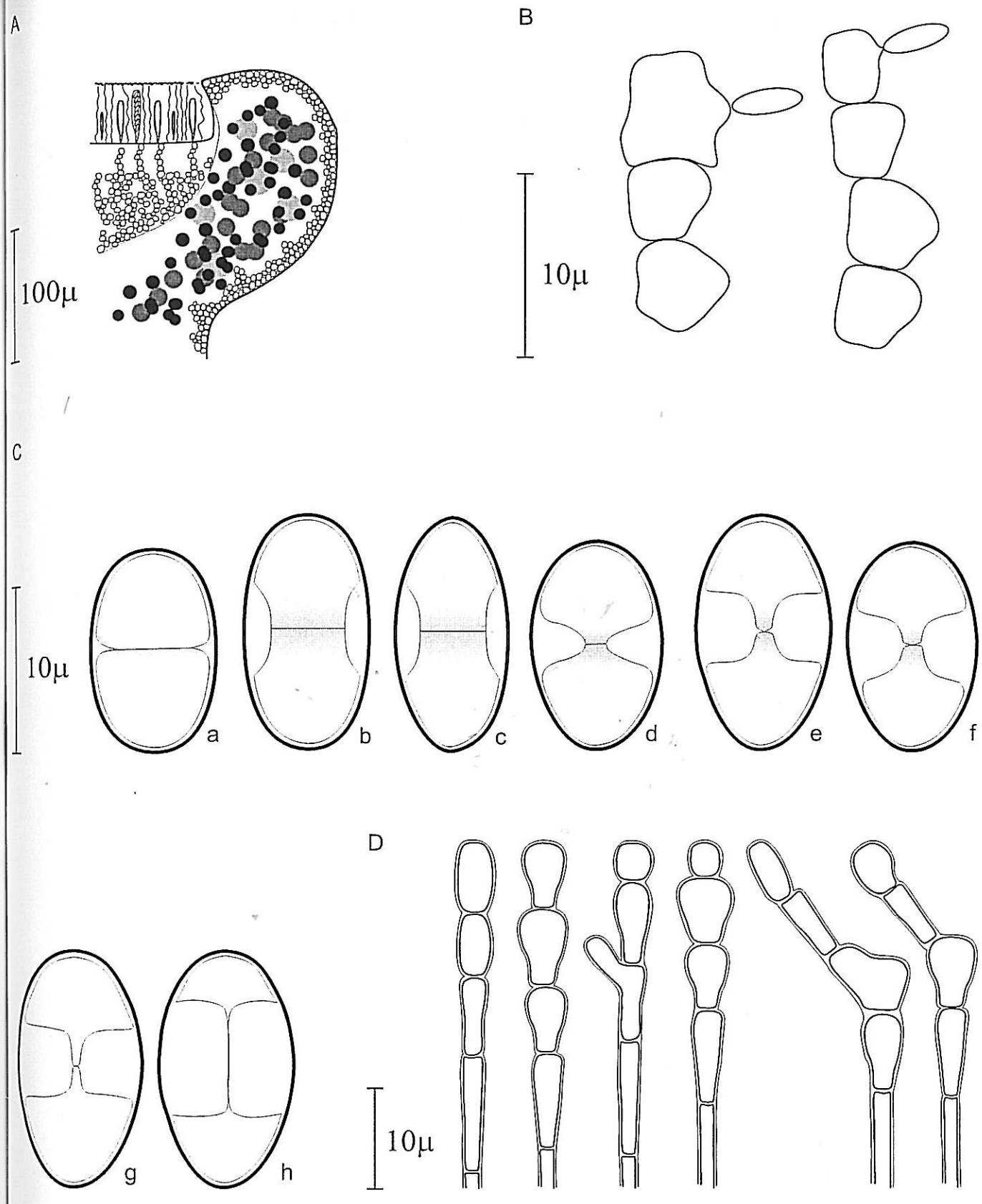


Fig. 3.15B. ***Caloplaca chlorina***. A, vertical section through an apothecium, showing absence of true excipulum; B, conidiogenous cells with conidia; C, ascospores (a-d, young spores; e-h, ripe spores); D, paraphyses tips, the first type is the most common.

Distribution: Probably occurring throughout the Czech Republic, but not enough records gained. Altitudinal maximum: 1180m 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; Kvilda, Horská Kvilda (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; Kyjov, Milotice, horizontal sides of bricks in the wall, 2.7.2003; Oslavany, in Oslava river valley, gneiss rock, 6.8.1919, Suza (PRM); Tišnov, Doubrovník, 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.

16. *Caloplaca chrysodeta* (Vain. ex Räs.) Dombr., Konsp. Fl. Lish. Murm. Sev.-Vost. Finlyandii: 99. 1970.

Bas.: *Placodium chrysodetum* Vain. ex Räs. Ann. Acad. Sci. fenn., A, 34(4): 113. 1931.
Type: Finland. Turku Pori, Särkisalo, Kaukasalo, on calcareous stone, 18.8.1920, Vainio (TUR, lectotype).

Callopisma chrysodetum (Vain. ex Räs.) Räs., Ann. bot. Soc. zool.-bot. fenn. Vanamo 18(1): 41. 1943.

Leproplaca chrysodeta (Vain. ex Räs.) J.R. Laundon, Lichenologist 6: 103. 1974.

Diagnosis: Thallus leprose and plectenchymatous, dull orange, brownish to greyish yellow on the surface and creme to yellowish inside. Consisting of powdery globose granules, ca 0.1mm 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 monomorfic species, characteristic with dull orange, brownish to greyish yellow powdery thallus, K+ violet. *Caloplaca citrina* differs in having areoles with para-plectenchymatous cortical layer and in colour and shape of soredia, that are more or less yellow and smoother. *C. xantholyta* differs in bright yellow thallus and in distinctly delimited, occasionally sublobate thallus. Leprose species from other genera have different colour and K- reaction.

References to taxonomy: Laundon 1974, Purvis et al. 1992, Wetmore 2001.

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. dolomiticola, 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);
Northern Moravia. Hostýnské vrchy Mts., near "Čerňava" virgin forest, alt. 580m, vertical face of concrete wall, 12.5.1995, B. Gruna, Z. Palice (herb. Z. Palice).

Slovakia. Malá Fatra mts., Rájec, Fačkovo, mt. Klak, alt. cca. 1000m, limestone, in collection of Caloplaca dolomiticola, 22.7.2003; Martin, Kláštor p. Znievom, mt. Zniev, alt. cca 980m, dark overhang in limestone, 23.7.2003; Žilina, Súlov, "Súlovské skaly" rocks, dark overhangs in calcareous conglomerates, 21.7.2003.

17. *Caloplaca inconnexa* (Nyl.) Zahlbr., Cat. Lich. 7: 145. 1931.

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

Caloplaca inconnexa var. *nesodes* Poelt et Nimmis, Studia Geobot., Trieste 7, suppl. 1: 66. 1987.
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-areolate, 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. Thaline 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.

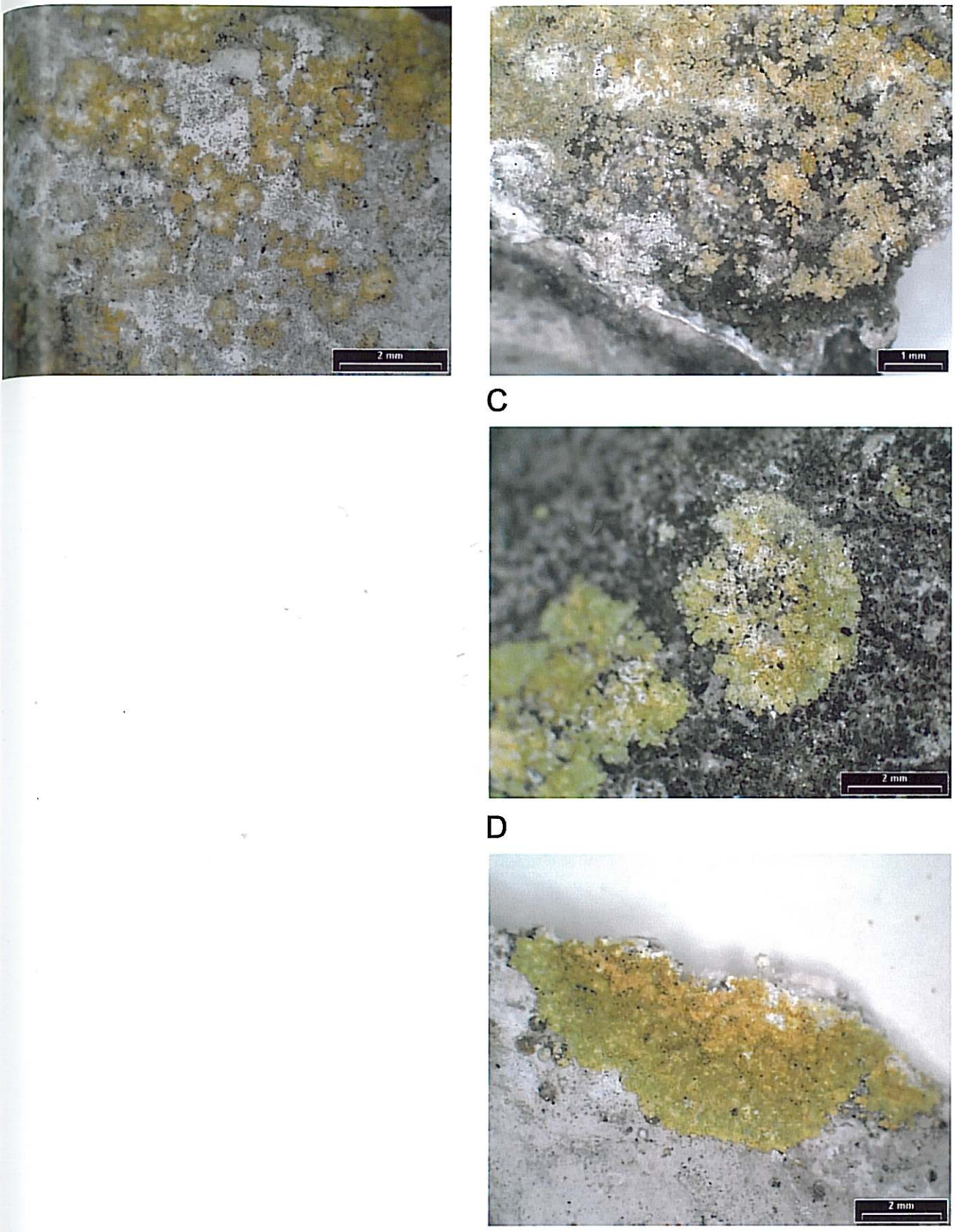


Fig. 3.16A. ***Caloplaca chrysodetha* and *Caloplaca xantholyta*.** A, B, Thallus of *Caloplaca chrysodetha*; C, D, Sharply delimited Thallus of *Caloplaca xantholyta*.

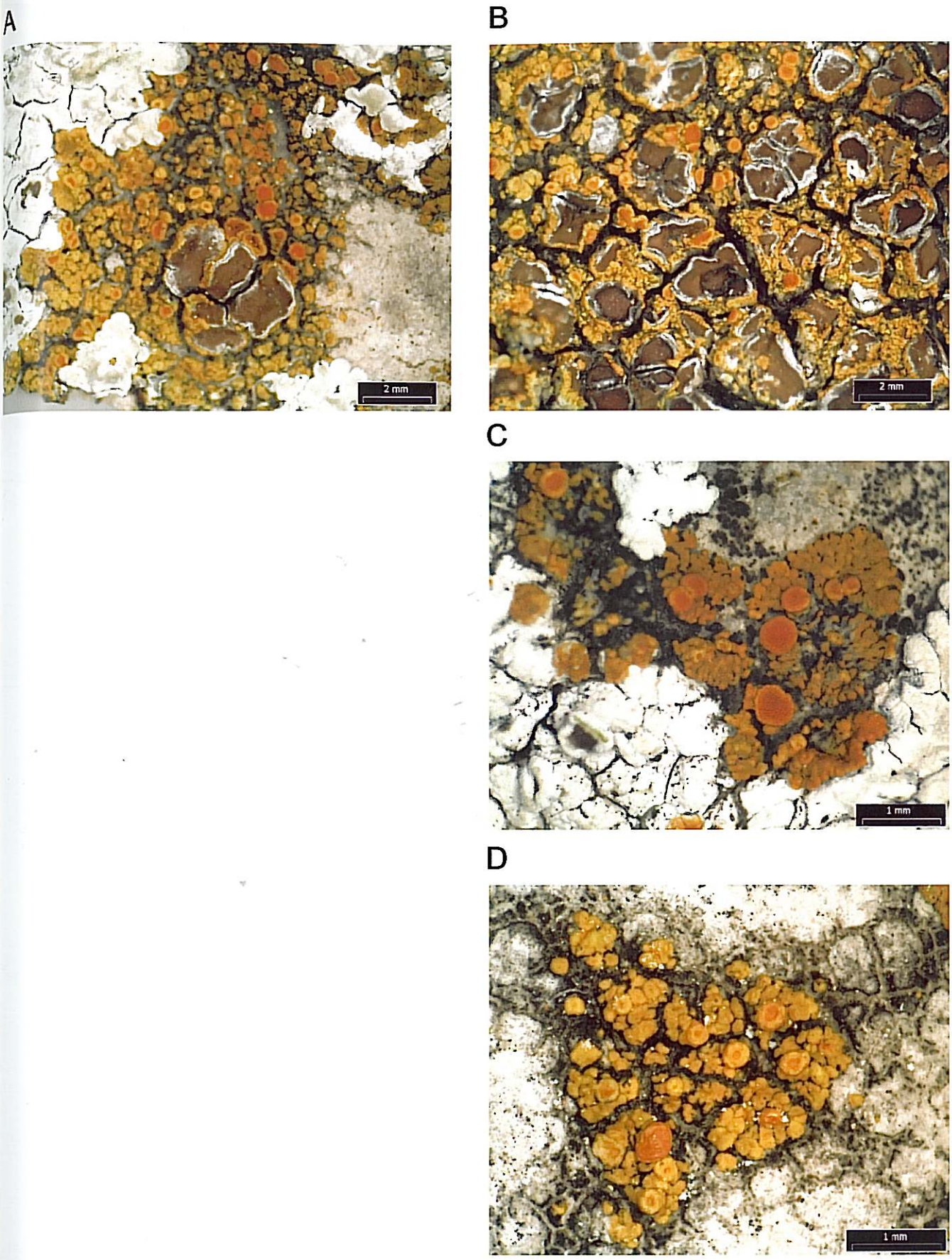


Fig. 3.17A. ***Caloplaca "inconnexa".*** A, Thallus parasited on *Acarospora cervina*; B, Thallus in detail; C, Distinctly lobate thallus, ;D, Young thallus, probably not parasitic.

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 dolomiticola 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 anthraquinons.

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. dolomiticola* s.l. Both differ in non-lobate, rather minute thallus and para-plectenchymatous excipulum (more information under *C. dolomiticola*).

References to taxonomy: Clauzade et Roux 1985, Poelt et Vězda 1981, Vězda 1970, Wirth 1995.

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. *nessodes*). Rarer hosts are *Lecanora muralis* and *Lobothallia radiosa*. *Caloplaca inconnexa* very rarely occurs also free-living.

Distribution: Rather mediterranean species. Only three times recorded from "Pavlovské 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 Svatý kopeček hill near Mikulov (Slovakia: 980m, Mt. Zniev, SW part of Malá Fatra Mts.).

Specimens seen: **Eastern Bohemia.** Úpice (distr. Trutnov), on calcareous sandstone, 1911, 1912, Kuťák (PRM 580611, 580616, sub *Caloplaca aurantiaca*).

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 parazitized 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 thali of Acarospora cervina, 24.2.2002.

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

Croatia. Dalmatia. Velebit Mts., Mali Alan, Podprag, on limestone, alt. 900m, 15.7.1973, Poelt (GZU).

France. Bouches-du-Rhone, Massif de la Sainte Baume, Col de l'Espigoulier, alt. 720m, limestone, on *Aspicilia calcarea*, 11.5.1980, Bellemére, Hafellner (GZU); Corse. Calvi, Capo au Cavallo, silicate rock near the coast, 9.12.1990, Obermayer (GZU, var. *nesodes*); Savoie. Genf, Saléve, alt. 1650-1720m, calcareous rock, 4.7.1981, Poelt (GZU); Vaucluse. Les Beaumettes, Collet de Brousse, calcareous rock, 16.7.1970, Poelt, Clauzade (GZU, "type-like sample").

Italy. Marettimo (Isolée Élgadi), 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. Genargentu Mts., Mt. Arbu, calcareous schist, alt. 1250m, 17.7.1987, Poelt (GZU); Sardinia. Monte Albo Mts., Cantoniera di St. Anna, Punta Cupetti, on limestone, alt. 900m, 25.7.1985, Poelt, Nimis (GZU).
Slovakia. Malé Karpaty Mts., Plavecké Podhradie, Pohanská, alt. 300-400m, dry slope with limestone outcrops. 29.6.1993, Pišút, Poelt (GZU 11-94); Martin, Kláštor p. Znievom, mt. Zniev, alt. ca 980 m, sunny limestone rock, often parasitic on Acarospora cervina, 23.7.2003.
Serbia. Montenegro. Prokletije Mts., 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).

18. *Caloplaca lactea* (A. Massal.) Zahlbr., Österr. Botan. Zeitschrift, 51: 347. 1901.

Bas.: *Callopisma luteoalbum* 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. Italici Ex. 236 (M).

Gyalolechia lactea (Massal.) Arnold, Flora 64: 311. 1881. et Flora 67: 257. 1884.

Caloplaca tarraconensis Nav.- Ros. ad. int. (nomen nudum). Nova Hedwigia 59: 258. 1994.

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.

Hypothecium colourless. Hymenium 70-80µm high. Asci 55-65 x 13-18µm in size. Hamathecium of 1.5-2µm thick paraphyses, single or sparsingly branched. Paraphyses tips distinctly swollen in tips, up to 5µm, usually 2-3 upper cells swollen. Ascospores ellipsoid, (11-)12-14(-16) x 6-8.5µm in size. Septum of ripe spores 2-3µm thick. Apothecia C-, K+ violet-red.

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

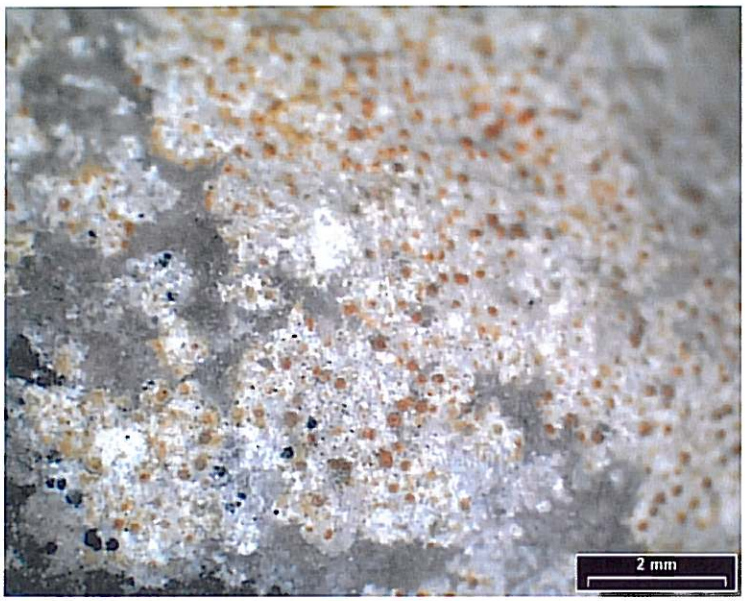
Taxonomic notes: Species belonging to *Caloplaca lactea* group. There are rather minute and not clear distinctive characters within this group. This taxon is characterised by endolithic thallus, small and rather pale orange apothecia, plectenchymatous excipulum, small spores with thin septa and usually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

A



B

C

Fig. 3.18A. ***Caloplaca lactea.*** A, Thallus with apothecia; B, Apothecia in detail; C, Apothecia in detail and small apothecial primordia (yellow-orange dots).

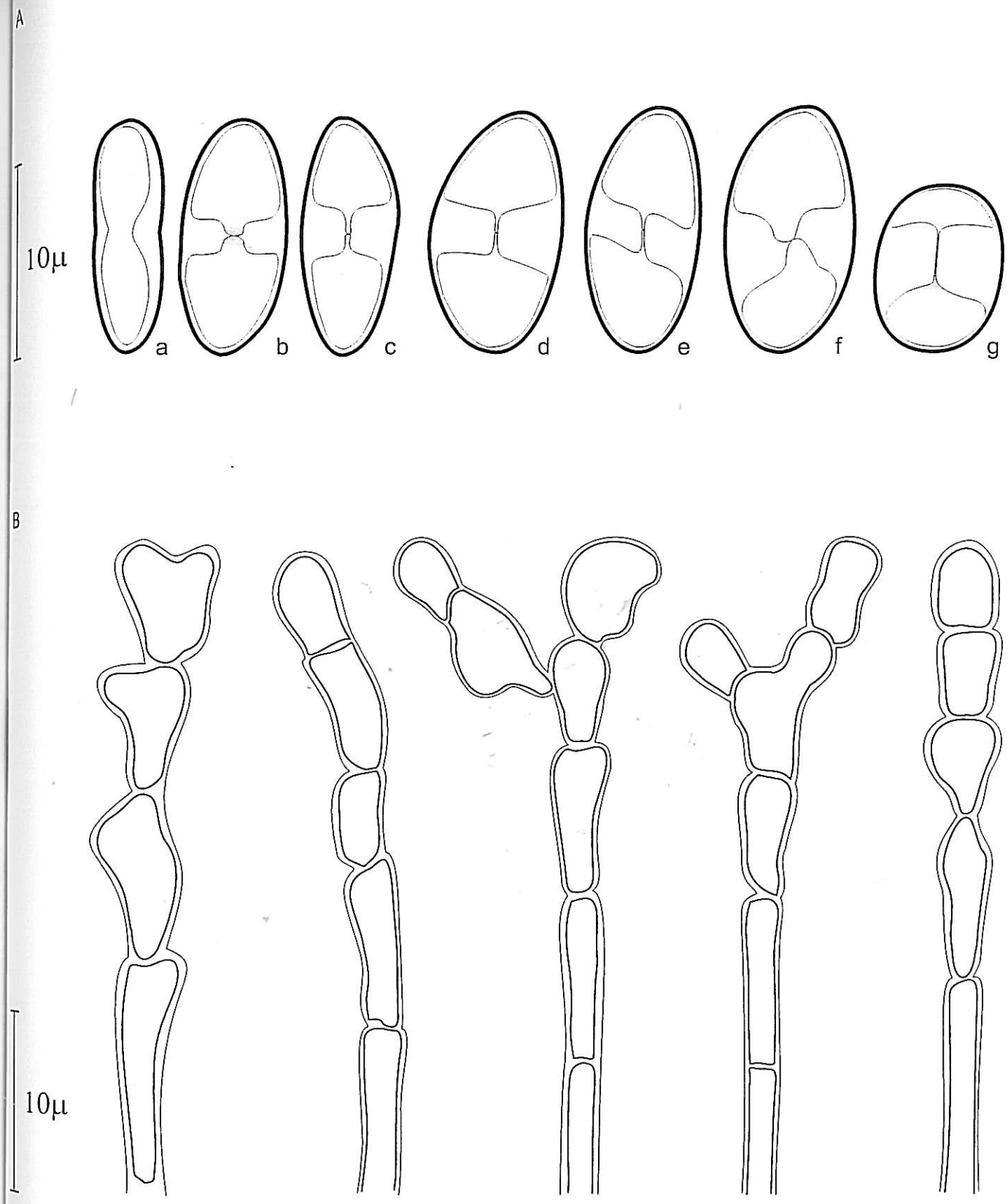


Fig. 3.18B. ***Caloplaca lactea***. A, ascospores (a, young spore; b-e, ripe spores; f,g, deformed spores); B, paraphyses tips.

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, plectenchymatous 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-plectenchymatous true excipulum and single, not branched paraphyses.

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

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.

Central Bohemia. Beroun, Srbsko, in Berounka river valley, calcareous rock, 10.8.2002, D. Svoboda (herb. D. Svoboda); Beroun, Srbsko, locality "Na Závěrce", calcareous rock, 13.10.2000, D. Svoboda (herb. D. Svoboda); Beroun, Srbsko, Barrandova jeskyně cave, calcareous rock, 23.10.2002, D. Svoboda (herb. D. Svoboda).

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.

Morocco. SW foothills of Haut-Atlas, Agadir, Aurir, walley of Asif Tamrhalcht river, alt. ca. 100-200m, calcareous stones, 6.12.2003.

Italy. Pelagiae Islands, Isla of Lampedusa, alt. 50m, calcareous pebbles in soil, 1992, Nimmis, Poelt, Vězda (A. Vězda: Lich. Rar. exs., no. 42).

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

20. *Caloplaca obliterans* (Nyl.) Blomb. et Forss., Points Förteckning: 69.1880.

Bas.: *Placodium obliterans* Nyl., Flora (Regensburg) 57: 7. 1874.
Type: Norway. Dovre, Kongsvold, 21.7.1875, Zettersted (H-Nyl. 29124, lectotype).

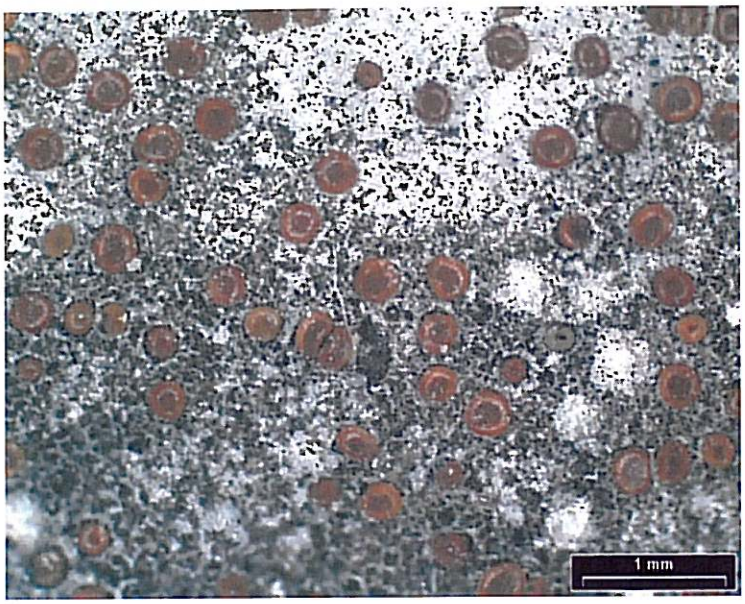
Syn.: *Calplaca cirrochroa* var. *obliterans* (Nyl.) Servít, Zpr. Kom. Přírod. Prozk. Moravy, sect. bot., Brno 6: 1-83. 1910.

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-.

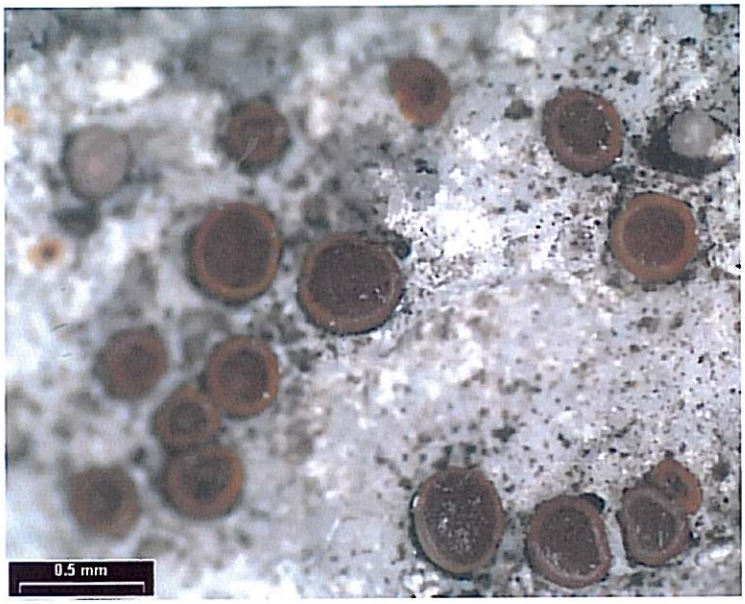
Apothecia and pycnidia not found in the Czech material.

Photographs: Fig. 3.20A.

A



B



C

Fig. 3.19A. ***Caloplaca marmorata.*** A, B, Indistinct endolitic thallus with apothecia; C, Apothecium in detail.

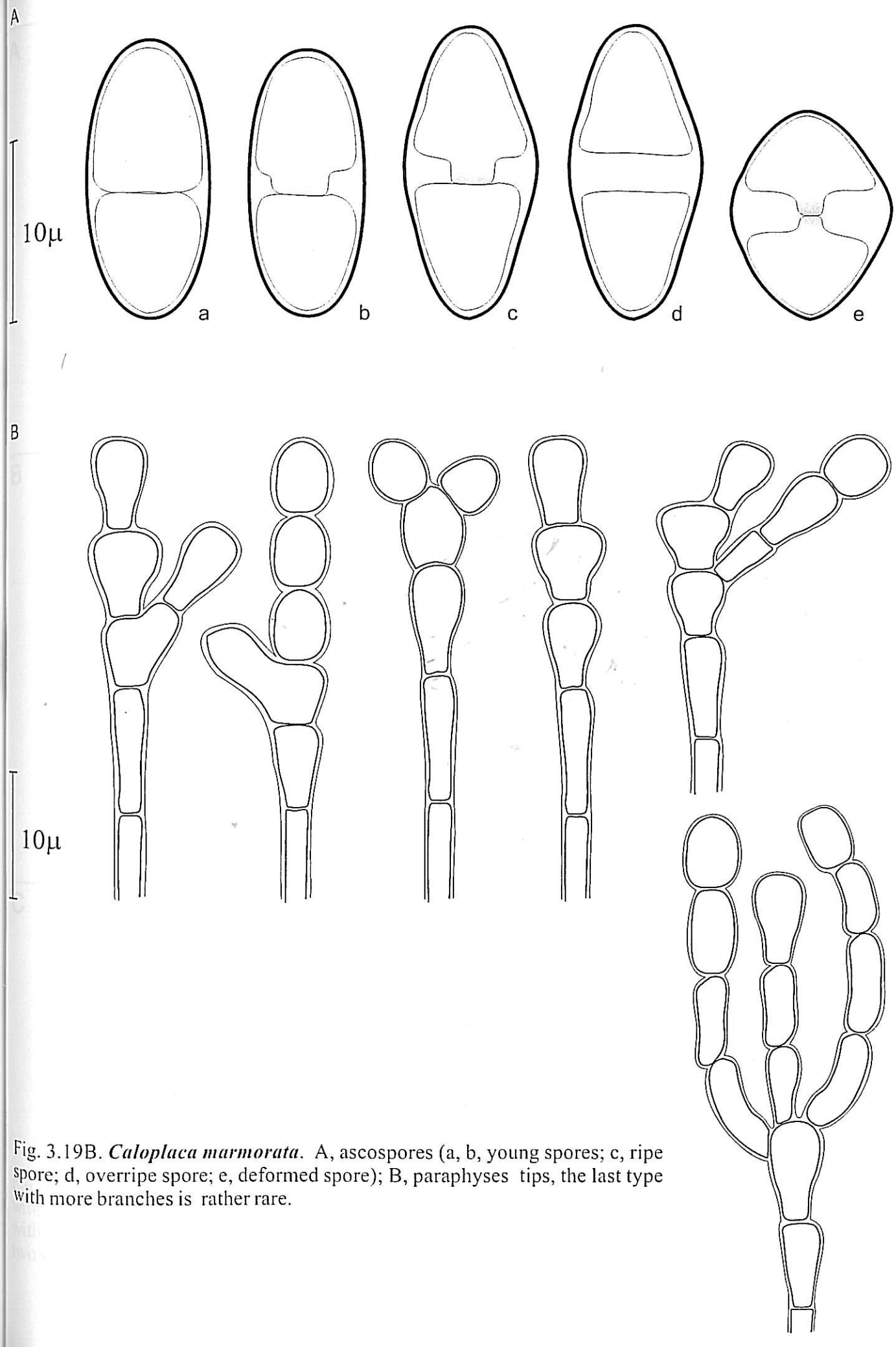
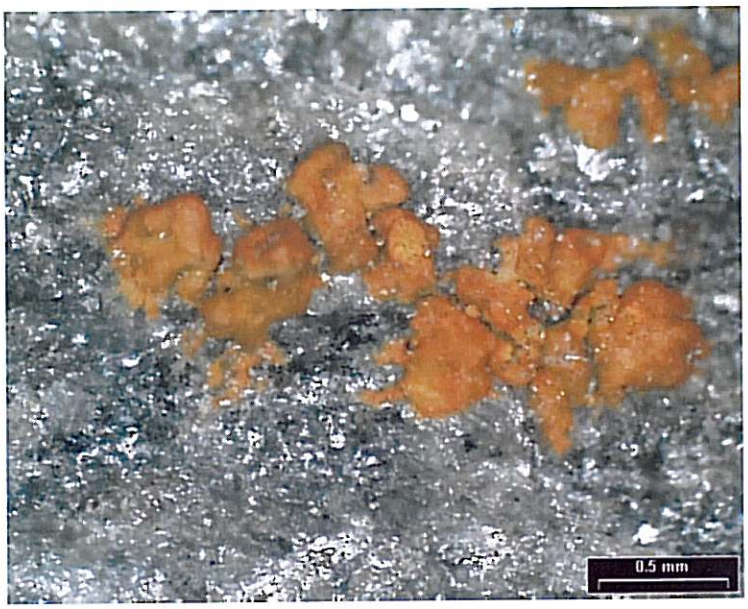


Fig. 3.19B. ***Caloplaca marmorata***. A, ascospores (a, b, young spores; c, ripe spore; d, overripe spore; e, deformed spore); B, paraphyses tips, the last type with more branches is rather rare.

A

B



C

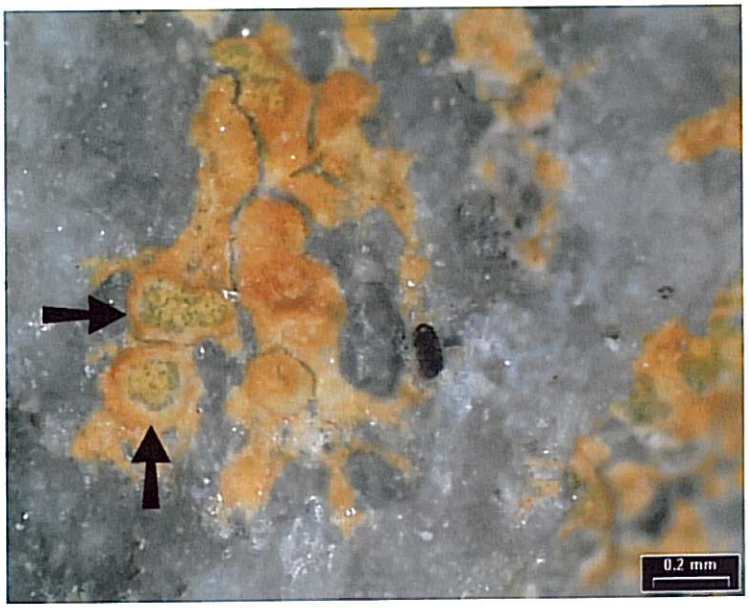


Fig. 3.20A. ***Caloplaca obliterans.*** A, Thallus with yellow-orange prothallus; B, Thallus with indistinct lobes; C, Small thallus with two soralia in central part (arrows).

Taxonomic notes: Species resembling *Caloplaca cirrochroa*. However, *C. cirrochroa* has typically developed marginal lobes, orbicular 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.

References to taxonomy: Purvis et al. 1992, Wade 1965, Wetmore et Kärnefelt 1998.

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

Associated lichen species: Caloplaca citrina, C. crenulara, C. holocarpa, C. saxicola, C. xerica.

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.

Specimens seen: **Nortern Bohemia.** Vrchlabí, Pec pod Sněžkou, "Obří důl" valley, a blind gully "Malá čertova zahrádka", alt. 1150-1200m, 50°43'30-35"N, 15°43'30"E, shaded porphyric rock, 27.7.2000, Z. Palice (herb. Z. Palice, no. 4990).

Northern Moravia. Jeseníky Mts., Vysoká hole Mt., central part of Velký kotel corrie, "Vitáskova rokle" ravine, a third/fourth rock-ledge below the Šmarda wall, alt. 1260-1265m, overhanging schistose rock, 11.6.2002, Z. Palice (herb. Z. Palice, no. 7030).

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

Sweden. Asele Lapmark, Villhelmina, Paroecia, Röberg, alt. 600m, half-shaded weathered rock, 15.7.1970, Santesson (Vězda: Lich. Sel. Exs. 922); Torne Lappmark. Abisko: Jiebernjiakk valley, alt. 400-450 m, 68°26'22"N, 18°53'26"E, overhanging mica-schistose rock, 25.7.2002, Z. Palice (herb. Z. Palice, no. 7711).

21. *Caloplaca ochracea* (Schaer.) Flag., Mém. Soc. d'Emul. Doubs: 257. 1886.

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

Lecanora tetrasticha Nyl., Flora (Regensburg) 57: 307. 1874.
Type: (H-Nyl. 29602, lectotype selected here!).

Caloplaca tetrasticha (Nyl.) Oliv., Mém. Soc. Sci. Nat. Cherbourg 37: 112. 1909.

Diagnosis: Thallus thin, endolithic or crustose epilithic, whitish, yellow dotted or yellow, having film-like appearance. The surface without cortex. Prothallus black, sometimes mosaic-forming. Algal cells 4.5-15μm in diameter. Thallus C-, N-, I-, K+/- violet-red.

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. Hamathecium 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 doted 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. dolomiticola* 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.

References to taxonomy: Clauzade et Roux 1985, Purvis et al. 1992, Wade 1965.

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.

Specimens seen: **Southrn 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"*

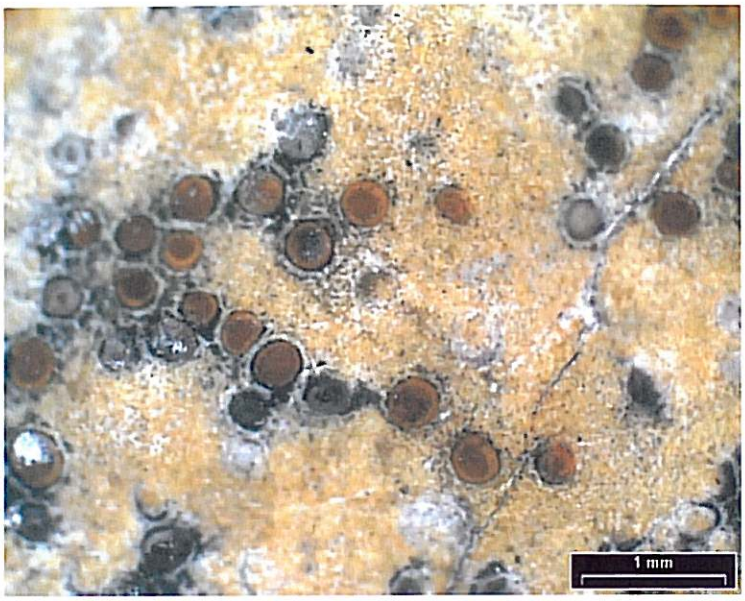
Diagnosis: Thallus blackish or dark to pale grey, distinctly mat, crustose-rimose, variably thick. Black, fibrilous prothallus rarely developed. Cortex usually not developed, rarely thin, up to 20μm thick, para-plectenchymatous. Epinecral layer often present, max. 25(-40)μm thick. Algal cells 4-18μm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

A



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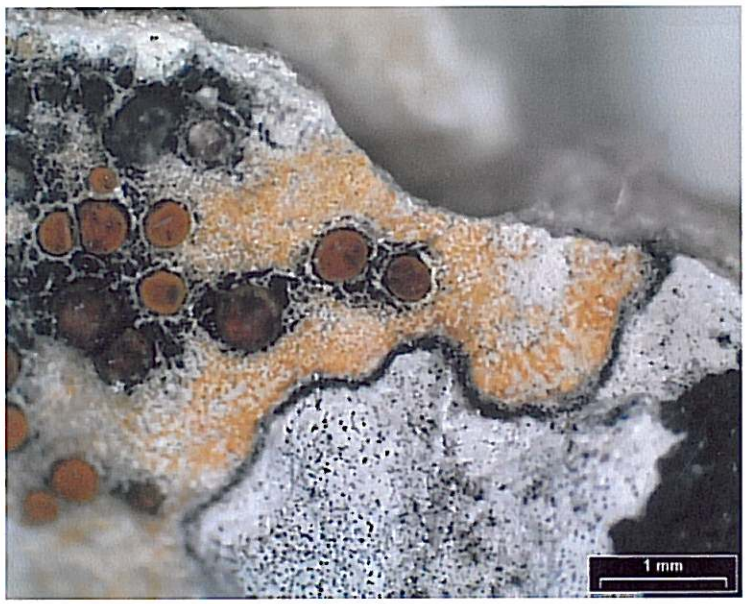

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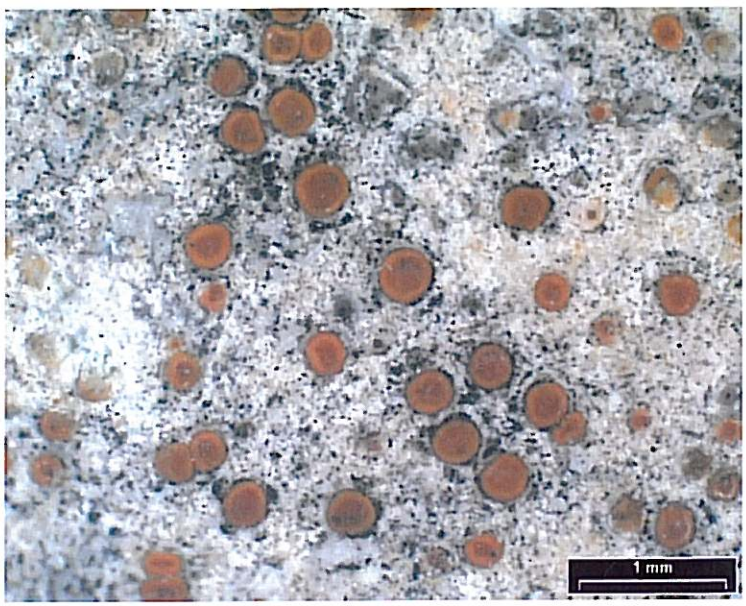


Fig. 3.21A. ***Caloplaca ochracea.*** A, Yellowish thallus with apothecia; B, Thallus delimited by black prothallus; C, Whitish thallus with apothecia.

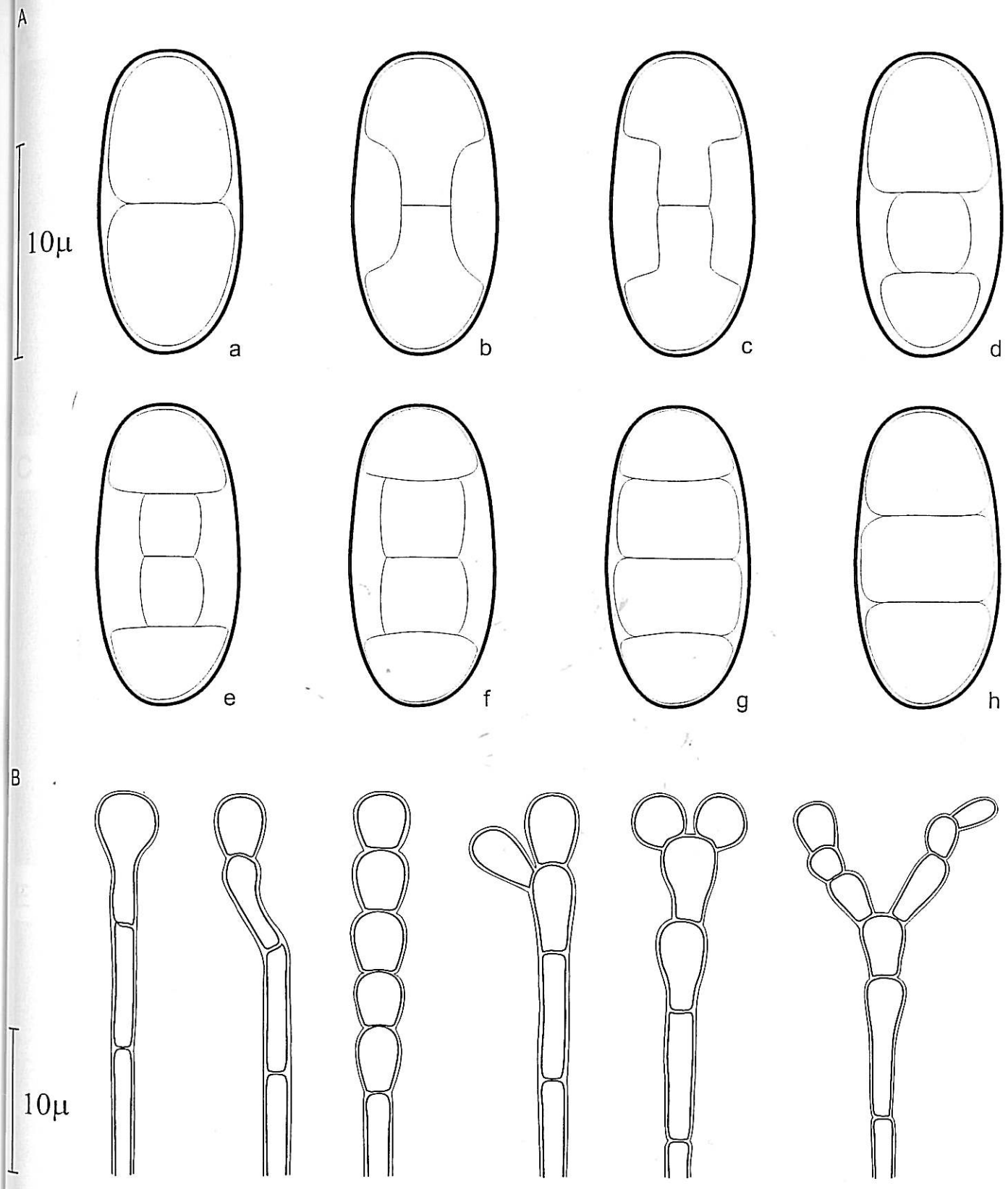


Fig. 3.21B. *Caloplaca ochracea*. A, ascospores (a-d, young spores; e-g, ripe spores; h, probably deformed spore); B, paraphyses tips.

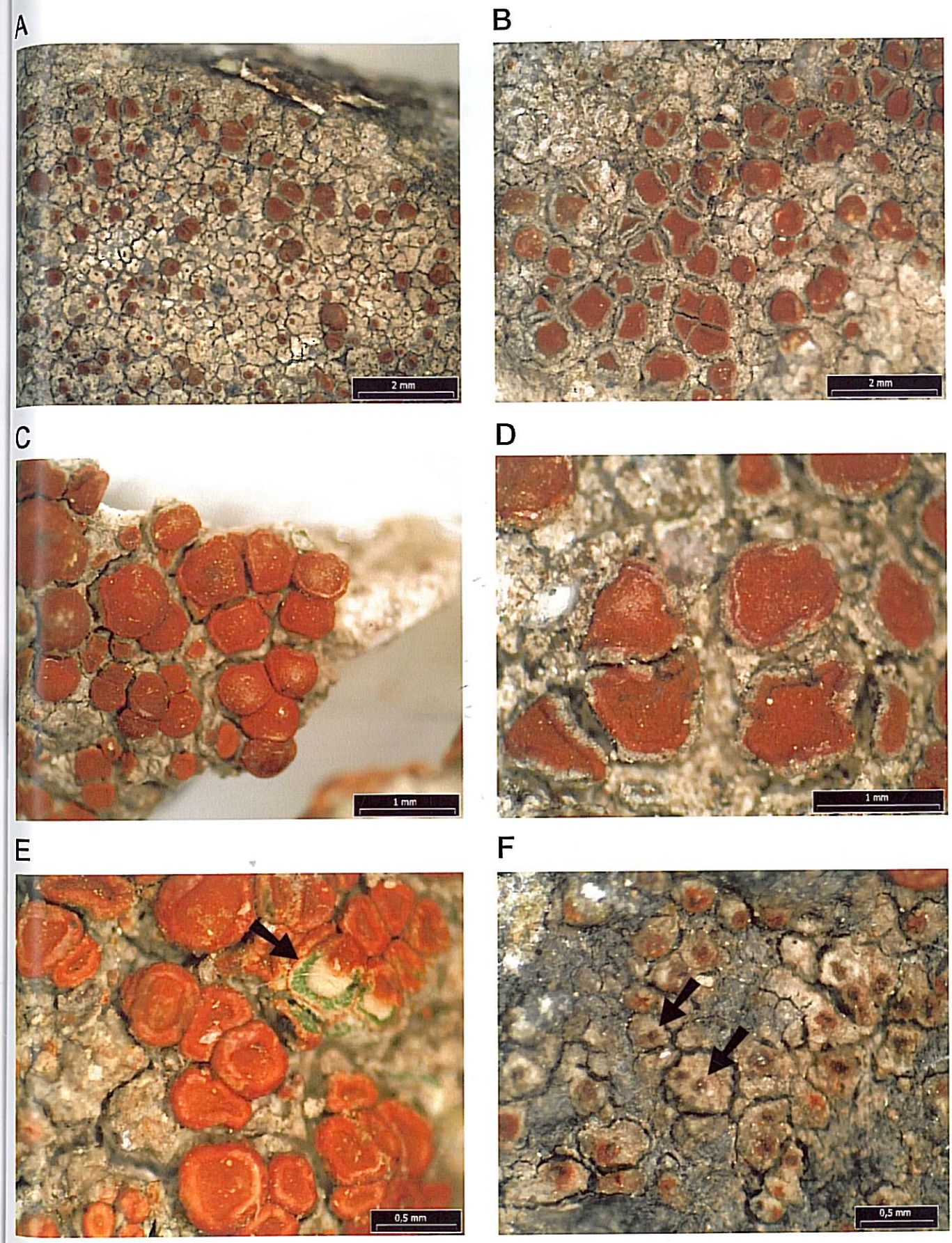


Fig. 3.22A. ***Caloplaca "pseudocrenularia"***. A, B, Thallus with apothecia; C, Apothecia without outer grey edge; D, Apothecia with outer grey edge; E, Apothecia in detail, algal cells in excipulum are visible in section (arrow); F, Thallus in detail, red pycnidia are visible (arrows).

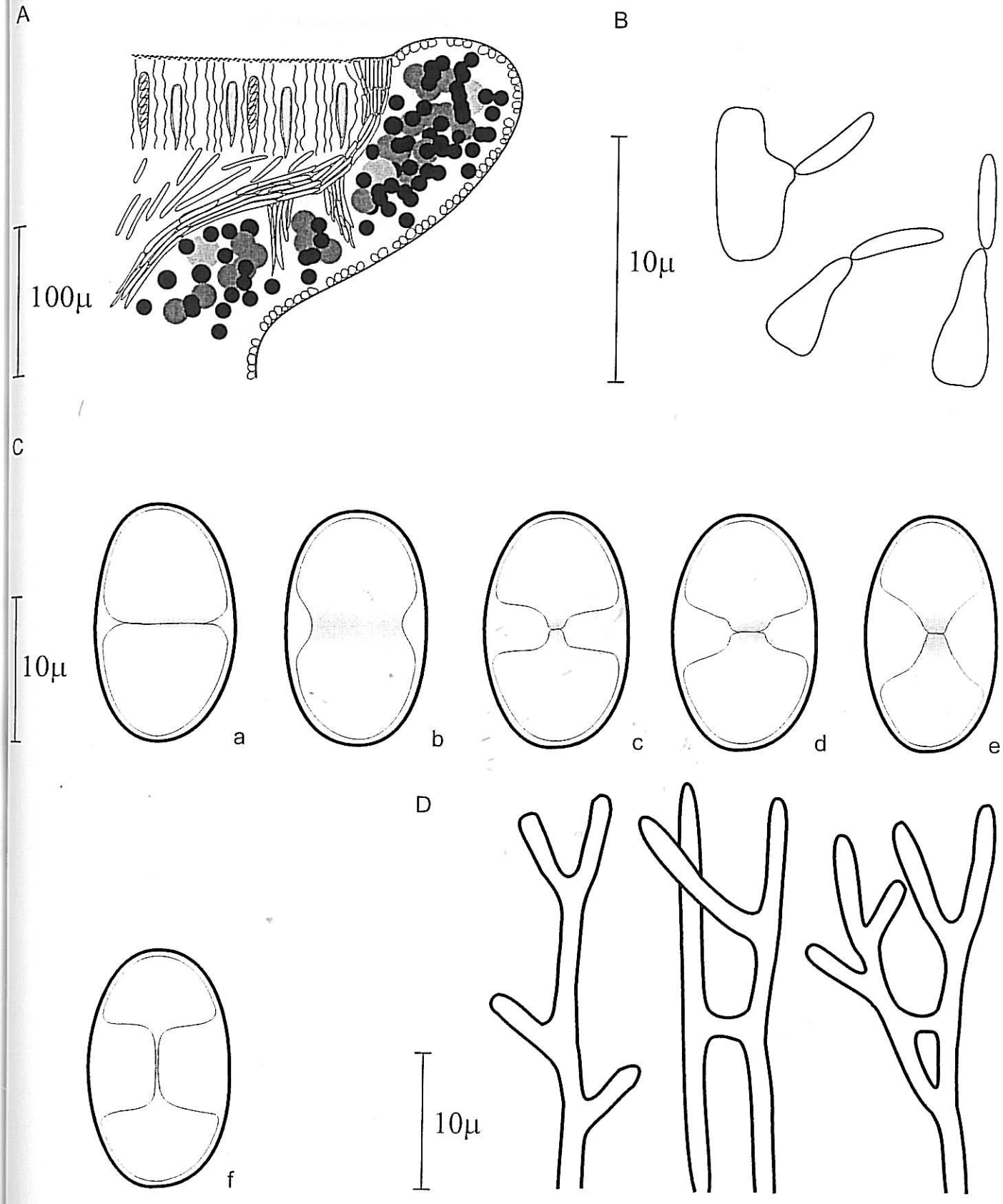


Fig. 3.22B. ***Caloplaca "pseudocrenularia"***. A, vertical section through an apothecium, showing plectenchymatous true excipulum consisting of thin cells (cca 2µ). This excipular tissue continues beneath hypothecium and occasionally expands with strands into algal layer. Tthere is high density of algae 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, contoures of strongly branched and anastomosed paraphyses that are not broadened in tips.

or long triangular, 3-7μm in diameter. Conidia bacilliform to narrowly ellipsoid, 3-5.5 x 0.5-1.2μm 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 glazed, 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.

Associated lichen species: Aspicilia contorta, Caloplaca arenaria, C. citrina, C. grimmiae, C. subsoluta, C. xerica, Candelariella vitellina, Lecanora muralis, Lecidella carpathica, Parmelia pulla, Rhizocarpon geographicum.

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. 250-280m, 1933, Suza (PRM 631055, sub *C. ferruginea*); Praha, Černošice, ?Budňany, in Berounka river valley, alt. 220m, 1933, Suza (PRM 631063, sub *C. ferruginea*) Praha, Chuchle, diabasic rocks, alt. 180-200m, 1.2. 1921, Suza (PRM 631062).

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

Bulgaria. Haskovo, Madžarovo, by the river Arda, 41°40'N, 25°50'E, volcanic boulder nearby the river, 29.10.2002.

Greece. Attika, Kap Sunion, serpentinit rock, 7.4.1971, J. Poelt (GZU).

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

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

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

Srbia. Vranje, Pljačkovica, NW of the town Vranje, ca 850m, 7.7.1977, H. Mayerhofer et J. Poelt (GZU); Vranje, Pljačkovica, NW of the town Vranje, 800-900m, 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. 880-900m, Serpentinit rock, 13.7.1974, J. Poelt (GZU).

23. *Caloplaca rubelliana* (Ach.) Lojka, Math. Termeszett. Kolzem. 11: 47. 1873.

Bas. : *Lecanora rubelliana* Ach., Lich. Univ. 376. 1810.
Type: Switzerland. coll. Schleicher (H-Ach. 1044, holotype).

Caloplaca amylacea H. Magn., Sv. Bot. Tidskr. 37: 280. 1943.
Type: New Zealand. Otago, North Otago, Bot. distr. Cronwell, rocks at the railroad station, G.E. et G. Du Rietz (UPS, holotype).

Diagnosis: Thallus orange-red to brown-red, typically crustose rimose, with sharp areoles, ca 0.2-0.4mm 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, 15–40μm thick, with several rows of isodiametric cells, 4.5-8μm in diameter. Algal layer continual para-plectenchymatous, algal cells 6-20μm 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 15-75μm thick, separated by thin cortex from neighbouring thalline tissues (fig....).

Hypothecium colourless. Hymenium low, 40-50μm high, asci small 30-37 x 9-11μm in size. Hamathecium of 1.5-2μm thick paraphyses, slightly branched. Paraphyses tips widened to 4.5μm, mostly 2-4 upper cells broadened (occasionally submonilliform). Ascospores very small, 7.5-9.5μm x 4-5μm in size. Septum of ripe spores 2.5-4μm, 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, 4-6.5μm in diameter. Conidia narrowly ellipsoid, (2.3-)3-3.8μm x 0.7-1.2μm 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 antropogenic sugstrates. No accompanied species or only several species occur together with *Caloplaca rubelliana.*

Associated lichen species: Caloplaca 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 Jihlavka river valley, near Ivančice (cf. Suza 1947, Vězda 1998). Altitudinal maximum: 300m, under the ruin of the castle Týřov, near Skryje (Central Bohemia).

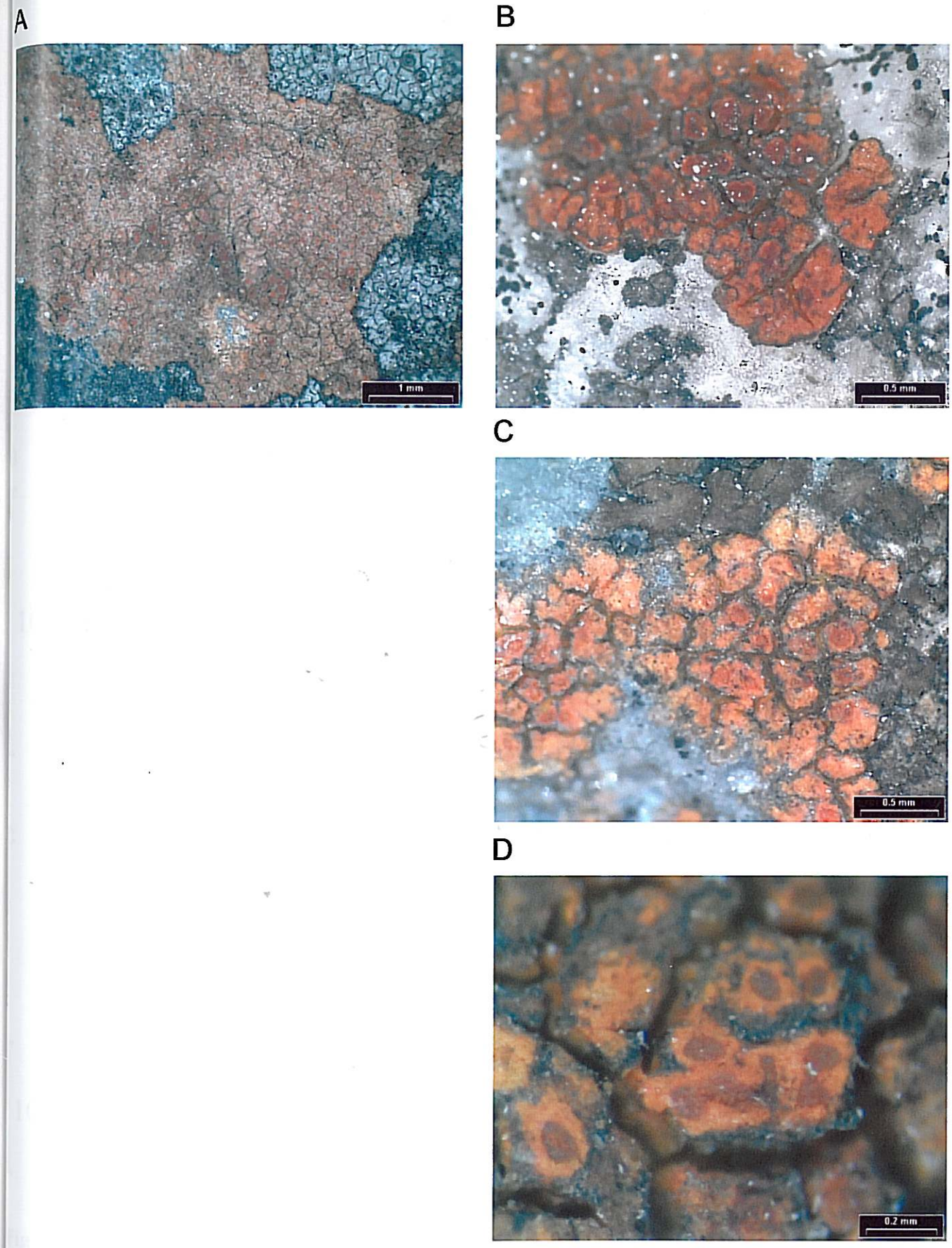


Fig. 3.23A. ***Caloplaca rubeliana.*** A, General view on thallus; B, C, Crustose-rimose thallus with apothecia; D, Apothecia that remain flat and immersed in detail.

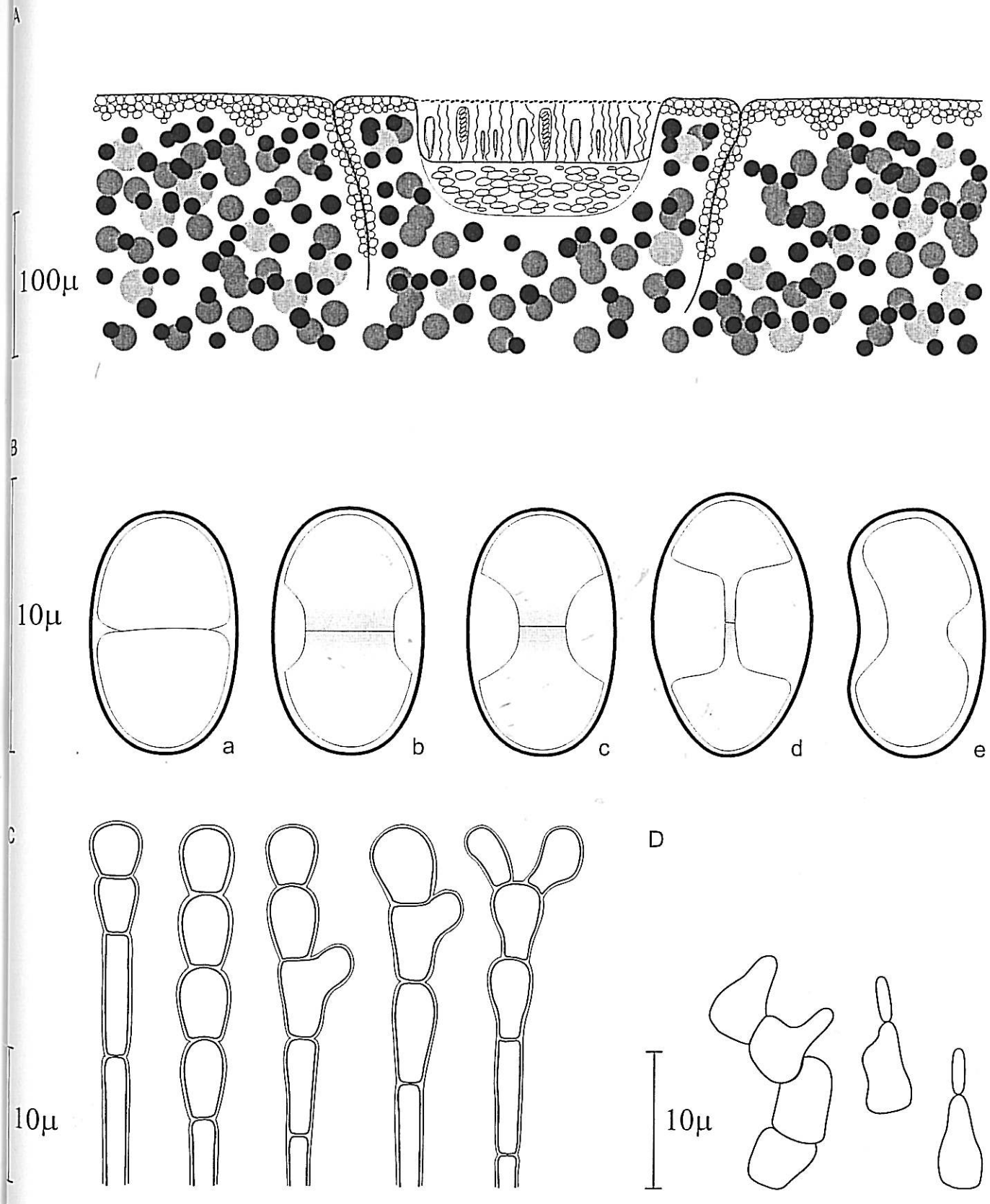


Fig. 3.23B. ***Caloplaca rubelliana.*** A, vertical section through a typically immersed apothecium, showing absence of true excipulum; B, ascospores (a-c, young spores; d, ripe spore; e, deformed spore); C, paraphyses tips; D, part of conidiophore with two upper conidiogenous cells; conidiogenous cells with attached conidia.

Specimens seen: **Central Bohemia.** Beroun, Zbečno, Račice, rocks in Berounka valley, alt. 250-300 m, 50°01'40"N, 13°55'30"E, S-faced schist rock, 14.8.2003; Praha, Libčice, Vltava river valley, on schist, alt. ca 200m, 17.10.1934, Suza (PRM); Řevnice, Hlásná Třebáň, 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", base-rich silicate rock, 16.9.2001.
Southern Moravia. Ivančice, Biskoupky, in Jihlavka river valley, granulitic rock, alt. 270m, 4.5.1931, Suza (PRM); Ivančice, Biskoupky, in Jihlavka river valley, granulitic rock, alt. 230m, 23.7.1931, Suza (PRM).

Italy. Sicily. Alicudi (Isla of Eliote), alt. 50m, basalt, 26.7.1994, Ottonello, Puntillo (Vězda: Lich. Rar. Exs. 164).
Spain. Murcia. El Ribaso, Cehegin, on volcanic rock, 15.4.1976, Egea, Llimona (Vězda: Lich. Sel. Exs. 2241).

24. *Caloplaca ruderum* (Malbr.) Laundon, Lichenologist 8:139. 1976.

Bas.: *Lecanora aurantiaca* var. *ruderum* Malbr., Luich. Norm. exs. no. 322. 1873.
Type: France. Seine-Inférieure, Rouen, Quevilly, on the mortar of calcareous walls, ?, Malbranche (UPS, lectotype).

Syn.: *Placodium decipiens* var. *ruderum* (Malbr.) Malbr., Bull. Soc. Amis. Sci. nat. Rouen 2, 13: 48. 1877.; *Placodium ruderum* (Malbr.) H. Olivier, Fl. Lich. Orne: 133. 1884.; *Lecanora decipiens* var. *ruderum* (Malbr.) Hue, F. Bot., Paris 5: 204. 1891.; *Placodium decipiens* subvar. *decipiens* f. *ruderum* (Malbr.) Boistel, Nouv. Fl. Lich. 2: 98. 1902.; *Gasparina decipiens* f. *ruderum* (Malbr.) Mereschk., Enum. Lich. Prov. Baltic.: 21. 1913.

Placodium decipiens var. *camboricum* Larb., Lich.-Herb. exs. no. 90. 1879. (nomen nudum, art. 32)
"Type": England. Cambridgeshire, on Walls of Milton Church and other churches in Cambridgeshire, ?, Larbalestier (BM).

Caloplaca incrustans H. Olivier, Revue Botanique, Courrensan 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-plctenchymatous, 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 ascocarps 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.

Hypothecium colourless. Hymenium 75-125µm high. Asci 40-60 x 12-18µm in size. Hamathecium of 1-1.5µm thick flexuose paraphyses. Paraphyses swollen at tips up to 5.5µm, usually 2 upper cells swollen. Ascospores ellipsoid, 10-15 x 6-8µm in size. Septum 2.5-5µm wide. Apothecia C-, N-, P-, K+ violet-red.

Pycnidia not seen.

Photographs: Fig. 3.24A.

Taxonomic notes: Species characterised by yellowish, never orange, pruinose thallus consisting of irregular shaped convex areoles or granules (easilly visible after removing of pruina, e.g. after 50% HNO_3 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.*

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

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, Dubné, Habří, the locality Háječky, 1 km W of the village, 48°58'50"N, 14°19'20"E, mortar on the old wall of church, 12.3.2002; Lhenice, Smědeč, 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.

25. *Caloplaca saxicola* (Hoffm.) Nordin, Caloplaca sect. Gasparina i Nordeuropa, 87. 1972.

Bas. *Psora saxicola* Hoffm., Descr. Adumb. Pl. Lich. 1 (3): 82, t. 17, f. 3. 1790.
Type: Sweden. (H-herb. Acharius, neotype selected by Nordin 1972)

Lecanora murorum (Hoffm.) Ach.
Parmelia murorum (Hoffm.) Ach.
Amphiloma murorum (Hoffm.) Körb. (Syn.: *Amphiloma murorum* var. *miniatum* (Hoffm) Körb.; *Amphiloma murorum* var. *vulgare* Körb.).
Caloplaca murorum (Hoffm.) Th. Fr. (Syn.: *Caloplaca murorum* var. *corticicola* (Nyl.) Zahlbr.; *Caloplaca murorum* var. *major* Th. Fr.; *Caloplaca murorum* var. *miniata* (Hoffm.) Th. Fr.; *Caloplaca murorum* var. *obliterascens* (Nyl.) Servít; *Caloplaca murorum* var. *pulvinata* (A. Massal.) Jatta).
Gasparrinia murorum (Hoffm.) Tornab. (Syn.: *Gasparrinia murorum* var. *lobulata* (Flörke) Syd.; *Gasparrinia murorum* var. *major* Stein; *Gasparrinia murorum* var. *miniata* (Hoffm.) Stein).

Lecanora miniata (Hoffm.) Ach.

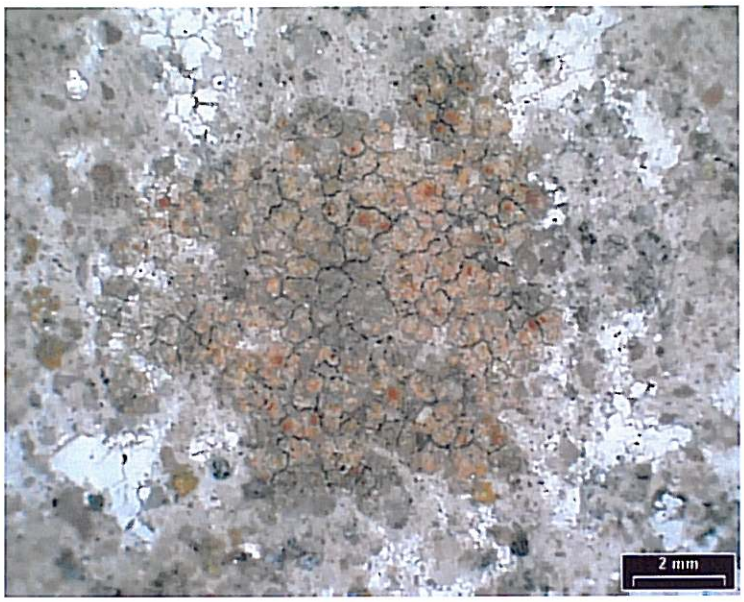
Caloplaca tegularis auct. (Syn.: *Caloplaca murorum* ssp. *tegularis* auct.; *Gasparrinia tegularis* auct.)

Caloplaca pusilla (A. Massal.) Zahlbr.

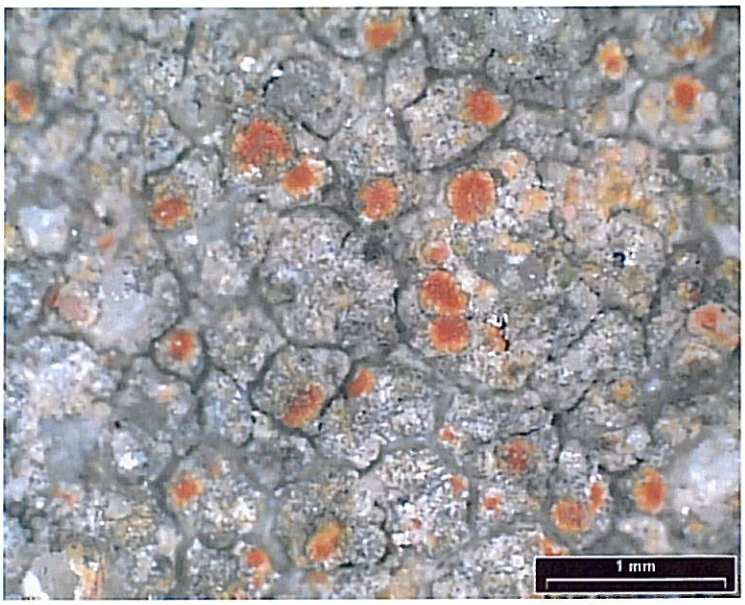
Diagnosis: Thallus yellow-orange, orange to orange-red, sometimes pruinose (mostly on calcareous substrata), usually orbicular, delimited with 0.5-1(-2)mm long marginal lobes, mostly up to 1cm in diameter (rarely to 2.5cm). Marginal lobes convex, shortly branched, 0.1-0.5mm wide. Thallus areolate in centre. Commonly found (mostly in shaded habitats) forms completely without marginal lobes, with thin rimose to areolate thallus (var. *obliterascens*). Prothallus inconspicuous or distinct, fibrilous, 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, plectenchymatous. 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

A



B



C

Fig. 3.24A. ***Caloplaca ruderum.*** A, General view on thallus; B, Thallus with apothecia; C, Apothecia with typical yellow edge in detail.

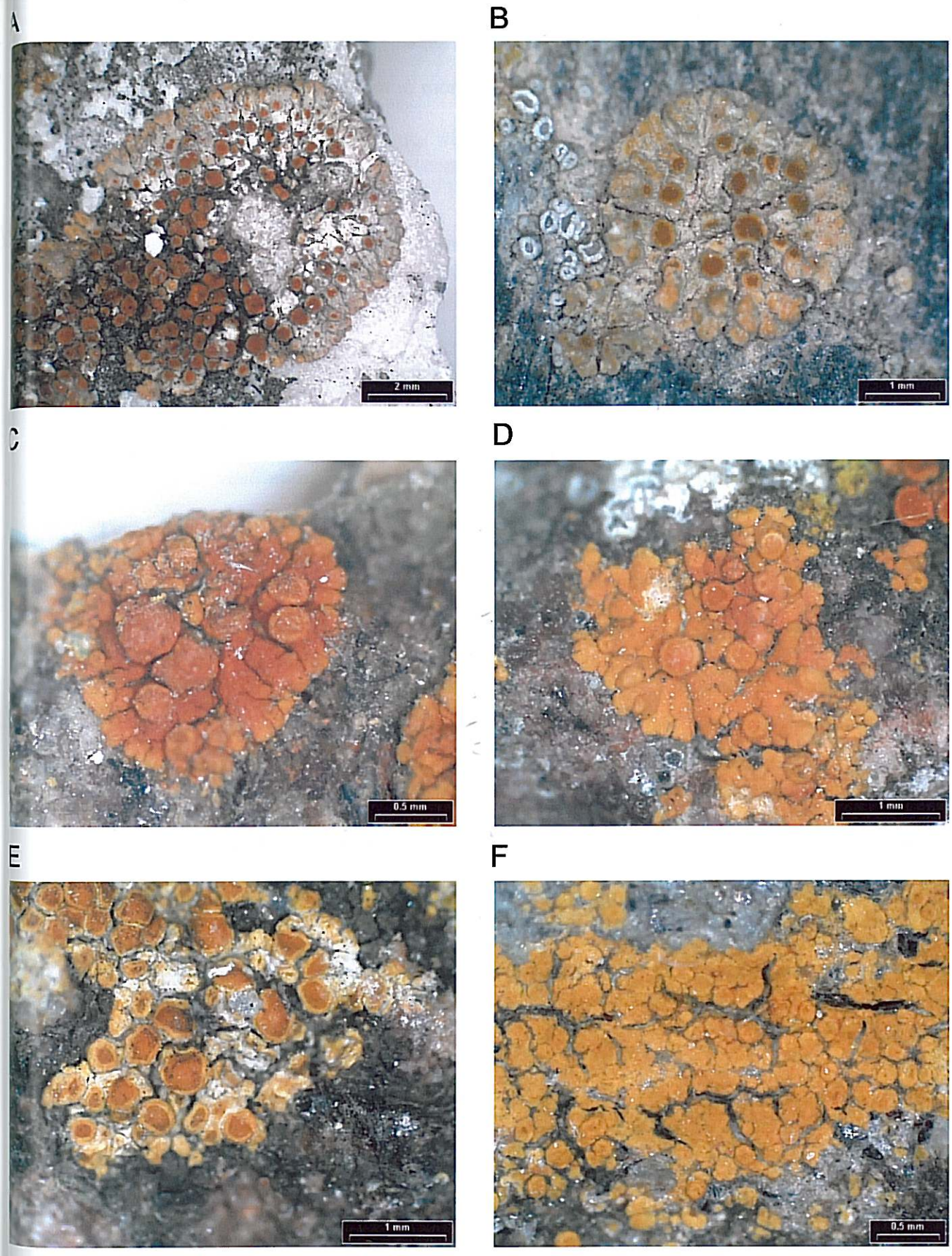


Fig. 3.25A. ***Caloplaca saxicola.*** A, Pruinose thallus typical for calcareous substrata; B-D, Various thallus shapes from non-calcareous substrata; E, Poorly developed thallus without distinct marginal lobes; F, Typical form growing in damp situations completely without marginal lobes.

isodiametric 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. Asci 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. Ascospores 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. aurantia* and *C. flavescens* have larger thalli and broad citriform 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.

References to taxonomy: Poelt et Vězda 1981, Purvis et al. 1992, Wade 1965, Wetmore 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 albolutescens, C. aurantia, C. citrina, C. crenulatella, C. cyrrochroa, C. decipiens, C. demissa, C. dolomiticola, C. flavescens, C. holocarpa, C. teicholyta, Candelariella aurella, C. vitellina, Lecanora albescens, L. dispersa, L. hagenii sensu Wirth 1995, *L. muralis, Lepraria rigidula, Lecidella stigmatea, Phaeophyscia nigricans, P. orbicularis, Physcia caesia, Polysporina 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, Vechtrovka, calcareous rock, 25.4.2001, D. Svoboda (herb. D. Svoboda, sub *C. chrysodeta*); Beroun, Sedlec, in the valley of Kačák brook, on diabas, 6.1.2001, D. Svoboda (herb. D. Svoboda, sub *C. chrysodeta*); Hořovice, 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); Hořovice, Točník, ruin of castle Žebrák, alt. 350m, 49°53'20"N, 13°53'10"E, concrete in the wall of ruin, 31.5.2003; 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 castle, 17.9.2001.

Southern Bohemia. Dubné, Habří, the locality Háječky, 1 km W from the village, 48°58'50"N, 14°19'20"E, gneiss stone in the wall, 12.3.2002; Husinec, Výrov, stone walls in the village, 49°03'00"N, 13°59'50"E,

gneiss rock, var. *obliterascens*, 10.3.2002 (369, 375); Husinec, Výrov, stone walls in the village, 49°03'00"N, 13°59'50"E, gneiss rock, not var. *obliterascens*, 10.3.2002; Křemže, Třísov, rocks ca 200 m A from the ruin of the castle Dívčí kámen, 48°53'30"N, 14°21'30"E, silicate rock, having reduced thallus, 16.5.2002; 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; Pohorská Ves, Pohoří na Šumavě, alt. 910 m., 48°35'50"N, 14°41'30"E, weathered granite next to the road, 12.5.2002; Prachatice, Vitějovice, 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 Zábrdská 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. Karlovy 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 Krašov in Berounka river valley, alt. 300 m, 49°57'N, 13°35'30"E, schist stone in wall of ruin, 14.9.2003.

Northern Moravia. Jeseníky Mts., Vysoká hole Mt., Velký kotel corrie, "Němcův kámen" rock-face, alt. 1170-1180m, schistose overhang, 10.6.2002, Z. Palice (herb. Palice).

Southern Moravia. Mikulov, Sedlec, the locality Skalky, 1,5 km SW from the village, 48°53'40"N, 16°40'30"E, terciéry 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 "Soutěska" 2 km N from the villagePavlov, Klentnice, the locality "Soutěska" 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*).

26. *Caloplaca subsoluta* (Nyl.) Zahlbr., Cat. Lich. Univ. 7: 185. 1931.

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

Lecanora subsoluta (Nyl.) Nyl. in Wedd., Bull. Soc. Bot. France 23: 98. 1876.

Callopisma aurantiacum var. *irrubescens* Nyl. ex Arn., Verh. Zoo.-Bot. Ges. Wien 29: 353. 1879.
Type: Anzi, Lich. Ex. min. rar. super. Ital. 135 (W).

Caloplaca irrubescens (Nyl. ex Arn.) Zahlbr. , Verh. Zoo.-Bot. Ges. Wien 48: 365. 1898.

Xanthoria modesta Zahlbr., Bull. Torrey Bot. Club 35: 298. 1908.
Type: USA. Arizona. (Pima Co.), Tuscon, Station I,northward facing basalt, 2.500 ft. (762 m), March, 1908, J.C. Blumer (W).

Caloplaca modesta (Zahlbr.) Fink, Lichen Fl. U.S. 361. 1935.

Callopisma americanum Malme, Ark. Bot. 20A(9): 298. 1908.
Type: Brazil. Rio Grande do Sul. Silveira Martins pr. Santa Maria, Malme (Malme, Lich. Austroam. 124; S, lectotyp).

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

Blastenia novomexicana Fink ex Hedr., Mycol. 26: 163. 1934.
Type: USA. New Mexico. (San Miguel Co.?), Las Vegas, 12. Nov. 1925, Bro. Anect (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.

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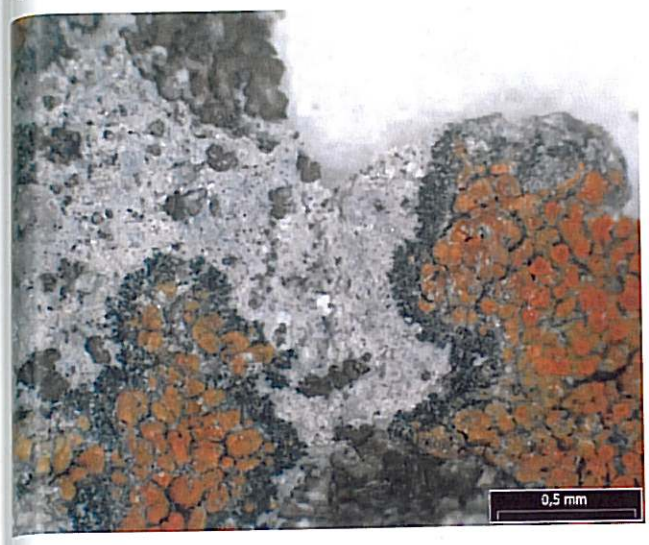

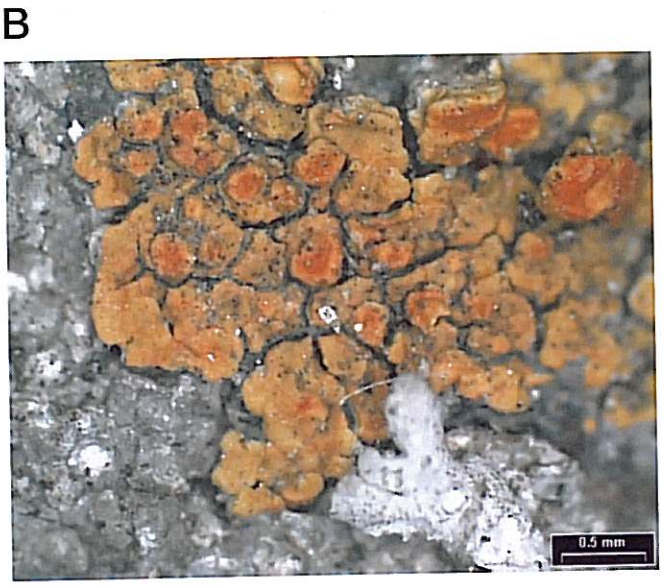

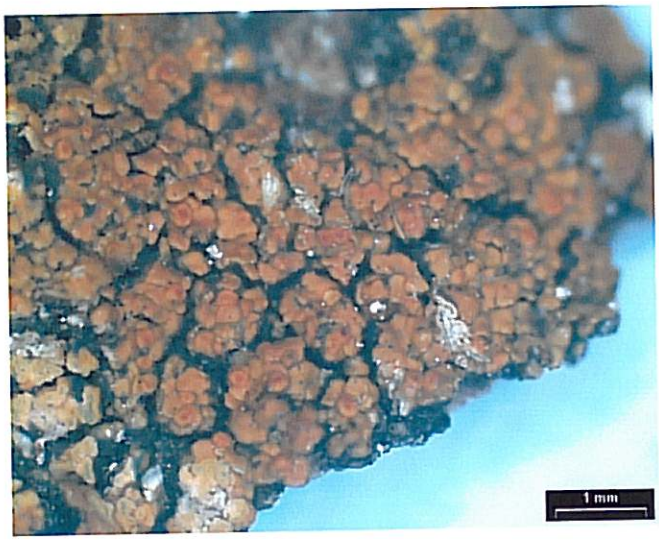

Fig. 3.26A. ***Caloplaca subsoluta.*** A, General view on thallus delimited by black prothallus; B, C, Crustose-rimose thallus with apothecia; D, Heavily sublobate thallus (rather rare).

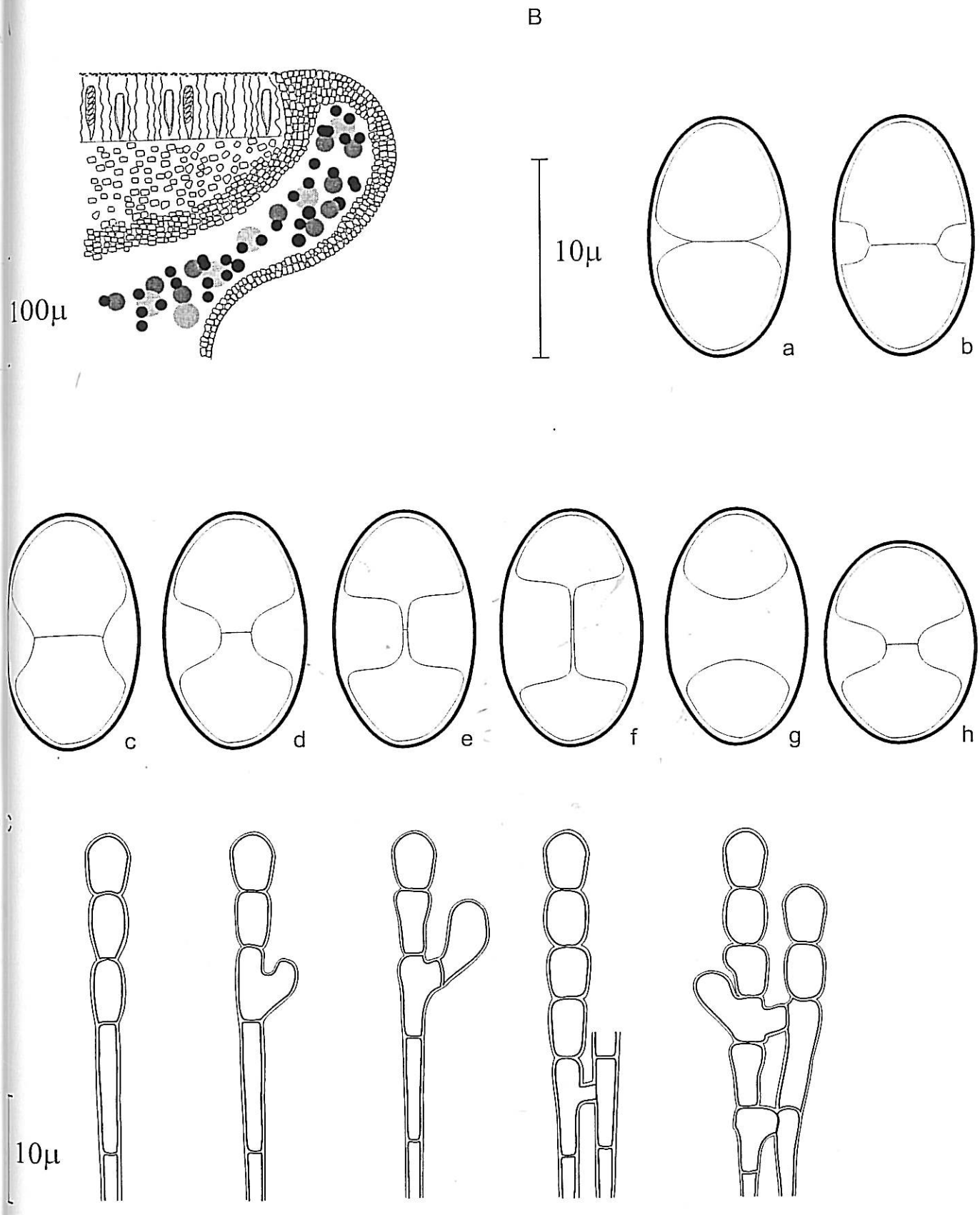

Fig. 3.26B. ***Caloplaca subsoluta***. A, vertical section through an apothecium, showing paraplectenchymatous true excipulum and hypothecium; B, ascospores (a-d, young spores; e,f, ripe spores; g, overripe spor; h, deformed spor); C, paraphyses tips.

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). Thaline 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-plectenchymatic 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. dolomiticola*, 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*.

References to taxonomy: Wetmore 2003.

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 (eg. andesite, basalt, diorite, gneiss, granite, schist, some conglomerates and sandstones). On well-lit, mostly south-facing rocks it forms large colonies, that bland 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 falax*.

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, Rokytná 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 Lovoš" hill in the České středohoří Mts. and rocks in the Blanice river valley in the Southern Bohemia).

Distribution maps: Suza 1942, 1947.

Specimens seen: **Central Bohemia.** Beroun, Hlásná Třebáň, rocks in the Berounka river, alt. 220m, schist, 10.6.1933, Suza (PRM); Beroun, Křivoklát, 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

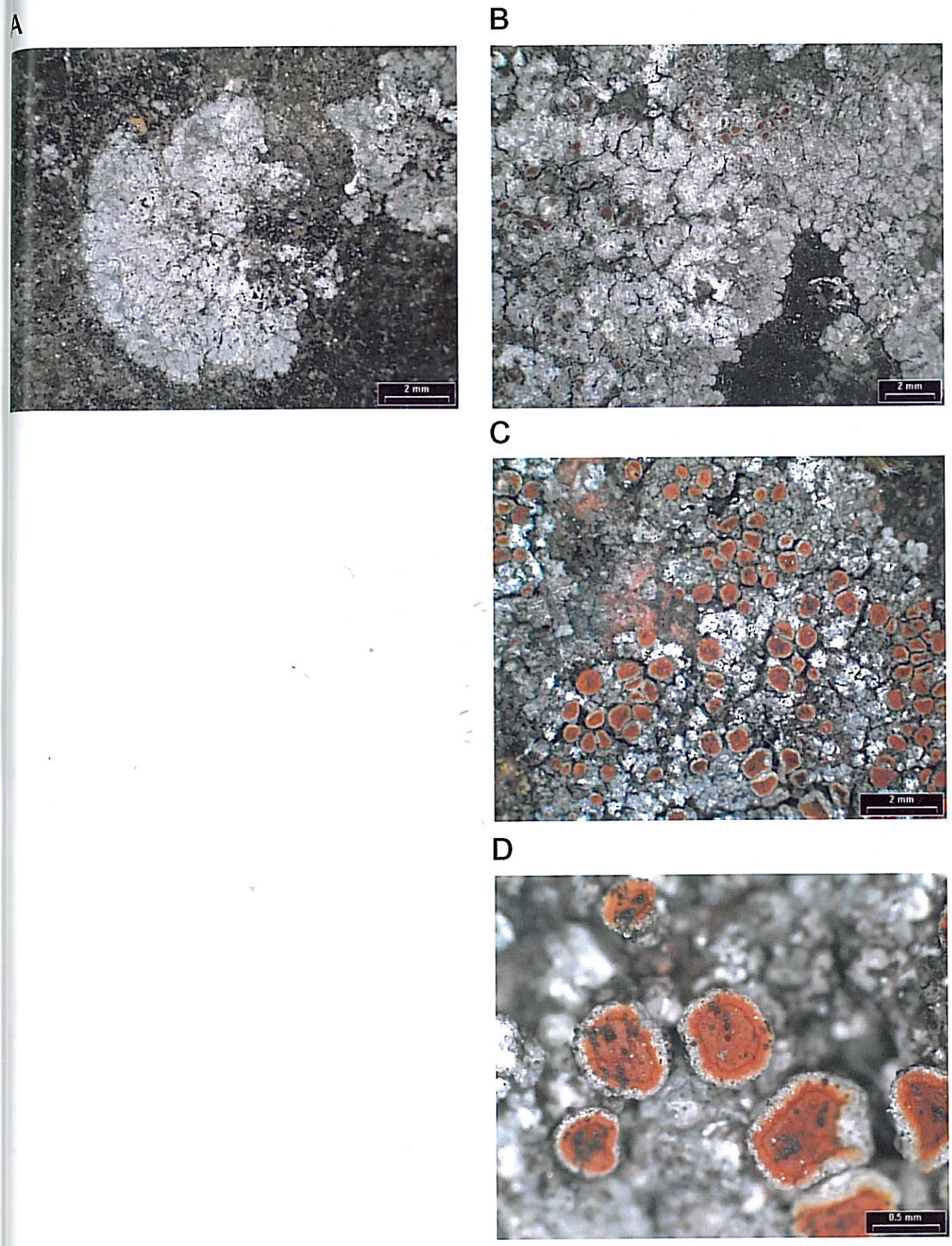

Fig. 3.27A. ***Caloplaca teicholyta.*** A, Thallus without apothecia (common); B, Thallus with apothecia (very rare); C, Thallus with apothecia in detail; D, Apothecia in more detail.

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, Hilitzer (PRM); Rakovník, Skřiváň, 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, alight spilite rock, 16.9.2002; Řevnice, 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; Štěchovice, locality "Svatojánské proudy" in valley of Vltava river, alt. 220m, schist rock, 8.10.1934, Suza (PRM).

Eastern Bohemia. Chrast, Vrbatův Kostelec, diorit, 1913, Kuťák (PRM).

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

Southern Bohemia. České Budějovice, Kamenný 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, vertical side, 17.11.2002; Český Krumlov, Staré Dobrkovice, protected area "Kalamandra", in the village, alt. 530 m., exp. S, 48°49'15"N, 14°17'00"E, vertical side of base-rich gneisseous rock, 8.11.2002; Lažiště, 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, Zvíkovské Podhradí, the castle Zvíkov, alt. 360 m, 49°26'20"N, 14°11'40"E, S-faced rocks beneath the castle, 4.8.2003; Velešín, Hrachovy Hory, the ruin of the medieval castle Velešín, 48°50'00"N, 14°28'45"E, gneiss rock, 7.3.2002;

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

Southern Moravia. Biskupice, rocks above Jaroměřička river, alt. 370m, serpentinit, 6.1929, Suza (PRM); Hrubšice, rocks in valley of Jihlava river, alt. 230m, serpentinit, 5.8.1919, Suza (PRM); Ivančice, Biskoupky, on the serpentine rocks, 5.8.1956, A. Vězda (Vězda: Lich. Bohem. Exs. 206); Brno, Veverská Bytýška, rocks above Svratka river, alt. 340-350m, conglomerates, 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 conglomerates, 19.5.1996, Gruna, Palice; Náměšť n. Oslavou, ruin "Ketkovický hrad", rocks above Oslava river, alt 350m, gneiss, 1921, Suza (PRM); Třebíč, Mohelno, rocky steppe on the left side of the river Jihlava, serpentinit, 1932, Suza (PRM); Znojmo, rock above Dyje river, alt. 210m, granit, 2.5.1920, Suza (PRM); Znojmo, Nový Hrádek, rovk above Dyje river, alt. 350m, schist, 29.3.1932, Suza (PRM).

France. Var. Evenos, alt. 300m, basaltic rock, 3.4.1972, Rondon (Vězda: Lch. Sel. Exs. 1171).

Germany. Baden-Württemberg. Singen, Mt. Hohentweil, alt. 550m, phonolyte rock, 1971, Wirth (Vězda: Lch. Sel. Exs. 1074).

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 walley, andesitic conglomerates, 26.7.2003; Prešov, rocks above village Fintice, alt 300-400m, andesit, 4.8.1938, Suza (PRM); Prievidza, Podhradie pri Prievidzi, on ruin, alt. 550-600m, andesitic rock, 8.1930, Suza (PRM); Spišská Nová Ves, Primovice, Sv. Ondřej, alt. 650m, bazaltic rock, 15.7.1930, Suza (PRM); Zvolen, rocks in the "Neresnica" valley, 300-400m, 16.5.1933, Suza (PRM).

27. *Caloplaca teicholyta* (Ach.) Steiner, Sitz. kaiserl. Akad. Wiss. Wien 104: 384-393. 1895.

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

? *Lichen arenarius* Pers., Neue Annal. der Botan.: 1: 27. 1794. (Syn.: *Lecanora craspedia* var. *arenaria* (Pers.) Ach.; *Lecidea erythrocarpa* var. *arenaria* Schaer., Enum. crit. lich. Eur.: 145. 1850.; *Placodium arenarium* Hepp, Eur. Flecht.: 199. 1853.).
? *Caloplaca arenaria* (Pers.) Müll. Arg., Mém. Soc. Phys. et Hist. Natur. Genéve 16: 387. 1862.).

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

Caloplaca caliacrae Cretz, Lich. Rom. Ex., No. 78., 1939.

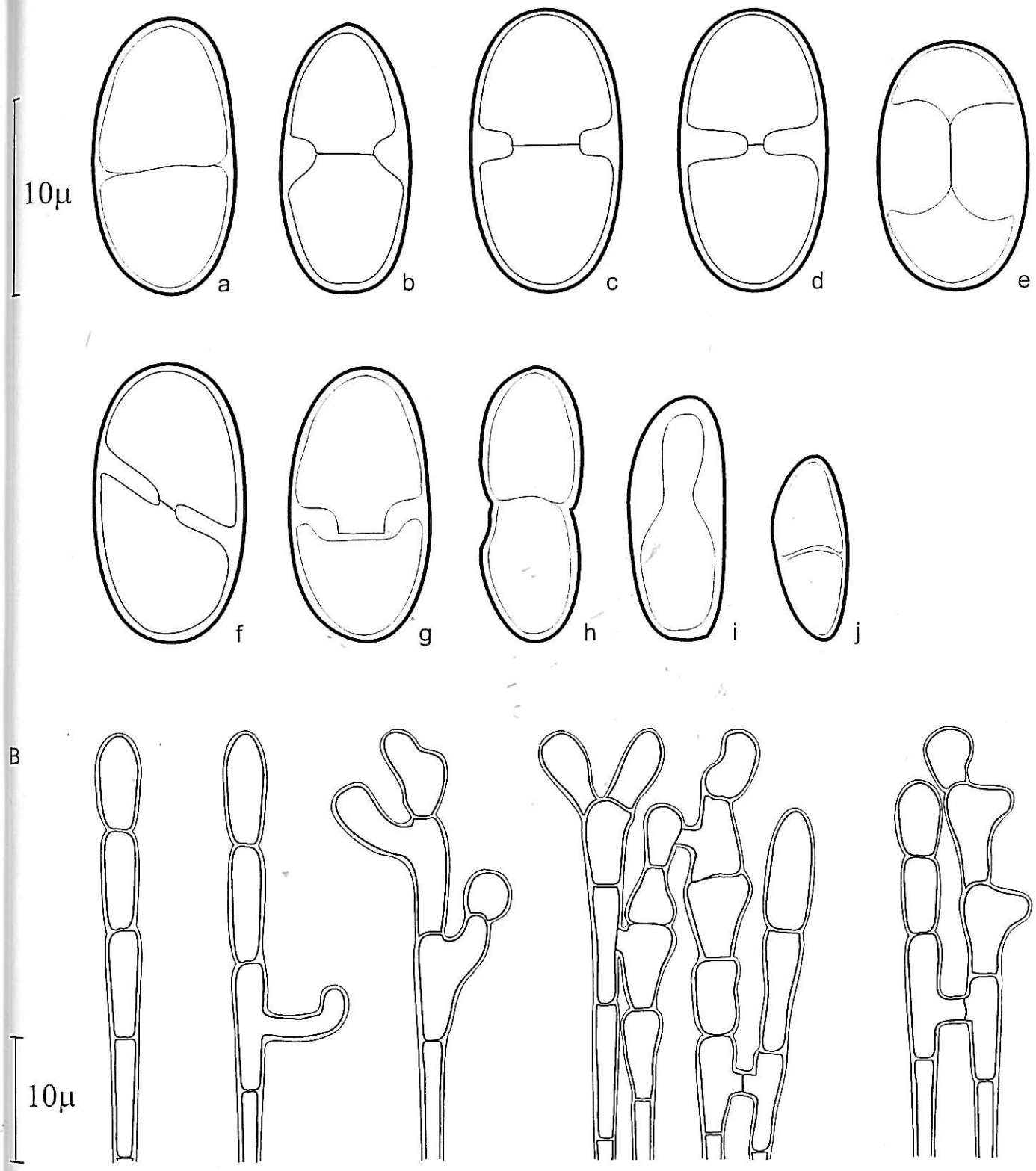

Fig. 3.27B. ***Caloplaca teicholyta***. A, ascospores (a-c, young spores; d, ripe spore; e, overripe spore; f-j, deformed spores); B, paraphyses tips.

Type: Romania. Distr. Caliacra, Cap-Caliacra, alt. 5-10m, 24.4.1938, P. Cretzoiu (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 caesiorufus 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 arenarium, friabile, ferrugineum, inveni. Crusta parca unc. 1-1,5 lata inaequalis. Scutella planiusculae, subrugosae, margine demum pallescunt*" ("thallus leprose, dusty, grey; apothecia yellow-red. Species always found on weathered ?ferrugineous sandstone. Thallus scanty 1-1.5 inches (in diameter), unequally broad. Apothecia flat, sub-wrincled (when old?), apothecial margine 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 Cretzoiu 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, sorediate 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*.

References to taxonomy: Khodosovstev et al. 2002, Purvis et al. 1992, Wetmore 1996, Wade 1965.

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.

Associated lichen species: Aspicilia calcarea, A. contorta, A. cf. *leprosescens, Buellia alboatra, Caloplaca albolutescens, C. citrina, C. crenulatella, C. decipiens, C. dolomiticola, C. holocarpa, C. saxicola, C. xerica, Candelariella aurella, C. medians, Endocarpon pusillum, Lecanora albescens, L. dispersa, L. muralis, Lobothalia radiosa, Phaeophyscia nigricans, P. orbicularis, Placocarpus schaereri, Rinodina gennari, Sarcogyne regularis, Staurothele frustulenta, S. rufa, Verrucaria macrostoma, V. macrostoma* f. *furfuracea, V. nigrescens, V. ochrostoma, Xanthoria elegans, X. papillifera.*

Distribution: Common throughout the Czech Republic.

Specimens seen: **Central Bohemia.** Beroun, Český kras carst, in Berounka river valley, "Hradby" calcareous rocks, alt. 250m, 19.1.2003, D. Svoboda (herb. Svoboda); Beroun, Srbsko, in Berounka river valley, "Tomáškův lom" quarry, exposed calcareous rock above the river, alt. 235m, 19.9.2002, D. Svoboda (herb. Svoboda); Praha, Bůtovice, on diabas, 250-280m, 6.5.1938, Suza (PRM).

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, Třebenice, ruin of castle Košťál, 2 km N of the village, alt. 470 m, 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, Třebenice, Vlastislav, ruin of castle Skalka, alt. 300 m, 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. serpentine outcrop, with *Aspicilia contorta, Staurothele crustulenta*, 8.11.2003; Písek, in the town, concrete, 15.5.2003; Písek, Protivín, Čačárky, 49°12'10"N, 14°13'40"E, horizontally facing concrete, 3.5.2003; 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; Strañany, Doudleby, 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 Dívčí 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.

28. *Caloplaca xantholyta* (Nyl.) Jatta, Nuovo. G. bot. ital. II, 9: 476. 1902.; Zahlbr., Cat. Lich. Univ. 7: 272. 1931.

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!).

Physcia xantholyta (Nyl.) Arnold, Flora (Jena) 64: 310. 1881. (Syn.: *Placodium xantholytum* (Nyl.) Nyl., Lich. Envir. Paris: 46. 1896; A.L. Sm., Monogr. Brit. Lich., ed. 2, 1: 204. 1918.; *Lepraria xantholyta* (Nyl.) Lett., Hedwigia 60: 93. 1918.).

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

Placodium citrinum var. *auratum* Anzi, Lich. Rar. Langobardi Exs. no. 542. 1873. (nom. nudum, Art. 32).
type: Italy (? dist. Verona), calcareous rocks, ?Massalongo, Anzi op. cit. no. 542 A (BM).

Crocyna aurea B. de Lesd., Revue bryol. lichén. 18: 79. 1949.

Diagnosis: Thallus bright yellow, leprose and plectenchymatous, 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.

Taxonomic notes: Easily distinguishable monomorfic species, characteristic with bright yellow, powdery, K+ violet, sublobate thallus. *Caloplaca citrina* differs in having effuse thallus with presence of cortex-covered areoles. *C. chrysodeta* differs in dirty orange to greyish-yellow thallus without distinct delimitation. Leprose species from other genera differ in having K- reaction.

References to taxonomy: Laundon 1974, Purvis et al. 1992, Wetmore 2001.

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.

Specimens seen: **Slovakia.** Martin, Kláštor p. Znievom, mt. Zniev, alt. cca 980m, dark overhang in limestone, 23.7.2003; "Slovenský ráj" National Parc, Hrabušice, nature reserve "Prielom Hornádu" - upper part, 48°57'30"N, 20°24'20"E, alt. 540m, shaded vertical calcareous rock, 9.6.1998, Bayerová, Halda, Palice (herb. Z. Palice).

Great Britain. N. Wales. Bangor, Griffith, 1882 (H-Nyl, no. 30281).

29. *Caloplaca xerica* Poelt et Vězda in Poelt, Mitteil. Bot. München 12: 1-32. 1975.

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).

? *Caloplaca cerina* var. *areolata* Zahlbr., Österr. bot. Z. 53: 289. 1903. (Syn.: *Caloplaca areolata* (Zahlbr.) Clauzade ex Vězda, Schedae ad Lich. sel. exs., 711. 1968.).

Type: Italy. Bocche di Cattaro, Devesite near Castelnuevo, 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*). Thalli often delimited by fibrilous 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 paraplectenchymatous, 4-4.5μm in diameter. Soredia 20-50μm in diameter. Algal layer paraplectenchymatous, 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 morfology 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.

Associated lichen species: Aspicilia contorta, A. gibbosa, A. cf. leprosescens, A. redescens, Caloplaca citrina, C. crenulatella, C. decipiens, C. *dolomiticola, C. subsoluta, C. teicholyta, Candelariella aurella, Lecania inundata, Lecanora dispersa, L. garovaglii, L. muralis, Lecania inundata, Lobothalia radiosa, Peltula euploca, Phaeophyscia nigrescens, P. orbicularis, Staurothele frustulenta, S. rufa, Verrucaria nigrescens, Xanthoria elegans.*

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. 3.2
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apothec
(rare).

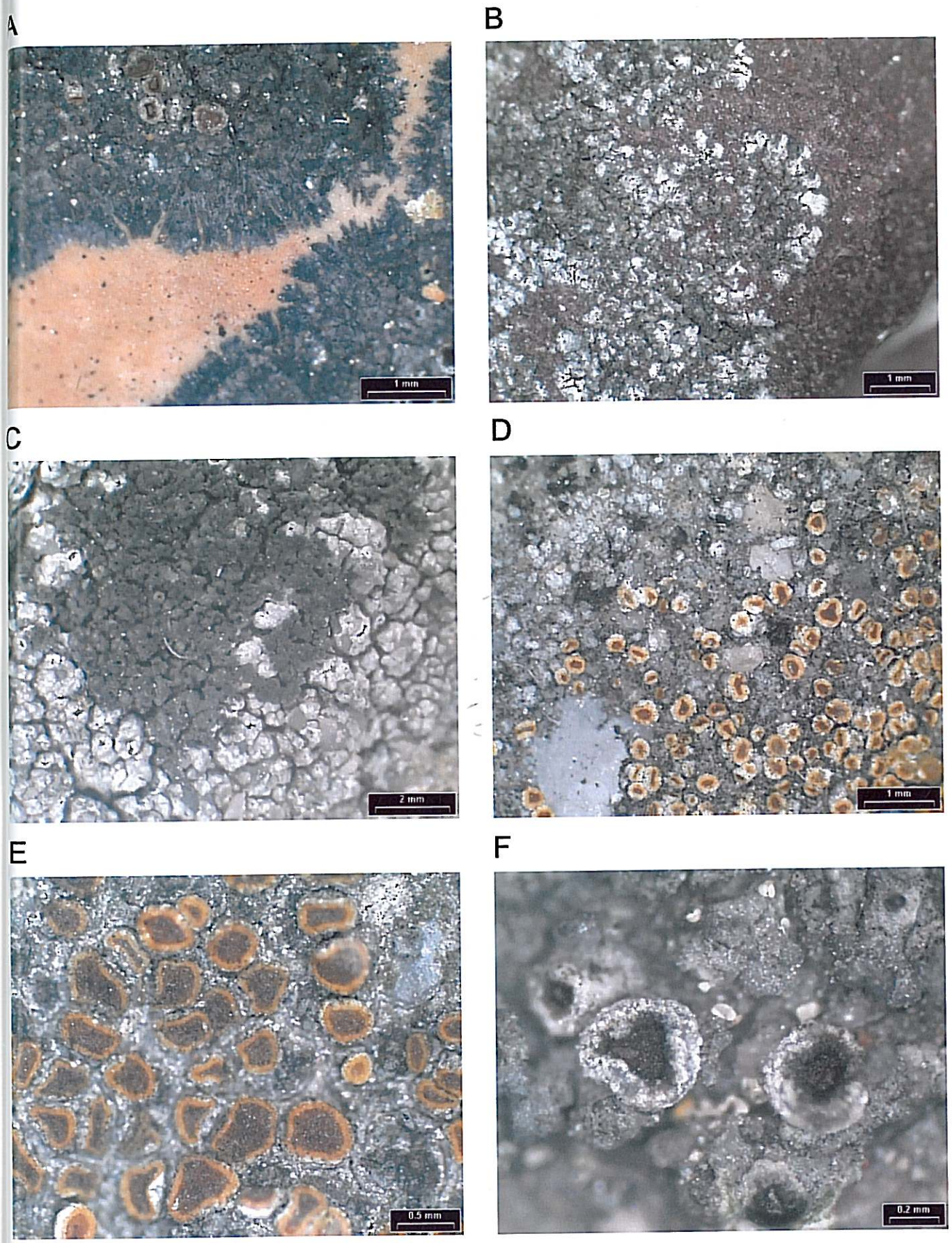

Fig. 3.28A. ***Caloplaca xerica.*** A, Thallus delimited by dark grey prothallus; B, Heavily pruinose thallus producing soralia (dark grey); C, Thallus with marginal lobes parasitic on *Aspicilia*; D, Thallus with young apothecia; E, Apothecia without distinct outer greyish margin; F, Dark apothecia with grey outer margin. (rare).

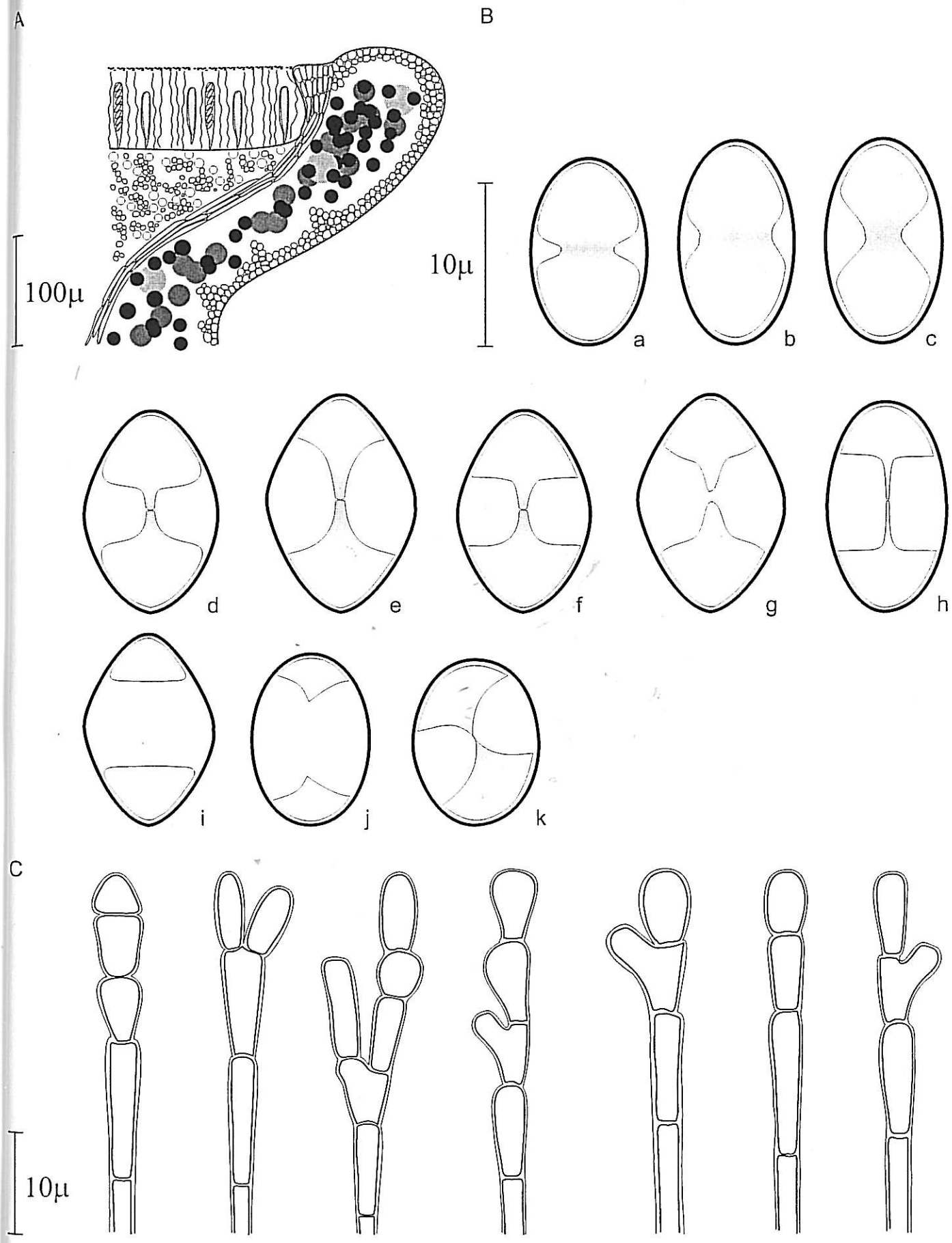

Fig. 3.28B. ***Caloplaca xerica***. A, vertical section through an apothecium, showing plectenchymatous true excipulum consisting of elongated cells; plectenchymatous tissue surrounds hypothecium at the bottom; B, ascospores (a-c, young spores; d-h, ripe spores; i-j, overripe spores; k, deformed spore);C, paraphyses tips.

altitudes) on natural substrates ("Křivoklátská pahorkatina" upland, Moravian pathhills of "Českomoravská vrchovina" upland, České středohoří Mts. and Chřiby 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, Hostím, beneath the hill Hradiště, on weathered carbonate stone, alt. 290m, D. Svoboda (herb. D. Svoboda, in collection of *Caloplaca dolomiticola*, 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, Pustověty, in the village, 50°03'20"N, 13°49'E, horizontal concrete plate, 31.5.2003; 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; 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'N, 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, 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; Vodňany, Bavorov, small bridge S of the village, horizontal concrete plate, 4.6.2003.

Western Bohemia. 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.

Northern Moravia. Jeseníky Mts., Vysoká hole Mt., NE part of Velký kotel corrie, "Beckeho 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 Schlanders, 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 Čabrad' in Litava river walley, 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**

1. *Caloplaca caesiorufa* (Ach.) Flag., Revue Mycol. 17: 104. 1895.

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* Schreder (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. albolutescens*, *C. arenaria*, *C. ceracea*, *C. crenularia* and *C. scotoplaca*) collected in different countries. I have seen some other *C. caesiorufa* samples, mostly Poelt's, Suza's and Zahlbruckner's, that all belong to *C. arenaria* or *C. ceracea*.

2. *Caloplaca Ferrarii* (Bagl.) Jatta, Sylloge Lich. Ital.: 251. 1900.

Bas.: *Callopisma Ferrarii* Bagl., Memor. Accad. Scienc. Torino, ser. 2, 17: 406 and fig. 6. 1858.
Type: Italia. Liguria. Stazzano presso Serravalle, sopra i massi arenisi, coll. P. Ferrari (MOD?).

Caloplaca ferrarii 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. Servít!]). However, *C. ferrarii* var. *diabasicola* is in fact a junior synonym of *Caloplaca crenulatella* (cf. Navarro-Rosines et Hladun 1996).

3. *Caloplaca scotoplaca* **(Nyl.)** H.Magn., K. Vet. Vitterh. Samh. Handl., ser. B 3: 53. 1944.

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

The name *Caloplaca scotoplaca* 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. scotoplaca* 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.

4. *Caloplaca subpallida* H. Nagnusson, Bot. Notis. 1945: 305. 1945.

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

Syn.: *Caloplaca oxfordensis* Hedr., Mycol. 26: 162. 1934.
Type: U.S.A. Ohio. Bulter Co., near Oxford, 9.8. 1909, Fink (MICH, holotype)

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*.

5. *Caloplaca vitellinula* (Nyl.) Oliv., Expos. Lich. Ouest. Fr. 1: 232. 1897.

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. Discusion

4.1. Recent taxonomic research

The genus *Caloplaca* is currently and intensively investigated. Several monographies, mostly on traditional base, have been created (Navarro-Rosinés et Hladun 1996, Wade 1965, Wetmore 1994, 1996, 1997, 2001, Wunder 1974). A lot of new species have been described, even from Europe (e.g. Arup 1993, Breuss 1990, Egea et Llimona 1983, Khodosovtsev et al. 2002, Kondratyuk 1998, Laundon 1992, Navarro-Rosinés et Roux 1995, Poelt 1975, Søchting et Fröberg 2003, Søchting et Stordeur 2001, Thor 1988, Tretiach et al. 2003, Vězda 1978). Most descriptions are based only on morphology and ecology, but some of them are supported by chemical and molecular data.

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. dolomiticola*. It is the subject of speculation, if such taxon contains one heteromorphic or more monomorphic species. Clasical 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. Anthraquinons are characteristic metabolites occurring within the genus *Caloplaca*. Seven specific anthroquinons were recognised within the genus *Caloplaca* by Santesson (Santesson 1970), using lichen mass spectrometry. Recently, 13 different anthraquinons (chlorinated 7-chloremodin and fragilin, non-chlorinated emodin and parietin and their oxidative forms) were recognised by Søchting (Søchting 2001). Søchting 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 anthraquinons (Søchting et Fröberg 2003). Beside anthraquinons some other secondary metabolites were found, such as lecidea green, thalloidima 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. albolutescens*, *C. crenulatella*, *C. chrysodetha*, *C. inconnexa*, *C. "pseudocrenularia"* and *C. ruderum* have not been mentioned from the Czech Republic so far (cf. Vězda et Liška 1999). 4 species, such as *C. caesiorufa*, *C. ferrarii*, *C. scotoplaca* 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.

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Acknowledgements

I thank David Boukal, Othmar Breus, Pavel Cudlín and his co-workers Pavel and Lukáš, Martin Grube, Josef Halda, Štěpánka Hulová, Jan Kaštovský, Jana Kocourková, Jan Kučera, Anna Lepšová, Roland Moberg, Pier Luigi Nimis, Walter Obermayer, Zdeněk Palice, Uwe Passeuer, Hannah McPherson, Karel Prach, David Svoboda, Anders Tehler, Orvo Vitikainen, Anna Vondráková, Ladislav Vondrák, Martin Grube.

I do not thank all the herbarium-curators, who refused to communicate with me.