



PROTOPARMELIA HYPOTREMELLA, A NEW STERILE CORTICOLOUS SPECIES FROM EUROPE, AND ITS LICHENICOLOUS FUNGI

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Abstract: *Protoparmelia hypotremella* van Herk, Spier & Wirth, a sterile corticolous lichen, is described as a species new to science, so far known from Austria, SW Germany and the Netherlands. It is rapidly spreading in Germany and the Netherlands. It is apparently close to *P. oleagina*, and is often found growing together with that species on oak trees along roads in the Netherlands. Both species are host to the lichenicolous fungi *Sphinctrina anglica* and *Tremella wirthii*.

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Introduction

The corticolous lichen flora of roadside trees in western Europe is among the best known lichen floras in the world. Mainly due to environmental stress (air pollution with sulphur dioxide), the composition of this flora has changed drastically during this century. After a steady decrease in biodiversity until the seventies, in recent decades a rapid increase in species diversity has been observed in formerly polluted areas, due to significantly falling levels of sulphur dioxide (van Herk 1993). Those lichens now on the increase are mainly the same species that had decreased. There are, however, a few remarkable exceptions. Among these are two corticolous species of *Protoparmelia*, viz. *P. oleagina* (Harm.) Coppins and the new species *P. hypotremella* (Fig. 1), which is described below.

Both *Protoparmelia* species are spreading rapidly on old roadside trees in the Netherlands, especially on *Quercus robur*, where the new species is now known from more than 100 localities. In the Netherlands both species of *Protoparmelia* are known only in a sterile condition. Since 1988 the new species has been repeatedly found by the last author in SW Germany on *Quercus*, *Fagus* and *Pinus sylvestris*. Finally, it was found by the third author during an excursion in lowland Austria, organized by Dr F. Berger (Kopfung) during the IAL congress at Salzburg in 1996, this time on *Fagus*. It was also recently collected in Austria at higher altitudes, up to 1670 m, on *Larix decidua* and on wood.

Protoparmelia oleagina has recently been reported from the Netherlands (van Herk 1993). The identity was confirmed by comparing the Dutch specimens

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(Fig. 2) with fertile British material. In our opinion the species is correctly placed in *Protoparmelia*. It represents one of the few corticolous species known in the genus.

The new species of *Protoparmelia* had been incorrectly called *Hypocenomyce caradocensis* (Leight. ex Nyl.) P. James & G. Schneider in the Dutch literature (Brand *et al.* 1988), as both species are rather similar in appearance (Fig. 3). The oldest record of *P. hypotremella* in the Netherlands probably dates from 1972 as a field record called '*Toninia caradocensis*' during a mapping programme. At the same locality *P. hypotremella* is still present. Both in Germany and in the Netherlands the species is known to grow on trees from which it was definitely absent 5 years earlier. In 900 sample plots of mainly wayside trees in the Netherlands the number of records increased from 15 in 1989 to 29 in 1994, thus nearly a 100% increase in 5 years. It is remarkable that the new species is not known from Great Britain, whereas *P. oleagina* is known there, but with a different habitat preference, being more common on wooden fences and in native pine forest.

As all known old records of *P. hypotremella* are from mountain areas in central Europe, this region probably comprises the original, 'natural' habitat, from which it has recently started to spread over lowland western Europe. A similar phenomenon has been observed with *Chaenotheca ferruginea* (Turner ex Ach.) Mig., *Cyphelium inquinans* (Sm.) Trevis., *Hypocenomyce sorophora* (Vain.) P. James & Poelt, *Lecanora conizaeoides* Nyl. ex Crombie, *Mycoblastus fucatus* (Stirt.) Zahlbr and *Parmeliopsis ambigua* (Wulfen) Nyl. (Wirth 1985).

Materials and Methods

All specimens of the new species in the herbaria ABL (hb. Aptroot), STU, hb. van Herk (Soest) and hb. Spier (Amersfoort) have been examined. The Austrian, German and Dutch specimens of *P. hypotremella* and *P. oleagina* have also been checked for lichenicolous fungi. Fertile British material of *P. oleagina* was borrowed from E. The chemistry of both *P. hypotremella* and *P. oleagina* has been checked by HPLC using collections from the type locality of *P. hypotremella*. Some additional specimens have been tested by TLC.

The species

Although the new species is not known to produce apothecia, we describe it here in *Protoparmelia* for the following reasons:

1. The cortical and internal structures (including the photobiont) match other *Protoparmelia* species, especially *P. oleagina*.
2. Both *P. oleagina* and the new species host *Sphinctrina anglica* and *Tremella wirthii* (see below).
3. The chemistry fits *Protoparmelia* and is in fact identical to that of *P. oleagina*.

***Protoparmelia hypotremella* van Herk, Spier & Wirth sp. nov.**

Species corticola. Thallus sterilis, griseus vel olivaceus, granulatus ad microsquamulosus, corticatus. Squamae ad 0.2(-0.6) mm latae, ad 0.1 mm altae, cum marginibus pallidioribus,

acidum lobaricum continentes; prothallo deficiente. Epicortex 5–10 μm altus; cortex paraplectenchymaticus, 15–25 μm altus, cellulis 6–9 μm diam; medulla 60–150 μm alta; algas chlorococcoideas, 6–12 μm diam, in parte superiore continens. Habitus cum *Protoparmelia oleagina* et *Hypocenomyce caradocensis* congruens.

Typus: The Netherlands, Friesland, Oldeberkoop, on *Quercus robur* along Oosterwoldse Weg, alt. 2 m, 30 October 1996, C. M. van Herk 2493-5 (B—holotypus; ABL, B, E, STU, hb. Diederich, hb. van Herk, hb. Spier—isotypi; TLC!).

(Figs 1, 4, 5)

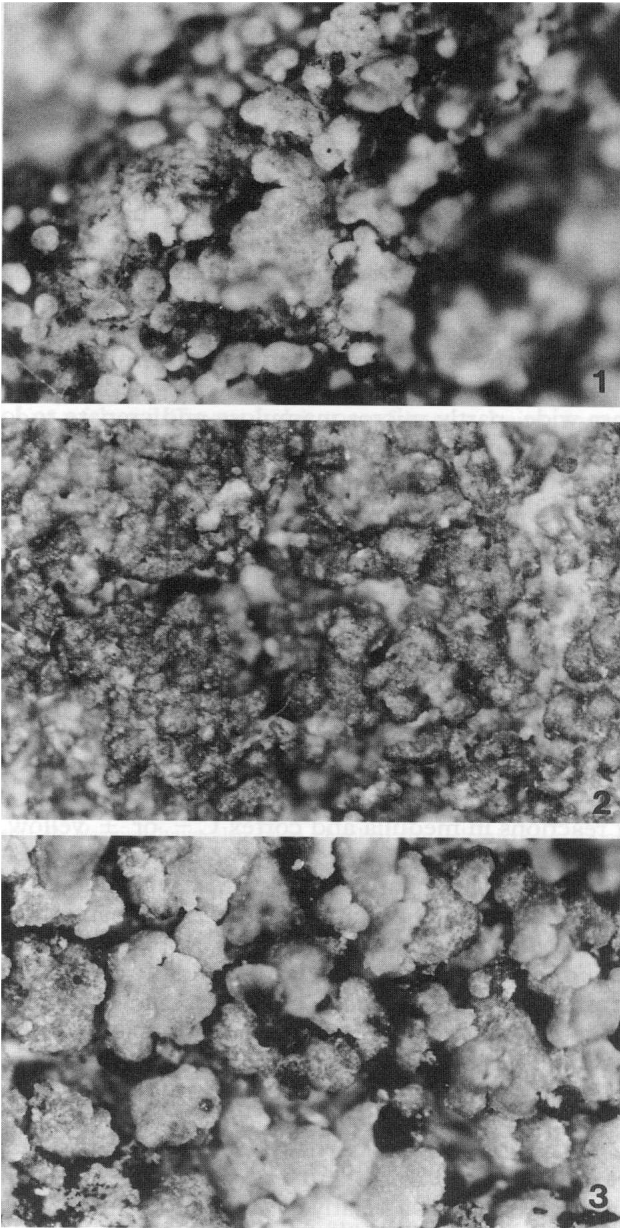
Thallus corticolous, indeterminate, covering areas of up to several square decimetres, grey to pale olivaceous to buff, paler along the margins of the granules, dull to slightly glossy, consisting of squamulose granules, corticate, without prothallus, without discernible thallus below or around the granules. *Granules* partly isidia-like, convex, rounded to elongate or globose, c. 0.1 mm high, c. 0.2 mm wide, partly microsquamulose and crenate to lobate, convex to flat or slightly concave, gnarled, up to 0.3 mm high, up to 0.6 mm wide. Microsquamules sometimes bearing isidia-like granules, which are relatively dark-tipped, but furthermore identical to the regular isidia-like granules. Margins of the granules often eroding and less corticate, often whitish, always paler than the surface. The squamulose granules randomly occur amongst the isidia-like granules, not predominantly along the margins of the thallus. *Internal structure*: Epicortex 5–10 μm thick, hyaline; cortex 15–25 μm thick, pale brownish due to pigments, paraplectenchymatous, with lumina c. 6–9 μm wide; medulla 60–150 μm thick, rather loose, hyphal, with filaments c. 3–5 μm wide, walls partly incrustated with crystals (lobaric acid?); upper layer of the medulla filled with chlorococcoid algae of c. 6–12 μm diam.

Ascomata and *conidiomata* unknown.

Chemistry: Lobaric acid (major, determined by HPLC), \pm unknowns (minor); spot reactions in medulla and cortex C – or \pm yellow, K – , KC – or +pink, PD – , UV+ +white.

Etymology: From *hypo*, under, and *Tremella* referring to the occasional presence of the lichenicolous fungus *Tremella wirthii*, and at the same time reminiscent of *Hypocenomyce caradocensis*.

Ecology and distribution: **The Netherlands**: Mainly on old wayside *Quercus robur* trees, occasionally on *Q. rubra*. It prefers sun-exposed, more or less wind-sheltered sites with a slightly to moderately eutrophicated, usually dusty, rough bark. Mean bark pH: 5.15 (3 records). It occurs in species-rich communities (mean number of lichens per site of ten trees: 26), often accompanied by *Buellia griseovirens* (Turner & Borrer ex Sm.) Almb., *Ochrolechia androgyna* (Hoffm.) Arnold, *Pertusaria coccodes* (Ach.) Nyl., *Pyrrospora querneae* (Dicks.) Körb. and *Protoparmelia oleagina* (Table 1). It is common in most areas with a relatively low sulphur dioxide level and old *Quercus* trees, except in the coastal dune area. Only a few records are known from the southern part of the country, with higher sulphur dioxide levels. All records are from areas below 100 m alt. **Germany**: More than ten records, mostly in Baden-Württemberg, on *Fagus*, *Pinus sylvestris* and *Quercus* trees in generally slightly more sheltered places, both in lowland and upland (c. 500–1000 m) regions. The recent localities are only slightly polluted by



1 mm

Figs 1-3 Habitus photographs. Fig. 1. *Protoparmelia hypotremella* (type). Fig. 2. *Protoparmelia oleagina* (from the type locality of *P. hypotremella*). Fig. 3. *Hypocenomyce caradocensis* (Austria, Aptroot 39932).

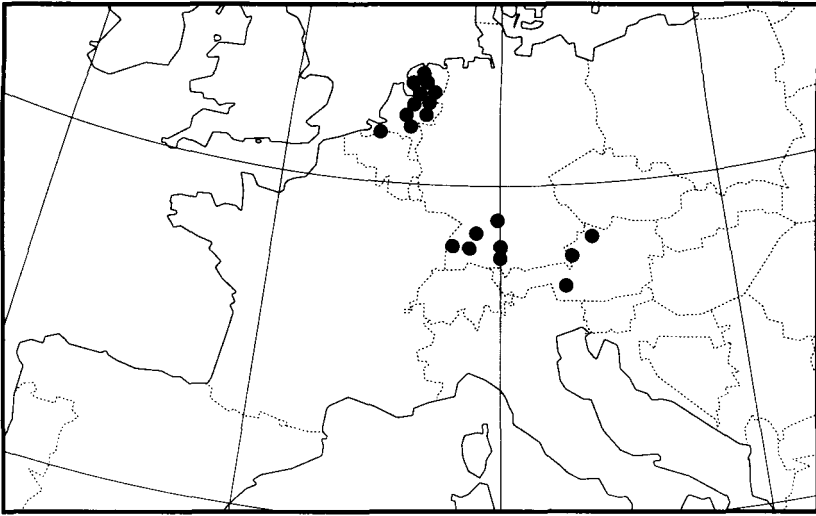


FIG. 4. Known distribution of *Protoparmelia hypotremella*. The species may well be present in areas adjacent to those indicated, where no recent surveys have been carried out.

sulphur dioxide, but the trees are mostly poor in species, with one exception, where both lichenicolous fungi were present, together with for example *Agonimia tristicula* (Nyl.) Zahlbr., *Parmelia pastillifera* (Harm.) R. Schubert & Klem. and *Phaeophyscia endophoenicea* (Harm.) Moberg. **Austria:** Known from very different habitats, including old, eutrophicated *Fagus* trees in a wood along the Donau at lower altitude (400 m) and *Larix decidua* in the higher (1670 m) Alps.

Discussion: The new species resembles *Protoparmelia oleagina* (Fig. 2), with which it shares the internal structure, the alga, the characteristic, dull to slightly glossy surface and the presence of lobaric acid. However, the thallus of *P. oleagina* is continuous and its isidia-like structures are only outgrowths of it. The thallus is therefore more delimited. The isidia are consistently smaller (c. 0.1 mm diam.) and the thallus colour is much darker (grey to olivaceous brown or black), without paler margins to the 'granules'. The difference in colour is not due to environmental effects, as can be observed when both species grow side by side, which happens rather often (Table 1). At these localities both species behave as distinct entities. The major chemical compound of *P. hypotremella*, lobaric acid, was found to be present in *P. oleagina* as well. This represents the first report of lobaric acid in the latter species, for which only some unknown substances were reported before (Coppins 1992). Lobaric acid is common in the genus. *Protoparmelia oleagina* does not show the positive UV-reaction of *P. hypotremella*. In microscopical preparations a K+ oily substance reaction can be observed in *P. oleagina* and *P. montagnei* (Fr.) Poelt & Nimis, but not in *P. hypotremella*.

The new species could be mistaken for *Hypocenomyce caradocensis* (Fig. 3), with which it shares the microsquamules, but not the gnarled isidia-like

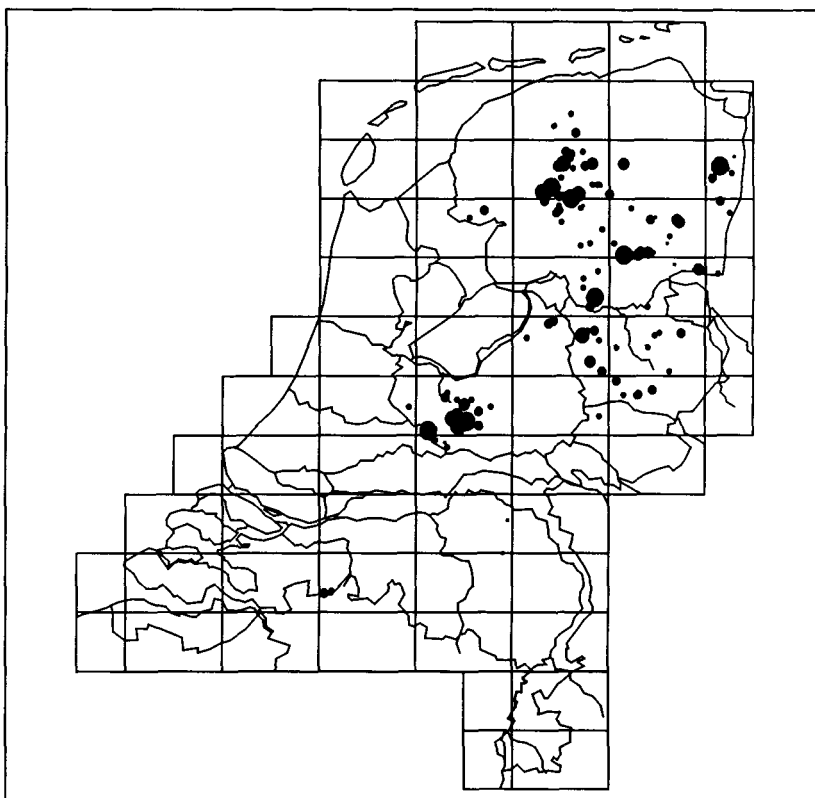


FIG. 5. Distribution of *Protoparmelia hypotremella* in the Netherlands, based upon herbarium specimens and field records. Small dots indicate single specimens, large dots places with abundant growth (more than 1 dm² per tree). The field records are based on a mapping programme of 6000 localities with ten *Quercus robur* trees, carried out between 1989 and 1995 by the third author.

structures. The chemistry is different: *H. caradocensis* is sometimes UV+ white, but this is due to unknown substances, not to lobaric acid. The internal structure is also different as *H. caradocensis* has periclinally oriented hyphae in the cortex, the surface is dull to almost felty, and it often has a frosty appearance. Moreover, the microsquamules in *H. caradocensis* tend to be more divided and often overlapping; they remain convex and become larger (up to 1 mm).

Finally, the grey isidia-like granules are reminiscent of sterile specimens of *Bacidia rubella* (Hoffm.) A. Massal., which differ in the fairly uniform, pale grey to greenish grey colour and in the different chemistry (no substances, UV-).

Selected specimens (see Fig. 4): **Austria:** *Oberösterreich:* Steinerfelsen near Schlögener Schlinge along the Donau, halfway between Linz and Passau, alt. 540 m, on *Fagus*, 4 ix 1996, C. M. van Herk s.n. (hb. van Herk, with *Tremella wirthii*), A. Aptroot 39902 (ABL, with *Tremella wirthii*), F. Berger 10160 (hb. Berger, hb. Diederich, with *Tremella wirthii*). *Osttirol:* Hohe Tauern,

Glocknergruppe, Dorfertal, alt. 1670 m, on *Larix decidua*, with *Sphinctrina anglica*, 6 ix 1990, R. Türk (STU); Virgen, Zedlach, alt. 1600 m, on wood, with *Sphinctrina anglica*, 2 viii 1988, R. Türk, distributed in Vězda, *Lich. sel. exs.* no. 2281 (B).—**Germany:** Bayern: Neu-Ulm, Holzheim, Steinheim, 6 ii 1991, V. Wirth 21713 (STU, with *Tremella wirthii*). Württemberg: Neckar, Leonberg, Warmbronn, on *Quercus*, 28x1988, V. Wirth 17412 (STU, with *Tremella wirthii*); Schwäbische Alb, Dotternhausen, Plettenberg, 1000 m, on *Pinus sylvestris*, 28x1993, V. Wirth 25272 (STU); Baden: Schwarzwald, Lahr, 520 m, on *Quercus*, 9 viii 1988, V. Wirth 16992 (STU, with *Sphinctrina anglica*).—**The Netherlands** (see fig. 5): (all below 100 m alt.) Friesland: Type. Drenthe: Havelte, Nijeveense Bovenboer, on *Quercus* along road, 8 ix 1985, A. Aptroot 15791 (ABL); Hoogeveen, Noordsche Schut, on *Quercus* along road, 5 vii 1991, C. M. van Herk 2233-10 (hb. van Herk, with *Sphinctrina anglica*). Overijssel: Tubbergen, on *Quercus*, along road, 1 vi 1989, C. M. van Herk 234 (hb. van Herk). Gelderland: Hoewelaken, on *Quercus*, 5 iv 1991, L. Spier 2302 (hb. Spier, with *Tremella wirthii*); same locality, 1 ii 1993, L. Spier 4391 (hb. Spier, TLC!). Utrecht: Leusden, on *Quercus* along road, 3 xii 1993, C. M. van Herk 4017 (hb. van Herk, with *Sphinctrina anglica*); same locality, 11 iii 1996, A. Aptroot 39082 (ABL), B. J. Coppins s.n. (E); same locality, 2 vi 1991, L. Spier 2468 (hb. Spier, TLC!); Renswoude, on *Quercus* along road, 27 i 1984, W. O. van der Knaap s.n. (ABL); Hooglanderveen, on *Quercus* in wood, 27 iii 1991, L. Spier 2306 (hb. Spier, with *Sphinctrina anglica*, TLC!). Noord-Brabant: Wernhout, on *Quercus* along road, 5 viii 1993, C. M. van Herk 3492-9 (hb. van Herk).

Lichenicolous fungi

Two species of lichenicolous fungi have been found on both *Protoparmelia oleagina* and on *P. hypotremella*:

Tremella wirthii Diederich has been observed on most of the German, on a single Austrian, and on two Dutch specimens of *P. hypotremella*. In the type locality of *P. hypotremella*, it grows on *P. hypotremella* and on *P. oleagina*.

Sphinctrina anglica Nyl. has been observed on British and Dutch material of *P. oleagina* (Coppins 1992; Spier & van Herk 1993), and on Austrian, Dutch (Spier & van Herk 1993) and German material of *P. hypotremella*. Older records of *S. anglica* have often been published as growing on unidentified lichen thalli. As both *Protoparmelia* species are poorly known by lichenologists and are mostly sterile, is it conceivable that some of these literature records are also on *Protoparmelia*.

The lichenicolous species of *Tremella*, and probably also the species of *Sphinctrina* are highly specialized fungi, each of them restricted to a small monophyletic group of lichens. The existence of two lichenicolous species, known only on *P. oleagina* and on *P. hypotremella*, is a strong argument to consider both lichen species as closely related.

Specimens examined: *Tremella wirthii* (the specimens mentioned by Diederich 1996: 164–166 are not repeated here). **Austria:** Oberösterreich: Steinerfelsen near Schlägener Schlinge along Donau, halfway between Linz and Passau, alt. 540 m, on *Fagus*, on *P. hypotremella*, 4 ix 1996, A. Aptroot 39902 (ABL), F. Berger 10160 (hb. Berger, hb. Diederich) & C. M. van Herk s.n. (hb. van Herk).—**The Netherlands:** (all below 100 m alt.) Friesland: Oldeberkoop, on *Quercus robur* along Oosterwoldse Weg, on *P. hypotremella*, 30x1996, C. M. van Herk 2493-5 (hb. Diederich, hb. van Herk); *ibid.*, on *P. oleagina*, C. M. van Herk 2493-4 (hb. Diederich, hb. van Herk); Gelderland: Hoewelaken, on *Quercus*, on *P. hypotremella*, 5 iv 1991, L. Spier 2302 (hb. Spier).

Sphinctrina anglica (selected specimens). **Austria:** Osttirol: Hohe Tauern, Glocknergruppe, Dorfertal, alt. 1670 m, on *Larix decidua*, on *P. hypotremella*, 6 ix 1990, R. Türk (STU); Virgen, Zedlach, alt. 1600 m, on wood, on *P. hypotremella*, 2 viii 1988, R. Türk, distributed in Vězda, *Lich. sel. exs.* no. 2281 (B).—**Germany:** Baden: Schwarzwald, Lahr, 520 m, on *Quercus*, on

TABLE 1. Lichen composition of 95 roadside sample plots with *Protoparmelia hypotremella* in the Netherlands*

Species	Number of plots where present
<i>Anaptychia ciliaris</i>	1
<i>Arthonia spadicea</i>	2
<i>Bacidia arnoldiana</i>	23
<i>Buellia griseovirens</i>	81
<i>B. punctata</i>	94
<i>Calicium glaucellum</i>	1
<i>C. viride</i>	3
<i>Candelaria concolor</i>	18
<i>Candelariella reflexa</i>	18
<i>C. vitellina</i>	39
<i>C. xanthostigma</i>	12
<i>Chaenotheca chrysocephala</i>	1
<i>C. ferruginea</i>	7
<i>Cladonia</i> species	29
<i>Cliostomum griffithii</i>	19
<i>Dimerella pineti</i>	1
<i>Diploicia canescens</i>	12
<i>Evernia prunastri</i>	87
<i>Gyalideopsis anastomosans</i>	3
<i>Haematomma ochroleucum</i> var. <i>porphyrium</i>	39
<i>Hypocenomyce scalaris</i>	19
<i>Hypogymnia physodes</i>	35
<i>H. tubulosa</i>	6
<i>Lecanora aitema</i>	5
<i>L. carpinea</i>	19
<i>L. chlarotera</i>	69
<i>L. conizaeoides</i>	32
<i>L. dispersa</i>	27
<i>L. expallens</i>	94
<i>L. hageni</i>	7
<i>L. horiza</i>	13
<i>L. muralis</i>	4
<i>L. pulicaris</i>	27
<i>L. saligna</i>	1
<i>L. symmetrica</i>	9
<i>Lecidella elaeochroma</i>	36
<i>L. flavosorediata</i>	12
<i>L. scabra</i>	2
<i>Lepraria incana</i>	91
<i>Micarea nitschkeana</i>	3
<i>Mycoblastus fucatus</i>	1
<i>Ochrolechia androgyna</i>	32
<i>O. turneri</i>	1
<i>Opegrapha atra</i>	3
<i>O. vulgata</i>	1
<i>Parmelia acetabulum</i>	59
<i>P. caperata</i>	21
<i>P. comiocarpa</i>	2
<i>P. elegantula</i>	16
<i>P. exasperatula</i>	18

TABLE 1. Continued

Species	Number of plots where present
<i>P. glabratula</i>	13
<i>P. laciniatula</i>	11
<i>P. revoluta</i>	37
<i>P. saxatilis</i>	17
<i>P. subaurifera</i>	75
<i>P. subrudecta</i>	78
<i>P. sulcata</i>	87
<i>P. tiliacea</i>	3
<i>Pertusaria albescens</i>	25
<i>P. amara</i>	35
<i>P. coccodes</i>	42
<i>P. pertusa</i>	32
<i>Phaeophyscia orbicularis</i>	18
<i>Phlyctis argena</i>	51
<i>Physcia adscendens</i>	42
<i>P. caesia</i>	33
<i>P. dubia</i>	15
<i>P. tenella</i>	89
<i>Physconia distorta</i>	1
<i>P. enteroxantha</i>	4
<i>P. grisea</i>	9
<i>Placynthiella icmalea</i>	3
<i>Protoparmelia hypotremella</i> sp. nov.	95
<i>P. oleagina</i>	22
<i>Pseudevernia furfuracea</i>	18
<i>Pyrrhospora quernea</i>	57
<i>Ramalina farinacea</i>	77
<i>R. fastigiata</i>	66
<i>R. fraxinea</i>	2
<i>R. lacera</i>	2
<i>Schismatomma decolorans</i>	26
<i>Sphinctrina anglica</i>	4
<i>Strangospora pinicola</i>	5
<i>Trapeliopsis granulosa</i>	1
<i>Tremella wirthii</i>	1
<i>Usnea</i> species	2
<i>Xanthoria candelaria</i>	76
<i>X. parietina</i>	60
<i>X. polycarpa</i>	82

*At each site usually ten *Quercus robur* trees are investigated. Mean number of species per site = 26. Data collected by the third author during mapping programme at the request of the Dutch government.

P. hypotremella, 9 viii 1988, V. Wirth 16992 (STU).—**The Netherlands:** (all below 100 m alt.) *Drenthe:* Wezup, on *Quercus* along road, on *P. oleagina*, 3 vii 1991, C. M. van Herk 2219-4 (hb. van Herk); Hoogeveen, Noordsche Schut, on *Quercus* along road, on *P. hypotremella*, 5 vii 1991, C. M. van Herk 2233-10 (hb. van Herk). *Gelderland:* Hooglanderveen, on *Quercus* in wood, on *P. hypotremella*, 21 iii 1991, L. Spier 2306 (hb. Spier). *Utrecht:* Leusden, on *Quercus* along road, on *P. hypotremella*, 3 xii 1993, C. M. van Herk 4017 (hb. van Herk); Woudenberg, on *Quercus* along road, on *P. oleagina*, 16 iii 1994, C. M. van Herk, 4052 (hb. van Herk).

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