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The lichenicolous fungi invading *Xanthoria parietina*

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Joy in looking and comprehending is nature's most beautiful gift.

(Albert Einstein)

Abstract:

Fleischhacker Antonia 2011. The lichenicolous fungi invading *Xanthoria parietina*.

Due to nitrogen pollution *Xanthoria parietina* is a vastly spreading macrolichen at least in Europe. Therefore the thallus surface area available for infection by lichenicolous fungi is dramatically increased. Based mainly on Central European material the diversity of lichenicolous fungi invading either thalli and/or ascomata of *X. parietina* has been investigated. The aim of the study was to present a comprehensive treatment of the mycoflora living on this host.

So far 32 species are known to be able to live on *X. parietina*, placing this common macrolichen among the lichen species with an astonishingly rich fungus flora. Various fungal orders contribute one to several members to the xanthoriicolous fungus diversity (number of affiliated taxa in brackets): *Pleosporales* (5), *Capnodiales* (4), *Hypocreales* (4), *Arthoniales* (3), *Verrucariales* (3), *Lecanorales* (1), *Dothideales* (1), *Atheliales* (1), *Tremellales* (1), *Corticiales* (1), *Liceales* (1) and further anamorphic fungi (7).

Five taxa exhibit a narrow host spectrum and appear to be restricted to the *Xanthoria parietina* group, six species appear to be host-specific at the family level. Fifteen species are obligately lichenicolous fungi with a broad host spectrum, whereas six taxa are facultatively lichenicolous, hence more than 60 percent belong to the omnivorous element.

Arthonia parietinaria Fleischhacker & Hafellner is described as new to science. *Polycoccum slaptoniense* and *Pronectria xanthoriae* are new records to Austria.

Various degrees of host specificity of the xanthoriicolous fungi may also be used to support or reject phylogenetic reconstruction models of *Teloschistales*.

Whereas some species such as *Telogalla olivieri*, *Xanthoriicola physciae* and *Arthonia parietinaria* have been present in many of the richer collections, others, like *Hainesia xanthoriae* or *Pronectria xanthoriae*, appear to remain rare even in a *Xanthoria parietina*-dominated landscape.

Kurzzusammenfassung:

Fleischhacker Antonia 2011. Die lichenicolen Pilze auf *Xanthoria parietina*.

Aufgrund von verstärktem Stickstoffeintrag in die Natur gehört *Xanthoria parietina* zu jenen Großflechten, die sich zumindest in Europa erheblich ausbreiten. Daher nimmt die für Infektionen durch lichenicole Pilze verfügbare Thallusoberfläche dramatisch zu. Basierend auf hauptsächlich zentraleuropäischem Material wurde die Diversität von lichenicolen Pilzen, die entweder den Thallus und/oder die Ascomata von *X. parietina* befallen, untersucht. Ziel der Arbeit war, eine umfassende Bearbeitung der Mycoflora dieser Wirtsflechte vorzulegen.

Derzeit sind 32 Arten dafür bekannt, auf *X. parietina* lebensfähig zu sein. Somit gehört diese häufige Großflechte zu jenen Flechtenarten, die eine erstaunlich reiche Pilzflora beherbergen. Verschiedene Pilzordnungen steuern ein bis mehrere Mitglieder zur xanthoriicolen Pilzdiversität bei (Anzahl von zugewiesenen Taxa in Klammer): *Pleosporales* (5), *Capnodiales* (4), *Hypocreales* (4), *Arthoniales* (3), *Verrucariales* (3), *Lecanorales* (1), *Dothideales* (1), *Atheliales* (1), *Tremellales* (1), *Corticiales* (1), *Liceales* (1) and further anamorphic fungi (7).

Fünf Taxa zeigen ein enges Wirtsspektrum und scheinen beschränkt auf die *Xanthoria parietina* Gruppe zu sein, sechs Arten zeigen sich als wirtsspezifisch auf Familienebene. Fünfzehn Arten sind obligat lichenicole Pilze mit einem breiten Wirtsspektrum. Sechs Taxa hingegen sind fakultativ lichenicol. Somit gehören mehr als 60 Prozent zum omnivoren Element.

Arthonia parietinaria Fleischhacker & Hafellner wird als eine neue Art beschrieben. *Polycoccum slaptoniense* und *Pronectria xanthoriae* werden erstmals für Österreich nachgewiesen.

Verschiedene Grade der Wirtsspezifität der xanthoriicolen Pilze können auch verwendet werden, um phylogenetische Modele der *Teloschistales* zu bestätigen bzw. abzulehnen.

Wohingegen einige Arten wie *Telogalla olivieri*, *Xanthoriicola physciae* und *Arthonia parietinaria* in vielen der reicheren Sammlungen vorhanden waren, scheinen andere wie *Hainesia xanthoriae* oder *Pronectria xanthoriae* sogar in einer *Xanthoria parietina*-dominierten Landschaft selten zu bleiben.

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1. Introduction

1.1 *Xanthoria parietina*

1.1.1 Systematics, biology and ecology

Xanthoria parietina (L.) Th. Fr., the type species of *Xanthoria*, is a lichen-forming ascomycete with a great commonness in Europe (Itten & Honegger 2010). It is firstly recognized by its yellow to orange or green-gray (shade form) thallus. Its upper surface appears wrinkled and is smooth to shiny. Further it is characterized by the presence of apothecia, immersed to protruding pycnidia and ellipsoid conidia. *X. parietina* does not produce any vegetative symbiotic propagules but is able to disperse vegetatively via thallus fragments (Honegger et al. 2004; Lindblom & Ekman 2005). For characters distinguishing *X. parietina* from other *X.* species see tab. 1.

The genus *Xanthoria* includes about 30 species. It belongs to the *Teloschistales* on order and to the *Teloschistaceae* on family level (Gaya et al. 2008).

For the habitus appearance and the complete taxonomical position of *X. parietina* see fig. 1.

Fungi

Ascomycota

Pezizomycotina

Lecanoromycetes

Lecanoromycetidae

Teloschistales

Teloschistaceae

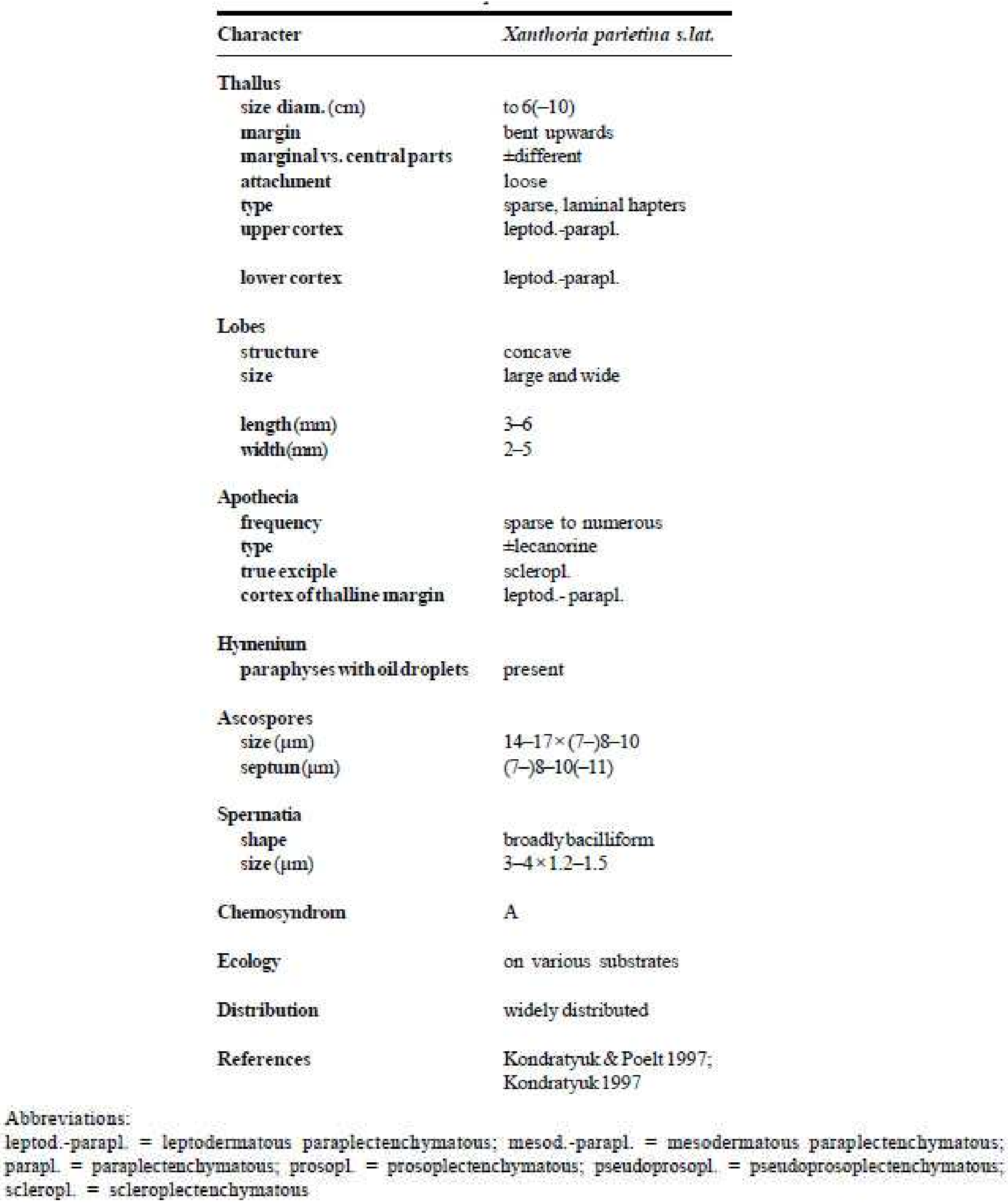
Xanthoria

Xanthoria parietina

Figure 1: *Xanthoria parietina* and its systematic position (classification from Index Fungorum 2008).

Teloschistaceae is a very large family of lichenized fungi and it comprises several well known genera such as *Teloschistes*, *Xanthoria* and *Caloplaca*. Characteristic features of the *Teloschistaceae* are the frequent presence of anthraquinones, various thallus forms (from fruticose to endolithic crustose), the green alga *Trebouxia* or related genera as photobiont, apothecia mostly with well-developed thallin margins, a I+ blue outer layer of the ascus tip and the discharge of ascospores through a vertical slit (Gaya et al. 2008) after a prolongation of all ascal wall layers to the hymenial surface (Bellemère et al. 1986).

Table 1: Character states of *Xanthoria parietina* useful for species delimitation (data from Kondratyuk et al. 2006).



Character	*Xanthoria parietina s.lat.*
Thallus	
size diam. (cm)	to 6(–10)
margin	bent upwards
marginal vs. central parts	±different
attachment	loose
type	sparse, laminal hapters
upper cortex	leptod.-parapl.
lower cortex	leptod.-parapl.
Lobes	
structure	concave
size	large and wide
length (mm)	3–6
width (mm)	2–5
Apothecia	
frequency	sparse to numerous
type	±lecanorine
true exciple	scleropl.
cortex of thalline margin	leptod.- parapl.
Hymenium	
paraphyses with oil droplets	present
Ascospores	
size (µm)	14–17 × (7–)8–10
septum (µm)	(7–)8–10(–11)
Spermatia	
shape	broadly bacilliform
size (µm)	3–4 × 1.2–1.5
Chemosyndrom	A
Ecology	on various substrates
Distribution	widely distributed
References	Kondratyuk & Poelt 1997; Kondratyuk 1997

Abbreviations:
leptod.-parapl. = leptodermatous paraplectenchymatous; mesod.-parapl. = mesodermatous paraplectenchymatous; parapl. = paraplectenchymatous; prosopl. = prosoplectenchymatous; pseudoprosopl. = pseudoprosoplectenchymatous; scleropl. = scleroplectenchymatous

Beside the *Physciacae* the *Teloschistaceae* are one of the key families for the understanding of thallus evolution within natural groups. After the exclusion of some heterogenous elements (e.g. *Protoblastenia*) it was possible to circumscribe the family by some anatomical characters, of which the *Teloschistes*-type asci proved to be the only one that holds all members of the family together (Honegger 1978, Bellemère et al. 1986). A family in this circumscription is also supported by molecular data (Miadlikowska et al. 2007).

Even for little trained lichenologists it is possible to assign a specimen to the *Teloschistaceae* or even to one of its genera. However, at the generic limits even specialists may have difficulties to place correctly samples of certain species. The reason for this seeming contradiction is that as a result of evolutionary processes (thallus, ascospore, secondary chemistry) the generic limits between various genera of *Teloschistaceae* are often not very clear. Reflections on the phylogeny of teloschistalean fungi were published as early as the major linking phenotypic characters became evident (Poelt & Hafellner 1980, Kärnefelt 1989) and the authors came to conclusions which partly still hold in times of the application of molecular methods.

Foliose *Teloschistaceae* are traditionally classified in the genus *Xanthoria*. Before the availability of molecular data and in times of a broader genus concept the presence of a lower cortex on a foliose thallus was regarded as key character to distinguish this genus from other genera in *Teloschistaceae*, namely effigurate to subfoliose species groups in *Caloplaca* (“subgen. *Gasparrinia*) (Poelt & Hafellner 1980, Kärnefelt 1989). However already Poelt & Hafellner (1980) argued that xanthoriod lichens may have evolved in some parallel evolutionary lines from caloplacoid ancestors.

Important phenotypic character complexes for defining or recognizing species groups in xanthorioid lichens are the types of plectenchyma of the cortical layers, the plectenchyma arising from the lower thallus surface by which the thalli are attached to the substrate, the anatomy of the apothecial margins and the shape of the pycnoconidia (Kondratyuk & Kärnefelt 1997, Kondratyuk & Poelt 1997, Poelt & Petutschnig 1992a, b). Up to the late 1990ies expressions and combinations of these characters were mainly used in keys and for the definition of species (Lindblom 2009). But in more recent times for various species groups of *Xanthoria* several new additional genera have been described (Kondratyuk & Kärnefelt 1997, 2003) but most of them are not generally accepted. Of these *Xanthomendoza*, *Rusavskia* and *Oxneria* would include some of the European *Xanthoria* species.

After the exclusion of these genera practically only the *Xanthoria parietina* group remains in the narrowly circumscribed genus. Apart of the type *X. parietina* and several extra-European species *Xanthoria aureola* will in any case continue to belong there.

A number of phylogenetic trees based on various molecular datasets have been published in recent years. They try to answer various questions on various taxonomic levels. Some have the entire family in focus (Gaya et al. 2008), others concentrate on traditional genera or species groups (Fedorenko et al. 2009, Franc & Kärnefelt 1998, Gaya 2009, Gaya et al. 2003, Lindblom & Ekman 2005, Søchting & Lutzoni 2003, Søchting et al. 2002) and several on the infraspecific genetic diversity, namely of *Xanthoria parietina* (Honegger et al. 2004, Lindblom 2009).

In a phylogenetic analysis concentrating on xanthorioid *Teloschistaceae* and based on ITS- and mtSSU sequence data Fedorenko et al. (2009) were able to distinguish five main species groups in *Xanthoria* coll., which could also be regarded as closely related genera. With a more balanced taxon selection covering the entire family *Teloschistaceae* the grouping of the xanthorioid species is less clear, mainly because some of the clades containing xanthorioid species have sister groups with caloplacoid taxa (Gaya et al. 2008, Søchting & Lutzoni 2003). This is practically the final proof of parallel evolutionary lines of various levels of thallus organization.

In Europe *Xanthoria* s. str. contains two collective species, the predominantly epiphytic *X. parietina* and the predominantly saxicolous *X. calcicola*. The data support the distinction of the two species (Franc & Kärnefelt 1998, Lindblom & Ekman 2005). Interestingly Lindblom & Ekman (2005) find also arguments to distinguish *X. calcicola* and *X. aureola* (see tab. 2), the later has been regarded a heterotypic synonym of the former.

Table 2: Distinguishing features between the three related *Xanthoria* species, *X. parietina*, *X. aureola* and *X. calcicola* (Lindblom & Ekman 2005).

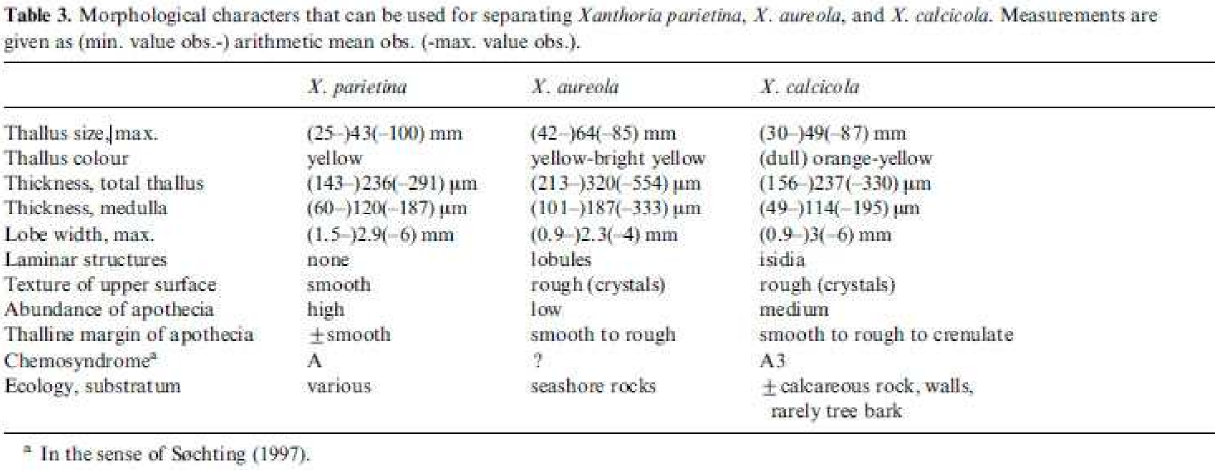


Table 3. Morphological characters that can be used for separating *Xanthoria parietina*, *X. aureola*, and *X. calcicola*. Measurements are given as (min. value obs.-) arithmetic mean obs. (-max. value obs.).

	X. parietina	*X. aureola*	*X. calcicola*
Thallus size, max.	(25–)43(–100) mm	(42–)64(–85) mm	(30–)49(–87) mm
Thallus colour	yellow	yellow-bright yellow	(dull) orange-yellow
Thickness, total thallus	(143–)236(–291) µm	(213–)320(–554) µm	(156–)237(–330) µm
Thickness, medulla	(60–)120(–187) µm	(101–)187(–333) µm	(49–)114(–195) µm
Lobe width, max.	(1.5–)2.9(–6) mm	(0.9–)2.3(–4) mm	(0.9–)3(–6) mm
Laminar structures	none	lobules	isidia
Texture of upper surface	smooth	rough (crystals)	rough (crystals)
Abundance of apothecia	high	low	medium
Thalline margin of apothecia	± smooth	smooth to rough	smooth to rough to crenulate
Chemosyndrome[a]	A	?	A3
Ecology, substratum	various	seashore rocks	± calcareous rock, walls, rarely tree bark

[a] In the sense of Søchting (1997).

As Lindblom & Ekman (2005) already showed there is a great genetical variation within the species *X. parietina*. A similar observation was made by Itten & Honegger (2010) who investigated the genetic diversity within and among populations of this lichen. The study revealed that there exists a high diversity of genotypes with the highest variation within populations. Reasons for this surprising result have been discussed but the lack of comprehending the complete dispersal ecology of *X. parietina* has shown that further investigation is necessary. So Itten & Honegger (2010) have only hypothesized about how dispersal works. One possibility is a short distance dispersal by grazing invertebrates like lichenivouros mites who can contain ascospores of the lichen and photobiont cells in their feces. A passive transport of ascospores, thallus fragments, lichenivorous mites and/ or their fecal pellets by birds is also assumed. Several studies of fungi and their spore dispersal by animals have already revealed possible hints for such mechanisms (Mitchell & Parkinson 1976, Lilleskov & Bruns 2005, Renker et al. 2005).

X. parietina occurs not only on natural but also on anthropogenic substrata reaching from tree bark and rocks to walls and fences (Hill & Woolhouse 1966, Itten & Honegger 2010). It is widely distributed on the world where it is common in urban, industrial and agricultural areas. The abundance of this lichen is doubtless due to its tolerance to high irradiance, seawater elements and air pollution namely nitrogen containing ions (Gaio-Oliveira et al. 2004, 2005).

Due to its commonness and easy accessibility *X. parietina* is certainly a frequently investigated lichen and a popular model for several studies. For this one it constitutes the substrate, the host of diverse lichenicolous fungi.

1.1.2 Distribution

Figure 2: Worldwide distribution of *Xanthoria parietina* (Feuerer 2011).

Fig. 2 shows a distribution map of *Xanthoria parietina* which is based on the evaluation of literature, mainly checklist-data (Feuerer 2011). It is most likely incomplete and perhaps even afflicted with faults but gives a good overview of the almost worldwide distribution of this macrolichen.

So, *X. parietina* is common in North and South America, widely distributed on the whole European continent, has been reported from Africa and Asia and astonishingly also from Australia and New Zealand. There the lichen is regarded as an introduced species, where it is difficult to distinguish from the morphologically similar native species. There is strong evidence that the Australian *X. parietina* has been introduced from southern Europe (Itten & Honegger 2010).

1.1.3 The effects of nitrogen pollution

Due to the increase of atmospheric nitrogen deposition the composition of lichen communities has changed during the last decades. Numerous studies have been already carried out in order to understand the underlying mechanisms for nitrogen tolerance of several lichen species and to point out the consequences for whole lichen associations (Gaio-Oliveira et al. 2004, Frati et al. 2007, Munzi et al. 2009).

Main sources of nitrogen which is deposited in the atmosphere are nitrogen oxides (NO_x) and ammonia (NH_3) (Frati et al. 2008). In industrial and urban areas the dominant nitrogen form is oxidized nitrogen, whereas in rural areas reduced nitrogen is the major source (Gaio-Oliveira et al. 2005). So human acitivities in agriculture such as intensive livestock farming, fertilization and cultivation of nitrogen-fixing crops on the one hand and in industry such as the use of fossil fuels on the other hand can lead to increased atmospheric nitrogen contents and further to nitrogen pollution (Munzi et al. 2009). It is known that there is generally more reduced nitrogen emission than oxidized one, leading to the assumption that farmers are the main nitrogen waste producers (Frati et al. 2008).

Since it is known that *Xanthoria parietina* is a nitrophytic lichen it has been one of the most popular bioindicators or examined lichen species if air pollution or especially nitrogen effects were investigated (Silberstein et al. 1996a, b, Gaio-Oliveira et al. 2004, 2005, Brodo et al. 2007, Frati et al. 2007, 2008, Munzi et al. 2009, 2010, Olsen et al. 2010).

As Silberstein et al. (1996b) have shown, *X. parietina* has probably developed several defence mechanisms against damage by air pollution. They classified them into two classes. The first includes mechanisms such as oxidation of SO_2 to non-toxic sulphate, an increased content of glutathione, an increase in amino acid synthesis and an increased enzymatic detoxification of active oxygen forms, which are induced or stimulated when being exposed to air pollutants. The second consists of constitutive defence strategies like an efficient buffering capacity, a relatively high content of potassium and the antioxidant effect of parietin. The spread of *X. parietina* as a consequence of eutrophication is partly explained by having a low cation exchange capacity. So nitrogen has a limited possibility to bind with the cell walls and as a result a possible toxication is avoided (Frati et al. 2007, 2008, Munzi et al. 2009).

Gaio-Oliveira et al. (2004) investigated the effects of different ammonium concentrations on the vitality of *X. parietina*. They were able to demonstrate that the lichen has a relatively high nitrogen tolerance and that the photobiont was less affected than the mycobiont. Various reasons for the higher resistance of the photobiont were discussed such as the greater mycobiont surface that is exposed to nitrogen. The authors also assumed that the photobiont can better transform the assimilated ammonium into non-toxic compounds (e.g. amino acids and proteins, new cells). They concluded that the photobiont has the advantage in obtaining carbohydrates from photosynthesis whereas the mycobiont is dependent on the photobiont in this case. Furthermore Gaio-Oliveira et al. (2005) showed in an investigation on *X*. *parietina* that with increasing thallus nitrogen the chlorophyll a and ergosterol concentrations increased, with a higher increase in chlorophyll a content.

Members of *Xanthorion* communities (*X*. *parietina*, *Physcia adscendens*, *Phaeophyscia orbicularis* and others) are supposed to be nitrophytic, photophilous and rather xerophytic and to occur predominantly on trees with a bark pH ranging from 5 to 7. Since it has been shown that in areas with intense agriculture the bark pH for *Quercus robur*, which is normally acid, has increased it was hypothesized that the effect of ammonia emissions on lichens is due to a rise in bark pH. In Italy, where dust leads to a drier bark and to a rise in bark pH, one can find *Xanthorion* species also on *Quercus* trees. So in northern and central Europe it is assumed that ammonia pollution causes a shift in lichen species composition from acidophytic to nitrophytic species, whereas in the Mediterranean area from neutro-nitrophytic to strictly nitrophytic species (Frati et al. 2007, 2008). Similar observations can be made in Central Europe, as here in recent times large *Xanthoria parietina* populations colonize branches and twigs in the lower canopy of *Picea abies* and *Larix decidua* namely along roadsides and forest edges in the neighbourhood of pastures.

Munzi et al. (2010) hypothesized that different effects on lichen communities depend on the amount of exposed nitrogen but also on the time span in which lichens are affected. In general, a loss of biodiversity along with an increase in nitrogen can be observed (Munzi et al. 2009).

In consideration of the fact that *X*. *parietina* is a vastly spreading macrolichen in many European countries it will probably become even more dominant in the future. One of the remaining questions is whether the larger and more frequent populations of *X*. *parietina* have an influence on the diversity and commonness of its lichenicolous fungi or not.

1.2 Lichenicolous fungi

Lichenicolous fungi are a group of organisms that form three- or simetimes four to five-membered associations with lichens. They can interact with their lichen hosts as saprotrophs, parasites and parasymbionts (Hawksworth 1982b, Clauzade et al. 1989, Lawrey & Diederich 2003).

According to Hawksworth (1982b) the term parasite for a lichenicolous fungus is only used if it causes visible damage to its host lichen either as local or complete destruction of the host, as the production of discolorations or as the development of gall-like malformations. The author distinguishes further between saprophytes, which may be obligately lichenicolous or widespread also occuring on other substrates and parasymbionts, which have a stable relationship with their hosts. So it is assumed that parasymbionts obtain surplus carbohydrates from the algae of the lichens and that the displacement of the mycobiont by the parasymbiont in order to form a new lichen thallus is possible.

Parasitical behaviour ranges from relatively commensalistic to aggressive and is aimed at obtaining fixed carbon from living lichens. The saprotrophic lichenicolous fungi are supposed to have rather loose and short-term interactions with lichens and get their fixed carbon from decaying lichen tissues. So many of them can not be termed as obligately lichenicolous.
Most of the lichenicolous fungi are supposed to be biotrophic and to exhibit a low virulence, tend to be host-specific and usually do not kill entire lichen thalli. A lengthy coevolution may underlie this interaction. In contrast, necrotrophic mycoparasites on lichens show a high virulence, are generalized in their host selection and kill their hosts (Lawrey & Diederich 2003).

Diederich (2000) hypothesizes that almost all host-specific lichenicolous fungi live on a group of lichens that is monophyletic and that the fungi are as old as the ancestor of these lichens.

But there is a gap in knowledge concerning the background of the interactions between lichenicolous fungi and their hosts, that is to say the mechanisms of cellular contact, nutrient exchange or virulence (Lawrey & Diederich 2003). Rios et al. (2000) already observed varios infection mechanisms of lichenicolous fungi and found that some of them infect the photobionts with haustoria. They also discovered mycoparasites. Some lichenicolous fungi are supposed to degrade parts of the host plectenchyma.

Most of the lichenicolous fungi are supposed to be host-specific on various levels. 95% of them should be found only on a single host genus and around 99% are thought to be specialized to some extent (Lawrey & Diederich 2003).

Over 95% of already described lichenicolous fungi are ascomycetes. In general, they produce either apothecia, perithecia or pseudothecia as ascomata, which are mostly between 0.1 and 0.4 mm in diameter. The life cycle of lichenicolous ascomycetes may also be incompletely known. They are called coelomycetes, if they are able to produce vegetative mitospores enclosed within pycnidia, or hyphomycetes, if the conidiophores are loose and not fixed in an enclosed structure (Lawrey & Diederich 2003).
Three groups of lichenicolous basidiomycetes can be distinguished, namely the lichenicolous Agaricales, a heterogeneous assortment of sclerotial fungi (e.g. *Athelia*, *Marchandiobasidium*) and the heterobasidiomycetes (e.g. *Tremella*, *Syzygospora*) (Lawrey & Diederich 2003).

An intensive literature, herbarium and fresh material research showed the occurrence of 32 lichenicolous species on *Xanthoria parietina*. They belong to several fungal orders (number of affiliated taxa in brackets, taxonomic classification from Index Fungorum 2008/ MycoBank 2011): *Pleosporales* (5), *Capnodiales* (4), *Hypocreales* (4), *Arthoniales* (3), *Verrucariales* (3), *Lecanorales* (1), *Dothideales* (1), *Atheliales* (1), *Tremellales* (1), *Corticiales* (1), *Liceales* (1) and further anamorphic fungi (7).
For a detailed treatment of the species see the chapter on results.

The lichenicolous fungi of *Xanthoria parietina*:

Etayo & Berger (2009) already investigated the diversity of lichenicolous deuteromycetes which contribute to the decomposition of *Xanthoria parietina*.
The aim of this study was to give an overview of all taxa of lichenicolous species already recorded on *Xanthoria parietina*, to make new records and document them with voucher specimens in the herbarium GZU, to possibly discover and describe new species and to elucidate if the host lichen becoming so common and dominant has an influence on the regional diversity and commonness of its lichenicolous fungi.
Furthermore an attempt is made to use the various degrees of host specificity of the xanthoriicolous fungi to support or reject phylogenetic reconstruction models of *Teloschistales*.

2. Material and methods

Great amounts of branches covered with *Xanthoria parietina* were collected from trees which are a preferred substrate for this macrolichen, like *Juglans regia* or *Fraxinus excelsior* from various localities occasionally on single days from October 2010 until July 2011 and checked for the occurrence of lichenicolous fungi. The species were identified with the aid of already named fungi from the herbarium of the Institute of Plant Sciences in Graz (GZU), with the determination key from Clauzade et al. (1989) and other literature (see chapter on results). This first study phase resulted in the preparing of a number of herbarium specimens deposited in the herbarium GZU. Further specimens of GZU and a loan from P. Diederich completed the material studied.

For the compilation of a list of all lichenicolous fungi growing on *Xanthoria parietina*, literature was screened, as well as herbaria were combed through in addition to the investigation of fresh material.

The searching for fungi as well as morphological studies were carried out under a dissecting microscope (WILD M3B, 6.4-40x). Anatomy was studied with a light microscope (ZEISS Axioskop, 40-1000x). Sections were usually done by hand. In order to obtain very thin sections (12-15 µm) a freezing microtome (LEITZ) was used.

Tab water was generally the liquid for the microscopic preparations as well as for the measurements. Furthermore, the following standard microscopic reagents were used: KOH (K), Lugol’s reagent (I), lactic acid-cotton blue (LCB) and cresyl blue (CRB).

Photographs were taken with a LEICA WILD M3Z stereo-microscope and a ZEISS HBO 50 light microscope assembled with a ZEISS Axiocam MRc5 camera.

3. Results

3.1 Obligately lichenicolous fungi

3.1.1 Lichenicolous fungi with a host-specificity to the *Xanthoria parietina* group

I. *Arthonia parietinaria* Fleischhacker & Hafellner, sp. nov. (*Arthoniomycetes*: *Arthoniales*/*Arthoniaceae*)

MycoBank xxxxxx

Latin diagnosis to be added in the manuscript for publication.

Type: Austria, Steiermark (Styria), Oststeirisches Hügelland, Graz, eastern suburban area, Ragnitztal, near the rivulet "Ragnitzbach'' at lower end of Dr. Hanischweg, 47°04'35''N / 15°28'50''E, ca. 380m, GF 8958/2, old orchard, on canopy branches of recently felled *Juglans regia*, (1), 1.VII.2010, J. Hafellner 77067 (GZU – holotype, BCN, BR, CANB, E, GZU, LE, M, NY, PRM, UPS – isotypes). Isotypes to be distributed in Lichenicolous Biota no. adhuc ined.

Figure 3: *Arthonia parietinaria* on *Xanthoria parietina* (Hafellner 77067, holotype).

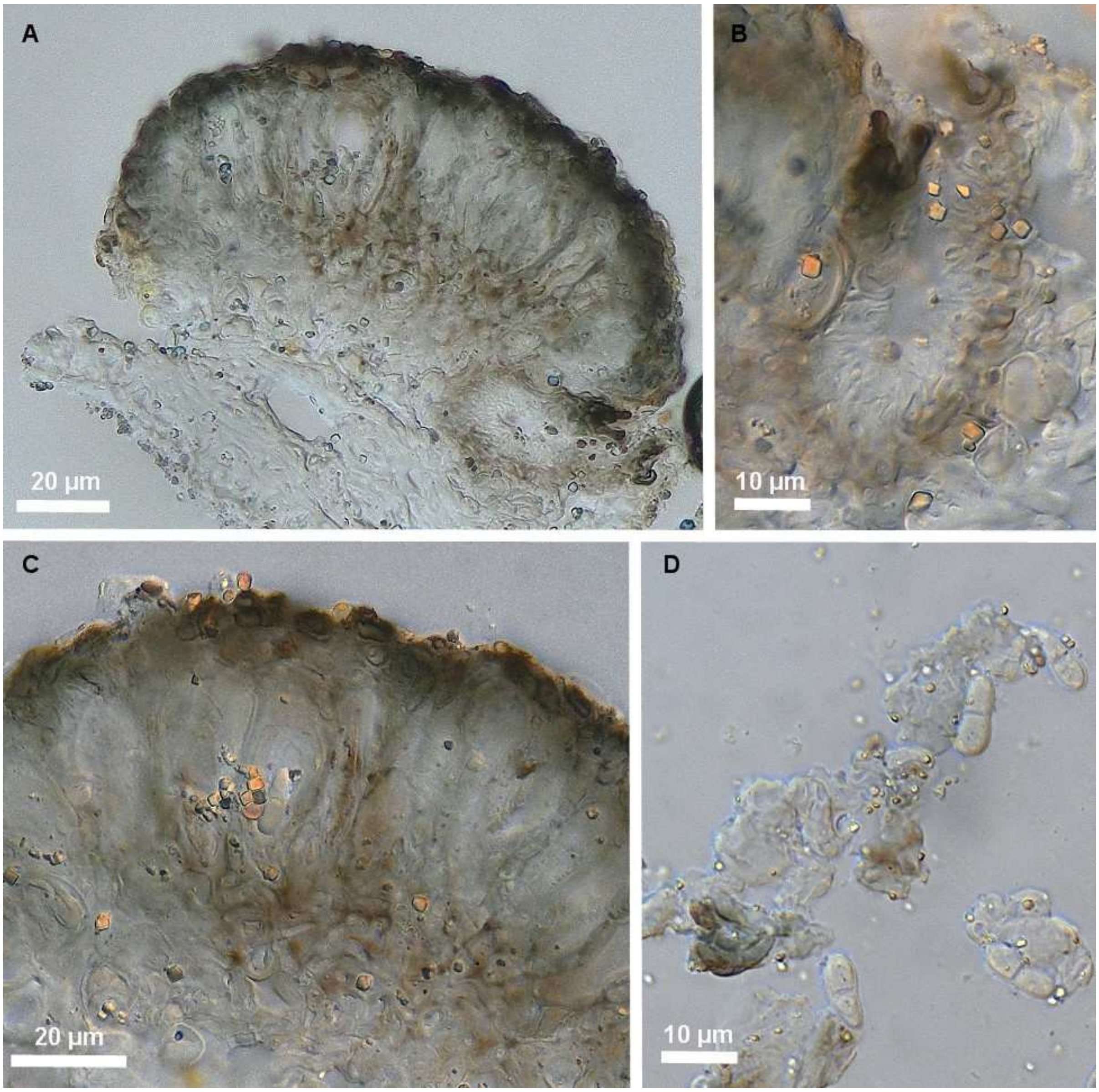


Figure 4: *Arthonia parietinaria*. A, Ascoma and pycnidium in longitudinal section. B, Pycnidium close-up of A. C, Hymenium. D, Squash preparation with some ascospores. From holotype, medium: water.

Iconography: Vězda 1970: 223, fig. 1 (drawings of asci, ascospores and paraphysoids); Giralt 1996: 365, fig. 54 a (drawing of ascospores); this paper: 17, fig. 3 (habit photograph), 18, fig. 4 (A, vertical section of an ascoma and a pycnidium; B, pycnidium in longitudinal section; C, part of the hymenium; D, ascospores in squash preparation).

Exsiccata (all on *Xanthoria parietina*): Hafellner, Lichenicolous Biota no. adhuc ined. – isotypes (BCN, BR, CANB, E, GZU, LE, M, NY, PRM, UPS) [the Ragnitz material]. – Hafellner, Lichenicolous Biota no. adhuc ined. – duplicates of paratype (BR, CANB, E, GZU, M, NY, UPS) [the Stifting material]. – Hafellner, Lichenicolous Biota no. adhuc ined. –

duplicates of paratype (BCN, BR, CANB, GZU, LE, NY, UPS) [the St. Michael material]. – Hafellner, Lichenicolous Biota no. adhuc ined. – duplicates of paratype (BR, CANB, E, GZU, NY, PRM, UPS) [the Cezsoca material]. – Santesson, Fungi Lichenicoli Exs. no. 377, sub *Arthonia molendoi* (GZU).

Etymology: *Arthonia parietinaria* is named after its host, *Xanthoria parietina*.

Description: Ascomata blackish, dull, up to 0.24 mm in diam., arranged in groups of up to 30 – 50, convex, more or less roundish, distributed over the surface of the host thallus including apothecia, where it causes no destruction but sometimes slight discolorations. Exciple lacking. Hymenium pale greyish, K/I+ blue, 30-45 µm tall. Epihymenium dark brown with a bluish tinge, K+ chestnut-brown. Hypothecium brown, K/I-, directly underneath lying hyphae K/I+ blue. Vegetative hyphae K/I+ blue. Interascal filaments paraphysoidal, septate, branched and anastomosed, apically swollen with pigmented cap (about 2-5 µm thick). Asci clavate, 8-spored, K/I+ blue, hemiamyloid ring structure in the endoascus present, dehiscence fissitunicate, 26-35(-37) x (11)-12-15.5-(16.5) µm. Ascospores hyaline (when old, getting brownish), K/I-, 1-septate, upper cell somewhat broader and mostly shorter, perispore present, (9)-10-12-(13.5) x (3)-4-5-(6) µm. Pycnidia globose. Non-pigmented parts of the pycnidial wall K/I+ blue. Conidiophores of type I-II (Vobis & Hawksworth 1981) producing ellipsoid pycnospores. Lichenicolous fungus growing on *Xanthoria parietina*.

Arthonia parietinaria is not rare but in the past it has not been recognized as a distinct species. Previous records of this species usually have been published under the name *Arthonia molendoi* or *A*. *epiphyscia*. *A*. *parietinaria* differs from *A*. *molendoi* and *A*. *epiphyscia* in causing larger infections and therefore also by the higher mean numbers of ascomata per infected patch. A further distinguishing characteristic is the host selection. It can be distinguished from *A*. *molendoi* by the less intense coloration of the ascomata (black in *A*. *molendoi*, blackish with brownish tinge in *A*. *parietinaria*). For differences between *A*. *parietinaria*, *A*. *molendoi* and *A*. *epiphyscia* visible in a light microscope see tab. 3.

Table 3: Selected character states of *Arthonia parietinaria* and the often confused *A*. *molendoi* and *A*. *epiphyscia*.

	A. parietinaria	***A. molendoi***	***A. epiphyscia***
colour of hymenium	pale greyish	pale brownish	pale brownish
pigmentation of epihymenium	dark brown with a bluish tinge	dark brown with a red brown tinge	olive brown
chemical reactions of epihymenium	K+ chestnut-brown	K-	K-
colour of hypothecium	brown	pale yellowish	olive brown

Remarks: Kukwa (2004) who classified it as *Arthonia* aff. *molendoi* states that the hypothecium reacts hemiamyloid (different in the protologue!). Perhaps the layer was confused with the hyphae beneath which are K/I+ blue.

Hosts: *Xanthoria parietina* (1) (thallus and apothecia). *Xanthoria parietina* var. *adpressa*, *X. candelaria* var. *torulosa* and *Xanthomendoza fallax* are recorded in the literature (see paragraph on distribution).

Ecology: *Arthonia parietinaria* lives on *Xanthoria parietina* where it causes no destruction. The hyphae which according to its reactivity belong to this fungus occur in the vicinity of living algal cells of the host thallus. Its behaviour is therefore regarded as parasymbiotic. Larger groups of ascomata may cause slight discolorations on the host thallus. In this case the fungus could be called “a weak parasite” as well. It is not rare and has been rather frequently reported in recent years. This might correlate with the permanently increasing occurrence of the host lichen due to nitrogen pollution (see chapter in introduction). *Arthonia parietinaria* is found in various habitats ranging from solitary trees and orchards to open forests.

Distribution: *Arthonia parietinaria* is widely distributed and has been reported under various names for many countries. The following distribution data are based on records from various *Arthonia* species (*Arthonia molendoi* or *A.* aff. *molendoi* (A) or *A. molendoi* p.p. or *A.* aff. *molendoi* p.p. (A#), *Arthonia epiphyscia* or *A. epiphyscia* s. l. (B) or *A. epiphyscia* p.p. (B#), *Arthonia clemens* or *Conida c.* (C), *Arthonia destruens* or *Conida d.* (D), *C. destruens* f. *maculans* (E) and *Conida lecanorina* (F)) always with *Xanthoria parietina* as reported host. The abbreviation p.p. means that the authors mentioned *Xanthoria parietina* as one of several hosts. The species is so far known from the following European countries: Austria (Rehm 1890: 423 f. as (E), Keissler 1913: 386 as (F), 1930: 72 ff. as (C)), Belgium (Ertz et al. 2008: 39 f. as (A), Santesson 2008: 10 as (A)), Estonia (Suija et al. 2010b: 105 as (A)), Germany (Rehm 1890: 423 f. as (E), Triebel & Scholz 2001: 214 as (B), Cezanne et al. 2008 as (B), Brackel 2010b: 9 as (A)), Italy (Brackel 2011: 67 as (A#) including a record on an additional host *Caloplaca cerina*), Lithuania (Motiejūnaitė et al. 2011: 40 as (A)), Norway (Santesson 1993: 17 as (A#) with additional host *Xanthoria polycarpa*), Poland (Kukwa 2004: 67 as (A) with short description, Czyzewska & Kukwa 2009: 17 f. as (A#)), Slovakia (Vězda 1970: 221 as (B) with short description (identity uncertain)), Spain (Werner 1937: 64 as (C) on *Xanthoria candelaria* var. *torulosa*, Giralt & Gomez-Bolea 1988b: 195 as (B), Calatayud et al. 1995: 369 as (A#), Giralt 1996: 364 ff. as (B) with short description and drawing of ascospores (365: Fig. 54 a), Martínez et al. 2002 as (B), Burgaz et al. 2007: 139 as (A), Etayo 2010: 36 ff. as (A#)), Sweden (Santesson 1993: 17 as (A#) with additional host

Xanthoria polycarpa), Switzerland (?Rehm 1890: 424 as *Arthonia nephromiaria* (this record remains doubtful because Stizenberger (1882: 479) to which Rehm refers to cites only *Physcia stellaris* as host under that name; other records of the species from Switzerland to which Rehm might refer to we could not trace)), Ukraine (Kondratyuk & Khodosovtsev 1997: 589 as (C), as (D) with additional host *Xanthoria lobulata*), the British Isles (Hawksworth 1975 as (B), Coppins 1992: 81 as (B#), Hitch 2010: 120 as (A)). From Africa it is reported from Morocco (Werner 1932: 163 as (C), 1938: 134 as (C)). In America it is already known from Chile (Etayo & Sancho Garcia 2008: 46 as (A) on *Xanthomendoza fallax*). Asian reports exist for Israel (Kondratyuk et al. 2005 as (A#) including an additional host *Xanthoria mediterranea*). In Australasia it has been reported from New Zealand (Kondratyuk & Galloway 1994: 26 as (B) on *Xanthoria parietina* var. *adpressa*).
Based on specimens cited below the species is added to the Mycoflora of Croatia, Greece, Luxembourg, Slovenia, Armenia and the Canary Islands.

Further specimens examined (representing paratypes): **Europe: Austria:** Steiermark, Oststeirisches Hügelland, Loimeth ca. 8 km NW von Fürstenfeld, 47°06’52’’N / 16°01’56’’E, ca. 335 m s. m., GF 8862/3, Mähwiese mit zerstreuten Obstbäumen, an tief hängenden Kronenästen von *Malus domestica*, (1), 16.X.2010, leg. A. Fleischhacker 10001 (GZU). – Steiermark, Oststeirisches Hügelland, Loimeth ca. 8 km NW von Fürstenfeld, 47°06’52’’N / 16°01’56’’E, ca. 335 m s. m., GF 8862/3, Mähwiese mit zerstreuten Obstbäumen, an tief hängenden Kronenästen von *Juglans regia*, (1), 16.X.2010, leg. A. Fleischhacker 10005 (GZU). – Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06’57’’N / 15°26’18’’E, ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 21.III.2011, leg. M. Pinter, det. A. Fleischhacker 11007 (GZU). – Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06’57 ’’N / 15°26’18’’E, ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 5.VI.2011, leg. M. Pinter, det. A. Fleischhacker 11015 (GZU). – Steiermark, Nördliche Kalkalpen, Hochschwab-Gruppe, Seetal W von Seewiesen, ca. 10 km NE von Aflenz, 47°37’14’’N / 15°15’02’’E, ca. 950 m s. m., GF 8357/4, Baumreihe am Rand einer Weidefläche, an Kronenästen von *Fraxinus excelsior*, (1), 20.VII.2011, leg. A. Fleischhacker 11017 & M. Sebernegg (GZU). – Steiermark (=Styria), Oststeirisches Riedelland, 7.3 km E of the center of Graz, 300 m SW of Neudörfl, 47°05’06’’N, 015°31’55’’E, (grid number 8959/1), 44 0 m altitude, *Fraxinus* trees between a street and a brook, on dead twigs of *Fraxinus excelsior*, (1), 3.VII.2011, leg. W. Obermayer (12171), det. J. Hafellner (2011) (GZU). – Styria (Steiermark), Nördliche Kalkalpen, Ennstaler Alpen, Radmer an der Hasel ca. 9 km SW von Hieflau, S-Hänge N ober dem Schloß Greifenberg, 47°31’50’’N / 14°42’45’’E, ca. 940 m, GF 8454/3, Baumreihe am Rand einer Mähwiese, auf tief hängenden Kronenästen von *Fraxinus excelsior*, (1), 19.XI.2006, leg. J.

Hafellner no. 69282 (GZU). – Steiermark (Styria), Nordalpen, Nördliche Kalkalpen, Hochschwab-Gruppe, Seetal W von Seewiesen, ca. 10 km NE von Aflenz, 47°37'15''N / 15°15'20''E, ca. 930 m, GF 8357/4, Baumreihe am Rand einer Mähwiese, an tief hängenden Kronenästen von *Fraxinus excelsior*, (1), 18.XI.2007, leg. J. Hafellner no. 69400 (GZU, herb. Hafellner). – Steiermark (Styria), Steirisches Randgebirge, Fischbacher Alpen, [„Oststeirisches Hügelland''], an der Straße von Birkfeld nach Ratten, N der Abzweigung nach Strallegg, 47°25'05''N / 15°41'40''E, ca. 645 m, GF 8560/3, Ufergehölzstreifen, an *Fraxinus excelsior*, (1), 22.X.1989, leg. J. Hafellner no. 22193 & A. Hafellner (GZU). – Steiermark (Styria), Oststeirisches Riedelland, 7 km NE of the centre of Graz, along the road from Stifting to Schaftal, close to the junction to Schillingsdorf, 47°06'09''N / 15°30'42''E, ca. 435 m alt., GF 8859/3, fruit trees in a meadow by the road, on twigs of *Pyrus communis*, (1), 18.V.2010, leg. W. Obermayer no. 11931 (GZU) (duplicates distributed in Hafellner, Lichenicolous Biota no. adhuc ined.). – Steiermark (Styria), Sausal, Kitzeck ca. 9 km W von Leibnitz, am NW Ortsrand, 46°47'35''N / 15°26'00''E , ca. 480 m, GF 9258/2, alter Obstgarten, an Zweigen von *Juglans regia*, (1), 22.I.2011, leg. J. Hafellner no. 77054 (GZU). – Steiermark (Styria), Grazer Bergland, 1.7 km SW of Kumberg, c. 0.2 km N of the Pölzenkapelle along the road to St. Radegund, 47°09'03"N / 15°31'01"E, c. 515 m alt., GF 8859/1, edge of a forest along the road, on branches of *Juglans regia*, (1), 22.II.2011, leg. W. Obermayer no. 12149 (GZU). – Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07'18''N / 16°13'17''E, ca. 265 m s. m., GF 8863/3, Streuobstwiese, an tief hängenden Kronenästen von *Juglans regia*, (1), 28.XI.2010, leg. A. Fleischhacker 10010 & B. Fleischhacker (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35'19''N / 14°27'57''E, ca. 580 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an Kronenästen von *Juglans regia*, (1), 23.I.2011, leg. F. Schlatti, det. A. Fleischhacker 11012 (GZU). – Carinthia (Kärnten), Zentralalpen, Saualpe W von Wolfsberg, ca. 1 km W von St. Michael an der Straße nach Lading, 46°50'05''N / 14°47'10''E, ca. 550 m, GF 9154/4, Obstbäume in einer Standweide, auf nach einem Sturm jüngst zu Boden gefallenen, morschen Zweigen von *Juglans regia*, (1), 25.XII.2010, leg. J. Hafellner no. 76737 (GZU) (duplicates distributed in Hafellner, Lichenicolous Biota no. adhuc ined.). – **Belgium**: De Panne, Westhoek, NE border of nature reserve. 51º05'N / 02º34'E. Grid: IFBL, C056, on *Sambucus* in a dune, (1), 4.I.2008, leg. & det. Paul Diederich (n. 16731) = Santesson, Fungi Lichenicoli exs. 377 (GZU). – **Croatia**: Dalmatien, Insel Korčula, nahe der Stadt Korčula, 47°57'20''N / 17°07'55''E, ca. 70 m, Macchie, an Zweigen eines abgestorbenen Baumes, (1), 8.VIII.2004, leg. N. Cernic (herb. Hafellner 41734). – **Germany**: Bayern (Bavaria), Allgäu, Bayerniederhofen NE vom Bannwaldsee, ca. 10 km NE von Füssen, am SE Ortsrand, 47°37’25’’N / 10°48’15’’E, ca. 800 m, Streuobstwiese neben einem Gehöft, an Ästen von *Sambucus nigra*, (1), 6.IX.2004, leg. J. Hafellner no. 77194 (GZU). – **Greece**: Western Macedonia, Kozani distr., Mt. Vourinon, on slopes exposed to the E, open forest over ophiolithic rock, on branches, (1), 7.VII.1956, leg. K. H. Rechinger (GZU). – **Luxembourg:** distr. Lorrain, Lorentzweiler, Roude Bam., alt. 225 m., IFBL: L8.46.31, UTM: KA.90, sur *Sambucus*, dans un jardin, sur *Xanthoria parietina*, sub *Arthonia molendoi*, 23.III.2010, leg. et det. P. Diederich 16909 (herb. Diederich). – distr. Lorrain, Entre Dudelange et Kayl, Haardt, IFBL: M8.54.23, UTM: KV.88, sur les branchettes de *Salix*, sur *Xanthoria parietina*, sub *Arthonia molendoi*, cum *Xanthoriicola physciae*, 10.IV.2011, leg. et det. P. Diederich 17158 (herb. Diederich). – **Slovenia**: Central Alps, Kobansko, Koralpe, Bistrica (Feistritz) valley c. 9 km NW of Muta (Hohenmauthen), close to the border to Austria, surroundings of former border station on E (= orographically left) river bank, 46°39’15’’N / 15°07’10’’E, ca. 460 m, orchard, on twigs of *Sambucus nigra*, (1), 5.X.2008, leg. J. Hafellner no. 77110 & L. Muggia (GZU). – Southern Alps, Julian Alps, Cezsoča S of Bovec, SE above the village, 46°19’10’’N / 13°33’20’’E, c. 380 m, solitary trees on the roadside, on branches in the lower canopy of *Juglans regia*, (1), 4.VII.2003, leg. J. Hafellner no. 77510 (GZU) (duplicates distributed in Hafellner, Lichenicolous Biota no. adhuc ined.). – **Switzerland**: Kanton Bern, Berner Alps, by the road from Meiringen to Rosenlaui, S above Meiringen near the inn Zwirgi, 46°42’45’’N / 08°10’55’’E, elevation c. 980 m, roadside trees, on recently fallen dead branches of *Fraxinus excelsior*, (1), 24.VIII.2006, leg. J. Hafellner no. 77458 (GZU). – Kanton Graubünden, Engadiner Alps, Sesvenna group, San Niclà c. 12 km NE of Scuol, N of the church close to the right river bank of the Inn, 46°51’30’’N / 10°25’35’’E, elevation c. 1080 m, bushes beside a dungheap, on branches of *Sambucus nigra*, (1), 22.VIII.2006, leg. J. Hafellner no. 77196 (GZU). – **Asia**: **Armenia:** Syunik province, road from Dilijan to Ijevan; SW of Ijevan along the river Aghstev, 40°49’08’’N / 45°06’26’’E, c. 600 m alt, slopes along the road, on branches of *Prunus* spec., (1), 24.VII.2005, leg. S. Harutyunyan no. 33-30b (GZU). – **Africa**: **Canary Islands**: El Hierro, Mirador de las Playas NE ober dem Ort Taibique, am Rand der SE-exponierten Abbrüche, ca. 1060 m, 27°44’N / 17°58’W, lockerer Kiefernwald, auf Zweigen von *Pinus canariensis*, (1), 14.II.1995, leg. J. Hafellner no. 48238. (herb. Hafellner). – Tenerife, Macizo de Anaga, Chamorga, 28°34’N / 16°09’20’’W, ca. 650 m, auf einzelnen Lorbeerbäumen in Gratnähe, (1), 24.II.1989, leg. J. Hafellner no. 36508 & A. Hafellner (GZU).

Specimens of *Arthonia molendoi* studied for comparison:

Europe: Austria: Salzburg, Pinzgau, Hohe Tauern, Glockner-Gruppe, Bergkamm NW vom Kitzsteinhorn, E-Hänge der Hinteren Rettenwand ca. 2 km W ober der Krefelder Hütte, 47°12’35’’N / 12°40’50’’E, ca. 2600 m, GF 8742/3, kalkhaltiger Grünschiefer, auf Eexponierten Schrofen, auf *Xanthoria elegans*, 20.VII.1996, leg. J. Hafellner no. 38292 & H. Wittmann (GZU). – **Sweden**: Torne Lappmark, Jukkasjärvi sn, Umgebung von Abisko, NW-exponierte Hänge des Njulla S von Björkliden, 68°24 'N / 18°41'E, 700 m alt., on *Xanthoria elegans*, 2.VIII.1980, leg. H. Mayrhofer (GZU).

Specimens of *Arthonia epiphyscia* studied for comparison:

Europe: Austria: Salzburg, Nördliche Kalkalpen, Hochkönig Massiv NE von Dienten, W-Hänge der Taghaube, am Steig ober der Erich-Hütte, ca. 1650 m, 47°24'10''N / 13°02'50''E, MTB 8544/3, subalpine Weide zwischen *Pinus mugo*-Beständen, auf Kalkblöcken, 29.VIII.1996, auf *Physcia dubia*, leg. J. Hafellner 47357 (GZU). – **Norway:** Oppland, Gem. Vågå, N-Ufer des Sees Vågåvatn ca. 2 km W von Vågåmo, ca. 450 m, S-exp. Schieferschrofen in einer Triftweide, 29.VIII.1984, auf *Physcia dubia*, leg. J. Hafellner 11424 & A. Ochsenhofer (herb. Hafellner).

II. *Phacothecium varium* (Tul.) Trevis., Linnaea 28: 298 (1856).

MycoBank 432006

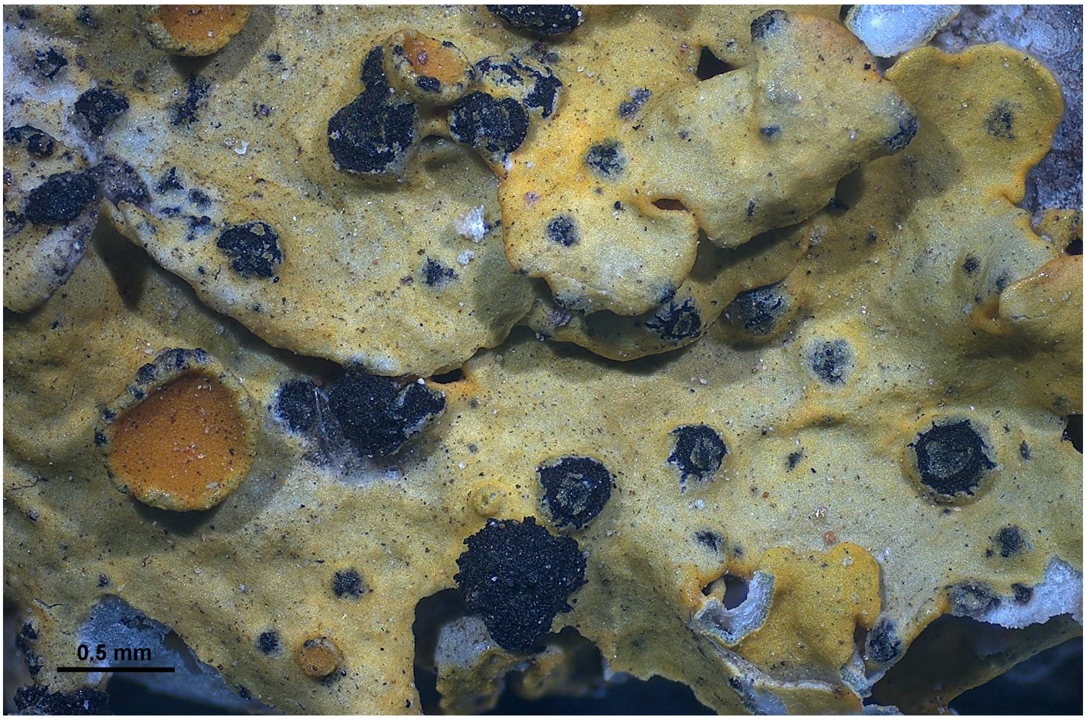


Figure 5: *Phacothecium varium* on *Xanthoria parietina* (Hafellner 47633).

Phacopsis varia Tul., Ann. Sci. Nat., Bot., ser. 3, 17: 125 (1852). – *Celidium varium* (Tul.) A.Massal., Misc. Lich.: 44 [15] (1856) (Hafellner 2009b). – *Arthonia varia* (Tul.) Jatta, Syll. Lich. Ital.: 471 (1900) (Hafellner 2009b).

Type: [Mauritania], on *Parmelia parietina* (locality data from protologue / Tulasne 1852:126, PC, STR – holotype lost, fide Hafellner 2009b); lectotype: Ann. Sci. Nat., Bot., ser. 3, 17: planche XIV, figs 1-3 (1852); epitype: Canary Islands: Lanzarote, on the margin of Malpais-plateau short SW of the village Guiguan (SW of Tinajo), 29°02’2’’N / 13°41’5’’W, 280 m, on branches of *Ficus carica*, on *Xanthoria parietina*, 9.IV.1999, leg. J. Hafellner 47633 & A. Hafellner (GZU, duplicates in UPS, M).

Lecidea physciaria Nyl., Suppl. Lich. Paris: 8 (1897). – *Leciographa physciaria* (Nyl.) H. Olivier, Bull. Acad. Int. Geogr. Bot. 16: 48 (1906). – *Opegrapha physciaria* (Nyl.) D. Hawksw. & Coppins in Coppins et al., Lichenologist 24(4): 367 (1992).

Type : “Luxembourg, Paris, Ormes de Carel, 1827, Alph. De Brebisson n. 814” [H-Nyl. 11023 – lectotype, designated by Atienza (1992)]. N. v. (synonymy established by Nylander 1897: 8).

Mycobilimbia xanthoricola Räsänen, Ann. Bot. Soc. Zool.-Bot. Fenn. “Vanamo” 21, Notul. Bot. 16: 2 (1946) (Hafellner 2009b).

Type: For type information see Hafellner (2009b).

Iconography: Tulasne 1852: planche XIV, figs. 1-3 (drawings of asci surrounded by paraphysoids, ascospores, conidiogenous cells and microconidia); Giralt & Gómez-Bolea 1988b: 200, figs. 1 H – J (drawings of an ascus, ascospores and a microconidium); Atienza 1992: 161, figs. 1 C – N (drawings of microconidia and different stages of development of asci and ascospores); Hafellner 2009b: 95, figs. 1 – 2 (photomicrographs of asci and an ascoma in vertical section); this paper: 24, fig. 5 (habit photograph).

Description: The black ascomata of *Phacothecium varium* are firstly immersed in the host tissue but later becoming erumpent. They mostly appear in groups and are roundish to irregular shaped. The exciple is dark brown. The asci are clavate and have a stipe on the lower end and contain hyaline or brownish (when getting older with brown granules), 3-septate, ellipsoid ascospores with ends rounded. For further and detailed description see Hafellner (2009b).

Hosts (fide Hafellner 2009b)**:** *Xanthoria parietina* (1), *X. calcicola* (2), *X. aureola* (*X. ectaneoides*) (3), *X. parietina* f. *rutilans* (4), *X.* spec. (5). The fungus only occurs on thallus. Reports on other hosts have to be verified.

Remarks: A lectotype and an epitype were designated by Hafellner (2009b).The lectotype was determined because the type-material from Mauritania could not be traced in PC and

STR. As this illustration being the lectotype may be ambiguous the author designated an epitype.

Ecology: *Phacothecium varium* is restricted in its host selection to the *Xanthoria parietina* group but scarcely in its habitats (Hafellner 2009b). It lives parasymbiotic on its hosts (Atienza 1992).

Distribution: For previously reported distribution data see Hafellner (2009b). There are reports from the following European countries: Albania (Hafellner 2009b), Croatia (Hafellner 2009b), France (Diederich & Sérusiaux 2000 as *Arthonia varia*), Poland (Czyzewska & Kukwa 2009, Kukwa 2010), Spain (Triebel 2009) and from the Island Corfu (Abbott 2009 sub *Opegrapha physciaria*). In Africa the species has been recently reported from Libya (Thor & Nascimbene 2010 sub *Opegrapha physciaria*) and the Canary Islands (Boom & Etayo 2006, Hafellner 2010) and in America from the USA and Mexico (Ertz & Egea 2008).

Exsiccata: Hafellner, Lichenicolous Biota no. 97 (GZU). For further exsiccata see Hafellner (2009b).

Further specimens examined: Europe: Spain: Baleares: Mallorca, NW of Bunyola, 1.5 km SW of Orient, alt. 430 m, 39°43’30’’ N, 2°44’50’’E, on branches of *Quercus ilex* subsp. *rotundifolia*, in valley near river, (1), 30.III.2010, leg. et det. P. Diederich 16912 (herb. Diederich). – **Africa: Canary Islands:** Lanzarote, Peña de la Pequeña NE above the village Los Valles, El Agujero, summit area, 29°07’20’’N / 13°29’50’’W, *c*. 500 m alt., boulders and low cliffs of basaltic rock in succulent shrub community, on inclined rock faces exposed to the S, (2, thallus), 8.IV.1999, leg. A. Hafellner & J. Hafellner 47668 (GZU).

III. *Polycoccum slaptoniense* D. Hawksw., Lichenologist 26(4): 342 (1994).

MycoBank 362854

Type: “England, South Devon, Slapton, Slapton Ley National Nature Reserve, east end of Duck Marsh near The Causeway, on *Xanthoria parietina* on *Sambucus nigra*, 2. October 1993, D. L. Hawksworth (IMI 359711 – holotypus)” n. v. (locality data from protologue, Hawksworth 1994: 342).

Iconography: Hawksworth 1994: 343, fig. 3 (drawings of galls, an ascoma wall in vertical section, an ascus filled with ascospores, the apex of an ascus and ascospores); Ertz et al. 2008: 46, fig. 7 (photograph of the habitus on *Xanthoria parietina*); this paper: 27, fig. 6 (photograph of galls on *Xanthoria parietina*).

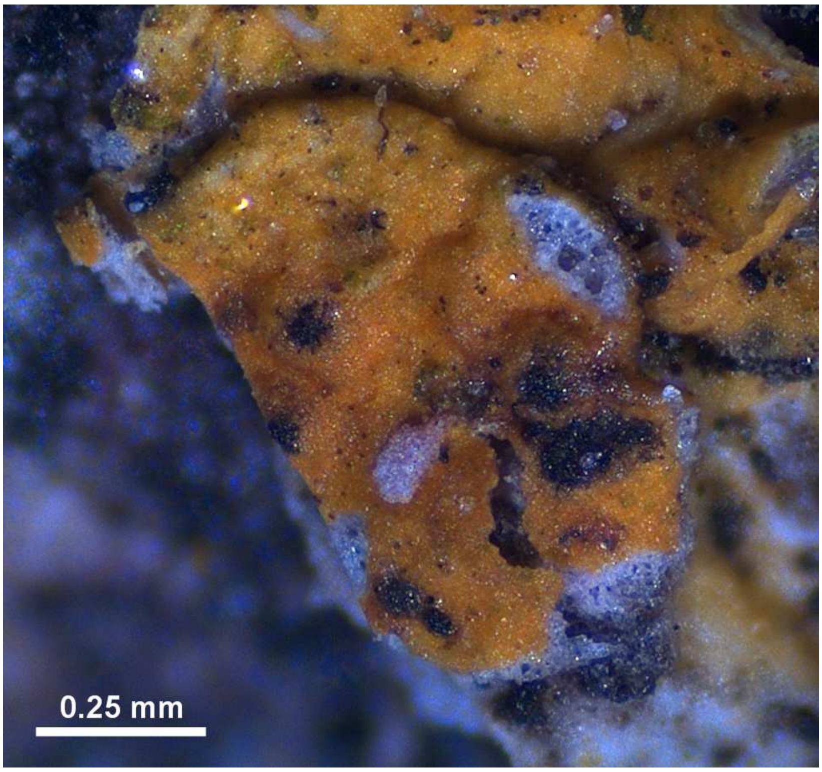


Figure 6: *Polycoccum slaptoniense* on *Xanthoria parietina* (Fleischhacker 10023).

Description: *Polycoccum slaptoniense* forms protruding perithecia, which are surrounded by a thallus collar. The black “dots”, as seen in fig. 6., are the ostiolar regions of immersed perithecia. For more morphological and anatomical details see the protologue. For full description see the protologue.

Hosts: *Xanthoria parietina* (1) (apothecia and thallus).

Remarks: The fungus can not be distinguished from *Phoma epiphyscia* in surface view under the hand lense or dissecting microscope.

Distribution: The species is so far known from the following European countries: Belgium (Ertz et al. 2008), England (Hawksworth 1994), Germany (Kocourková & Brackel 2005, Brackel 2009) and Italy (Brackel 2008c).
Based on the specimen cited below the species is herewith reported for the first time in Austria.

Specimen examined: Europe: Austria: Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07’18’’N / 16°13’17’’E, ca. 265 m s. m., GF 8863/3, Streuobstwiese, an tief hängenden Kronenästen von *Juglans regia*, (1), 28.XI.2010, leg. A. Fleischhacker 10023 & B. Fleischhacker (GZU).

IV. *Telogalla olivieri* (Vouaux) Nik. Hoffm. & Hafellner, Biblioth. Lichenol. 77: 109 (2000).

MycoBank 467698

Verrucaria xanthoriae f. *megaspora* H. Olivier, Lich. Fr., Suppl. 1: 14 (1907). – *Laestadia olivieri* Vouaux, Bull. Soc. Mycol. France 28: 216 (1912) as nom. nov. for *Verrucaria xanthoriae* f. *megaspora*. – *Guignardia olivieri* (Vouaux) Sacc., Syll. Fung. 24 (2): 786 (1928). – *Guignardia verrucicola* f. *olivieri* (Vouaux) Keissl., Rabenhorst's Kryptogamen-Flora, 2. Aufl., 8: 342 (1930).

Type: [France], Hérault, at Roquehaute, on *Xanthoria parietina* v. *rutilans*, leg. A. de Crozals (?PC – holotype) n. v. (locality data from protologue, Olivier 1907b: 14).

Figure 7: *Telogalla olivieri* forming galls on *Xanthoria parietina* (Fleischhacker 10011).

Iconography: Hawksworth 1975: 190, fig. 5 (drawings of galls, an ascoma in longitudinal section, peridial cells, ascus, ascospores, a pycnidium in longitudinal section, conidia and conidiogenous cells); Hawksworth 1983: 37, fig. 43 (drawing of ascospores); Giralt & Gómez-Bolea 1988b: 200, fig. 1 b – d (drawings of an ascoma in vertical section, an ascus and ascospores); Hoffmann & Hafellner 2000: 114, fig. 29 (drawing of an ascoma in longitudinal section) and Fig. 30 (drawings of an ascus and its ascospores), unpaginated tables, figs. 53

– 54 (photomicrographs of a gall and an ascoma in vertical section); Diederich et al. 2009: 87, fig. 4 (photograph of infected thallus of *Xanthoria parietina*); this paper: 28, fig. 7 (habit photograph).

Description: *Telogalla olivieri* forms characteristic galls on the thallus and the edge of the apothecia of *Xanthoria*. The orange-yellow of these galls is usually slightly more intense than the yellow of the host. Ascomata and pycnidia are immersed in the galls. In the perithecoid ascomata clavate verrucarialean asci develop which contain eight ellipsoid to fusiform ascospores. The pycnidia are globose or almost so and the pycnospores are bacilliform. For detailed description see Hawksworth (1975) and Hoffmann & Hafellner (2000).

Hosts: *Xanthoria parietina* (1) (thallus), *Xanthoria calcicola* (2) (thallus).

Remarks: As the taxonomy of the species in our opinion is resolved and the characters of the specimens seen by us fit perfectly the protologue we did not try to get the type-material which – if it is part of the Crozals-Herbarium – ought to be the posited in PC (Hawksworth 1974).

Distribution: *Telogalla olivieri* is probably very common but its galls although large nevertheless inconspicuous might often be overlooked. For earlier distribution see Hoffmann & Hafellner (2000). In recent years the species has been collected from the following European countries: Albania (Hafellner & Kastha 2003), Austria (Hafellner & Wieser 2000, Grube & Rios 2001, Hafellner & Obermayer 2001, Obermayer 2002, Hafellner 2002a, 2003a, b, c, 2007, 2008a, 2009a, Hafellner et al. 2004, 2005a, b, 2008), Belgium (Diederich et al. 2009), Croatia (Hoffmann & Hafellner 2000), Estonia (Aptroot et al. 2005), France (Roux et al. 2001, 2006a), Germany (Kocourková & Brackel 2005, Brackel & Kocourková 2006, Brackel 2010b), Italy (Brackel 2008a, b, 2010a, 2011), Luxembourg (Diederich & Sérusiaux 2000), Montenegro (Bilovitz et al. 2010), the Netherlands (Sparrius et al. 2001), Poland (Kukwa 2005, Kukwa & Czarnota 2006, Czyzewska & Kukwa 2009), Spain (Boqueras 2000, Martinez et al. 2002, Triebel 2003, 2009, Etayo 2010) and the British Isles (Hitch 2002, 2007a, 2009, 2010, Orange 2006, Coppins & Price 2009). From Asia it has been found from 2000 to date in Turkey (Hafellner & John 2006) and Israel (Kondratyuk et al. 2005).

Exsiccata: Hafellner, Lichenicolous Biota nos. 10 (GZU), 28 (GZU). – Obermayer, Lichenoth. Graec. no. 216 (GZU). – Triebel, Microf. Exs. no. 491 (GZU). – Santesson, Fungi Lichenicoli Exs. nos. 11, 81, 132, sub *Guignardia olivieri* (GZU).

Further specimens examined: Europe: Austria: Steiermark, Graz, Mariatrost, Roseggerweg 134, 47°05’46’’N / 15°28’51’’E, ca. 470 m s. m., GF 8958/2, Garten, an Kronenästen von *Juglans regia*, (1), 17.I.2011, leg. M. Pinter, det. A. Fleischhacker 11002

(GZU). – Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06’57’’N / 15°26’18’’E, ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 21.III.2011, leg. M. Pinter, det. A. Fleischhacker 11008 (GZU). – Steiermark, Weststeirisches Hügelland, Schadendorfberg ca. 13 km SW von Graz, 47°00’14’’N / 15°18’43’’E, ca. 405 m s. m., GF 8957/4, Garten, an Kronenästen von *Juglans regia*, (1), 24.III.2011, leg. M. Pinter, det. A. Fleischhacker 11011 (GZU). – Steiermark, Nordalpen, Nördliche Kalkalpen, Hochschwab-Gruppe, Seetal W von Seewiesen, ca. 10 km NE von Aflenz, 47°37’14’’N / 15°15’02’E, ca. 950 m s. m., GF 8357/4, Baumreihe am Rand einer Weidefläche, an Kronenästen von *Picea abies*, (1), 20.VII.2011, leg. A. Fleischhacker 11019 & M. Sebernegg (GZU). – Ibid., an Kronenästen von *Fraxinus excelsior*, (1), 20.VII.2011, leg. A. Fleischhacker 11020 & M. Sebernegg (GZU). – Steiermark, Steirisches Randgebirge, Fischbacher Alpen, 2.2 km S of Fischbach, valley of the brook Fischbach, near ‚Anger’, 47°25’22’’N, 015°38’’35’’E, (grid number 8559/4), 845 m altitude, on *Fraxinus excelsior*, (1), 30.III.2011, leg. W. Obermayer 12158 (herb. Obermayer in GZU). – Steiermark, Oststeirisches Riedelland, 7.3 km E of the center of Graz, 300 m SW of Neudörfl, 47°05’06’’N, 015°31’55’’E, (grid number 8959/1), 440 m altitude, *Fraxinus* trees between a street and a brook, on dead twigs of *Fraxinus excelsior*, (1), 3.VII.2011, leg. W. Obermayer 12172, det. J. Hafellner (herb. Obermayer). – Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07’18’’N / 16°13’17’’E, ca. 265 m s. m., GF 8863/3, Streuobstwiese, an tief hängenden Kronenästen von *Juglans regia*, (1), 28.XI.2010, leg. A. Fleischhacker 10011 & B. Fleischhacker (GZU). – Ibid., an tief hängenden Kronenästen von *Malus domestica*, (1), 28.XI.2010, leg. A. Fleischhacker 10024 & B. Fleischhacker (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’20’’N / 14°27’54’’E, ca. 600 m s. m ., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an tief hängenden Kronenästen von *Juglans regia*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10018 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’20’’N / 14°27’59’’E, ca. 580 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an tief hängenden Kronenästen von *Fraxinus excelsior*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10026 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’19’’N / 14°27’57’’E , ca. 580 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an Kronenästen von *Juglans regia*, (1), 23.I.2011, leg. F. Schlatti, det. A. Fleischhacker 11013 (GZU). – **The Netherlands:** (Noord-Holland), Hoorn, harbour, on brick of wall, (2), 10.I.1997, leg. A. Aptroot 40190, det. P. Diederich (herb. Diederich). – **Croatia:** Istarska (Istrien), ca. 400 m SW der Kirche Sveta Marija od Lakuća, Macchie entlang des Weges von Dvigrad/ Due Castelli durch das Leme-

Tal / Limski draga zum Leme-Kanal / Limski-kanal, 45°07’33’N, 13°48’36’’E, 105 m, (1), 3.VI.2011, leg. M. Pinter L003, det. A. Fleischhacker (herb. Pinter).

V. *Xanthoriicola physciae* (Kalchbr.) D. Hawksw. in Hawksworth & Punithalingam, Trans. Brit. Mycol. Soc. 61: 67 (1973).

MycoBank 325579

Figure 8: *Xanthoriicola physciae* on apothecia of *Xanthoria parietina* (Fleischhacker 10002).

Gymnosporium physciae Kalchbr., Math. Term. Közlem. 3: 299 (1865) and Hedwigia 4: 120 (1865). – *Coniosporium physciae* (Kalchbr.) Sacc., Syll. Fung. 4: 246 (1886).

Type: Kalchbrenner (1865), when describing *Gymnosporium physciae*, also cited in addition to the Hungarian material a Fuckel-exsiccate without any number. On occasion of introducing the combination Hawksworth & Punithalingam (1973) examined a specimen of Fuckel, Fungi Rhen. Exs. no. 100. According to them a specimen of this syntypes is located in S, but no lectotype was designated.

Further synonyms according to Keissler (1930): *Spilomium xanthoriae* H. Olivier, *Spilomium xanthoriae* var. *epicrassa* H. Olivier and *Spilomium ramalinae* H. Olivier, but the types of these taxa need to be revised.

Iconography: Hawksworth & Punithalingam 1973: 68, fig. 7 (drawings of infected apothecia of *Xanthoria parietina*, conidiophores, conidia and conidiogenous cells); Hawksworth 1979: 267, fig. 42 (photographs of infected apothecia of *Xanthoria parietina*, photomicrographs of conidiophores, conidiogenous cells, an optical section and a surface view of a conidium and scanning electron micrographs of conidia and their verrucose ornamentation); Giralt & Gómez-Bolea 1988b: 203, fig. 4 d (drawings of a conidium and conidiophores); Ruibal et al. 2011: 98, fig. 1 (photograph of the infection and photomicrographs of conidiogenous cells and conidia); this paper: 31, fig. 8 (habit photograph).

Description: As a result of the infection, the lichen thallus and apothecia turn dark brown to black. The vegetative hyphae, bearing the conidiogenous cells and the conidia, are septate and pale brown. The branched conidiophores bear terminal conidiogenous cells, at the end of which the brown, spherical, spinous conidia are exposed. For detailed description see Hawksworth & Punithalingam (1973).

Hosts: *Xanthoria parietina* (apothecia and thallus).

Remarks: Keissler (1930), who states to have found *Xanthoriicola physciae* not only on *Xanthoria parietina*, but also on other lichens, evidently did not have a clear concept of the species. The reports on *Xanthoria polycarpa* (Vouaux 1914, Keissler 1930) could be true.

As Ruibal et al. (2011) have shown, the dematiaceous hyphomycete *Xanthoriicola physciae* is likely to be a member of the family *Teratosphaeriaceae* belonging to the order *Capnodiales*. This phylogenetic placement was established by the application of molecular techniques.

Ecology: *Xanthoriicola physciae* is generally found at very humid and shady locations (Etayo & Berger 2009). It is very common in Europe (see distribution) and seems to be the most frequent parasite on *Xanthoria parietina*.

Distribution: The species is so far known from the following European countries: Austria (Maurer et al. 1983, Hafellner et al. 1992, 2005a, b, 2008, Obermayer 1993, Hafellner & Maurer 1994, Berger 1996, 1999, 2000, Hafellner 1997, 1999, 2000, 2003a, b, c, 2008b, 2009a, Hafellner & Wieser 2000, Hafellner & Obermayer 2007, Priemetzhofer 2008, Etayo & Berger 2009, Breuss & Brand 2010), Belgium (Diederich & Sérusiaux 2000, Boom & Boom 2006, Van den Broeck et al. 2006, Santesson 2008, Van den Broeck & Hantson 2008), Czech Republic (Kocourková 2000), Denmark (Christiansen 1986, Hansen 1987, 1997, Alstrup et al. 1988, 2004, Christensen et al. 1995, Søchting et al. 2007), Estonia (Randlane & Saag 1999, Aptroot et al. 2005, Suija 2005, Suija et al. 2010a), Finland (Vitikainen 1991), France (Olivier 1903, 1907a, b, Bouly de Lesdain 1907, 1909, 1910, 1912, 1914, 1924, Vouaux 1914, Lettau 1958, Rondon 1969, Roux et al. 2001, 2006a, b, 2008, Sparrius et al. 2003, Triebel 2003, Diederich et al. 2006), Germany (Allescher 1887, Jaap 1905a, b, Keissler 1910, Lettau 1912, 1919, 1958, Erichsen 1941, Poelt & Steiner 1963, Feuerer & Höhne 1980, Wirth 1987, Hauck 1996, Otte & Rätzel 1998, Triebel 1998, Litterski 1999, Sparrius 2000, Triebel & Scholz 2001, Schiefelbein 2003, 2006, Brackel 2005, 2010b, Aptroot et al. 2006, Brackel & Kocourková 2006, Aptroot & Stapper 2008, Bruyn et al. 2008, Cezanne et al. 2008), Greece (Abbott 2009), Hungary (Kalchbrenner 1865), Italy (Santesson 1994a, Nimis et al. 1994, Nimis & Tretiach 1999, Brackel 2011), Latvia (Czarnota & Kukwa 2010), Lithuania (Motiejūnaitė et al. 1998, 2008, Motiejūnaitė 1999, 2000, 2002, 2009), Luxembourg (Diederich et al. 1988, Diederich 1989), Montenegro (Bilovitz et al. 2010), the Netherlands (Boom & Aptroot 1997, Aptroot et al. 2000a, Boom 2004, Boom & Boom 2009), Norway (Santesson 1993), Poland (Kukwa & Motiejūnaitė 1999, Kukwa 2000, 2004, 2005, Czyzewska et al. 2001, 2006, Kukwa et al. 2002, 2010, Jando & Kukwa 2003, Zalewska et al. 2004, Kukwa & Czarnota 2006, Kukwa & Jabłońska 2008, Szymczyk & Zalewska 2008, Szymczyk & Kukwa 2008, Czyzewska & Kukwa 2009, Kukwa & Flakus 2009), Russia (Stepanchikova et al. 2011), Slovakia (Lisická & Lackovičová 1999, Czarnota et al. 2006), Slovenia (Prügger et al. 2000), Spain (Santesson 1960, Giralt & Gomez-Bolea 1988a, b, Etayo & Blasco Zumeta 1992, Navarro-Rosinés et al. 1994, Calatayud et al. 1995, Giralt 1996, Llimona Pagès et al. 1998, López de Silanes et al. 1998, Boqueras 2000, Fos & Barreno 2002, Martínez 2002, Martínez et al. 2002, Pérez-Ortega 2007, Burgaz et al. 2007, Etayo 2008, Etayo & López de Silanes 2009), Sweden (Santesson 1984, 1986, Thor 1993, Santesson et al. 2004), Ukraine (Coppins et al. 1998, Kondratyuk 1999, Bielczyk et al. 2005), the British Isles (Hawksworth & Punithalingam 1973, Fox 1997, Davey et al. 2004, Hitch 2005, Preece & Blackwell 2004, Preece 2009, Simkin 2009, Cannon & Powell 2011) and from the Balearic Island Majorca (Etayo 1996b, Boom 1999). From Africa it has already been reported from Libya (Thor & Nascimbene 2010) and the Canary Islands (Pitard & Harmand 1911, without host, Hafellner 1995, 2005, Ertz & Diederich 2009). In Asia it is known from Israel (Kondratyuk et al. 2005) and Iran (Sohrabi & Alstrup 2007). In Australasia there are reports from New Zealand (Pennycook & Galloway 2004, Galloway 2007b) and Australia (McCarthy 2010 , doubtful host).

Exsiccata: Alstrup, Lichenes Danici Exs. no. 71 (GZU). – Jaap, Fungi Sel. Exs. no. 71 sub *Coniosporium physciae* (GZU). – Poelt & Steiner, Lich. Alp. no. 198 sub *Coniosporium physciae* (GZU). – Santesson, Fungi Lichenicoli Exs. Nos 50, 100, 200 and 400 (GZU). –

Thümen, Fungi austr. no. 531 sub *Gymnosporium physciae* (GZU). – Triebel, Microf. Exs. no. 350 (GZU).

Further specimens examined: Europe: Austria: Steiermark, Oststeirisches Hügelland, Loimeth ca. 8 km NW von Fürstenfeld, 47°06’52’’N / 16°01’56’’E, ca. 335 m s. m., GF 8862/3, Mähwiese mit zerstreuten Obstbäumen, an tief hängenden Kronenästen von *Malus domestica*, auf *Xanthoria parietina*, 16.X.2010, leg. A. Fleischhacker 10002 (GZU). – Steiermark, Graz, Liebenau, Murfeld, 47°00’59,17’’N / 15°27’41,39’’E, ca. 335 m s. m., GF 8958/4, Garten, an Kronenästen von *Ginkgo biloba*, auf *Xanthoria parietina*, 19.III.2011, leg. M. Pinter, det. A. Fleischhacker 11005 (GZU). –Ibid., Garten, an Kronenästen von *Ginkgo biloba*, auf *Xanthoria parietina*, 9.XII.2010, leg. M. Pinter, det. A. Fleischhacker 10022 (GZU). – Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07’18’’N / 16°13’17’’E, ca. 265 m s . m., GF 8863/3, Streuobstwiese, an tief hängenden Kronenästen von *Malus domestica*, auf *Xanthoria parietina*, 28.XI.2010, leg. A. Fleischhacker 10008 & B. Fleischhacker (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’20’’N / 14°27’54’’E, ca. 600 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an unteren Kronenästen von *Laburnum* x *watereri*, auf *Xanthoria parietina*, 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10017 (GZU). – **Luxembourg:** distr. Lorrain, Capellen, near the railway station, IFBL: M8.13.11, UTM: KA.80., sur *Sambucus*, on *Xanthoria parietina*, 4.XI.2007, leg. et det. P. Diederich 16713 (herb. Diederich). – distr. Lorrain, Entre Dudelange et Kayl, Haardt, IFBL: M8.54.23, UTM: KV.88, sur les branchettes de *Salix*, sur *Xanthoria parietina*, as admicture in specimen of *Arthonia parietinaria*, 10.IV.2011, leg. et det. P. Diederich 17158 (herb. Diederich). – **Portugal:** Algarve, S of Lagoa, Carvoeiro, gardens in village, on *Prunus amygdalus*, on *Xanthoria parietina*, 31.III.2005, leg. et. det. P. Diederich 16048 (herb. Diederich). – **Spain:** Baleares, Mallorca, NW of Bunyola, 1.5 km SW of Orient, alt. 430 m., 39°43’30’’ N, 2°44’50’’ E, on branches of *Quercus ilex* subsp. *rotundifolia*, in valley near river, on *Xanthoria parietina*, 30.III.2010, leg. et det. P. Diederich 16911 (herb. Diederich).

3.1.2 Lichenicolous fungi with a host-specificity to the *Teloschistaceae*

VI. *Arthonia sytnikii* S. Kondr., in S. P. Wasser (ed.), Botany and mycology for the next millennium: Collection of scientific articles devoted to the 70th anniversary of academician K. M. Sytnik: 309 (1996).

MycoBank 414622

Type: “Australia: Adelaide, Pearoon Island, Great Anotr. Bight, on *Xanthoria ligulata* (Korber) P. James, [date unmentioned] Cleland 1 /23 (LD – holotype)” n. v. (locality data from protologue, Kondratyuk 1996: 309).

Iconography: Kondratyuk 1996: 310, fig. a (photograph of the habitus); Kondratyuk 2002: 312, fig. 4 (drawings of ascus, paraphysoids, ascospores and conidia).

Description: *Arthonia sytnikii* is a gall-inducing lichenicolous fungus. These galls are yellow and have ascomata scattered thereon. In the clavate asci develop 1-septate, hyaline ascospores which appear more slender than the ones of *Arthonia parietinaria*. The upper parts of the paraphysoids have a brownish pigment (also different from *Arthonia parietinaria* which has only a pigmented cap on the interascal filaments). For a detailed description see the protologue or Kondratyuk (2002).

Hosts: *Xanthoria parietina* (1) (thallus), *X. ligulata* (2) (thallus) (Kondratyuk 1996), *Xanthoria* sp. 1 (Kondratyuk 2002), which was later described as *X. dissectula* (Kondratyuk et al. 2004) (3), *Xanthoria* sp. 2 (Kondratyuk 2002), possibly identical with *X. angustata*, which is given as one of hosts later (Kondratyuk et al. 2009) (4).

Ecology: Indicated by the formation of galls *Arthonia sytnikii* shows a parasymbiontic rather than a parasitic behaviour. No discolorations or destroyed areas were observed on the host tissue.

Distribution: *Arthonia sytnikii* has only been reported from the southern hemisphere. In Africa the species is so far known from South Africa (Kondratyuk 2002). Furthermore it has been reported from the South American country of Chile (Etayo & Sancho Garcia 2008). In Australasia it is known from Australia (Kondratyuk 1996, 2002) and from New Zealand (Kondratyuk 2002, Hafellner & Mayrhofer 2007).

Specimen examined: Australasia: New Zealand: North Island, Auckland, Kawakawa Bay E of Auckland, 36°55’30’’S / 174°27’30’’E, 0–20m, coastal rocks, (2), 9.I.1985, leg. H. Mayrhofer 16174 & G. J. Samuels (GZU).

VII. *Cercidospora xanthoriae* (Wedd.) R. Sant., The lichens and lichenicolous fungi of Sweden and Norway: 57 (1993).

MycoBank 360970

Verrucaria xanthoriae Wedd., Bull. Soc. Bot. France 21 : 347 (1874). – *Physalospora xanthoriae* (Wedd.) Sacc. & D. Sacc., Syll. Fung. 17: 587 (1905).

Type: "Apothecia ad thallum *Parmeliae* (*Xanthoriae*) *parietinae* var. *rutilantis* parasitica…Observé sur un seul échantillon de la plante nourricière signalée…"(? – holotype) n. v. (locality data from protologue, Weddell 1874: 347).

For further synonyms see Santesson (1993).

Description: *Cercidospora xanthoriae* forms immersed, black ascomata in the plectenchyma of its hosts. Under the light microscope the ascomatal wall is dark green in colour and nearly black in the vicinity of the ostiolum. Further characteristics are the elongated subcylindrical asci containing mainly 4 1-septate hyaline ellipsoid or fusiform ascospores which sometimes have one narrower cell. For further descriptions and notes see the protologue and Zhurbenko (2009).

Hosts: *Xanthoria parietina* (1)?, *X*. *elegans* (2) (apothecia and thallus) (Alstrup & Hawksworth 1990 sub *C*. *caudata*, Santesson 1993, Hafellner & John 2006, Alstrup et al. 2009 sub *C*. *epicarphinea*, Zhurbenko 2009), *X*. *calcicola* (3) (thallus) (Hafellner 2002b), *X*. spec. (4) (Roux et al. 2006a), *Xanthomendoza fallax* (5) (Knudsen & Lendemer 2005).

Remarks: *C*. *xanthoriae* belongs to a so far taxonomically unresolved species group around *C*. *caudata* and *C*. *epicarphinea*.

The protologue indicates that the type species is *Xanthoria parietina* because the variety "*rutilans*" is an infraspecific taxon or modificant of it.

Cercidospora xanthoriae contains mostly 4 ascospores per ascus and not 6 to 8 as Hafellner & John (2006) already observed. This is different than stated in the protologue.

Distribution: The species on (1) is so far known from France (Weddell 1874 on *X*. var. *rutilans*) and the Canary Islands (Etayo 2000 on *X*. spec., most likely belonging to the "*Xanthoria parietina*-group" because of the locality data).

Specimens examined: Africa: Kanarische Inseln: Tenerife: W-Abhang des Pico Viejo ca. 6 km E oberhalb Chio, ca. 1080 m, an Lavablöcken, (3, thallus), 11.II.1989, leg. J. Hafellner 32886 & A. Hafellner (herb. Hafellner). – La Palma: Außenseite der Caldera de Taburiente, im Taleinschnitt kurz SSE von La Cumbrecita, ca. 1200 m, 28°41'10''N / 17°51'05''W, Lichtung mit einigen *Ficus carica*-Bäumen und Vulkanitblockwerk, auf bemoosten Vulkanitblöcken, (3, thallus), 27.XI.1991, leg. J. Hafellner 29508 (herb. Hafellner).

VIII. *Lichenodiplis poeltii* S. Kondr. & D. Hawksw. in Kondratyuk, in S. P. Wasser (ed.), Botany and mycology for the next millennium: Collection of scientific articles devoted to the 70th anniversary of academician K. M. Sytnik: 313 (1996).

MycoBank 434526

Type: “Australia: Adelaide: near Adelaide University, North Terrace, on *Xanthoria parietina* s.l. [date unmentioned] E.G. Du Rietz (LD – holotype)” n. v. (locality data from protologue, Kondratyuk 1996: 313).

Iconography: Kondratyuk 1996: 310, fig. c (photograph of the habitus); Kondratyuk 2002: 310, fig. 1 (photograph of infected apothecia of *Xanthoria filsonii*), fig. 2 (photograph of conidia), 311, fig. 3 (drawing of conidia and conidiogenous cells).

Description: *Lichenodiplis poeltii* is recognized by its black immersed or erumpent conidiomata which occur singly on the host tissue. Further diagnostic characters: conidiomata entirely filled with the conidiogenous cells, conidiogenous cells more or less cylindrical, septate, hyaline, upper cells often brownish; conidia 1-septate, pale brown, more or less cylindrical, sometimes irregularly bent, septum slightly waved or not even. For detailed description see Kondratyuk (2002).

Hosts: *Xanthoria parietina* (1) (thallus), *X. ligulata* (2) (thallus), *X. filsonii* (3) (apothecia and thallus) (Kondratyuk 1996, 2002).

Remarks: The report from Etayo & Berger (2009) who state to have found *Lichenodiplis poeltii* in Austria should be rechecked.

Distribution: The species is so far reported from Austria (Etayo & Berger 2009), Australia (Kondratyuk 1996, 2002) and New Zealand (Hafellner & Mayrhofer 2007).

Specimen examined: Australasia: New Zealand: South Island, Canterbury, Banks Peninsula E of Christchurch, Okainsbay, 43°43’S / 173°02’E, 0–20 m, coastal rocks, (2), 6.IX.1981, leg. H. Mayrhofer 16269 (GZU).

IX. *Pronectria xanthoriae* Lowen & Diederich, Mycologia 82(6): 788 (1990).

MycoBank 128264

Type: “England, Derbyshire, Bakewell, Over Haddon, 43/2?6, in apothecia and thallus of *Xanthoria parietina* on limestone wall, 13 Apr 1985, D. L. Hawksworth 5513” (IMI 294074 – holotype) n. v. (locality data from protologue, Lowen & Diederich 1990: 788)

Iconography: Lowen & Diederich 1990: 789, fig. 1 (drawings of ascus, ascospores, ascoma in vertical section, perithecial surface and wall, enlarged ascomatal hyphae penetrating the host).

Description: The infection with *Pronectria xanthoriae* leads to a discoloration (orange to red) of the host tissue which is easily recognized with the naked eye. On the host there is an elevation of the tissue which encircles the ascomata (see Fig. X) which shine through in the center in a dark orange colour. The perithecial wall is light orange and full of orange oil drops which are also inside the perithecium. The asci are clavate and slender and contain 8 hyaline, 1-septate, ellipsoid and verruculose ascospores. For detailed description see the protologue.

Hosts: *Xanthoria parietina* (1) (thallus and apothecia), *Xanthomendoza fulva* (2) (thallus).

Ecology: One characteristic of the genus *Pronectria* is that it tends to behave parasitically (Lowen & Diederich 1990). The existence of discoloured areas as well as necrotic patches on the examined host tissues leads to the assumption that *Pronectria xanthoriae* must be a parasite.

Distribution: The species is so far known from the following European countries: Denmark (Ferdinandsen & Winge 1909: 316 as *Nectria fuckelii*), England (Lowen & Diederich 1990, Hawksworth 1994), Estonia (Aptroot et al. 2005, Suija et al. 2010a), Germany (Kocourková & Brackel 2005), Italy (Brackel 2008b, 2011), Latvia (Motiejūnaitė et al. 2006), Lithuania (Motiejūnaitė 2002, 2007), Luxembourg (Diederich 1989, Lowen & Diederich 1990), Poland (Kukwa & Jabłońska 2008), Slovakia (Vězda 1970 as *Nectriella coccinea*), Spain (Etayo 1998) and Sweden (Ihlen & Wedin 2005). From Asia it has been reported from Turkey (Halıcı et al. 2009 on (2)).

Specimens examined: Europe: Austria: Steiermark, Nordalpen, Dachstein-Gruppe, Ramsau 4.6 km NNW of Schladming, 1.4 km W of the church of the village Ramsau am Dachstein, by the road to Vorberg, 47°25’16’’N / 13°38’10’’E, c. 1170 m alt., GF 8547/4, roadside trees, on branches of unnamed decidous tree, (1), 25.II.2011, leg. W. Obermayer 12148, det. J. Hafellner (GZU). – **Luxembourg:** (distr. Lorrain), NE Bergem, Schéierboesch.

IFBL: M8.44.12; UTM: KV.88, sur *Populus*, (1), 26.VIII.1987, leg. et det. P. Diederich 8511 (herb. Diederich). – **Turkey:** Malatya, Hekimhan, Yilanli mountain, E of Kursunlu village, alt. 1840 m, 38°40’52’’ N, 37°52’36’’ E, on *Pyrus*, (2), 19.VIII.2005, leg. M. Candan, det. P. Diederich (herb. Diederich).

X. *Sphaerellothecium parietinarium* (Linds.) Hafellner & V. John, Herzogia 19: 168 (2006).

MycoBank 510619

Microthelia parietinaria Linds., Trans. R. Soc. Edinb. 25: 541 (1869). – *Didymosphaeria parietinaria* (Linds.) Sacc. & D. Sacc., Syll. Fung. 17: 681 (1905). – *Endococcus parietinarius* (Linds.) Clauzade & Cl. Roux, Les champignons lichenicoles non lichenisés (Montpellier): 28 (1976).

Type: “Parasitic on thallus of *Physcia parietina*, L., Cottishall, in Herb. Kew; on a single fragment of the *Physcia*.” (K? – holotype) n. v. (locality data from protologue, Lindsay 1869: 541).

Mycoporum physciicola Nyl., Flora 56: 299 (1873). – *Discothecium physciicola* (Nyl.) Vouaux, Bull. Trimestriel Soc. Mycol. France 29: 48 (1913).

Type: “Supra *Physciam parietinam* decoloratam in Gallia prope Ranton (Vienne), supra corticem Populi (J. Richard).” (? – holotype) n. v. (synonymy established by Nylander 1873: 299).

Iconography: Lindsay 1869: plate XXIII., fig. 33 (drawing of ascospores), Hawksworth 1983: 37, fig. 37 (drawing of ascospores).

Description: *Sphaerellothecium parietinarium* produces black and globose ascomata which are numerously distributed over the apothecia and thallus of its hosts. Further important characters: Ascomatal wall dark brown to blackish, asci clavate, shortly stipitate and 8-spored, ascospores ovoid but oblong, brown, 1-septate, vegetative hyphae pale brown. For further and detailed description see Roux & Triebel (1994).

Hosts: Farer away from the see *Sphaerellothecium parietinarium* is generally found on *Xanthoria parietina* (1) (apothecia and thallus) (Nylander 1873, Olivier 1907a, Bouly de Lesdain 1909, Rondon 1969, Hawksworth 1982a, Boqueras et al. 1989, Roux & Triebel 1994, Santesson 1994b, Calatayud et al. 1995, Etayo 1996b, Navrotskaya et al. 1996, Hitch 1998, 2006, 2007a, Aptroot et al. 2000a, Søchting et al. 2007, Triebel 2009, Eichler et al. 2010), in coastal regions on *Xanthoria calcicola* (2) (apothecia and thallus) (Boom et al. 1996, Diederich & Sérusiaux 2000, Hafellner & John 2006).

Remarks: One characteristic of the genus *Sphaerellothecium* is the superficial, on the host tissue growing, dark pigmented mycelium which lacks the species *S. parietinarium*. But nevertheless a transfer in this genus was made by excluding the affiliation to the genus *Endococcus* with important features (Hafellner & John 2006).
As indicated by the lacking reaction of the ascal gel with I, the species cannot belong to *Endococcus*.

Ecology: The major sites of collected *Sphaerellothecium parietinarium* are located in mediterranean-atlantic areas (Hafellner & John 2006). Since the fungus produces only sligth discolorations on the host, the question is still unanswered whether the fungus behaves in a parasitc or in a parasymbiotic way.

Distribution: For distribution data until 2006 see Hafellner & John (2006). Afterwards the species has been reported from the following European countries: Belgium (Eichler et al. 2010), Denmark (Søchting et al. 2007),Great Britain (Hitch 2006, 2007a) and Spain (Triebel 2009). In Africa it has been found in Libya (Thor & Nascimbene 2010 on *Xanthoria* cf. *parietina*.). It has also been reported from New Zealand (Galloway 2007a sub *Endococcus parietinarius*).

Exsiccata: Santesson, Fungi Lichenicoli Exs. nos. 208, 263 sub *Endococcus parietinarius* (GZU). – Triebel, Microf. Exs. no. 670 (GZU).

Further specimen examined: Europe: England: Devon, E Sidmouth, Felssturzbereich von Kreidekalkfelsen zwischen Branscombe Mouth und Beer Head, 50°19’N / 03°05’-07’W, 0-110 m, auf Zaunsäulen der Absperrung ober dem Felssturz, (1), 22.IX.1994, leg. A. Wilfling 732 (GZU).

XI. *Tremella caloplacae* (Zahlbr.) Diederich, Sérusiaux et al., Lejeunia 173: 31 (2003).

MycoBank 399374

Lindauopsis caloplacae Zahlbr., Ber. Deutsch. Bot. Ges 24: 145 (1906).

Type: Crete: an Kalkfelsen bei Kristallenia, 1904, R. Sturany (W 11196 – lectotype) designated in Sérusiaux et al. (2003) n.v.

Iconography: Zahlbruckner 1906: plate X., figs. 1–4 (drawings of an infected apothecium in longitudinal section, hyphae with haustoria and basidia); Millanes et al. 2011: 13, fig. 1 F (habitus photograph on *Caloplaca* sp.).

Description: An infection with this fungus leads to a more or less conspicuous, subconvex gall-formation on the apothecia of *Xanthoria parietina*. For a detailed description of *Tremella caloplacae* (T. sp. 1) see Diederich (1996).

Hosts: *Xanthoria parietina* (1) (apothecia), *Caloplaca arenaria* (2), *C. arnoldii* (3), *C. aurantia* (4), *C. carphinea* (5), *C. saxicola* (6) (Sérusiaux et al. 2003).

Remarks: So far unpublished sequence data (Millanes & Diederich in lit.) place the tremelloid fungus next to *Tremella caloplacae* and it seems reasonable to use that name, at least for the time being.

Ecology: The fungus is apparently not so rare but may be easily overlooked because infected hymenia are not discoloured. As the basidiomata develop only on the apothecial discs its behaviour seems to be parasitic on the mycobiont. Lichenicolous species of *Tremella* are considered as parasites by Diederich (1996).

Distribution: Sérusiaux et al. (2003) summarized the known distribution. According to them the species is known from the European countries Austria, France, Great Britain, Greece (Crete) and Spain, furthermore from Algeria in northern Africa.

Specimens examined: Europe: Austria: Steiermark, Graz, Liebenau, Murfeld, 47°01’01’’N / 15°27’43’’E, ca. 330 m s. m., GF 8958/4, Garten, an Kronenästen von *Malus domestica*, (1), 23.II.2011, leg. M. Pinter, det. A. Fleischhacker 11004 (GZU). – Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06‘57“N / 15°26‘18“E, ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 21.III.2011, leg. M. Pinter, det. A. Fleischhacker 11010 (GZU). – Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06‘57“N / 15°26‘18“E , ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 5.VI.2011, leg. M. Pinter, det. A. Fleischhacker 11016 (GZU). – Steiermark, Nordalpen, Nördliche Kalkalpen, Hochschwab-Gruppe, Seetal W von Seewiesen, ca. 10 km NE von Aflenz, 47°37‘14“N / 1 5°15‘02“E, ca. 950 m s. m., GF 8357/4, Baumreihe am Rand einer Weidefläche, an Kronenästen von *Picea abies*, (1), 20.VII.2011, leg. A. Fleischhacker 11018 & M. Sebernegg (GZU). – Steiermark, Steirisches Randgebirge, Fischbacher Alpen, 2.2 km S of Fischbach, valley of the brook Fischbach, near ‘Anger‘, 47°25‘22“N, 015°38‘35“E, (grid number 8559/4), 84 5 m altitude, on *Fraxinus excelsior*, (1), 30.III.2011, leg. W. Obermayer 12159 (GZU). – Steiermark (Styria), Nordalpen, Dachstein-Gruppe, Ramsau 4.6 km NNW of Schladming, 0.5 km N of the church of the village Ramsau am Dachstein, by the farm Feldlhof, 47°25’35’’N / 1 3°39’10’’E, c. 1180 m alt., GF 8547/4, orchard, on branches of *Malus domestica*, (1), 25.II.2011, leg. W. Obermayer no. 12147, det. J. Hafellner (GZU). – Steiermark (Styria), Nordalpen, Dachstein-Gruppe, Ramsau 4.6 km

NNW of Schladming, 1.4 km W of the church of the village Ramsau am Dachstein, by the road to Vorberg, 47°25’16’’N / 13°38’10’’E,, c. 117 0 m alt., GF 8547/4, roadside trees, on branches of unnamed deciduous tree, (1), 25.II.2011, leg. W. Obermayer no. 12148a, det. J. Hafellner (GZU). – Steiermark (Styria), Oststeirisches Hügelland, Graz, eastern suburban area, Ragnitztal, near the rivulet “Ragnitzbach” at lower end of Dr. Hanischweg, 47°04’35’’N / 15°28’50’’E, ca. 380 m, GF 8958/2, old orchard, on canopy branches of recently felled *Juglans regia*, (1), 1.VII.2010, leg. J. Hafellner no. 77075 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’20’’N / 14°27’59’’E, ca. 580 m s. m., GF 9452 /2, Arboretum an schwach W-geneigten Hängen, an tief hängenden Kronenästen von *Fraxinus excelsior*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10025 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35‘20‘‘N / 14°27‘59‘‘E, ca. 580 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an Kronenästen von *Fraxinus excelsior*, (1), 23.I.2011, leg. F. Schlatti, det. A. Fleischhacker 11006 (GZU). – **Slovenia:** Southern Alps, Julian Alps, Cezsoča S of Bovec, SE above the village, 46°19’10’’N / 13°33’20’’E, c. 380 m, solitary trees on the roadside, on branches in the lower canopy of *Juglans regia*, (1), 4.VII.2003, leg. J. Hafellner no. 77507 (GZU).

3.1.3 Lichenicolous fungi with a reported broad host spectrum

XII. ***Hainesia xanthoriae*** Brackel, Ber. Bayer. Bot. Ges. 79: 16 (2009).

MycoBank 519640

Type: “Deutschland, Bayern, Oberpfalz, Kreis Neustadt a. d. Waldnaab, NW Hardt bei Floß, im *Sambucus nigra*-Gebüsch, auf *Xanthoria parietina*, 535 m, 26.X.2007, W.v.B. (hb IVL 4566 – Holotypus, M – Isotypus)” n. v. (locality data from protologue, Brackel 2009: 16)

Iconography: Brackel 2009: 17, fig. 1A (drawing of a conidiophore with conidia), 18, fig. 2 (photograph of infected apothecia of *Xanthoria parietina*), fig. 3 (photomicrograph of a conidioma in vertical section); Eichler et al. 2010: 37, fig. 2 (photograph of the habitus), fig. 3 (photomicrograph of a conidioma in vertical section).

Description: The fungus forms round brown conidiomata, which are scattered or in small groups “sitting” on the surface of the host. A section through a conidiomata shows a brown wall, branched and septate conidiophores and the typical filiform, hyaline conidia. For further details see the protologue.

Hosts: *Xanthoria parietina* (1) (apothecia and thallus), *X. polycarpa* (2) (apothecia and thallus), *X. elegans* (3) (apothecia and thallus), *Phaeophyscia orbicularis* (4) (Brackel 2009).

Ecology: This species seems to be rare since it has not been found very often. No discolorations or destroyed lichen tissues were observed on the hosts.

Distribution: The species is so far known from the following European countries: Austria (Brackel 2010b), Germany (Brackel 2009, 2010b) and Luxembourg (Eichler et al. 2010). In North America it is already reported from Greenland (Brackel 2009).

Specimens examined: Europe: Luxembourg: distr. Lorrain, Strassen, à 400 m au NE du châlet des Scouts, IFBL: M8.14.23, UTM: KA.80, sur *Fraxinus*, (1), 25.IV.2009, leg. et det. P. Diederich 16959 (herb. Diederich). – Lorentzweiler, Roude Bam, alt. 225 m, IFBL: L8.46.31, UTM: KA.90, sur *Syringa*, dans un jardin, (1), 23.III.2010, leg. et det. P. Diederich 16906 (herb. Diederich).

XIII. *Illosporiopsis christiansenii* (B. L. Brady & D. Hawksw.) D. Hawksw. in Sikaroodi et al., Mycol. Res. 105 (4) : 457 (2001).

MycoBank 467757

Hobsonia christiansenii B. L. Brady & D. Hawksw., Lowen et al., Mycologia 78(5) : 842 (1986).

Type : "Italy, Idro, on *Candelaria concolor* (Dickson) B. Stein, on *Populus* sp., 4 September 1977, M. Skytte Christiansen (IMI 226836 – Holotypus ; herb. Christiansen 595 – Isotypus)." N. v. (locality data from protologue, Lowen et al. 1986: 842).

Iconography: Lowen et al. 1986: 843, figs. 3-7 (photomicrographs of conidia and the conidial development), 844, figs. 8-9 (drawings of conidia and the habitus).

Description: *Illosporiopsis christiansenii* is easily recogized by its pink sporodochia which produce masses of conidia. This looks like a "pink granulose mass" on the host tissue. The conidia are hyaline, irregulary shaped, consisting of several cells, septate and have a helicoid structure. For detailed description see the protologue.

Hosts: *Xanthoria parietina* (1) (thallus), *Candelaria concolor* (2), *Physcia aipolia* (3), *P. stellaris* (4), *P. tenella* (5), *P. semipinnata* (6) (Lowen et al. 1986), *P. dubia* (7) (Aptroot et al. 2005), *Melanelia exasperatula* (8) (Kukwa 2004), *Flavoparmelia baltimorensis* (9) (Lawrey 1993), *Phaeophyscia orbicularis* (10) and probably further hosts.

Remarks: The species originally described in *Hobsonia* was shown to be phylogenetically distant from the type species *H. mirabilis* resulting in the description of the genus *Illosporiopsis*, a genus in the nectrioid clade, whereas the type species of *Hobsonia* turned out to be a basidiomycete (Sikaroodi et al. 2001).

Ecology: *Illosporiopsis christiansenii* is supposed to colonize foliose lichens in a nutrient-rich environment and not to cause intense pathogenity (Lowen et al. 1986). This fungus is a typical invader of *Xanthorion* communities including *Xanthoria parietina* (Obermayer 1993, Kocourková 2000, Hafellner 2003a, Santesson et al. 2004, Cezanne et al. 2008, Czyzewska & Kukwa 2009, Stepanchikova et al. 2011) although this is not the most common host.
As Lawrey (1993) shows this fungus might even have been able to develop defensive strategies during coevolution which eventually ended in the beneficial use of certain secondary metabolites produced by its favourite host in North America, *Flavoparmelia baltimorensis*.

Specimens examined: Europe: Austria: Steiermark, Steirisches Randgebirge, Fischbacher Alpen, im Feistritztal zwischen Ratten und Rettenegg, kurz SW der Einmündung des

Klaffeneggbaches, 47°30’20’’N / 15°46’10’’E, ca. 80 0 m, MTB 8460/4, Ufergehölzstreifen, auf Stammborke von *Salix*, (1), 22.X.1989, leg. J. Hafellner 46298 (GZU). – Steiermark, Oststeirisches Hügelland, Loimeth ca. 8 km NW von Fürstenfeld, 47°06’52’’N / 16°01’56’’E, ca. 335 m s. m., GF 8862/3, Mähwiese mit zerstreuten Obstbäumen, an tief hängenden Kronenästen von *Malus domestica*, (1, 10), 16.X.2010, leg. A. Fleischhacker 10003 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’22’N / 14°27’57’’E, ca. 590 m s. m. , GF 9452/2, Arboretum an schwach W-geneigten Hängen, an unteren Kronenästen von *Sambucus nigra*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10016 (GZU).

XIV. *Lichenoconium xanthoriae* M. S. Christ., Friesia 5(3–5): 212 (1956).

MycoBank 299794

Type: “Denmark, North Jutland, Råbjærg parish, Bunken Klitplantage, on the apothecia of *Xanthoria polycarpa* (Ehrh.) Rieber growing on dead branches of *Cytisus scoparius* (L.) Link in a pine plantation on dune sand. Collected 26.VI.1942 by M. Skytte Christiansen (Collection no. 8564)” (C – holotype) n. v. (locality data from protologue, Christiansen 1956: 215).

Iconography: Christiansen 1956: 213, fig. 1 (photograph of the type material with infected apothecia) and 214, fig. 2 (drawings of pycnidia in vertical section, pycnidial wall-cells, conidia, pycnidial wall-cells with conidiophores and young conidia); Hawksworth 1977: 164, fig. 2D (drawings of conidiogenous cells and conidia) and plate 29 D, F-J (photographs of infected apothecia of *Xanthoria polycarpa*, *Parmelia olivacea* and *Cetraria sepincola*, conidia variously magnified); Hawksworth 1983: 38, fig. 59 (drawing of conidia).

Description: *Lichenoconium xanthoriae* is recognized by its black and erumpent pycnidia which appear on the apothecia or thallus of the host. In contrast to *Phoma epiphyscia* it forms brown and more ore less globose conidia. For further and detailed description see Christiansen (1956) or Hawksworth (1977).

Hosts: *Xanthoria parietina* (1) (apothecia and thallus), *X. polycarpa* (2) (apothecia), *X. candelaria* (3), *X. elegans* (4), *Teloschistes chrysophthalmus* (5), *Cetraria sepincola* (6), *Melanohalea olivacea* (7), *M. exasperata* (8), *Cetrelia olivetorum* (9), *Cladonia chlorophaea* (10).

Remarks: Another *Lichenoconium* species may be found on *Xanthoria parietina*, namely *Lichenoconium usneae*. There has been one report from Southern Italy (Brackel 2011: 74), which should be revised. For a detailed description and for further hosts of this species see Hawksworth (1977).

Ecology: The most frequent host of *Lichenoconium xanthoriae* is probably *Xanthoria polycarpa*. In the commonly applied sense this fungus has a relatively broad host spectrum since it does not only infect *Xanthoria* but also other genera of lichens. Molecular data would be useful to confirm this. The distribution data show that *L. xanthoriae* is widespread but not very common.

Distribution: The species is so far known from the following European countries: Austria (Obermayer 1993, on (1), but with additional host *Xanthoria elegans* strongly in need of confirmation, Berger & Türk 1993, Hafellner 1997, 2002a, 2003a, Hafellner et al. 2004, 2005a, Priemetzhofer 2008, Etayo & Berger 2009), Belgium (Boom & Boom 2006), Czech Republic (Hawksworth 1977, on (1), Kocourková 2000), Denmark (Christiansen 1956, 1986, Hawksworth 1977, on (2), Hansen 1997, on (10), 2006, Alstrup et al. 2004, Søchting et al. 2007), Estonia (Halonen et al. 2000, Suija & Jüriado 2002, Suija 2005), France (Bouly de Lesdain 1914, allocation because of host (1), Roux et al. 1999), Germany (Hawksworth & Diederich 1991, Scholz 1995, Litterski 1999, Aptroot et al. 2002, on (2), Schiefelbein 2003, 2006, 2009, Kocourková & Brackel 2005, on (1, 2), Brackel & Kocourková 2006, Cezanne et al. 2008, on (1, 2), Brackel 2009), Italy (Brackel 2008b), Lithuania (Motiejūnaitė et al. 1998, Motiejūnaitė 1999, 2000, 2002), Luxembourg (Diederich 1989, Diederich et al. 1991, on (1)), the Netherlands (Aptroot et al. 2000b, Sparrius et al. 2002, Boom 2004, Boom & Boom 2009), Poland (Kukwa & Motiejūnaitė 1999, Kukwa 2000, 2004, 2005, Kukwa et al. 2002, 2010, Jando & Kukwa 2003, Sparrius 2003, Kukwa & Czarnota 2006, Kukwa & Jabłońska 2008, Szymczyk & Zalewska 2008, Czyzewska et al. 2008, Kukwa & Flakus 2009, Czyzewska & Kukwa 2009), Portugal (Boom & Etayo 2000, on (6)), Russia (Zhurbenko & Himelbrant 2002, on (3), Alstrup et al. 2005, on (6, 7, 8), Zhurbenko 2009, on (2)), Spain (Atienza et al. 1993, Giralt 1996, Burgaz et al. 2007, Etayo 2008), Sweden (Santesson 1949, 1984, 1986 all on (2), Hawksworth 1977, on (2, 7), Thor 1993), Ukraine (Kondratyuk 1999) and the British Isles (Hawksworth 1977, on (1, 2), Hawksworth & Minter 1980, on (9), Hitch 1994, 2007b, Wolseley & James 2005). From Africa it has already been reported from the Canary Islands (Etayo 1996a). In America it is known from Mexico (Triebel et al. 1991, on (5)), Colombia (Etayo 2002), Mexico or USA (Diederich 2004) and USA (Knudsen & Kocourková 2009). Furthermore it has been reported from the subantarctic Falkland Islands (Diederich 2003, on (3)).

Exsiccata: Santesson, Fungi Lichenicoli Exs. Nos 19, 84 both on (2) (GZU). – Alstrup, Lichenes Danici Exs. no. 66 (9) (GZU).

Further specimens examined: Europe: Austria: Steiermark, Hochschwab-Gruppe, an der Straße von Thörl zum Ghf Bodenbauer, kurz vor dem Moarhaus ca. 2.5 km NW von

Innerzwain, ca. 840 m, an *Sambucus racemosa*, (1), 20.VI.1985, leg. J. Hafellner 13312 (GZU). – Steiermark, Steirisches Randgebirge, Fischbacher Alpen, im Feistritztal ca. 2.5 km S von Birkfeld, am orographisch rechten Ufer der Feistritz kurz ober der Einmündung des Gasenbaches, 47°19‘55“N / 15°41‘45“E, ca. 530 m, MTB 8660/3, Ufergehölzstreifen, auf tiefhängenden Zweigen von *Fraxinus*, (1), 25.XII.2000, leg. J. Hafellner 53741 (GZU). – Ibid., im Waisenbachgraben ca. 5.5 km NNW von Birkfeld, 47°23‘50“N / 15°39‘15“E, ca. 710 m, MTB 8659/2, einzelne Laubbäume am Bachufer, auf unteren Kronenzweigen von *Fraxinus*, (1), 16.X.1999, leg. J. Hafellner 50619 (GZU). – Steiermark, Seetaler Alpen, W-Abhang 10 km ONO von Neumarkt, im Grotscher unter dem Kreiskogel, ca. 1900 m, MTB 8953/1, Glimmerschieferblock, (4), 3.VII.1988, leg. et det. W. Obermayer (GZU). – Steiermark, Schladminger Tauern, Hochwildstelle S von Pruggern, südöstlicher Vorgipfel, 2630 m, Grundfeld 8648/4, südwestseitige Gneisschrofen mit Erdspalten, (4), 14.V.1988, leg. J. Hafellner 21792 & A. Hafellner (GZU). – **Belgium:** distr. Mosan, Ferrières, right side of the river Ourthe, c. 1 km N of Ferme de Palogne, IFBL: G7.52, sur de petites branchettes tombées d’un arbre, (2), 9.X.2004, leg. et det. P. Diederich 16076 (herb. Diederich). – **Luxembourg:** Somme, distr. Picard, au NWW de Crécy-en-Ponthieu, Machy, extrémité ouest du village, jardins et forêt avoisinante (= forêt de Crécy), IFBL: H22.38.11, sur *Syringa*, (2), 8.VIII.2004, leg. et det. P. Diederich 15895 (herb. Diederich). – **Luxembourg:** distr. Lorrain, Mamer, Tossebierg, IFBL: M8.14.31, UTM: KA.80, sur *Sambucus*, (2), 23.VIII.1997, leg. et det. P. Diederich 12878 (herb. Diederich).

XV. *Marchandiomyces aurantiacus* (Lasch) Diederich & Etayo, Etayo & Diederich, Mycotaxon 60: 421 (1996).

MycoBank 436727

Illosporium aurantiacum Lasch, Rabenh., Fungi Eur. Exsicc., Cent. 1, nr. 74 in Bot. Zeitung 17(35): 304 (1859).

Type: [Poland], “in lichenibus trunci *Pyri mali* pr. Driesen, G. W. Lasch” (? – holotype) n. v. (locality data and “K, M, UPS – isotypes” according to Etayo & Diederich 1996: 421).

Teleomorph: *Marchandiobasidium aurantiacum* Diederich & Schultheis, Diederich et al., Mycol. Res. 107(5): 524 (2003).

Type: “Belgium: Lorraine distr.: Lischert (coord. IFBL: L7.36.44), behind Thoen house, on *Pyrus* branches in garden, on *Physcia tenella*, 21 Dec. 2001, D. Thoen & P. Diederich 15133 (LG – holotypus; hb. Diederich – isotypus).” n. v. (locality data from protologue, Diederich et al. 2003: 524).

Iconography: Diederich et al. 2003: 524, figs. 1-3 (photographs of sclerotia and developing basidioma on *Physcia tenella* and mature basidioma), 525, fig. 4 (drawings of basal hyphae, young, immature and mature basidia and basidiospores).

Description: *Marchandiomyces aurantiacus* is easily recognized by its orange sclerotia which are distributed over the host tissue. The lichen area around this bulbills becomes friable and pale. For further details and a detailed description of the teleomorph see Diederich et al. (2003).

Hosts: The fungus is a typical invader of macrolichens in *Xanthorion* communities including *Xanthoria* sp. (Diederich & Sérusiaux 2000).

Remarks: There are also reports of *Marchandiomyces corallinus* on *Xanthoria parietina* in the literature which might be wrong because *M. corallinus* preferably attacks lichens growing on acidic substrates. So a potential *M. aurantiacus* is likely to be hidden behind such findings. For feasible misunderstandings see the paragraph on distribution.

Ecology: The observed infections of *Marchandiomyces aurantiacus* on *Xanthoria parietina* cause a complete lichen bleaching. According to Etayo & Berger (2009) the fungus acts as a decomposer of lichens.

Distribution: On *Xanthoria parietina* the species is so far known from the following European countries: Austria (Etayo & Berger 2009, Pokorny 1854, sub *Illosporium roseum*, Keissler 1930, sub *Illosporium roseum*), Belgium (Van den Broeck & Hantson 2008), France (Triebel 2003, sub *Marchandiomyces corallinus*), Italy (Brackel 2011, sub *Marchandiomyces corallinus*) and Lithuania (Motiejūnaitė 2009).

Specimens examined: Europe: Austria: Steiermark, Graz, Liebenau, Murfeld, 47°01’13,5’’N / 15°27’34’’E, ca. 335 m s. m., GF 89 58/4, Garten, an Kronenästen von *Magnolia* sp., auf *Xanthoria parietina*, 16.II.2011, leg. M. Pinter, det. A. Fleischhacker 11003 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’23’’N / 14°27’57’’E, ca. 59 0 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an unteren Kronenästen von *Laburnum* x *watereri*, auf *Xanthoria parietina*, 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10021 (GZU).

XVI. ***Paranectria oropensis*** (Ces.) D. Hawksw. & Piroz., Canad. J. Bot. 55: 2555 (1977).

MycoBank 319195

Sphaeria (*Nectria*) *oropensis* Ces., in Rabenhorst, Bot. Zeitung 15: 406 (1857). – *Dialonectria oropensis* (Ces.) Cooke, Grevillea 12 (64): 111 (1884). – *Cucurbitaria oropensis*

(Ces.) Kuntze, Revis. Gen. Pl. 3: 461 (1898). – *Ciliomyces oropensis* (Ces.) Höhn., Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. 1 115: 673 (1906).

Type: "Parasiticam in thallo *Biatorae* (*decolorantis*?)…prope amplissimum Sanctuarium Stae. Mariae Deiparae in Monte Oropa (provinciae Bugellensis – Pedemont.) legi exeunte Sept. 1856." = Rabenhorst, Klotzschii Herbar. Ed. nova no. 524 (B – holotype) n. v. (locality data from protologue, Rabenhorst 1857: 406).

Iconography: Höhnel 1906: 672, fig. 2 (drawings of an ascus, ascomata and ascospores); Hawksworth 1983: 38, fig. 82 (drawing of an ascospore); Hafellner & Obermayer 2009: 179, fig. 2 (photographs of infected lichens), 182 – 183, fig. 3 – 4 (photographs of infected *Phaeophyscia orbicularis*), 186, fig. 5 (photographs of mature ascomata), 187, fig. 6 (photomicrographs of the hymenium, ascus and ascospores).

Description: *Paranectria oropensis* has whitish to pale pink, hairy ascomata which are scattered on a subiculum spreading over the thallus of the host. The asci are 8-spored and clavate and produce hyaline, fusiform ascospores which are transverse and longitudinal septate and have one cilia on both cuspidate ends. For detailed description see Höhnel (1906) and Keissler (1930).

Hosts: *Paranectria oropensis* has a very wide host spectrum. For a detailed list of various host lichens see Hafellner & Obermayer (2009). Within the genus *Xanthoria* and relatives it has already been collected on: *Xanthoria parietina* (1), *X. candelaria* (2) (Diederich & Sérusiaux 2000), *Xanthomendoza fallax* (3) (Hafellner & Obermayer 2009).

Ecology: According to Hafellner & Obermayer (2009) *Paranectria oropensis* is an aggressive pathogen which is not host specific. Due to its pathogenity it has the capability to open lichen synusia on bark. The behaviour of this fungus therefore can help lichens to recolonize the previously decayed areas. Similar to *Athelia arachnoidea*, *Paranectria oropensis* is a lichenicolous fungus that does not coexist with their hosts but kills them. Both species are responsible for an increase in the community dynamics on bark.

Specimens examined: Europe: Austria: Steiermark, Steirisches Randgebirge, Stubalpe, niedrige Felsausbisse, alte Bergulme in einer Weide, kurz westlich des Hofes "Bachgößler" am oberen Teigitschgraben NW Hirschegg, +/- südseitig exponiert, +/- 1110 m, (3), 8.X.1989, leg. J. Poelt (GZU). – Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07'18''N / 16°13'17''E, ca. 265 m s. m., GF 8863/3, Streuobstwiese, an tief hängenden Kronenästen von *Juglans regia*, (1), 28.XI.2010, leg. A. Fleischhacker 10009 & B. Fleischhacker (GZU).

XVII. ***Phoma epiphyscia*** Vouaux, Bull. Trimestriel Soc. Mycol. France 30: 197 (1914).

MycoBank 209310

Type: [France], Ghyvelde, on the thallus of *Xanthoria parietina* and *Phaeophyscia orbicularis*, leg. M. Bouly de Lesdain (? – holotype) n. v. (locality data from protologue, Vouaux 1914: 197). “Greenland, Narssaq d., 1 km S of Qagssiarssuk, 61°08’N, 45°32’W, alt. 140 m, on *Phaeophyscia sciastra*, 4 Aug. 1980, Alstrup 801422h” (C – neotype) n. v. (locality data from Alstrup & Hawksworth 1990: 54).

Iconography: Alstrup & Hawksworth 1990: 53, fig. 30 A – B (photomicrographs of a conidioma and its wall in longitudinal section with conidiogenous cells and conidia in development), C (drawing of conidia).

Description: *Phoma epiphyscia* has black and globose conidiomata which are immersed in the thallus and apothecia of *Xanthoria parietina*. They are surrounded by a more or less clearly visible collar of the thallus. The infection leads to discolorations (orange to red) and dying processes of the host tissue. The conidiomata wall is brown and has very short conidiogenous cells in which the hyaline elliptical conidia are produced. An important feature of the conidia are the two guttules. For further description see the protologue or Hawksworth (1981) and Alstrup & Hawksworth (1990).

Hosts: *Xanthoria parietina* (1) (apothecia and thallus), *X. elegans* (2) (apothecia and thallus) (Zhurbenko 2009), *Physcia adscendens* (3) (Brackel 2010b), *Physcia tenella* (4) (Brackel 2011), *Physcia stellaris* (5) (Søchting et al. 2007), *Phaeophyscia orbicularis* (6) (Vouaux 1914, Martínez et al. 2002), *Phaeophyscia sciastra* (7) (Alstrup & Hawksworth 1990), *Physconia muscigena* (8) (thallus) (Zhurbenko 2009).

Remarks: According to Hawksworth (1981) and Alstrup & Hawksworth (1990) the herbarium of Bouly de Lesdain was destroyed in 1940 and so the type specimen is supposed to be lost. Furthermore there is no type material mentioned in the remnants of Vouaux’s herbarium (Rondon 1969). Therefore Alstrup & Hawksworth (1990) designated a neotype.

The habitus of *Phoma epiphyscia* is very similar to that of *Polycoccum slaptoniense*. It is therefore assumed that there exists an anamorph-teleomorph connection between both states.

Some authors (see paragraph on hosts) use a very broad species concept. Most of the specimens ought to be checked again and the species concept is in need of critical revision.

Phoma pisutii on a *xanthorioid* lichen species, namely on *Oxneria* (*Xanthoria*) *ulophyllodes* (Kondratyuk et al. 2010) is evidently a different species.

Ecology: The infections of *Phoma epiphyscia* which are sometimes very small might easily be overlooked and this could be the reason why it has not frequently been reported although it might be more common. Its cause of discolorations and progressive destructions on the host leads to the assumption that the fungus is a parasite.

Distribution: *Phoma epiphyscia* on (1) is so far known from the following European countries: Austria (Keissler 1930: 541 f. as *Phoma lichenis* which is probably belonging to *Phoma epiphyscia*, Etayo & Berger 2009), Estonia (Aptroot et al. 2005), France (Vouaux 1914), Germany (Brackel 2007), Italy (Brackel 2008b, 2011), Spain (Etayo 2010), Sweden (Santesson 1993) and Ukraine (Kondratyuk et al. 2010). From Africa it has already been reported from Morocco (Werner 1939).

Specimens examined: Europe: Austria: Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06’57’’N / 15°26’18’’E , ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 21.III.2011, leg. M. Pinter, det. A. Fleischhacker 11009 (GZU). – Steiermark, Nordalpen, Nördliche Kalkalpen, Hochschwab-Gruppe, Seetal W von Seewiesen, ca. 10 km NE von Aflenz, 47°37’14’’N / 1 5°15’02’’E, ca. 950 m s. m., GF 8357/4, Baumreihe am Rand einer Weidefläche, an Kronenästen von *Fraxinus excelsior*, (1), 20.VII.2011, leg. A. Fleischhacker 11021 & M. Sebernegg (GZU). – Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07’18’’N / 16°13’17’’E, ca. 265 m s. m., GF 8863 /3, Streuobstwiese, an tief hängenden Kronenästen von *Juglans regia*, (1), 28.XI.2010, leg. A. Fleischhacker 10012 & B. Fleischhacker (GZU).

XVIII. *Pyrenochaeta xanthoriae* Diederich, Mycotaxon 37: 318 (1990).

MycoBank 126697

Type: [Luxembourg], SE Lasauvage, Grand Bois, on *Acer*, on *Xanthoria parietina*, 29.VIII.1987, leg. P. Diederich 8970 (LG – holotype, herb. Diederich – isotype) n. v. (locality data from protologue, Diederich 1990: 318).

Iconography: Diederich 1990: 319, fig. 10 (drawings of conidiophores, conidiogenous cells and conidia); this paper: 53, fig. 9 (photomicrograph of a pycnidium in longitudinal section with hairs and conidia).

Description: *Pyrenochaeta xanthoriae* is recognizable under the dissecting microscope by its stiff brown hairs protruding from the pycnidia which are half immersed in the thallus and apothecia. These setae are fixed in the pycnidial wall next the ostiole. The pycnidia are more or less globose. A characteristic feature of this fungus is that the conidiogenous cells develop both intercalarly and apically on septate conidiophores. The conidia are hyaline and ellipsoid. For further description see the protologue.

Hosts: *Xanthoria parietina* (1) (apothecia and thallus), *Physcia leptalea* (2) (Brackel 2011), *P. biziana* (3) (Brackel 2011). Records from lichens other than *X. parietina* would be worth to be restudied.

Ecology: *Pyrenochaeta xanthoriae* which is difficult to see because of its tiny pycnidia and the small infections is assumed to lead to the destruction of small parts of the lichen thalli which are getting bleached or discoloured.

Distribution: The species on (1) is so far known from the following European countries: Austria (Hafellner 1996, Etayo & Berger 2009), Belgium (Ertz et al. 2008), Estonia (Suija et al. 2009, 2010a), France (Roux et al. 2001), Germany (Kocourková & Brackel 2005, Brackel 2009, 2010b), Italy (Brackel 2008b, 2011), Lithuania (Motiejūnaitė et al. 2007), Luxembourg (Diederich 1989, 1990), Poland (Kukwa 2005, Czyzewska & Kukwa 2009), Russia (Alstrup et al. 2005) and Spain (Etayo & Blasco Zumeta 1992, Llimona et al. 1998, Etayo 2010).

Specimens examined: Europe: Austria: Steiermark, Oststeirisches Hügelland, Loimeth ca. 8 km NW von Fürstenfeld, 47°06’52’’N / 16°01’56’’E, ca. 335 m s. m., GF 8862/3, Mähwiese mit zerstreuten Obstbäumen, an tief hängenden Kronenästen von *Juglans regia*, (1), 16.X.2010, leg. A. Fleischhacker 10007 (GZU). – Steiermark, Graz, Mariatrost, Roseggerweg 134, 47°05’46’’N / 15°28’51’’E, ca. 470 m s. m., GF 8958/2, Garten, an Kronenästen von *Juglans regia*, (1), 17.I.2011, leg. M. Pinter, det. A. Fleischhacker 11001 (GZU). – Steiermark, Oststeirisches Hügelland, Graz, Andritz, Pfanghofweg 40a, 47°06’57’’N / 15°26’18’’E, ca. 410 m s. m., GF 8858/4, Garten, an Kronenästen von *Juglans regia*, (1), 21.III.2011, leg. M. Pinter, det. A. Fleischhacker 11014 (GZU). – Burgenland, Südburgenland, Rauchwart, Rauchwarter Berghäuser ca. 6 km SE von Stegersbach, 47°07’18’’N / 16°13’17’’E, ca. 265 m s. m., GF 8863 /3, Streuobstwiese, an tief hängenden Kronenästen von *Juglans regia*, (1), 28.XI.2010, leg. A. Fleischhacker 10014 & B. Fleischhacker (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’22’’N / 14°27’57’ ’E, ca. 590 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an unteren Kronenästen von *Sambucus nigra*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10015 (GZU).

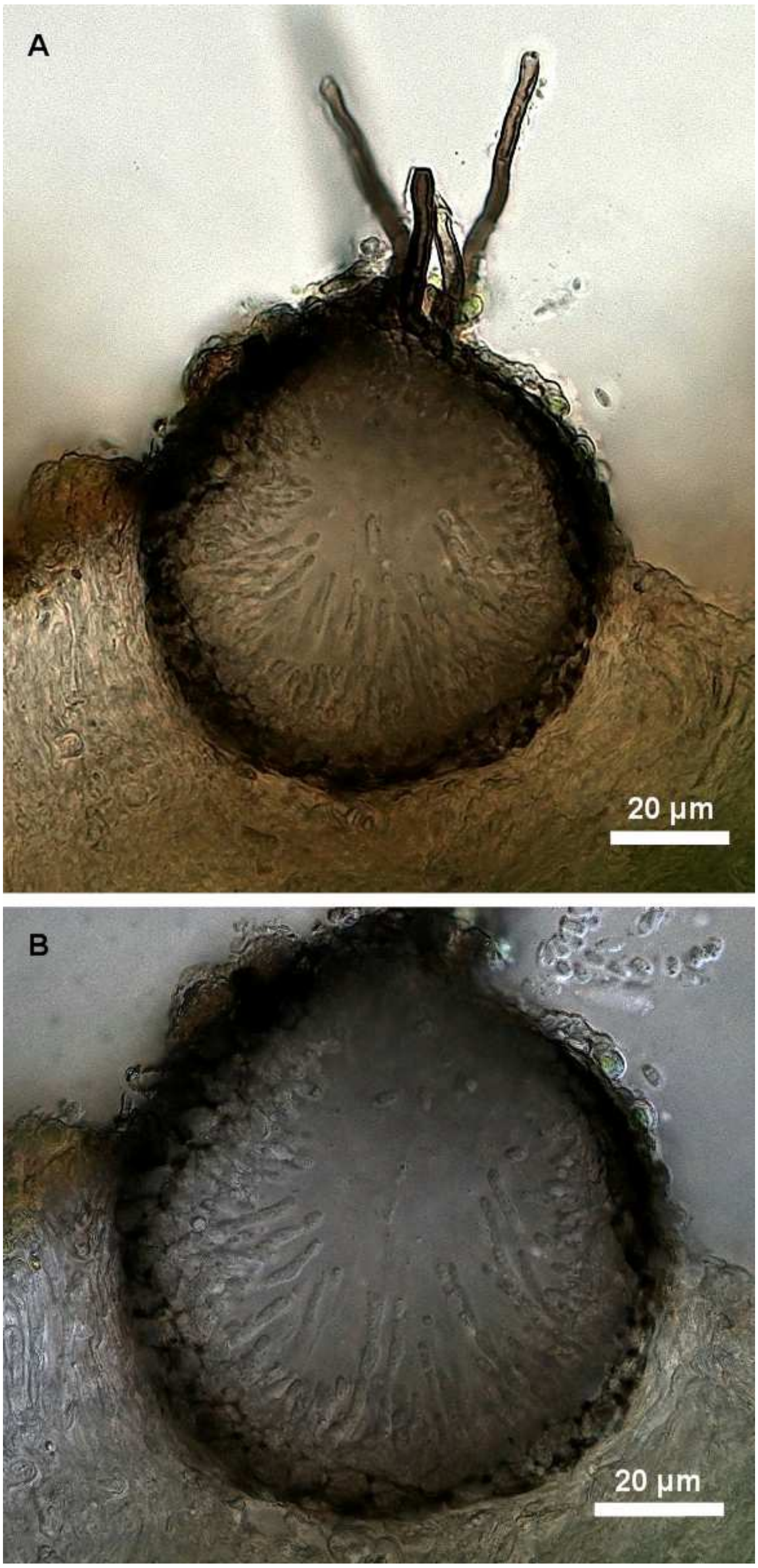


Figure 9: *Pyrenochaeta xanthoriae*. A, Pycnidium in longitudinal section with hairs. B, Pycnidium and conidia. (Fleischhacker 10007)

Further species but not treated in detail, reported on *Xanthoria parietina*:

XIX. *Acremonium antarcticum* (Speg.) D. Hawksw.

For a detailed description see Hawksworth (1979: 192).
The species has been reported on *Xanthoria parietina* from Estonia (Suija et al. 2009). In Europe *Acremonium antarcticum* has been reported several times on *Hypogymnia physodes*. The genus *Acremonium* represents anamorphic states of nectrioid pyrenomycetes (Rossman et al. 1999). *Acremonium antarcticum* as cited by Suija et al. (2009) has certainly been determined on morphological characters and may be different from the species on *Caloplaca regalis* which is the type host and a southern hemispherical member of *Teloschistaceae* (Hafellner, oral information). It could be possible that *Pronectria xanthoriae* represents the teleomorph of the *Acremonium* species on *Xanthoria parietina*.

XX. *Muellerella lichenicola* (Sommerf.: Fr.) D. Hawksw.

For a detailed description see Triebel & Kainz (2004: 674).

Specimen examined:

France (Pas-de-Calais, distr. Maritime): Cran aux Oeufs, top of cliff near village, IFBL: E22.14, on stems and branches of *Lycium barbarum*, on *Xanthoria parietina* (L.) Th. Fr., VI.2001, leg. et det. P. Diederich 16771 (herb. Diederich).

XXI. *Pseudorobillarda* spec. (see Etayo & Berger 2009)

XXII. *Intralichen christiansenii* (D. Hawksw.) D. Hawksw. & M. S. Cole

For a detailed description and for further hosts see Hawksworth (1979) and Hawksworth & Cole (2002).
There has been one report of *Intralichen christiansenii* on *Xanthoria parietina* from Germany (Cezanne et al. 2008: 190).

XXIII. *Stigmidium schaereri* (A. Massal.) Trevis.

For a detailed description see Roux & Triebel (1994: 505).
Stigmidium schaereri has been recorded on *Xanthoria parietina* in New Zealand (Galloway 2007b: 1696). This report refers to an earlier article by Kondratyuk & Galloway (1994: 29). Further hosts cited there are various *Pseudocyphellaria* species.

The name has often been used in a broad sense in the past. However, *Stigmidium schaereri*, the type species of the genus, is a specific invader of *Dacampia hookeri*. The lichenicolous fungus reported under that name from New Zealand upon *Xanthoria parietina* needs to be revised.

XXIV. *Catillaria nigroclavata*:

For detailed description see Hertel et al. (2007): 224 f.

Specimens examined:

Europe: Austria: Steiermark (Styria), Nordalpen, Nördliche Kalkalpen, Hochschwab-Gruppe, an der Straße von Thörl zum Gasthof Bodenbauer, ca 1.8 km NNW von St. Ilgen, kurz N des Weilers Innerzwain, 47°33'30''N / 15°09' 05''E, 780 m, GF 8456/2, Baumreihe entlang des Baches, an Stammborke junger *Fraxinus excelsior*, auf *Xanthoria parietina*, 31.XII.2010, leg. J. Hafellner no. 76873 (GZU). – **Switzerland**: Kanton Bern, Berner Alps, by the road from Meiringen to Rosenlaui, S above Meiringen near the inn Zwirgi, 46°42'45''N / 08°10'55''E, elevation c. 980 m, roadside trees, on recently fallen dead branches of *Fraxinus excelsior*, on *Xanthoria parietina*, 24.VIII.2006, leg. J. Hafellner no. 77459 (GZU).

XXV. *Endococcus rugulosus* coll. sub *Discothecium gemmiferum* (France, Vouaux 1913: 46 f. on *Xanthoria parietina*).

XXVI. *Monodictys anaptychiae* sub *Coniothecium anaptychiae* (France, Vouaux 1914: 312 f. on *Xanthoria parietina*, most likely refers to *Xanthoriicola physciae*).

Doubtful records of lichenicolous fungi on *Xanthoria parietina*:

Hafellner et al. (2004) cited a voucher with an occuring of ***Muellerella pygmaea*** and ***Zwackhiomyces coepulonus*** on *Xanthoria parietina*. The samples have been rechecked and as in reality the host is *Xanthoria elegans*, evidently an error in naming the lichen has happened.

3.2 Facultatively lichenicolous fungi

XXVII. ***Athelia arachnoidea*** (Berk.) Jülich, Willdenowia Beih. 7: 53 (1972).

MycoBank 309341

Corticium arachnoideum Berk., Ann. Mag. Nat. Hist. 13: 345 (1844). – *Terana arachnoidea* (Berk.) Kuntze, Revis. Gen. Pl. 2: 872 (1891). – *Athelia epiphylla* var. *arachnoidea* (Berk.) Krieglst., Beiträge zur Kenntnis der Pilze Mitteleuropas 12: 40 (1999).

Type: "Creeping over mosses and lichens on fallen sticks, Northamptonshire" (type-information from protologue / Berkeley 1844: 345); [England], Northampton, Blatherwycke Park, about 24 minutes SW of King´s Cliffe (K – holotype) n. v. (locality data from Jülich 1972: 53 ff.).

Hypochnus bisporus J. Schröt., in Cohn F.: Kryptogamenflora von Schlesien 3(1): 415 (1888). – *Corticium bisporum* (J. Schröt) Höhn & Litsch., Ann. Mycol. 4(3): 288 (1906). – *Corticium centrifugum* subsp. *bisporum* (J. Schröt.) Bourdot & Galzin, Hymén. De France: 199 (1928)/ Bull. Trimest. Soc. Mycol. Fr. 27:157 (1911) n. v. – *Athelia bispora* (J. Schröt) Donk, Fungus 27: 12 (1957).

Type: [Poland], Breslau, Oswitz, on fallen leaves and branches (? – holotype) n. v. (synonymy established by Schröter 1888: 415).

Anamorph: *Rhizoctonia carotae* Rader, Phytopathology 38: 444 (1948) (basionym information from Adams & Kropp 1996). – *Fibularhizoctonia carotae* (Rader) G.C. Adams & Kropp, Mycologia 88(3): 464 (1996).

Iconography: Berkeley 1844: plate IX, fig. 3 (drawing of the hymenium); Jülich 1972: 56, fig. 8 (drawings of hyphae, basidia and basidiospores of the type-material); Adams & Kropp 1996: 462, fig. 1 (SEM-photomicrograph of the hymenium), 463, figs. 2-4 (photograph of the hymenium on dead leaves and SEM-photomicrographs of the same), 464, fig. 5 (SEM-photomicrograph of calcium-oxalate-crystals on subhymenial hyphae), fig. 7 (SEM-photomicrograph of sclerotia on the hymenium), 465, fig. 8 (photograph of sclerotia in agar culture), fig. 11 (photomicrograph of sclerotia in vertical section); Yurchenko & Golubkov 2003: 276, fig. 1 (photographs of the mycelium and sclerotia on different substrate), 278, fig. 2 (drawings of the various types of hyphae and the calcium-oxalate-crystals), 279, fig. 3 (drawing of narrow sinuous hyphae among algal cells), fig. 4 (drawing of the sclerotium and details of the same), 280, fig. 5 (photograph of a basidioma and a patch of it), fig. 6 (drawing of basidioles); Hafellner & Obermayer 2009: 178, fig. 1b (photograph of the habitus on *Phaeophyscia orbicularis*).

Description: The fungus forms a whitish, cobwebby mycelium on its hosts and more or less globose, ochreous sclerotia which are scattered in groups on the host tissue. Similar in colour are its basidiomata but often with a more creamy tinge. They are thin and distributed like “patches” over the host. The hyphae are hyaline and septated and often bear aciform crystals on the surface. For a detailed description and for further microscopical characters see Jülich (1972), Hawksworth (1983), Parmasto (1998) and Yurchenko & Golubkov (2003).

Hosts: *Xanthoria parietina* (1), *X. polycarpa* (2), *X.* sp. (3) (Santesson et al. 2004). Many further corticolous lichens and even bryophytes are attacked by *Athelia arachnoidea* including *Caloplaca* sp., *Hypocenomyce scalaris*, *Hypogymnia physodes*, *Lecanora conizaeoides*, *Pertusaria amara*, *Phaeophyscia orbicularis*, *Physcia adscendens*, *P. dubia*, *P. stellaris*, *P. tenella* and others (Kocourková 2000, Czyzewska & Kukwa 2009).

Ecology: *Athelia arachnoidea* occurs unspecifically on various hosts, reaching from algae, bark and leaves of trees to lichens (Jülich 1972, Hawksworth 1983, Kukwa 2004). It acts as a parasite only during the winter. Its anamorph is known to cause a disease called “crater rot” which brings carrots to rot (Adams & Kropp 1996).

Distribution: The species on (1, 2, 3) is so far known from the following European countries: Austria (Keissler 1916: 119 sub *Corticium centrifugum* on (1), Hafellner & Obermayer 2001: 30 on (1), Hafellner et al. 2005a, 2008 on (1), Hafellner 2008b on (1)), Germany (Brackel & Kocourková 2006 on (1, 2)), Italy (Brackel 2011: 70 on (1)) and Poland (Czyzewska & Kukwa 2009 on (1)).

Specimens examined: Europe: Austria: Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’20’’N / 14°27’54’’E, ca. 600 m s. m., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an tief hängenden Kronenästen von *Juglans regia*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10019 (GZU). – Kärnten, Sattnitz, Sabuatach ca. 13 km ESE von Klagenfurt, ca. 700 m WSW des Gehöfts Wlattnig, 46°35’23’’N / 14°27’57’’E, ca. 590 m s. m ., GF 9452/2, Arboretum an schwach W-geneigten Hängen, an unteren Kronenästen von *Laburnum* x *watereri*, (1), 26.XII.2010, leg. F. Schlatti, det. A. Fleischhacker 10020 (GZU).

XXVIII. *Licea parasitica* (Zukal) G.W. Martin, Mycologia 34(6): 702 (1942).

MycoBank 287774

Hymenobolus parasiticus Zukal, Österr. Bot. Z. 43: 73 (1893). – *Hymenobolina parasitica* (Zukal) Zukal, Österr. Bot. Z. 43: 133 (1893). – *Orcadella parasitica* (Zukal) Hagelst., Mycologia 34(3): 258 (1942).

Type: "…parasitica in thallo *Physciae pulverulentae* et *Xanthoriae parietinae* sedentia. In vetusta salice prope St. Kantzian in Karinthia. Julio et Augusto mensibus." (?W or WU – holotype) n. v. (locality data from protologue, Zukal 1893: 74).

For heterotypic synonyms see Liu & Chang (2010).

Iconography: Zukal 1893: plate V, figs. 1-10 (drawings of various details of the fungus); Alexopoulos 1959: 28, fig. 5 (photograph of stalked sporangia); Ladó 1985: 19, figs. 6-8 (photomicrographs of spores); Martin & Alexopoulos 1969: plate I, fig. 10 (drawings of a sporangium and a spore); Liu & Chang 2010: 27, fig. 3 (photographs of fruiting bodies and a sporangium releasing spores, photomicrographs of spores near the margin of the peridium, margins of the opening part of a sporangium, spores, spores and a sporangium taken under SEM).

Description: The species is firstly recognized by its more or less globose, reddish to blackish sporangia which are superficially attached on the thallus of its hosts. The spores are globose and brown. For further and detailed description see the protologue, Martin & Alexopoulos (1969) and Liu & Chang (2010).

Hosts: *Licea parasitica* has quite often been found directly on the bark of trees (Alexopoulos 1959, Ladó 1985, Liu & Chang 2010). But it is also known for colonizing lichens, namely: *Xanthoria parietina* (1) (thallus), *Physconia distorta* (2) (thallus) (Zukal 1893), *Melanelia exasperatula* (3), *Physcia tenella* (4), *Physconia enteroxantha* (5) (Kukwa 2004), *Xanthomendoza fallax* (6), *X. fulva* (7), *Phaeophyscia orbicularis* (8), *Physcia semipinnata* (9) and probably further hosts.

Remarks: *Licea parasitica* is the only myxomycete described to occur on *Xanthoria parietina* but there has been no report of such a finding since Zukal (1893).

Distribution: The species on (1) and close relatives is so far known only from Austria (Zukal 1893 on (1), Obermayer 1993 on (6), Hafellner et al. 2004 on (7)).

Specimens examined: Europe: Greece: Insel Skopelos, in der SW-seitigen Bucht, auf *Ficus carica*, (1), 15. VIII. 1982, leg. E. Otepka, det. J. Hafellner (GZU).

Further species but not treated in detail, reported on *Xanthoria parietina*:

XXIX. *Atractium flammeum* (report on *Xanthoria parietina* for Austria, Keissler 1913: 391, Keissler 1916: 116).

For reports of **XXX. *Cladosporium macrocarpum***, **XXXI. *Epicoccum nigrum*** and **XXXII. *Periconia digitata*** on *Xanthoria parietina* see Etayo & Berger (2009).

Doubtful or wrong records:

Spolverinia punctum**:** Brackel (2010b: 22) describes it as facultatively lichenicolous since its occurings on *Xanthoria parietina*, *Physcia stellaris* and *P. tenella*. Junell (1964) has shown that the name is based on cleistothecia of *Phyllactinia guttata* (now *P. corylea*). In consideration of the facts that the cleistothecia of *Phyllactinia corylea* adhere to all types of solid which are available at the moment (e.g. lichens, carpophores of aphyllophoralean basidiomycets, bark, front shields…) and the fungus itself does not live on lichens, the term “lichenicolous” is misapplied.

4. Discussion

Similar studies with other host lichens have already been carried out (Hawksworth 1980 for *Peltigera*, Hafellner 1985 for *Brigantiaea*, Triebel 1989 for lecideoid lichens, Kalb et al. 1995 for *Haematomma*, Zhurbenko & Alstrup 2004 for *Cladonia*, Hafellner 2007b for *Tephromela*, Zhurbenko 2010 for *Stereocaulon*). An investigation of all lichenicolous fungi growing on one lichen genus or species is one possible approach to get an overview of the diversity of lichenicolous fungi. However, in this study, a species was taken as host. The same approach was choosen for example by Ihlen (1995) who studied the occuring of lichenicolous fungi on *Thamnolia vermicularis* in Norway.

In the following chapters the results are discussed and critically regarded.

4.1 Obligately lichenicolous fungi

4.1.1 Lichenicolous fungi with a host-specificity to the *Xanthoria parietina* group

The following five species of lichenicolous fungi appear to be restricted to the *Xanthoria parietina* group (taxonomic classification from Index Fungorum 2008/ MycoBank 2011): *Arthonia parietinaria* (*Arthoniales*), *Phacothecium varium* (*Arthoniales*), *Polycoccum slaptoniense* (*Pleosporales*), *Telogalla olivieri* (*Verrucariales*), *Xanthoriicola physciae* (*Capnodiales*).

So this result perfectly fits the hypothesis that in general lichenicolous fungi should be found on a single host genus (Lawrey & Diederich 2003).

As fig. 10 shows, *Phacothecium varium* and *Telogalla olivieri* colonize *Xanthoria parietina* but also *X*. *calcicola*. According to Franc & Kärnefelt (1998) and Gaya et al. (2008), these two *Xanthoria* species are closely related. The occuring of the two lichenicolous fungi on these two hosts supports this molecular finding but also the hypothesis of Diederich (2000) who states that the hosts of lichenicolous fungi should be monophyletic in most cases. Furthermore, *Phacothecium varium* is also found on *Xanthoria aureola*, which is closely related to *Xanthoria calcicola* (Lindblom & Ekman 2005).

Among this host-specific species three taxa doubtfully belong to the most common colonizers of *Xanthoria parietina*. These are *Xanthoriicola physciae*, *Telogalla olivieri* and *Arthonia parietinaria*.

As almost all lichenicolous fungi may be specialized (Lawrey & Diederich 2003), we did not hesitate to describe a new species, namely *Arthonia parietinaria*. This taxon seems to be restricted in its host selection and furthermore different by several characteristics (see chapter on results) from *Arthonia epiphyscia*, an invader of *Physcia* species (Grube 2007), and from *Arthonia molendoi*, which is generally found on *Caloplaca* and *Xanthoria* species (Grube 2007) with *Xanthoria elegans* being the type host (Santesson 1986). As fig. 10 demonstrates, *Arthonia parietinaria* has been reported on *Xanthoria parietina*, its type host, but also on *X*. *candelaria* (more precisely as var. *torulosa*) and *Xanthomendoza fallax*. Its occuring on the two latter should be rechecked as it is not very likely. But further phylogenetic studies within the *Teloschistaceae* are also necessary.

4.1.2 Lichenicolous fungi with a host-specificity to the *Teloschistaceae*

Six species of lichenicolous fungi may be host-specific to the *Teloschistaceae*. This group comprises *Arthonia sytnikii* (*Arthoniales*), *Cercidospora xanthoriae* (*Dothideales*), *Lichenodiplis poeltii* (anamorphic fungus), *Pronectria xanthoriae* (*Hypocreales*), *Sphaerellothecium parietinarium* (*Capnodiales*) and *Tremella caloplacae* (*Tremellales*) (taxonomic classification from Index Fungorum 2008/ MycoBank 2011).

Cercidospora xanthoriae and *Tremella caloplacae* do not colonize one single host genus (fig. 10). If the hypothesis, that about 95% of lichenicolous fungi should have only one lichen genus as host (Lawrey & Diederich 2003), is approximately true and the phylogenetic tree in Gaya et al. (2008) represents correct relationships, the host selection of these fungi is in need of revision. It could be possible that further species are “hidden” behind reports of these two fungi. Otherwise the relationship between *Xanthomendoza fallax*, *Xanthoria candelaria* and the *X*. *parietina* group should be checked too if these or one of these species will turn out as real host or hosts for *Arthonia parietinaria* and *Cercidospora xanthoriae*.

In consideration of the fact that there are also “gaps” in the host selection of the lichenicolous species in the phylogenetic tree of *Teloschistales* (fig. 10), it would be furthermore reasonable to test if some species of *Teloschistaceae* point out as further hosts.

The other four taxa (*Arthonia sytnikii*, *Lichenodiplis poeltii*, *Pronectria xanthoriae*, *Sphaerellothecium parietinarium*) occur on lichen species within the genus *Xanthoria* coll. It would be interesting to test how these *X*. species are related. Fig. 10 does not include all described species of the genus *X*. and is therefore not complete. So in future further phylogenetic reconstruction models of *Teloschistaceae* are needed and ought to be supported by data derived from the study of their lichenicolous fungi.

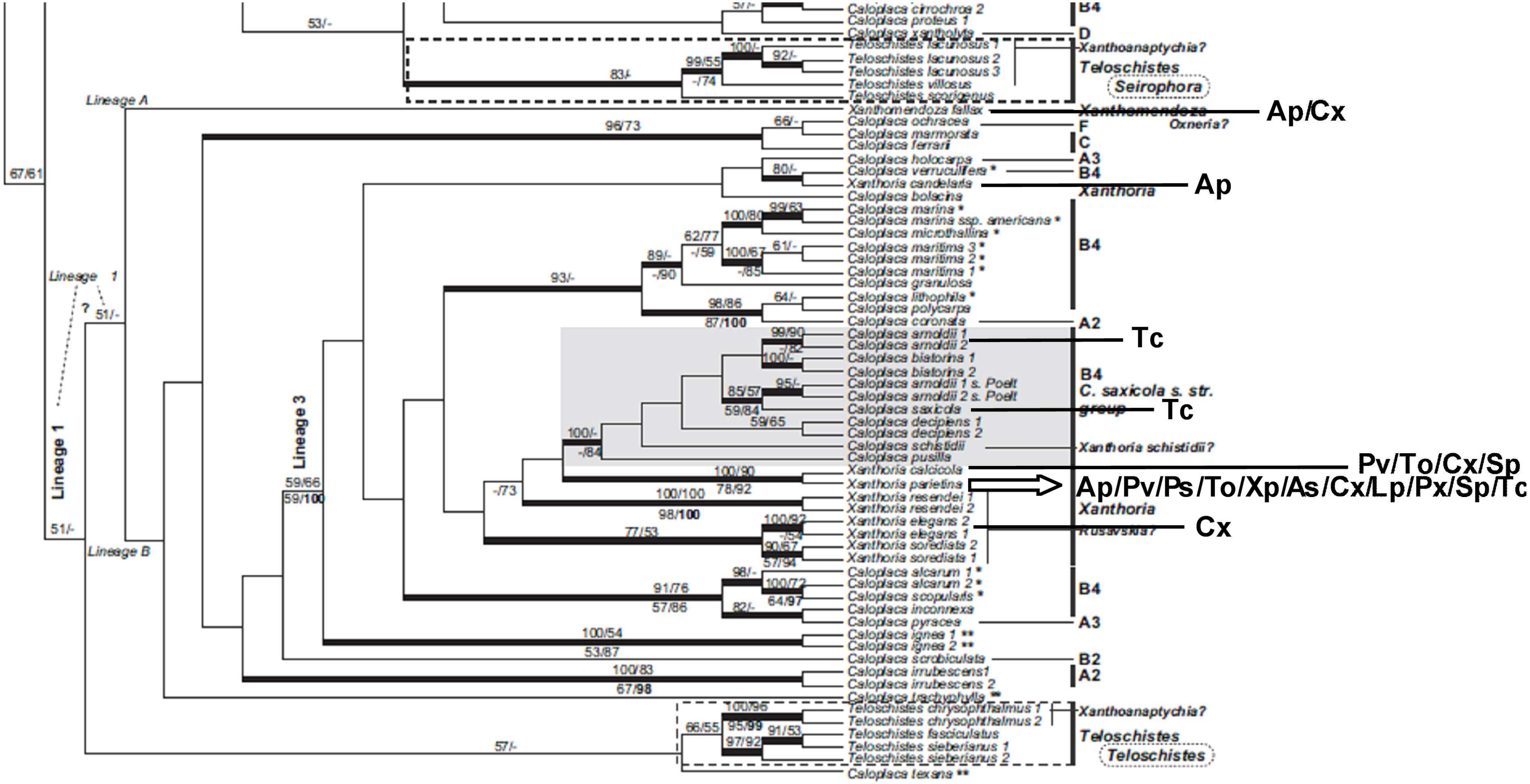


Figure 10: Part of the phylogenetic reconstruction model within the *Teloschistales*, based on ITS nrDNA (taken from Gaya et al. (2008)) with species representing host species for various lichenicolous fungi (*Arthonia parietinaria* (Ap), *Phacothecium varium* (Pv), *Polycoccum slaptoniense* (Ps), *Telogalla olivieri* (To), *Xanthoriicola physciae* (Xp), *Arthonia sytnikii* (As), *Cercidospora xanthoriae* (Cx), *Lichenoconium xanthoriae* (Lx), *Lichenodiplis poeltii* (Lp), *Pronectria xanthoriae* (Px), *Sphaerellothecium parietinarium* (Sp), *Tremella caloplacae* (Tc)).

4.1.3 Lichenicolous fungi with a reported broad host spectrum

The following fifteen species do not only occur on *Xanthoria parietina*, they rather show a broad host selection: *Hainesia xanthoriae* (anamorphic fungus), *Illosporiopsis christiansenii* (*Hypocreales*), *Lichenoconium xanthoriae* (anamorphic fungus), *Marchandiomyces aurantiacus* (*Corticiales*), *Paranectria oropensis* (*Hypocreales*), *Phoma epiphyscia* (*Pleosporales*), *Pyrenochaeta xanthoriae* (*Pleosporales*), *Acremonium antarcticum* (*Hypocreales*), *Muellerella lichenicola* (*Verrucariales*), *Pseudorobillarda* spec. (anamorphic fungus), *Intralichen christiansenii* (anamorphic fungus), *Stigmidium schaereri* coll. (*Capnodiales*), *Catillaria nigroclavata* (*Lecanorales*), *Endococcus rugulosus* coll. (*Verrucariales*) and *Monodictys anaptychiae* (anamorphic fungus) (taxonomic classification from Index Fungorum 2008/ MycoBank 2011).

This number appears to be relatively high in regard to the fact that most lichenicolous fungi should be found on a single host genus (Lawrey & Diederich 2003).

Otherwise, these fifteen fungi may have the function of decaying their host lichens, behave quite parasitically and many of them tend to have no long-term relationships with their hosts. One good example is *Paranectria oropensis* which is supposed to have the capability to open lichen synusia on bark (Hafellner & Obermayer 2009). So this lichenicolous fungi may belong to the group of necrotrophic mycoparasites, which is high virulent, destructive and tends to be generalized in its host selection (Lawrey & Diederich 2003).

4.2 Facultatively lichenicolous fungi

Six taxa are capable to develop on various substrates, among them also on the lichen *Xanthoria parietina*: *Athelia arachnoidea* (*Atheliales*), *Licea parasitica* (*Liceales*), *Atractium flammeum* (anamorphic fungus), *Cladosporium macrocarpum* (*Capnodiales*), *Epicoccum nigrum* (*Pleosporales*) and *Periconia digitata* (*Pleosporales*) (taxonomic classification from Index Fungorum 2008/ MycoBank 2011).

Own preliminary observations indicate that there exist further unspecific, not obligately lichenicolous fungi which also grow on *Xanthoria parietina*.

5. General discussion and conclusions

A total of 32 species of lichenicolous fungi have so far been reported on *Xanthoria parietina*. 16 percent of the taxa are specific to the *X. parietina* group, 19 percent show host-specificity to the *Teloschistaceae*, 47 percent are euryoecious obligately lichenicolous and 19 percent facultatively lichenicolous fungi (percentages rounded). Hence more than 60 percent of them belong to the omnivorous element.

The total number of species growing on *X. parietina* is relatively high in comparison with the number of lichenicolous fungi occuring on for example *Thamnolia vermicularis* (four species, Ihlen 1995), the genus *Brigantiaea* (seven species, Hafellner 1985), *Haematomma* (13 species, Kalb et al. 1995), *Tephromela* (13 species, Hafellner 2007b) or *Stereocaulon* (30 species, Zhurbenko 2010). Higher values of lichenicolous fungi are only reported on hosts like the genus *Peltigera* (40 species, Hawksworth 1980) and *Clandonia* (75 species, Zhurbenko & Alstrup 2004).

One reason for this high number is certainly the fact that *X. parietina* is a common macrolichen and vastly spreading in recent years (see chapter in introduction). It is surely one of the best investigated lichen species and therefore many lichenicolous fungi invading it have been found.

In summary, most of the lichenicolous fungi growing on *X. parietina* are not specific but omnivorous. Simultaneously, these ones are among the rare invaders of this host.

Species such as *Telogalla olivieri*, *Xanthoriicola physciae*, *Arthonia parietinaria*, *Tremella caloplacae* and *Pyrenochaeta xanthoriae* have been present in many of the richer collections and therefore appear to be rather common.

So, most of the commonest lichenicolous fungi invading *X. parietina* are specific and this is in accordance with the hypothesis that in general, the commonest lichenicolous fungi are biotrophic and restricted in its host selection (Lawrey & Diederich 2003).

Besides all specific data resulting from this investigation it was possible to demonstrate that *X. parietina* is a lichen species with an astonishingly rich fungus flora.

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