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The ultrastructure of the spore wall and ornamentation in the Xerocomus group of Boletus

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The spore wall of five selected species of the Xerocomus group of Boletus was studied with a transmission electron microscope (TEM). The wall is composed of five layers in all the species studied: a very thin electron-dense outer layer 1 (ectosporium), a moderately electron-dense layer 2 (perisporium), a thick and amorphous electron-dense middle layer 3a (exosporium) that passes gradually into a thinner, granular or granular-fibrillar and moderately electron-dense layer 3b (episporium), and an almost electron-transparent layer 4 (endosporium). A smooth spore surface was found in Boletus pulverulentus and B. chrysenteron. A striate exosporium covered by the ectosporium and the perisporium was found in B. pruinatus, rough warts originating from a disrupted perisporium and ectosporium in B. parasiticus, and very fine warts composed of outgrowths of the ectosporium and part of the perisporium in B. subtomentosus. A species of another group of the Boletales with conspicuous ornamentation (Strobilomyces strobilaceus) was examined as comparative material. The results of this TEM study are compared with SEM photographs of the spores of Xerocomus published by other authors, and methodological problems with the examination of spore wall ornamentation are discussed. The data revealed confirm the high value of spore wall architecture and ornamentation in the taxonomy of this genus. The separation of B. parasiticus in a new genus Pseudoboletus Šutara is supported by its spore wall ornamentation that is unique in the Boletaceae.

Key words: Xerocomus, Boletus, Strobilomyces, ultrastructure, transmission electron microscope, spore wall, ornamentation, taxonomy

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Pomocí transmisního elektronového mikroskopu byla studována stěna spor u pěti druhů hřibů ze skupiny suchohřibů. Stěna je tvořena pěti vrstvami: vnější, velmi tenkou elektrondenzní vrstvou 1 (ektosporium), pod ní je středně elektrondenzní vrstva 2 (perisporium), následuje tlustá a amorfní elektrondenzní vrstva 3a (exosporium), která postupně přechází v tenčí, granulární či granulárně-fibrilární a středně elektrondenzní vrstvu 3b (episporium), pod kterou leží vnitřní, téměř elektrontransparentní vrstva 4 (endosporium). Spory druhů Boletus pulverulentus a B. chrysenteron mají hladký povrch. U druhu B. pruinatus byl zjištěn podélně rýhovaný povrch exosporia, pokrytý ektosporiem a perisporiem, u druhu B. parasiticus jsou na povrchu spor hrubé bradavky vzniklé roztrháním perisporia a ektosporia a u druhu B. subtomentosus jemné bradavky tvořené výrůstky ektosporia a části perisporia. Pro porovnání byl studován druh Strobilomyces strobilaceus jako zástupce jiné skupiny řádu Boletales s výraznou ornamentikou spor. Výsledky celého studia jsou porovnány s fotografiemi spor z řádkovacího elektronového

mikroskopu, publikovanými v literatuře. Jsou diskutovány metodologické problémy spojené se studiem ornamentiky spor. Výsledky potvrzují vysokou taxonomickou hodnotu stavby stěny a ornamentiky spor u této skupiny hřibů. Oddělení druhu B. parasiticus do samostatného rodu Pseudoboletus Šutara je podpořeno nálezem ornamentiky, která je v čeledi Boletaceae unikátní.

1. INTRODUCTION

There is a relatively high number of studies on the spore wall of the *Xerocomus* group of *Boletus*. Perreau-Bertrand (1961, 1965) made extensive light microscopic examination of the ornamentation, structure and composition of the spore wall with the use of various chemical agents. Later she studied the ultrastructure of the spore wall in *Xerocomus* and other genera of the *Boletales* with a TEM (Perreau-Bertrand 1967). She distinguished five layers in the spore wall of *Xerocomus* using permanganate fixation. All species studied had a smooth spore surface, except for one case. The ornamentation was of exosporial or exceptionally perisporial origin in other genera. The SEM investigation of the spore morphology in the *Boletales* (Pegler et Young 1981) showed that the spore surface is ornamented in several species of *Xerocomus*. The authors reported a finely rugulose to verrucose ornamentation seemingly of myxosporial origin. Recently, Heinemann et al. (1988) and Oolbekkink (1991) published SEM photographs of the spores in *Xerocomus*. Oolbekkink studied 17 species of the *Xerocomus* group of *Boletus* and distinguished four types of spore surface: smooth, fibrillose or floccose, pitted and striate. He supposes the ornamentation to be of either exosporial or of perisporial origin. With the same method Klofac et Krisai– Greilhuber (1992) found a smooth spore surface in several species of *Xerocomus* and finely or roughly striate ornamentation in some species of *Boletellus*.

Although the knowledge of spore wall architecture and ornamentation in *Xerocomus* seems to be sufficient, there are many unresolved questions. Perreau-Bertrand (1967) reports no ornamentation in *Xerocomus* (with only one exception). However, the presence of warts, striae, and other surface structures is distinct according to the SEM studies mentioned. The statements concerning the origin of the spore ornamentation published in these papers are only assumptions that are not confirmed by recent TEM investigation. Besides, there are several taxonomical problems in *Xerocomus* that relate to the spore ornamentation and its origin, e. g. the position of *Boletus pruinatus* or the taxonomic value of the conspicuously pitted spore surface in *Boletus parasiticus* Bull.: Fr.

The present study was conducted to determine the structure of the spore wall and to reveal the origin of the spore wall ornamentation of selected "key" species in the *Xerocomus* group of *Boletus*. The results could contribute to a species delimitation in *Xerocomus* and a generic delimitation in *Boletaceae*.

2. MATERIAL AND METHODS

The collections used for this study are from the herbarium of the National Museum in Prague, Czechoslovakia (PRM): *Boletus chrysenteron* Bull., Bohemia, Roztocký háj, 9 Sept. 1978, leg. and det. Z. Pouzar, PRM 814499; *Boletus pruinatus* Fr. et Hök, Bohemia, Dlouhopolsko, 4 Oct. 1972, leg. and det. Z. Pouzar (as *B. fragilipes*), PRM 814351; *Boletus parasiticus* Bull.: Fr., Bohemia, Soběslavská blata, 7 Sept. 1980, leg. and det. F. Kotlaba, PRM 830591; *Boletus pulverulentus* Opat. in Wiegm.. Slovakia, Mláčik at Železná Breznica, leg. and det. Z. Pouzar, 30 Aug. 1986, PRM 842268; *Boletus subtomentosus* L.: Fr., Bohemia, Průhonice Park, leg. and det. F. Kotlaba, 6 Jul. 1983, PRM 831196; *Strobilomyces strobilaceus* (Scop.: Fr.) Berk., Bohemia, Kulivá hora, leg. and det. E. Wichanský, 4 Sept. 1964, PRM 603912.

For transmission electron microscopy (TEM), the fragments of the tubes were rehydrated in distilled water for 30 min. and then fixed in 2 % glutaraldehyde in 0.1 M cacodylate buffer at pH 7.2 during several days. Following transfers in 0.1 M cacodylate buffer with 10 min. intervals, the material was post-fixed in 1 % osmium tetroxide in 0.1 M cacodylate buffer for 1 h in the dark, washed six times in distilled water and stained in 1 % uranyl acetate for 1 h in the dark. After 3 washes in distilled water, the material was dehydrated with 10 min. intervals at 10 %, 25 %, 50 %, 70 %, 90 % and 3 x 100 % acetone. The material was embedded in Spurr's resin (Spurr 1969). The sections were cut on a Reichert ultramicrotome using a diamond knife and mounted on Formvar-coated single slot copper grids. They were stained with lead citrate (Reynolds 1963) at room temperature for 5 min. and washed four times with distilled water. The ultrathin sections were observed with a Zeiss EM 109 transmission electron microscope.

Abbreviations used: B. – *Boletus*, S. – *Strobilomyces*. Wherever the name *Xerocomus* is mentioned, "the *Xerocomus* group" of *Boletus* is meant.

3. RESULTS

3.1 Structure of the spore wall

The structure of the spore wall is very similar in the observed species of *Xerocomus* (Figs. 1, 3, 5, 8, 15). The spore wall is composed of the following layers: a very thin electron-dense outer layer 1, a moderately electron-dense layer 2 (25 – 95 nm), a thick middle layer 3 composed of two sublayers: an almost opaque outer layer 3a (120 – 220 nm) and a less electron-dense inner layer 3b (35 – 120 nm), and an electron transparent innermost layer 4 (45 – 80 nm). The thickness of the whole spore wall varies from 350 to 500 nm in the species studied.

Layer 1 is a pellicle covering the spore surface (e. g. Figs. 1, 3, 4, 7, 14, 16). It is often disrupted and only remains on some parts of the spore wall (Figs. 6, 7, 10, 11, 17). The appearance of layer 1 varies from a distinct and thin "line" (Figs. 4, 9) to an unequally thick and slightly floccose layer (e. g. Figs. 2, 3, 15, 16). These differences are probably caused by the use of herbarium material for the examination, by uneven staining of various parts of layer 1 or by the ultrathin sections not being exactly transversal.

The appearance and thickness of layer 2 is very similar in almost all the species studied (Figs. 2, 3, 5, 15; 25 – 94 nm). Only in *Boletus parasiticus* (Figs. 7, 8, 9, 11) layer 2 is almost twice as thick (about 150 nm) and discontinuous. In other species, this layer is smooth and covers the whole spore. It is closely attached to layer 3a and consists of a moderately electron-dense and finely granular substance.

Layer 3 constitutes the thickest part of the spore wall (200 – 300 nm). On the basis of different electron density and structure, it can be divided into two sublayers (Figs. 1, 3, 5, 6, 8, 13, 15). The outer layer 3a appears very homogenous and contains an amorphous electron-dense substance. On the other hand, the inner layer 3b is approximately twice as thin and characterised by a moderately electron-dense and granular or granular-fibrillar substance (this is particularly obvious in the Figs. 1, 3, 5, 6, and 15). The transition of these two sublayers is mostly gradual, in some cases almost indistinguishable (Figs. 3, 4, 8), but in other cases also very distinct (Figs. 1, 5, 6, 15). When all spores in one ultrathin section were carefully observed, these two layers were always distinguishable in the species studied.

Layer 4 forms the innermost part of the spore wall and is adjacent to the plasma membrane. It is amorphous, electron-transparent and in some cases filled with scattered granules (Figs. 5, 8, 9, 14, 15). It is present in both not quite mature (Fig. 4) and mature spores.

This description shows the general arrangement of the spore wall layers in *Xerocomus*. However, there are some specific features in the individual species and above all remarkable differences in the appearance and origin of the ornamentation between the species studied.

3.2 Ornamentation of the spore wall

A smooth spore surface was only observed in *Boletus pulverulentus* (Figs. 1, 2) and *Boletus chrysenteron* (Fig. 3). *B. chrysenteron* is reported to have longitudinally striate spores according to Heinemann et al. (1988) and Oolbekkink (1991), but such an ornamentation was not found in any of the spores observed. Low prominences (about 50 nm) changing with shallow depressions were found in layer 3a in cross sections of the spores in *Boletus pruinatus* (Figs. 4, 6). Longitudinal sections (Fig. 5) show no prominences in layer 3a. This means that layer 3a forms longitudinal ridges (striae) that are covered by layers 2 and 1. The distance between individual
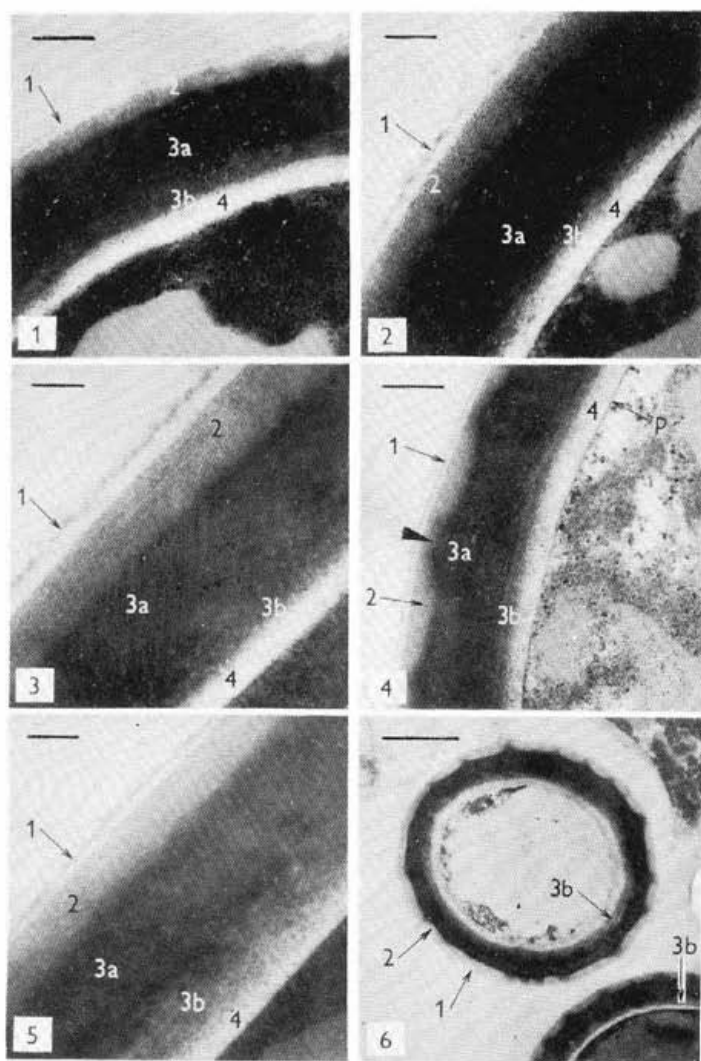
Figs. 1 – 6. Spore wall of *Boletus pulverulentus, B. chrysenteron,* and *B. pruinatus.* – 1. *B. pulverulentus,* cross section. Mature spore with smooth spore surface and relatively distinct layer 3b. (x 50 000, Bar = 0.2 μm). – 2. *B. pulverulentus,* cross section of mature spore. Layer 3a passes gradually into layer 3b that is less electron dense and slightly granular (x 85 000, Bar = 0.1 μm). – 3. *B. chrysenteron,* cross section. Mature spore with smooth spore surface and slightly floccose layer 1. Layer 3a passes gradually into moderately electron-dense and granular layer 3b (x 85 000, Bar = 0.1 μm). – 4. *B. pruinatus,* cross section of not quite mature spore. Layer 3a forms low prominences (arrow- head) that are covered by layers 1 and 2. Layer 3b has a granular-fibrillar structure (x 50 000, Bar = 0.2 μm). – 5. *B. pruinatus,* longitudinal section of mature spore. No prominences of layer 3a are present (x 85 000, Bar = 0.1 μm). – 6. *B. pruinatus,* cross section of mature spore (lower right corner) and not quite mature spore (in the center) that is covered by rests of layer 1. The moderately electron-dense layer 3b is very distinct on both spores. The prominences forming longitudinal ridges on the surface of layer 3a are more pronounced on the mature spore (x 12 000, Bar = 1 μm). Abbreviation: p = plasma membrane.
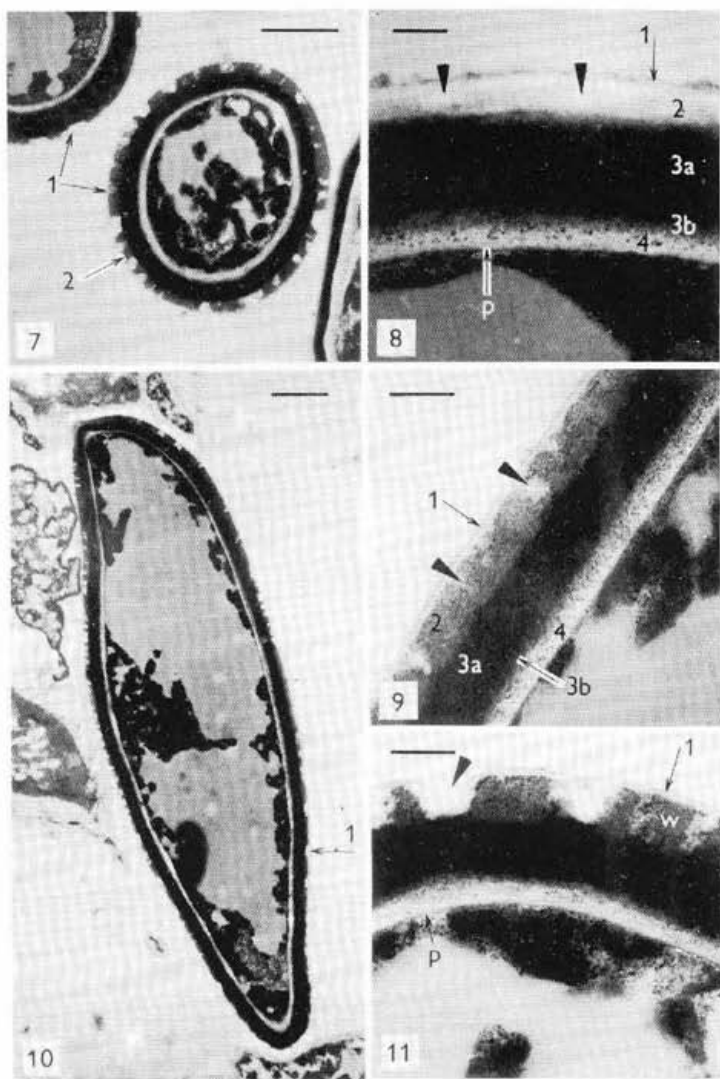
Figs. 7 – 11. Spore wall of *Boletus parasiticus*. – 7. Cross section of mature spores. Layer 2 is separated into fragments that are partly covered by layer 1 (x 12 000, Bar = 1 μm). – 8. The initial stage of spore ornamentation development, longitudinal section. Layer 2 begins to break up (arrow-heads), seemingly by the growth of the spore. Layer 3b differs from layer 3a on the basis of its electron density and finely granular structure. (x 85 000, Bar = 0.1 μm). – 9. Later stage of spore ornamentation development, longitudinal section. Layer 2 begins to separate into fragments (x 50 000, Bar = 0.2 μm). – 10. Mature spore, longitudinal section. The verrucose spore ornamentation is formed by fragments (warts) of layer 2 that are partly covered by layer 1 (x 4 400, Bar = 2 μm). – 11. Final stage of spore ornamentation development, cross section. Layer 2 is divided into fragments that form warts on the spore surface (see also Fig. 10). The disruption of layer 1 (arrow- head) indicates that the warts developed during the enlargement of the spore volume and resulting disintegration of layer 2 (x 50 000, Bar = 0.2 μm). Abbreviations: p = plasma membrane, w = wart.
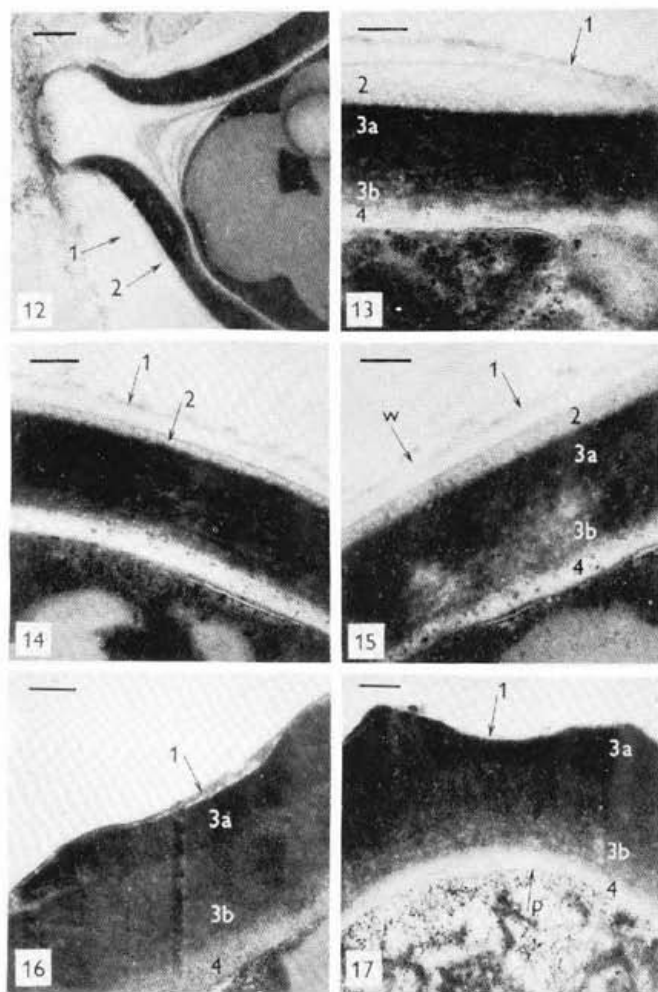
Figs. 12 – 17. Spore wall of *Boletus subtomentosus* and *Strobilomyces strobilaceus*. – 12. *B. subtomentosus*, longitudinal section of mature spore. The distance between the layers 1 and 2 is relatively great (x 30 000, Bar= 0.2 μm). – 13. *B. subtomentosus*, longitudinal section of not quite mature spore near the apiculus. Layer 1 is smooth and separated from layer 2 by an electron-transparent substance (x 85 000, Bar = 0.1 μm). – 14. *B. subtomentosus*, longitudinal section of mature spore. Layer 1 forms fine warts on the spore surface (x 85 000, Bar = 0.1 μm). – 15. *B. subtomentosus*, explanations see Fig. 14. Layer 3b is well discernable on the basis of its finely granular-fibrillar structure (see also Fig. 14) and moderate electron density. – 16. *Strobilomyces strobilaceus*, longitudinal section of not quite mature spore near the apiculus. The electron-dense layer 3a is covered directly by a thin layer that is very similar to layer 1 in the *Xerocomus* species examined. No layer resembling the moderately electron- dense and finely granular layer 2 of Xerocomus species is present (x 30 000, Bar = 0.25 μm). – 17. *S. strobilaceus*, cross section of young spore. The transition of the layers 3a and 3b is gradual. However, layer 3b is discernable on the basis of its moderate electron-density and granular structure. The prominences of layer 3a are still relatively low. Layer 1 forms only small rests between these prominences (x 30 000, Bar = 0.25 μm). For abbreviations see Figs. 7 – 11.

ridges differs in various parts of the spore wall (Fig. 6). The ridges are considerably higher and more distinct in mature spores (Fig. 6, in the lower right corner) than in spores of earlier stages of development. (Fig. 6, in the centre).

In *B. parasiticus*, the ornamentation originates from layer 2. This layer is continuous and smooth in immature spores (Fig. 8) but then begins to break up (Fig. 8, 9), seemingly by the growth of the spore. Finally, layer 2 consists of more or less separated fragments with an approximately square or rectangular cross section (Fig. 11). These fragments are covered with the continuous layer 1 (Fig. 9) which later becomes disrupted (Fig. 11). The presence of fragments both in longitudinal (Fig. 10) and cross sections of the spore wall (Fig. 7) shows that layer 2 forms verrucose or irregularly reticulate spore surface. The ornamentation is comparatively high as layer 2 is nearly as thick (about 170 nm) as the whole layer 3 (about 200 nm).

Layer 1 forms small outgrowths on the spore surface of *B. subtomentosus*. These structures are very fine in not quite mature spores and near the apiculus (Fig. 13) but very distinct in mature spores (Fig. 14, 15). They are approximately 25 – 35 nm high and irregularly arranged. The distance between layer 1 and 2 is much greater than in spores of other species studied. The data obtained show that the spore surface is covered by very faint and irregularly distributed warts of ectosporial origin.

From these data follows that the spore ornamentation of the observed species of *Xerocomus* is formed by: a) a ridged surface of layer 3a (*B. pruinatus*), b) disintegration of layer 2 and 1 (*B. parasiticus*) or c) fine warts formed by layer 1 together with part of layer 2 (*B. subtomentosus*). These types of ornamentation are of a different origin with respect to the layer of the spore wall and way of development.

To compare the results obtained in *Xerocomus* with another group of the order *Boletales* with ornamented spores, the related species (after Pegler et Young 1981) *Strobilomyces strobilaceus* was also studied. This species has a distinctly reticulate spore ornamentation (Perreau-Bertrand 1961, Pegler et Young 1981). The layers of the spore wall are arranged in other way than in *Xerocomus* (Figs. 16 – 19). The innermost layer (about 100 nm) seems to be identical with layer 4 in *Xerocomus*. The adjacent layer consists of granular and moderately electron-dense material that resembles the substance of layer 3b in *Xerocomus*. However, in contrast to *Xerocomus* species this layer is very thick (400 – 430 nm) and very distinct. Besides, narrow "columns" protrude from this layer into the outer layer (Figs. 18, 19). Around these "columns" an electron-dense substance is accumulated. This substance is strongly reminiscent of the material of layer 3a in *Xerocomus* and forms the reticulate ornamentation together with "columns" mentioned (200 – 220 nm without the ornamentation, about 480 nm including the ornamentation). In immature spores, there is an electron-dense pellicle present (Fig. 16) that covers

all outgrowths of the spore wall and resembles layer 1 in *Xerocomus*. The pellicle breaks up by the growth of the spore (Fig. 17) and it is not present (Figs. 18, 19) on mature spores.

The comparison shows that the spore wall in *S. strobilaceus* is much thicker than in *Xerocomus* species (about 1100 nm). Layer 2, which was observed in all spores of *Xerocomus*, is absent in *S. strobilaceus*. The next layers seem to be homologous with layers described for *Xerocomus* species but their arrangement and thickness is different. The ornamentation of mature spores is not covered by layer 1.

4. DISCUSSION

4.1 The spore wall

Using a TEM, Perreau-Bertrand (1967) distinguished five layers in the spore wall of several *Xerocomus* species. She used the following terms for their description: ectosporium, perisporium, exosporium, episporium and endosporium (originally ectospor, perispor, etc.; this form is not correct according to Singer, 1986). The ultrastructure of layers revealed by the present author (1, 2, 3a, 3b and 4 respectively) correlate to Perreau-Bertrand's description of the layers mentioned above. There are, however, several differences – after Perreau-Bertrand, the exosporium is clearly delimited from the episporium (the transition of these two layers is gradual in my case), the perisporium on her photographs is much thinner, etc. Nevertheless, the spore wall architecture is similar in both cases. Consequently, the spore wall layers are named in the following text as: 1 – ectosporium, 2 – perisporium, 3a – exosporium, 3b – episporium, 4 – endosporium. Although these terms are usually used for the description of the spore wall in light microscopy (Pegler et Young 1971, Singer 1986), they seem to be fully acceptable for description at the ultrastructural level in this case. They express the relative position of the individual layers of the spore wall as well as the differences in their structure in accordance with the terminology of the authors mentioned above.

The fact that layers with different appearance in the ultrathin sections are of different chemical composition was demonstrated by Rast et Hollenstein (1977). They revealed a mixture of granules and amorphous material together with some fibrils in the electron-dense outer layer of *Agaricus bisporus* spore wall, chitin fibrils embedded in a β – glucan-protein matrix in a moderately electron-dense middle layer and an almost electron-transparent mucous covering adjacent to the plasma membrane. The authors showed that the ultrastructure of the individual layers of the spore wall is in close relation to their chemical composition. Based on the great similarity of the ultrastructure of some layers in *A. bisporus* and selected species of *Xerocomus*, the electron-transparent endosporium in *Xerocomus* consists probably of a mucous substance. Further more, although the episporium (layer 3 b)

is not distinctly delimited from the exosporium (layer 3 a) in *Xerocomus* species, it seems to be of a different chemical composition than the exosporium. Its granular to slightly fibrillar structure resembles the appearance of the middle layer of *A. bisporus* spore wall. The presence of some fibrillar material (perhaps chitin) in this layer is possible. The exosporium in *Xerocomus* species is very similar to the outer layer in *A. bisporus* and seems to consist of an amorphous and probably pigmented substance. Clémençon (1970, 1977, 1986) writes that layers of the eusporium (= endosporium + episporium) are produced by different degree of dispersion of an electron-opaque "tunica" substance in a transparent "corium" matrix. His assumption seems to be incorrect with respect to the findings of Rast et Hollenstein (1977). This is another reason to use the terms endosporium and episporium for the layers 4 and 3b and not the terms corium and coriotunica. Besides, a hypothesis concerning the spore wall ontogeny should be supported by thorough developmental studies. The spore development in one species of the *Boletales* – *Boletus rubinellus* – was investigated by Yoon et McLaughlin (1984, 1986). They described six phases of the spore development based on nuclear behaviour and changes in wall layers and cytoplasm. The authors observed considerable changes of the spore wall ultrastructure during the development but from stage 2 the wall was composed of four layers: pellicle, perisporium, episporium and endosporium. These layers seem to correspond with the layers 1, 2, 3a and 4 in *Xerocomus*. The granular and moderately electron-dense layer (3b in *Xerocomus*) was not observed in mature spores of *Boletus rubinellus*. However, Yoon et McLaughlin (1986) observed that the electron-dense layer forming the thickest part of the spore wall in *B. rubinellus* became multi-layered during stage 6. This phenomenon was not observed in fully mature spores of *Xerocomus* species. The presence of the not distinctly delimited layers 3a and 3b could indicate immaturity of the spores with respect to the possibility of removing the fully mature spores during preparation of the material for TEM study. However, the layers 3a and 3b were discernible in all observed spores of all the species studied and parts of the tubes used for preparation were taken from quite mature fruitbodies. Besides, the maturity of spores in the fruitbody was controlled beforehand under the light microscope. Therefore, in accordance with Perreau–Bertrand (1967) the spore wall in the *Xerocomus* group of *Boletus* seems to be really five-layered. The trilamellate structure of the outermost layer (ectosporium) reported by Yoon et McLaughlin (1986), was not observed, probably because of the use of herbarium material.

It is necessary to discuss here the availability of herbarium material for a study. The use of herbarium specimens was an attempt to find out the degree of conservation of the ultrastructure of the spore wall after considerably long storing in a herbarium (the specimens used for this study were collected in the years 1964, 1972, 1978, 1980, 1983, and 1986). The comparison with the ultrastructure of spores from fresh material in *Boletus rubinellus* (Yoon et McLaughlin 1984, 1986) is very

interesting. The changes in the cytoplasm of the spores from herbarium material are considerable and the artefacts are clearly visible in many photographs, e. g. the absence or bad preservation of membranes (Figs. 4, 13, 14, 15) or disintegrated vesicles and the presence of particles without any structure (Fig. 17). Consequently, the interpretation of the structure of cytoplasm and membranes is problematical. The aggregations of lipids in a dense cytoplasm are discernible in some spores (e. g. Figs. 1, 7, 10, 12, 19) which is a typical feature of mature spore. On the other hand, the ultrastructure of the spore wall layers is quite comparable with the ultrastructure of the spores from living fruitbodies. The spore wall as a structure saving the cytoplasm between spore release and germination seems to be very resistant as to preservation of the structure in dry state. This conclusion is supported by the good preservation of ectosporium and perisporium on my spores, at least in the form of small remnants.

Pegler et Young (1981) reported that the epitunica (= exosporium) forms a thin but distinct layer in *Xerocomus*. This finding was not confirmed, besides, the term epitunica was delimited for the description of the spore wall layer in *Cortinarius* (Clémençon 1970, 1973) only.

4.2 Spore ornamentation

The spore ornamentation revealed by the use of a TEM is compared with SEM photographs of the spores in the *Xerocomus* group of *Boletus* made by other authors.

The finding of a smooth spore surface in *B. pulverulentus* (Fig. 1, 2) is in accordance with data by Oolbekkink (1991). However, Oolbekkink (1991) and Heinemann et al. (1988) report faint to distinct longitudinal striae on the spore surface of *B. chrysenteron* (the other species with smooth spores according to this paper, Fig. 3). Recently, Klofac et Krisai-Greilhuber (1992) confirmed that the spore surface is smooth in *B. chrysenteron* and the spores photographed by Oolbekkink (1991) and Heinemann et al. (1988) were taken from another species, probably *B. pruinatus*. Pegler et Young (1981) also found smooth spores in *B. chrysenteron*.

B. pruinatus shows distinct longitudinal ridges (striae) of exosporial origin. It is interesting that the ridges covered by perisporium and ectosporium (Fig. 4, 6) are visible on SEM photographs of the spore surface (Heinemann et al. 1988, Oolbekkink 1991, Klofac et Krisai-Greilhuber 1992). This phenomenon may be caused by the fact that the spores prepared by these authors were dry, whereas spores prepared by the present author were rehydrated in water for 30 minutes. The mucous perisporium seems to be closely attached to the exosporium in dry spores and does not fill the depressions between the striae. Rehydration of the perisporium may be the precondition of natural appearance of this layer. The same situation was observed by Farr (1983) in *Pholiota terrestris* and *P. highlandensis*

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where the distinct perisporial ornamentation was discernable with a SEM on fresh spores fixed in glutaraldehyde or on dried spores rehydrated in ethanol and water. On the other hand, no perisporial ornamentation was revealed on the spores from herbarium material without prior rehydration.

In *B. parasiticus* perisporial ornamentation was found, composed by fragments of layer 2 (Figs 9, 10, 11). It was supposed to be verrucose to irregularly reticulate. The SEM photographs of Pegler et Young (1981) and Oolbekkink (1991) prove this assumption. Oolbekkink names this ornamentation "conspicuously pitted" and supposes that it is formed by disintegration of ecto– and perisporium. This assumption is now confirmed by the images demonstrating that the ornamentation develops really in this way.

In *B. subtomentosus* fine warts of ectosporial and partly also perisporial origin were found on the spore surface (Figs. 14, 15). The spore surface is finely floccose or verrucose on the SEM photographs of Pegler et Young (1981), Heinemann et al. (1988) and Oolbekkink (1991) which is in accordance with my findings. However, the ornamentation is not formed by disintegration of ectosporium and perisporium, as Oolbekkink reports, but by fine verrucose outgrowths of the ectosporium.

Generally, the exosporial or perisporial origin of spore ornamentation was revealed by many authors, e. g. Perreau-Bertrand (1967, 1973, 1976), Pegler et Young (1971) and Singer (1986). The existence of ornamentation formed above all by the ectosporium is relatively surprising because this layer is supposed to be very fine and often disappearing. Its preservation seems to depend on the way of preparation of the material. Although the perisporial ornamentation is very distinct with a TEM and SEM in *B. parasiticus*, it is not visible with a light microscope which is confirmed by e. g. Šutara (1991). Only the exosporial ornamentation in *B. pruinatus* (Pouzar 1981, Klofac et Krisai-Greilhuber 1992, own light-microscopic observations) is faintly visible with a light microscope. It is obvious that the use of a SEM is necessary to distinguish finer types of ornamentation in *Xerocomus* (perisporial, ectosporial-perisporial). The origin of the ornamentation can be revealed only on the basis of a TEM study.

The TEM photographs of the spore wall in *Strobilomyces strobilaceus* (Figs. 18, 19) show that the reticulate ornamentation depicted by Perreau-Bertrand (1961) and observed by Perreau et Heim (1969) and Pegler et Young (1981) with a SEM is of exosporial but partly also of episporial origin. The episporium forms "columns" around which the exosporium is located. This is the fourth type of ornamentation (as regards its origin) revealed in the species studied. At maturity the spore surface is almost not covered by an ectosporium. The perisporium reported by Perreau-Bertrand (1967) was not observed.
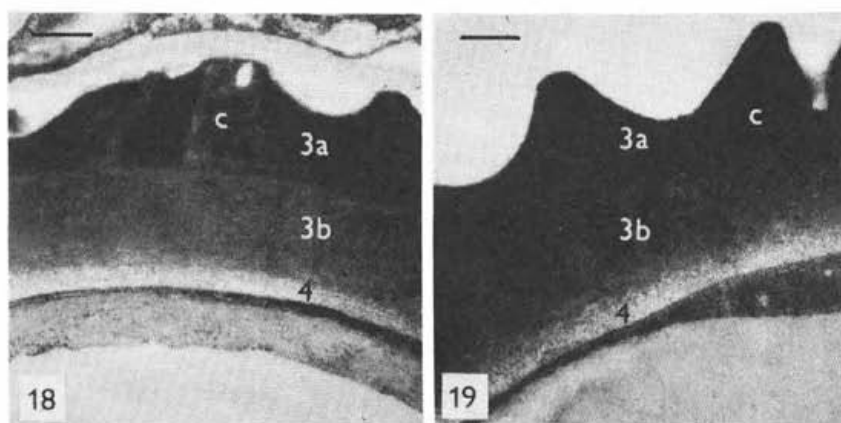
Figs. 18 – 19. Spore wall of *Strobilomyces strobilaceus*. – 18. Longitudinal section of mature spore near apiculus. Layer 3b is clearly different from layer 3a and forms "columns" projecting into layer 3a. Layer 1 is not present in the mature spore. – 19. Cross section of mature spore. Material of layer 3a is accumulated around narrow "columns" projecting from layer 3b, and forms "outgrowths" that compose reticulate ornamentation on the spore surface of this species (x 30 000, Bar = 0.25 μm).

4.3 Taxonomic implications

The taxonomic value of the ornamentation of spores in the *Xerocomus* group of *Boletus* was discussed by Oolbekkink (1991). The results of this study and findings published by Klofac et Krisai-Greilhuber (1992) somewhat change his conclusions. Oolbekkink (1991) insists that "the taxa of *B. chrysenteron* complex can be distinguished from *B. subtomentosus* complex by their striate spores". However, the observations of Pouzar (1981), Pegler et Young (1981), Klofac et Krisai-Greilhuber (1992), and my own results show that the true *B. chrysenteron* has smooth spores. A similar species with striate spores is *B. fragilipes* C. Martin that was reinstalled by Pouzar (1981) and considered to be a nomen dubium by Oolbekkink (1991). Klofac et Krisai-Greilhuber (1992) showed after a thorough discussion that the basionym of this species should be *Boletus pruinatus* Fr. et Hök. They proposed the new combination *Boletellus pruinatus* (Fr. et Hök) Klofac et Krisai-Greilhuber, above all on the basis of its striate spores. This is really a very important feature of the genus *Boletellus* but the second one is the boletoid trama (in comparison with a phylloporoid trama in *Xerocomus*). However, Klofac et Krisai-Greilhuber (1992) do not specify the trama type in their description of *Boletellus pruinatus*. They mention that the European species of the section *Chrysenteroidei* Sing. of *Boletellus* are expected to have a boletoid trama in young fruitbodies only and later the lateral stratum is almost parallel and resembles that in *Xerocomus badius*. Similarly, they mention the description of Watling (1968) where the trama is characterised as

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almost phylloporoid. Thus, the position of *Boletus pruinatus* is still unclear. The presence of spores with a striate exosporium is confirmed, but the problem of the trama type needs thorough study of the trama ontogeny.

The presence of distinct ornamentation in *Boletus parasiticus* is a very important feature. An ornamentation formed by disintegration of the perisporium and ectosporium is not known in *Xerocomus* and *Boletus*. This feature can serve as a further confirmation of the opinion published by Šutara (1991) on the isolated position of this species within *Xerocomus* and *Boletus*. *B. parasiticus* differs from other species of these genera by the parasitic way of life and above all by the sterile stipe surface. Consequently, Šutara (1991) described the new genus *Pseudoboletus* Šutara that includes *Pseudoboletus parasiticus* (Bull.: Fr.) Šutara. The unique spore ornamentation seems to support this classification.

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Antrodiella genistae – a new polypore for Czech Republic and Slovak Republic

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Vampola P. and Pouzar Z. (1994): Antrodiella genistae – a new polypore for Czech Republic and Slovak Republic. – Czech Mycol. 47: 185–188

The brief description, ilustrations of microfeatures and notes on distribution in Czech Republic and Slovak Republik of a rare polypore Antrodiella genistæ (Bourd. et Galz.) David are given in this paper.

Key words: Antrodiella genistae, Czech Republic, Slovak Republic, polypore

Vampola P. a Pouzar Z. (1994): Antrodiella genistæ – nový choroš pro Českou republiku a Slovenskou republiku. – Czech Mycol. 47: 185–188

V práci je uveden krátký popis, ilustrace mikroznaků a údaje o rozšíření vzácného choroše Antrodiella genistæ (Bourd. et Galz.) David v České republice a Slovenské republice.

The genus *Antrodiella* Ryv. et Johansen belongs to those genera of polypores which are intensively studied in Czech Republic in last time. Since 1984, when Kotlaba (1984) published summary data on geographic distribution and ecology of polypores in Czechoslovakia, several further species of the genus *Antrodiella* have been discovered in that territory (Vampola 1991a, 1991b, Vlasák 1990). The discussed species *Antrodiella genistæ* has been discovered in a territory of the former Czechoslovakia only recently, too. Although this fungus has been described by Bourdot et Galzin already in 1925, in mycological literature it is mostly incorrectly interpreted and confused with other species. Only when David et Lecot (1990) published a brief characterization of by them studied specimens, the existence of *A. genistæ* has been confirmed and is accepted now. In Europe this species has been known only from France and Yugoslavia, we can, however, to assent to Ryvarden et Gilbertson (1993) that this species probably is overlooked or confused with *Antrodiella semisupina* (Berk. et Curt.) Ryv. For mycologists studying polypores the brief description and some notes for the correct identification are presented below, for detailed descriptions we refer to works by Bourdot et Galzin (1928) and Ryvarden et Gilbertson (1993).
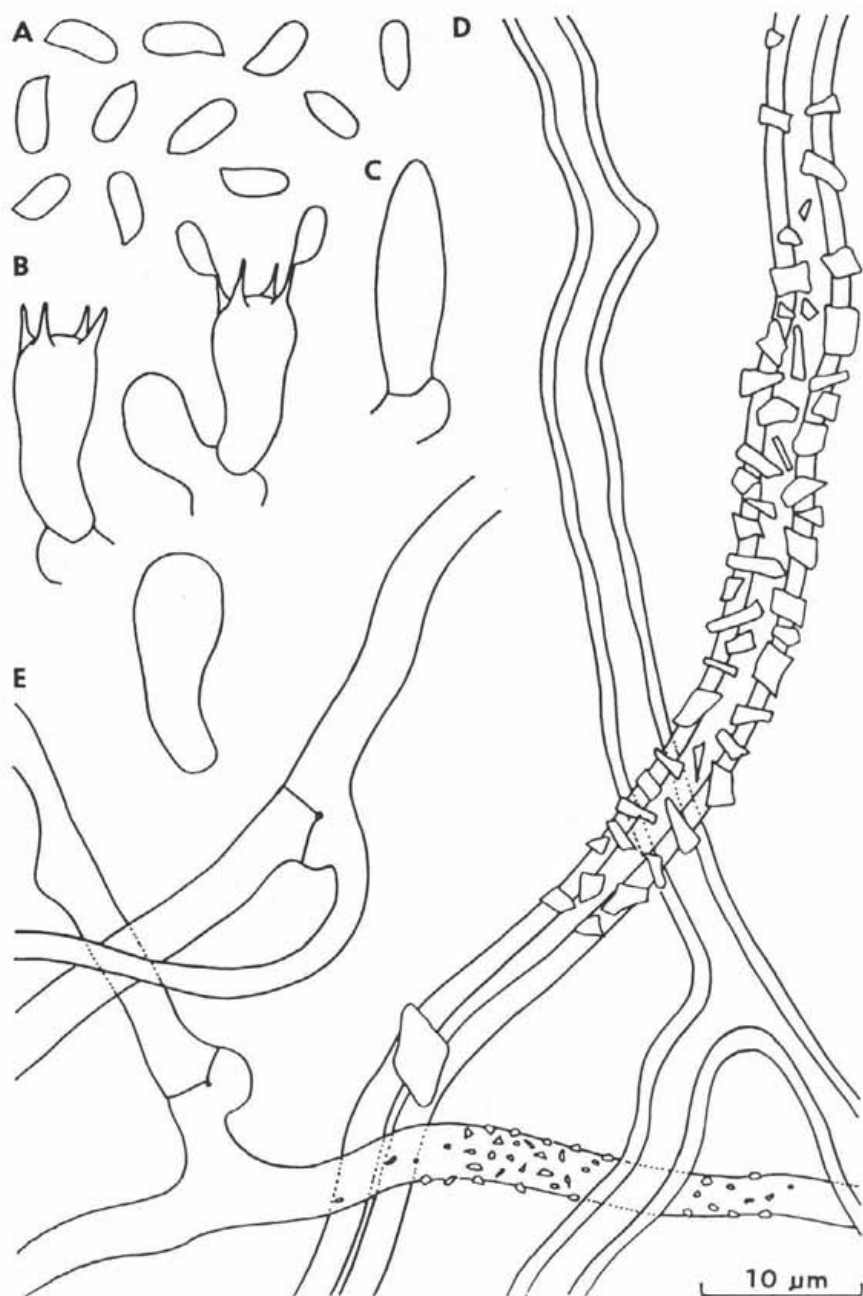
Fig. 1. *Antrodiella genistæ* (Bourd. et Galz.) David – A) spores, B) basidia, C) cystidiolum, D) thick-walled, partly incrusted skeletal hyphae, E) generative hyphae with clamps.

Antrodiella genistæ (Bourd. et Galz.) David

Syn.: *Coriolus genistæ* Bourd. et Galz.

Basidiocarps annual, usually effused-reflexed with narrow pilei, macroscopically indistinguishable from those of *A. semisupina;* the resupinate forms can sometimes have a broad byssoid margin and then are indistinguishable from basidiocarps of *A. romellii* (Donk) Niemelä. The colour of the whole basidiocarp is whitish, cream, yellowish to ochraceous. Hyphal system is dimitic, generative hyphae thin-walled with clamps, branched, in some parts finely incrusted, 2 – 4 μm wide. Skeletal hyphae thick-walled, unbranched to occasionally branched, in some parts often finely incrusted or coarsely-grained, 2 – 5 μm wide. The incrusted hyphae can most easily be observed in context in a layer attached to the substratum, in tubulotrama are very rare. Hymenium consists of basidia and unabundant cystidioles. Basidia are tetrasporic, clavate, with basal clamps, 8 – 15 x 4 – 5.5 μm. Cystidioles are fusoid, with basal clamps, of the same size as basidia. The thin-walled usually deformed cylindrical sterile elements rarely projecting from hymenium or edges of tubes could perhaps be considered as leptocystidia but will really be only swollen ends of hyphae. Basidiospores are hyaline, smooth, long ellipsoid to distinctly cylindrical, 3.5 – 5 x 1.7 – 2 μm.

Antrodiella genistæ has been confused with *Antrodiella onychoides* (Egel.) Niemelä which, however, has simple septate hyphae. The assumption that *A. onychoides* could be a haploid form of *A. genistæ* (cf. Ryvarden et Gilbertson 1993) is remarkable and in our opinion very probable. The correct answer, however, will be a matter of some further detailed study, especially of pure cultures.

As already mentioned above, the totally resupinate basidiocarps are indistinguishable from *Antrodiella romellii* (Donk) Niemelä, which, however, differs in strikingly broader ellipsoid basidiospores.

A. genistæ is till now known only from Europe, i. e. from France, Yugoslavia and now from the Czech Republic and the Slovak Republic, too. Till now it has been found on hardwoods of the genera *Alnus, Calluna, Cistus, Corylus, Fagus, Juglans, Quercus* and *Salix* but its hosts will certainly be more numerous.

The new localities of *A. genistæ* in Czech Republic and Slovak Republic:

Bohemia: Karlštejn pr. Beroun, loco "Velká hora", ad ramum dejectum *Quercus* sp., 23. XI. 1952, leg. et det. Z. Pouzar ut *Poria romellii* Donk, 16. VI. 1993 rev. P. Vampola (PRM 654 344). – Komárov (distr. Tábor), area tuta Soběslavská (= Borkovická) blata, ad ramum iacentem *Salicis cinereæ*, 17. IX. 1993, leg. et det. P. Vampola (MJ 459/93). – Varvažov, silva "Mýto", in alneto infra piscinam "Vosovický rybník", ad ramum emortuum *Alni glutinosæ*, 10. VIII. 1963, leg. M. Svrček, 28. I. 1975 det. F. Kotlaba ut *Poria romellii*, 14. I. 1994 rev. P. Vampola (PRM 316 921). – Třeboň, in alneto "U Jindrů", ad ramum iacentem *Alni glutinosæ*,

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30. X. 1965 leg. M. Svrček et J. Kubička, 4. II. 1975 det. Z. Pouzar ut *Poria romellii*, 14. I. 1994 rev. P. Vampola (PRM 610 442). – Zbořený Kostelec pr. Týnec nad Sázavou, in pede collis "Hradečnice", ad truncum emortuum *Quercus roboris*, 2. XI. 1980, leg. F. Kotlaba, det. Z. Pouzar ut *Tyromyces semisupinus*, 19. III. 1994 rev. P. Vampola (PRM 871 821). – Michnovka (distr. Hradec Králové), silva "Lhotáček", ad ramum iacentem *Quercus* sp., 25. IX. 1993, leg. et det. P. Vampola (MJ 501/93).

Moravia: Radostín (distr. Žďár nad Sázavou), ad ramum iacentem *Alni incanæ*, 4. VI. 1991, leg. et det. P. Vampola (MJ 2518). – Lanžhot (distr. Břeclav), area tuta "Ranšpurk", in cortice trunci frondosi, 3. XI. 1993, leg. A. Vágner, det. P. Vampola (BRNM). – Pornice ap. Kroměříž, silva "Valachy", 15. VIII. 1958, leg. H. Zavřel, det. F. Kotlaba et Z. Pouzar ut *Poria romellii*, 14. I. 1994 rev. P. Vampola (PRM 645 853).

Slovacia: Nová Sedlica (distr. Humenné), silva sub Jaraba skala, ad truncum iacentem *Fagi silvaticæ*, 10. X. 1990, leg. et det. P. Vampola (MJ 639/90).

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Antrodia pini-cubensis, a new polypore from the Caribbean area

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A new polypore Antrodia pini-cubensis Vampola, Kotlaba et Pouzar is described from a collection by the second author from Cuba in the Caribbean area. This fungus was reported ten years ago as a new species for Cuba under the incorrect name of Antrodia oleracea (Davids. et Lomb.) Ryv. A. pini-cubensis forms thin resupinate carpophores with small pores. It grows saprophytically on dead wood of Pinus cubensis and causes a brown rot of wood.

Key words: Antrodia pini-cubensis, Cuba, polypore

Vampola P., Kotlaba F. a Pouzar Z. (1994): Antrodia pini-cubensis, nový druh chorošů z karibské oblasti. – Czech Mycol. 47: 189–192

Je popsán nový druh chorošů Antrodia pini-cubensis Vampola, Kotlaba et Pouzar podle nálezů druhého z autorů na ostrově Kuba v karibské oblasti. Před 10 lety byla tato houba uvedena jako nový druh pro Kubu pod chybným určením jako Antrodia oleracea (Davids. et Lomb.) Ryv. A. pini-cubensis tvoří tenké resupinátní plodnice s drobnými póry a roste saprofyticky na mrtvém dřevu borovice Pinus cubensis. Působí hnědou hnilobu dřeva.

During a five month's stay in Cuba (November 19, 1966 – April 19, 1967) the second author collected rich material of many macromycetes in various parts of this island. Ten species of polypores were selected from this material and published as rare or new species for Cuba (Kotlaba, Pouzar et Ryvarden 1984). Among these species, one very interesting resupinate polypore was mentioned which has been collected on 13. III. 1967 on a fallen, dead trunk of the East-Cuban endemic pine *Pinus cubensis* Griseb. near Mayarí (SE of Holguín) in the mountains of Sierra de Nipe, province Oriente (eastern part of Cuba). Part of this material was sent to J. L. Lowe, who identified it at that time as *Poria oleracea* Davids. et Lomb. and, in the mentioned paper, it was cited as *Antrodia oleracea* (Davids. et Lomb.) Ryv.

In 1991, the first author studied several herbarium specimens of *Poria oleracea* Davids. et Lomb. on loan to the National Museum in Prague by the Forest Products Laboratory, Madison, U.S.A. and, at the same time, he also revised the above mentioned collection from Cuba. In a detailed comparative study, he ascertained that the Cuban fungus was surely not identical with *Poria oleracea*. He further found in the PRM herbarium an additional herbarium specimen of this fungus (PRM 879880), evidently a duplicate, which has been identified by L. Ryvarden

as *Antrodia* cfr. *oleagina*, i. e. the correct name of this species now appears to be *Amyloporia sordida* (Ryv. et Gilberts.) Vampola et Pouzar (see Vampola et Pouzar 1993). However, by a comparative study of the type of *Poria oleagina* Overh., from the mycological herbarium of the University of Pennsylvania (PACMA 00632), he came to the conclusion that Ryvarden's identification also cannot be accepted and the Cuban fungus is a new species. As further study led to the same conclusion, we describe it below as a new species.

Antrodia pini-cubensis Vampola, Kotlaba et Pouzar, spec. nov.

Carposomata annua, resupinata, tenua, albida usque cremea, circa 1.5 – 7 x 0.6 – 1.7 cm; tubulis brevibus, 0.3 – 1.5 mm longis, poris minutis, 6 – 7 per 1 mm, rotundatis usque angulato-rotundatis. Systema hypharum dimiticum, hyphis generativis fibuligeris, tenuiter tunicatis, 2 – 4 μm latis; hyphis skeleticis crasse tunicatis (cum tunica in solutione kalii hydroxydati introrsum incrassante), 2 – 4 μm latis, abundantibus, in subiculo saepe ramificatis. Hymenium basidiis late clavatis tetrasterigmaticis, 10 – 18 x 5 – 6.5 μm, et cystidiolis fusiformibus abundantibus, 8 – 18 x 4 – 5.5 μm, constitutum. Sporae hyalinae, laevis, tenuiter tunicatae, cylindricae, leniter arcuatae, 4.5 – 6.5 x 1.5 – 2.2 μm; omnes structurae non amyloideae, neque dextrinoideae, nec cyanophilae.

Typus: Cuba, provincia Oriente, montes Sierra de Nipe apud Mayarí; ad truncum iacentem putridum *Pini cubensis*, 13. III. 1967, leg. F. Kotlaba, in herbario Musei Nationalis Pragæ asservatur (holotypus: PRM 756464, isotypus PRM 879880).

Carpophores annual, resupinate, very thin, forming small irregular patches measuring mostly only 1.5 – 7 x 0.6 – 1.7 cm, which are whitish to cream. Tubes are very short, merely 0.3 – 1.5 mm long, thin-walled, with entire edges, under strong magnification finely ciliate. Pores are very small, 6 – 8 per 1 mm, rounded or at some places also angulate rounded. Subiculum is extremelly thin, cottony, nearly imperceptible, forming a very narrow sterile margin. The white woolly mycelium penetrates the fissures in the rotten wood.

Hyphal system is dimitic, formed by generative and skeletal hyphae. Generative hyphae are thin-walled, hyaline, branched, clamped, 2 – 4 μm wide; skeletal hyphae are unbranched, thick-walled, in the subiculum often branched, 2 – 4 μm thick; both hyphae are inamyloid and indextrinoid, but KOH solution causes an inward thickening of the skeletal hyphal wall. The hymenium is formed by basidia and numerous cystidioles. Basidia are broadly clavate, tetrasporic, with basal clamps, 10 – 18 x 5 – 6.5 μm. Cystidioles with basal clamps, slender fusiform with the apices sometimes sharp pointed, 8 – 18 x 4 – 5.5 μm. Spores are hyaline, smooth, thin-walled, cylindrical and slightly bent, inamyloid and indextrinoid, 4.5 – 6.5 x 1.5 – 2.2 μm. Collapsing spores are often strikingly wedge-shaped, narrowing to one end.
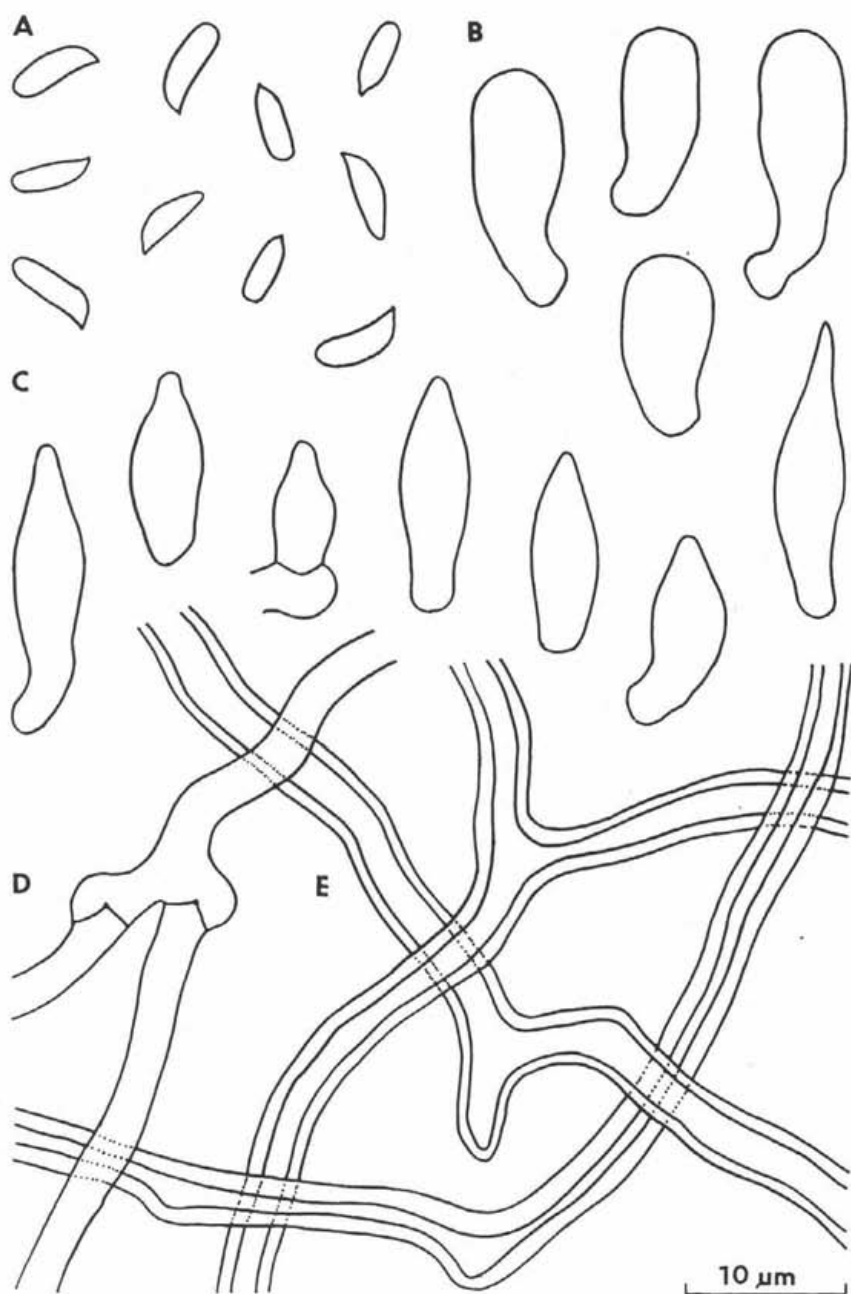
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Fig. 1. *Antrodia pini-cubensis* Vampola, Kotl. et Pouzar.
A) spores, B) basidia, C) cystidiols, D) generative hyphae, E) skeletal hyphae.

Del. P. Vampola

Locality: Cuba, north part of the province Oriente, in the Sierra de Nipe, SW of Mayarí (SE of Holguín), ca 500 m alt., on a fallen trunk of *Pinus cubensis*, 13. III. 1967, leg. F. Kotlaba (PRM 756464, 879880).

In the genus *Antrodia* s. l., there exist several resupinate species, which are either macro- or microscopically similar and may be mistaken for *A. pini-cubensis*.

Antrodia oleracea (Davids. et Lomb.) Ryv. grows on dead wood of frondose trees, especially oaks (it is unknown on conifers), and differs macroscopically by somewhat thicker carpophores with larger pores. Substantial differences, however, are present in the microstructure. The tubulotrama of *A. pini-cubensis* is dimitic with abundant thick-walled skeletal hyphae, whereas the tubulotrama of *A. oleracea* is monomitic and skeletal hyphae can only rarely be found and solely in the subiculum. The shape of the spores of both species is also different with those of *A. pini-cubensis* strikingly slender.

Macroscopically somewhat similar is *Amyloporia sordida* (Ryv. et Gilberts.) Vampola et Pouzar. This species, however, forms perennial stratified carpophores of a darker colour and its skeletal hyphae wholly dissolve in a solution of KOH.

Macroscopically very similar is *Antrodia albobrunnea* (Rom.) Ryv. but it differs microscopically by the presence of very striking brown generative hyphae in the subiculum.

Antrodia infirma Renvall et Niemelä (1992), recently described from Finland, is also somewhat similar. However, we have studied a specimen of this species and it is obvious that it differs by the somewhat larger spores and the structure of the subiculum and trama, where the skeletal hyphae are very rare.

In spite of the fact that *A. pini-cubensis* has until now only been found in Cuba, it occurs possibly in other countries too and, besides *Pinus cubensis*, perhaps also on further hosts, especially conifers. When collecting and studying resupinate polypores from the tropics and subtropics, *Antrodia pini-cubensis* should be taken in consideration.

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Type specimens of fungi
held in the Herbarium of the Slovak National Museum (BRA), Bratislava, Slovakia

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Lizoň P. (1994): Type specimens of fungi held in the Herbarium of the Slovak National Museum (BRA), Bratislava. Slovakia. – Czech Mycol. 47: 193–198

The fungus type collection held in the Slovak National Museum in Bratislava, Slovak Republic. contains 78 designated specimens.

Key words: Fungi, type specimens, BRA.

Lizoň P. (1994): Nomenklatorické typy húb v zbierkach Slovenského národného múzea (BRA), Bratislava, Slovensko. – Czech Mycol. 47: 193–198

Typová zbierka húb Slovenského národného múzea v Bratislave, Slovenská republika, zahrnuje 78 označených položiek.

The Herbarium of the Slovak National Museum (Department of Botany, Museum of Natural History) in Bratislava, Slovak Republic, was founded in 1924 and now includes about 70,000 specimens of fungi and myxomycetes (Lizoň 1983, Hradílek, Lizoň et Tlusták 1992). Numerous collectors have contributed collections to the fungus herbarium and the largest one (25,000 specimens) was donated to the Museum (Lizoň 1973) by Andrej Kmeť (1841–1908). His collections were studied by Giacomo Bresadola (1897), Domenico Saccardo (1896) and Pier Andrea Saccardo (1897) in the past and by numerous mycologists in the most recent years. Bresadola also studied some of Victor Greschik's (1862–1946) collections that are maintained at BRA too. A part of the collections of Carl Kalchbrenner (1807–1886), author of more than 400 new fungal taxa (Lizoň 1993), discovered in the town of Spišská Nová Ves, North Slovakia in the 1960's, contains 2,800 specimens of fungi. Collections of two other European mycologists, Johannes Andreas Bäumler (1847–1926) and Fridrich Hazslinszky (1818–1896), have been maintained at BP in Budapest and at SLO in Bratislava, respectively, and only a few of their specimens are to be found in BRA.

It is likely that several duplicates of type and authentic specimens, which are not now designated and are not listed here, have been incorporated in BRA and could be chosen as neotypes.

LIST OF TYPE SPECIMENS[1])

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[1]) If they are any doubts "type" of the type specimen is in parentheses.

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Galactinia moravecii Svrček, Čes. Mykol. 22: 90, 1968. ISOTYPE: Czech Republic (holotype in PRM).

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Melastiza flavida K. S. Thind & S. C. Kaushal, Bot. Notis. 132: 459, 1979. ISOTYPE: India (holotype in PAN).

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A handful of Aphyllophorales collected in Greece

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Kotlaba F. and Klán J. (1994): A handful of Aphyllophorales collected in Greece. – Czech
Mycol. 47: 199–206

26 species of Aphyllophorales collected by the authors in Greece, some new for that country,
are listed with rare or less abundant fungi represented by Inonotus rickii, Perenniporia tenuis,
Porotheleum fimbriatum and Vuilleminia coryli. Some of common species were also found on
unusual hosts, as e.g. Bjerkandera adusta and Trametes versicolor on Acacia retinodes, Lætiporus
sulphureus on Eucalyptus camaldulensis and Radulomyces confluens on Anagyris fœtida. The
rather rare Perenniporia tenuis was found on Bougainvillea glabra, Phlomis fruticosa and on Vitis
vinifera, whereas Vuilleminia coryli on Carpinus orientalis. For major part of these fungi represent
new records of hosts.

Key words: Aphyllophorales, host plants, Greece

Kotlaba F. a Klán J.: Přehršle nelupenatých hub sbíraných v Řecku. – Czech Mycol. 47:
199–206

Je uvedeno 26 druhů nelupenatých hub, které sbírali autoři v Řecku, přičemž některé z nich
jsou nové pro tuto zemi. Vzácné nebo méně hojné druhy představují Inonotus rickii, Perenniporia
tenuis, Porotheleum fimbriatum a Vuilleminia coryli. Některé z běžných druhů byly nalezeny na
neobyčejných hostitelích, jako např. Bjerkandera adusta a Trametes versicolor na Acacia retinodes,
Lætiporus sulphureus na Eucalyptus camaldulensis a Radulomyces confluens na Anagyris fœtida.
Vzácnější Perenniporia tenuis byla sbírána na Bougainvillea glabra, Phlomis fruticosa a Vitis
vinifera, zatímco Vuilleminia coryli na Carpinus orientalis. Pro většinu těchto hub představují
nové hostitele.

Due to the brevity of the touristic trips (J. K. 7. – 23. 7. 1975, F. K. 31. 5. – 6. 6.
1993) only a few species were collected with fungi belonging to the Aphyllophorales
published here. Some are new for the Greek mycoflora, the others are less rare
or even abundant, but some of them were found on quite unusual host trees or
shrubs, which are not recorded in the literature. All species listed in the paper
are represented by specimens in the herbaria of the Mycological Department of
the National Museum in Prague (PRM). For the identification or revision of some
species, we are thankful to Dr. Z. Pouzar, Head of the Department. Our names
are abbreviate to the initiales F. K. and J. K. whilst the small nuber of collected
species are arranged alphabetically (not systematically). The bibliographic work of
Pantidou (1973) is relied upon for the older mycological literature.

Bjerkandera adusta (Willd.: Fr.) P. Karst.

Náfplio (Nauplion),in the eastern part of the Peloponnese Peninsula (Peloponesos), c.15 m alt., in the town park in a wounded living trunk on *Acacia retinodes*, 2. VI. 1993, leg. et det. F.K. (PRM 878595).

A common polypore in most European countries on various hosts recorded here for the uncommon host tree and once previously reported from Greece by Pantidou (1973) as well as by Minter (1988).

Dichomitus campestris (Quél.) Domań. et Orlić

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead *Quercus* sp. branch, 9. VII. 1975, leg. et det. J. K. (PRM 879509).

A rather rare polypore occurring in many European countries, but mostly in warmer areas. In Greece, it is cited by Plank (1980) solely from Crete and by Minter (1988) from Meteora and Mt. Olympos (Olympus).

Ganoderma adspersum (S. Schulz.) Donk   Photo 1

Litochorion under Mt. Olympos (Olympus), c. 240 m alt., on the living trunk of *Morus alba*, 20. VII. 1975, leg. J.K., det. Z. Pouzar (PRM 874171); Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 15 m alt., in the town park on a stump of *Ligustrum lucidum* ?, 2. VI. 1993, leg. et det. F. K. (PRM 878596).

In southern and western Europe a rather abundant parasitic synanthropic fungus, harmful to trees and shrubs (especially of foreign origin). If the arboraceous *Ligustrum lucidum* was, on the basis of a stump, correctly identified, this will be a previously unknown host for *Ganoderma adspersum*. Pantidou (1973) cites it as *G. australe* on *Abies cephalonica* as well as Diamandis et Minter (1981).

Ganoderma lucidum (Leyss.: Fr.) P. Karst.

Olimbia (Olympia) near Pírgos (Pyrgo) in the western part of the Peloponnese Peninsula, c. 90 m alt., on the base of a living trunk of *Populus nigra*, 5. VI. 1993, leg. J. Košťál, det. F. K. (PRM 878616).

In Greece, evidently rather common, as reporetd by Pantidou (1973), according to literature, on several hosts but not on *Populus nigra*.

Ganoderma resinaceum Boud. in Pat.

In a dry creek bed (a tributary of the river Alpheios) NE of the village Karkalou, about 40 km NW of Trípoli (Tripolis) in the centre of the Peloponnese Peninsula, c. 800 m alt., on a *Salix* sp.

In Greece probably a rare species as Pantidou (1973) cites it from only a single literature source (as *Ganoderma lucidum* var. *resinaceum*).

Glœophyllum abietinum (Bull.: Fr.) P. Karst.

Hydra (Idra), an island lying NE of the Peloponnese Peninsula, cemetery above the small town Hydra, c. 300 m alt., on a rotten stump of *Cupressus sempervirens*, 1. VII. 1993, leg. L. et F. K., det. F. K. (PRM 878613).

In Greece, and elsewhere in Mediterranean, not rare polypore and growing rather often also on cypress (see Pantidou 1973, Plank 1980). It is considered by Plank (1980: 251) as a boreal species but this is not correct.

Hapalopilus rutilans (Pers.: Fr.) P. Karst.

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead *Quercus* sp. branch, 9. VII. 1975, leg. et det. J. K. (PRM 879520).

In Greece, a perhaps less abundant polypore. Pantidou (1973) does not report it from this country but Diamandis et Minter (1980) and Minter (1988) report it from Greece. In most European countries it is a common species.

Hymenochæte rubiginosa (Dicks.: Fr.) Lév.

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on the base of a dead *Quercus* sp. branch, 9. VII. 1975, leg. et det. J. K. (PRM 879505).

Pantidou (1973) does not mention this species from Greece although it is present in most European countries (it occurs especially in warmer areas on stumps or fallen trunks of oaks).

Hyphodontia quercina (Pers.: Fr.) J. Erikss.

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on the base of a dead *Quercus* sp. branch, 9. VII. 1975, leg. J. K., det. 4. 11. 1993 Z. Pouzar (PRM 879506).

Rather common hydnoid corticium in most European countries, but from Greece (Mt. Ossa, Panagios Monaster) recorded only by Minter (1988).

Inonotus rickii (Pat.) Reid

Iráklion (Eraclion), Crete, c. 15 m alt., in a town park on the living trunk of *Sambucus nigra*, 14. VII. 1975, leg. J. K., det. 6. 9. 1993. K. et Z. Pouzar (PRM 878625).

The most rare find in Greece (fourth locality in Europe) and for the first time on *Sambucus nigra* (see Kotlaba et Pouzar 1993).

Inonotus tamaricis (Pat.) R. Maire   Photo 2

Agia Triás, a spa 25 km of Thessaloniki (Salonica), N Greece, c. 5 m alt., on the trunk of a living *Tamarix* sp., 7. VII. 1975, leg. et det. J. K. (PRM 756258); Spétses (Spetsai), an island lying SE of the Peloponese Peninsula, ca 3 m alt., on an embankment of the small town Spétses on a living trunk of *Tamarix gallica*, 1. VI. 1993, leg. et det. F. K. (PRM 878603).

This parasitic polypore, with a granular core in the carpophore, is restricted to species of the genus *Tamarix* growing on the sea-coast (not on tamarisks planted inland). Uncommon in Greece, where it is known from only a few localities (see Pantidou 1973, Plank 1980, Klán 1978 – with a distribution map for the Mediterranean).

Lætiphorus sulphureus (Bull.: Fr.) Murill

Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 15 m alt., in front of the barracks, on the trunk of a living *Eucalyptus camaldulensis*, 2. VI. 1993, leg. et det. F.K. (PRM 878601).

A common polypore known on many host trees in Greece (see Pantidou 1973) as well as elsewhere, but so far in Europe most probably not on *Eucalyptus*.

Perenniporia tenuis (Schw.) Ryv.   Photo 3

In Tólo (Tolon), a small town near Náfplion (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 30 m alt., on a dead branch of *Vitis vinifera* in the yard of a house, 31. V. 1993, leg. et det. F. K. (PRM 878618), in the same town on a thin dead trunk of the lianian *Bougainvillea glabra* on a house wall, 4. VI. 1993, leg. et det. F. K. (PRM 878594); Hydra (Ídra), an island lying SE of the Peloponnese Peninsula, beneath the cementary above the small town Hydra, c. 120 m alt., on the base of a dead *Phlomis fruticosa*, 1. VI. 1993, leg. et det. F. K. (PRM878611).

A less abundant polypore, not found to be published from Greece although it is not absent in warmer areas of many European countries. The Greek collections were on three very interesting hosts, which have not been previously reported for this polypore in the literature.

Phellinus ferruginosus (Schrad.: Fr.) Pat.

Vicinity of Tsepélobon, N of Ionánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead *Quercus* sp. trunk, 9. VII. 1975, leg. et det. J. K. (PRM 879507, 879522).

It is rather common in the warmer parts of most European countries but, surprisingly, not previoussly reported from Greece; probably new for the Greek mycoflora.

Phellinus pini (Brot.: Fr.) A. Ames

Olimbia (Olympia) near Pírgos (Pyrgo) in western part of the Peloponnese Peninsula, c. 90 m alt.,on the trunk of a living *Pinus halepensis*, 12. VII. 1975, leg. et det. J. K.(PRM 879530), with the same locality and host, 5. VI. 1993, leg. J. Košťál, det. F. K. (PRM 878602); Asclepion near Epídavros (Epidaurus) in the north–eastern part of the Peloponnese peninsula, c. 90 m alt., on the trunk of a living *Pinus halepensis*, 3. VI. 1993, leg. et det. F. K. (PRM 878610); Athinai (Athens), SE Greece, in the park at the foot of Acropolis, c. 120 m alt., on the trunk of living *Pinus halepensis*, 6. VI. 1993, leg. et det. F. K. (PRM 878590).

In Greece (see Pantidou 1973) and elsewhere in the Mediterranean, a common and, at the same time, a remarkable parasite fungus of the Mediterranean Allepo Pine. In central and northern Europe it parasitizes mostly *Pinus sylvestris* and *P. rotundata (= P. uliginosa)*.

Phellinus punctatus (P. Karst.) Pilát

Above the small town Toló (Tolon), near Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 50 m alt., on the base of a living *Olea europæa*, 4. VI. 1993, leg. F. K., det. F. K. et Z. Pouzar (PRM 878608).

This fungus (rather common in most European countries) seems to be not so abundant in Greece as it is cited from this country only by Plank (1980) from Rhodos on *Ulmus* sp. at 700 m alt., and from Crete on olive-tree; in this collection, Plank found the typical hymenial setae, so that it was evidently the Mediterranean species *Phellinus pseudopunctatus* David, Dequatre et Fiasson 1982, which was at that time (1980) not yet described.

Phellinus tuberculosus (Baumg.) Niemelä

On slopes of Mt. Olympos (Olympus) near Kateríni (Katheriné) in N Greece, c. 1000 m alt., on *Prunus domestica* subsp. *insititia*, 23. VII. 1975, leg. et det. J. K. (PRM879517); Hydra (Ídra), an island lying SE of the Peloponnese Peninsula, in the cemetery above the small town Hydra, c. 130 m alt., on the trunk of living *Amygdalus communis*, 1. VI. 1993, leg. et det. F. K. (PRM 878619); Spétses (Spetsai), an island lying SE of the Peloponnese Peninsula, in the small town Spétses, c. 12 m alt., on the trunk of a living *Prunus domestica* subsp. *italica*, 1. VI. 1993, leg. et det. F. K. (field note-book); Mykénai (Mykens) N of Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 140 m alt., at the parking-place beneath the ruins, on the trunk of a dead *Amygdalus communis*, 3. VI. 1993, leg. et det. F. K. (PRM 878623).

A very common species which is known in the older literature as *Phellinus pomaceus* or *P. igniarius* subsp. *pomaceus*. It parasitizes especially various cultivated stone-fruit trees, in the Mediterranean chiefly almond-trees; in Greece, it is very abundant (see Pantidou 1973) as well as in most other European countries.

Polyporus arcularius (Batsch): Fr.

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead *Quercus* sp. branch, 9. VII. 1975, leg. et det. J. K. (PRM 879512).

In all warmer parts of Europe and also in Greece (see Pantidou 1973), a not rare polypore.

Polyporus varius (Pers.): Fr.

On slopes of Mt. Olympos (Olympus) near Kateríni (Katheriné), N Greece, c. 1800 m alt., on a fallen branch of *Fagus sylvatica*, 22. VII. 1975 (PRM 879532), and on wood of the same tree, 23. VII. 1975 (PRM 879510), leg. et det. J. K.

Not only in many European countries but surely also in Greece not missing polypore in spite of the fact that it is not mentioned in the literature from this country (perhaps new for the Greek mycoflora).

Porotheleum fimbriatum (Pers.) Fr.   Photo 4

On slopes of Mt. Olympos (Olympus) near Kateríni (Katheriné), N Greece, c. 1400 m alt., on a fallen branch of *Fagus sylvatica*, 2. VII. 1975, leg. J. K., det. 7. 10. 1993 F. K. et Z. Pouzar (PRM879502).

An interesting, not abundant resupinate fungus which is usually classified in the family Cyphellaceæ or even Polyporaceæ (it resembles pore fungus), but evidently

belongs to the independent family Porotheleaceæ Murrill 1916. A new species for the Greek mycoflora. *Porotheleum fimbriatum* is known from many European countries such as Austria, Czechoslovakia (Czech as well as Slovak Republic), France, Germany, Great Britain, Luxembourg, Portugal, Russia, Sweden, Switzerland (Cooke 1975) but also from Estonia, Italy, Norway, Poland, Ukraine etc.; it is most common in the Carpathians. In the literature it is known also as *Stromatoscypha fimbriatum* (Pers.: Fr.) Donk; the correct name, however, is *Porotheleum fimbriatum.* Donk (1959) gave reasons for correctness (at that time) of the name *Stromatoscypha*, but the nomenclatural starting point of mycological literature was changed in 1981 from 1821 to 1753. *Porotheleum* Fr. 1818 now has priority against the lichen genus *Porothelium* Eschw. 1824 (and so of course also *Stromatoscypha* Donk 1951).

Radulomyces confluens (Fr.: Fr.) Christ.

On Romvi (Rómdi), a small island lying SE of the small town Tólo (Tolon) near Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 20 m alt., on a dead branch of *Anagyris fœtida*, 4. VI. 1993, leg. F. K., det. Z. Pouzar (PRM 878624).

A rather common corticoid fungus in Europe (especially in warmer areas) which, however, was reported only once from Greece (Minter 1988). The Mediterranean shrub *Anagyris fœtida* (Fabaceæ) evidently represents a new host for this fungus.

Schizophyllum commune Fr.: Fr.

Olimbia (Olympia) near Pírgos (Pyrgos) in the western part of the Peloponnese Peninsula, c. 90 m alt., on the bark of a living trunk of *Populus alba*, 5. VI. 1993, leg. J. Košťál, det. F. K. (PRM 878588).

A common fungus growing on a number of hosts, also in Greece (see Pantidou 1973, Minter 1988).

Stereum hirsutum (Willd.: Fr.) Pers.

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead branch of *Quercus frainetto*, 9. VII. 1975, leg. et det. J. K. (PRM 879513); Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 15 m alt., in the town park on a stump of *Ligustrum lucidum* ?, 2. VI. 1993, leg. et det. F. K. (PRM 878599).

A common fungus on many broadleaved trees and shrubs in Europe, also in Greece (see Pantidou 1973, Minter 1988).

Trametes unicolor (Bull.: Fr.) Pilát

Slopes of Mt. Olympos (Olympus) near Kateríni (Katheriné), N Greece, c. 1000 m alt., on a dead branch of *Fagus sylvatica*, 22. VII. 1975, leg. J. K., det. 7. 10. 1993 F. K. et Z. Pouzar (PRM 879519).

In most European countries, a rather common polypore; in Greece, however, it is perhaps uncommon (see Pántidou 1973, Minter 1988).

Fig. 1 *Ganoderma adspersum.* Náfplio (Nauplion), S Greece, on a stump of *Ligustrum lucidum?,* 2. VI. 1993.

Photo F. Kotlaba

Fig. 2 *Inonotus tamaricis.* Spétses (Spetsai) Island, S greece, on the trunk of a living *Tamarix gallica,* 1. VI. 1993.

Photo F. Kotlaba

Fig. 3 *Perenniporia tenuis.* Hydra (Ídra)
Island, S Greece, on the base of a dead *Phlomis
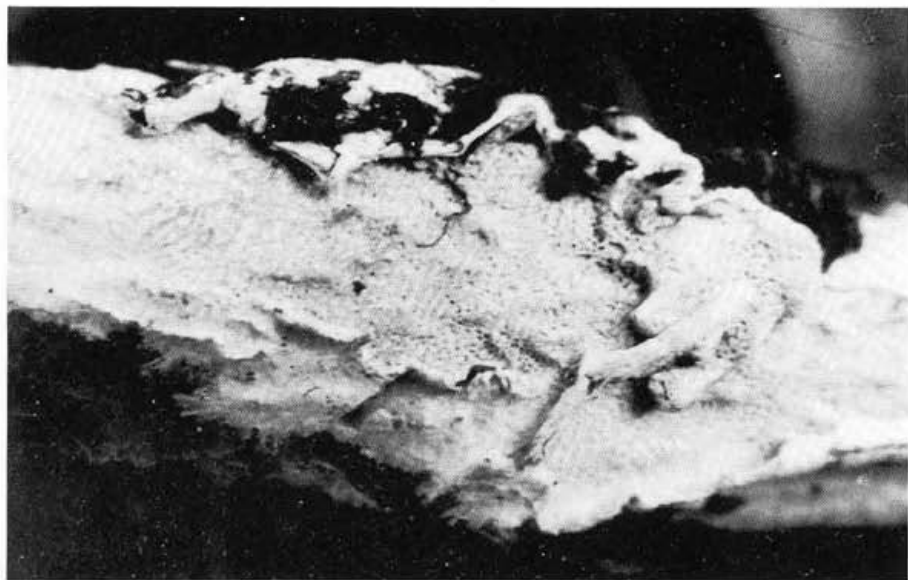fruticosa*, 12. VI. 1993.

Photo F. Kotlaba

Fig. 4 *Porotheleum fimbriatum.* Mt. Olym-
pos (Olympus), N Greece, on a fallen branch
of *Fagus sylvatica*, 2. VII. 1975.

Photo J. Klán

Trametes versicolor (L.: Fr.) Pilát

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead *Quercus* sp. branch, 9. VII. 1975, leg. J. K., det. 7. 10. 1993 F. K. et Z. Pouzar (PRM 879508); Náfplio (Nauplion) in the eastern part of the Peloponnese Peninsula, c. 15 m alt., in a town park on the wounded trunk of a living *Acacia retinodes*, 2. VI. 1993, leg. et det. F. K. (PRM 878615).

A quite common polypore which, in the case of *Acacia retinodes*, grew on an uncommon host.

Vuilleminia coryli Boid., Lanq. et Gilles

Vicinity of Tsepélobon, N of Ioánnina, NW part of the Pindos mountain range, c. 1000 m alt., on a dead branch of *Carpinus orientalis*, 9. VII. 1975, leg. J. K., det. 7. 10. 1993 F. K. et Z. Pouzar (PRM 879514).

A rather rare species of corticoid fungi, new for the mycoflora of Greece. Its geographical distribution is not known because it was not described until 1989. For the time being it is safely known from France (Boidin et al. 1983), the Czech and Slovak Republics (Kotlaba et Pouzar) 1993), Sweden, Finland, Estonia and Latvia (Kotiranta et Saarenoksa 1993) but it surely occurs also in other European countries. Its most common host is *Corylus avellana* and till now it has been published only twice on *Acer campestre*. The find of *Vuilleminia coryli* in Greece on *Carpinus orientalis* is the first known on this host tree.

Acknowledgements

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Book review

NARRENSCHWÄMME. Psychotrope Pilze in Europa.
Herausforderung an Forschung und Wertsystem. By JOCHEN GARTZ.
Editions Heuwinkel, Schweiz, 1993. 136 pages, 78 illustrations, Sfr. 87.

Jochen Gartz, born in 1953, is a chemist and mycologist in Leipzig (Germany) and has now published a valuable multi-disciplinary book psilocybin-containing mushrooms.

The title "Narrenschwämme" (fools mushrooms) is an old German name for psychoactive mushroms and testifying to an ancient familiarity with this fascinating mushrooms in the German speaking world and elsewhere in Europe. About 20 years ago he begun his study about indolic derivatives in higher fungi (Agaricales).

In his book he included the results of many field trips, isolation of various mycelia of psilocybian species and cultivation of many mushrooms as well as innumerable analysis with the most modern analytical techniques. In "Narrenschwämme" you can also find many well written self experiments of some scientists with the mushrooms. So the reader will get a whole view into the strange world of the "magic mushrooms". A main wish of the author is that psychotropic alkaloids of the mushrooms will find their way into psychiatry and psychotherapy again.

The text is well legible and the pictures are in black and white or coloured. Most mushroom pictures are good colour plates (tipped–in) and the cultivated fruit bodies have a green, red or black backgroumd. The reproduction af the slides with red background causes a somewhat unnatural appearance.

There are ten chapter in the book. In the first chapter the author explains why he wrote his book. Then he surveying his territoy briefly including some old historical signs of the knowledge of such mushrooms even in Europe in a second chapter.

After this Gartz commences with a chapter on all important psychotropic mushrooms of Europe with *Psilocybe semilanceata, Psilocybe cyanescens, Panaeolus subbalteatus, Inocybe aeruginascens, Gymnopilus purpuratus, Conocybe cyanopus* and *Pluteus salicinus*. There are good colour plates of all except *C. cyanopus* which is very rare but he includes a photo of cultivated sclerotium of this species. For the first time in literature there is a comparison of these species in the fields of occurence, distribution, substratum, frequency and fruiting time as well as in their content of alkaloids psilocybin, psilocin, baeocystin and other metabolites. In a short chapter the author mentions some dangerous possibilities of confusion of psilocybian species with deadly mushrooms of the genera *Galerina* and *Inocybe*. Some fatalities of such mechanism occurred in the USA. Another short chapter describes an important feature of the psilocybian mushrooms: the blueing of mycelia and fruit bodies in many species.

In the sixth chapter there is a extensive description of some principal cultivation parameters of saprophytic species in general following by the results of the cultivation of the "magic mushrooms" in Mexico. New and important results are the description of the cultivation of European species like *Psilocybe semilanceata* and *Gymnopilus purpuratus* and the finding that complete reproduction barriers have been found between strains of collections of *Psilocybe bohemica* and *Psilocybe cyanescens* (USA) which did not form dikaryons (In contrast to the comparison of Krieglsteiner who used only microscopic features). It seems clearly that the collections from Europe and America are autonomous species with a similar habitat as wood chips and humus sharing but a different genetic heritage.

In the large seventh chapter (pages 83-114) Gartz writes about the occurence of psychotropic mushrooms in North, Middle and South America, Asia, Australia, Africa, Hawaii, Europe and some oceanic islands. It is admirable how many facts he has found in relation to old and recent intoxications from all over the world.

Both following chapters are specially important for people who work in medicine and particulary in psychiatry. The alkaloids of these mushrooms are only minor toxic but have a strong psychoactivity even in amounts of a few milligrams.

In the last chapter Gartz bemoans the legal restrictions which have closed the door for using this promising aid to psychotherapy and expresses the hope for reclassify these drugs as experimental medicines like in the early sixties. We also need more knowledge of distribution, taxonomy and secondary metabolites of hallucinogenic species in Europe and even in the world.

There are 224 references in this book from the field of medicine up to pure mycological literature.

Gartz thinks that only by reopening the doors to thorough research of these substances can we guarantee that the mushrooms what the Germans call the "fools mushrooms" don't end up making fools of us all.

I share his confidence.

Marta Semerdžieva

Trametites eocenicus, a new fossil polypore from the Bohemian Eocene

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Knobloch E. and Kotlaba F. (1994): Trametites eocenicus, a new fossil polypore from the Bohemian Eocene. – Czech Mycol. 47: 207–214

Trametites eocenicus Knobloch et Kotl. (Polyporaceæ) from Radvanov, the Staré Sedlo Formation (Lower Tertiary, Upper Eocene) in W Bohemia (Czech Republic) is described. This fossil lignicolous polypore grew most probably in a subtropical forest formed of broad-leaved evergreen angiospermous plants.

Key words: Trametites eocenicus, fossil polypore, Upper Eocene, Bohemia, Czech Republic.

Knobloch E. a Kotlaba F. (1994): Trametites eocenicus, nový fosilní choroš z českého eocénu. – Czech Mycol. 47: 207–214

Je popsán druh Trametites eocenicus Knobloch et Kotl. (Polyporaceæ) ze starosedelského souvrství (starší terciér, svrchní eocén) z Radvanova v z. Čechách. Tento fosilní choroš rostl s největší pravděpodobností v subtropickém vždyzeleném lese tvořeném širokolistými krytosemennými rostlinami.

INTRODUCTION

Proofs of fossil fungi are of various kinds. Primarily are the results of the destructive activity of fungi on wood (see e. g. Hartig 1878, 1894), then fossil spores, of which it is mostly unknown as to which genera and species of recent fungi belong (see e. g. Elsik et al. 1990, Ethridge Glaas et al. 1987), and, finally, impressions of carpophores or, also, their remains. Only with fossil fungi with perennial or, at least, hard leathery carpophores from the Tertiary, and especially the Quaternary, it is possible to state more exactly to which genera or even species they belong (see e. g. Gennard, Hackley 1989, Hübsch 1974, Killermann 1938, Kreisel 1957, 1977, Skirgiello 1961, Straus 1952 a,b), and only in such cases where the context of carpophore, spores or other microstructures have been preserved. Modern mycological methods for recent fungi cannot work in fact without the microscopical study of carpophores, and is much more difficult with fossil fungi.

In most fossil fungi of the Tertiary age, carpohores are usually not preserved and, therefore, it is impossible to identify them to any recent fungal genera with certainty, as we have at our disposal solely their impressions in the rock. For this reason, it is best to accomodate them in special genera with the modified names of those recent fungal genera, which they resemble. In our case, the impression closely

resembles some species of the genus *Trametes* Fr. (sensu lato) and so the fossil genus at our disposal is *Trametites* Straus, and under which we describe our fossil polypore as a new species.

DESCRIPTION OF THE NEW SPECIES

Trametites eocenicus Knobloch et Kotlaba, spec. nov.

Carpophores bracket-like, imbricate, with a rather thin, semiorbicular pilei 6.5 x 7.5 cm, rounded margins; upper surface of the pilei slightly zoned and remarkably radiatelly fibrous to faintly sulcate. Pores or other macro-, as well as micro-, features, are not known.

Holotype from Radvanov is preserved in the Paleontological Department of the National Museum, Prague, no. G 6508 (see fig. 1, 2), 1986, leg. E. Knobloch.

Type locality: Radvanov near Sokolov, W Bohemia (Czech Republic), light yellow, soft sandstone of the Staré Sedlo Formation, Upper Eocene, Lower Tertiary.

Fig. 1 *Trametites eocenicus* Knobloch et Kotl. – upper view of the pileus surface.
Photo by H. Vršťalová

Fig. 2 *Trametites eocenicus* Knobloch et Kotl. – semilateral view.
Photo by H. Vršťalová

DISCUSSION

We are only able to describe relatively few macromorphological features for this new fossil polypore as we have at our disposal only an impression in the sandstone. For this reason, we do not know if this fungus had pores (round, elongated, labyrinthic, small or large etc.) on the lower part of the pileus, or if the hymenophore was even lamellate (as it is e. g. in the species of the genus *Lenzites* Fr.). The most similar to our impression from Radvanov are some species of the recent genus *Trametes* Fr. in the broad sense (but other genera cannot be completely excluded).

The generic name *Trametites* was initially published by A. Meschinelli in Saccardo's Sylloge fungorum 10: 97, 1892 (Sylloge fungorum fossilium). There is, however, no generic description and so the name *Trametites* Meschinelli (as it is sometimes cited) was not validly published from the nomenclatural point of view – it is, therefore, a so-called "nomen nudum" (moreover Fr. is given as the author of the genus *Trametites* although Fries only described the recent genus of polypores, and, in addition, as *Trametes* and not *Trametites*). Nomeclaturally, the fossil genus *Trametites* was validly published only in 1950 by A. Straus (see Zijlstra in Farr et al. 1986), when he described the fossil polypore *Trametites undulatus* (with a so-called "descriptio generico-specifica").

Trametites eocenicus is the first and only known fossil Tertiary polypore found in the Czech Republic. Other fungal finds from the Staré Sedlo Formation belong mostly to rusts (Uredinales) which parasitized leaves of angiosperms and are well preserved as impressions in fine Tertiary sandstone.

It is clear that pore-fungi, having perennial carpohores of woody or hard leathery consistency, were rather suitable for preservation in sediments – more often in the Quaternary than in Tertiary sediments; however, pore-fungi having annual, soft fleshy carpophores could not be preserved and would therefore disappear, most probably during several weeks, or at least months, after their development.

Hübsch (1974) described from the Older Quaternary, at Ehringsdorf in E Germany, a new fossil polypore *Trametes ehringsdorfensis* Hübsch and another find, which he assigned to cf. *Trametes confragosa* var. *tricolor* (Bull. : Fr.) Pilát. The last named fungus is considered in recent mycology by some mycologists to be an independent species, *Dædaleopsis tricolor* (Bull.: Fr.) Bond. et Sing.; it is characterized by the dark colours of the zonated pileus and the lamellate hymenophore. All finds from Ehringsdorf had very distinct lamellae on the lower part of the pilei. Kreisel (1977) considered all these fossils as belonging to the recent species *Lenzites warnieri* Dur. et Mont. The impressions of fossil polypores from travertine – Ehringsdorf near Weimar in Germany and, also, from Öcseny in Hungary (see Kreisel 1977, Taf. 57, fig. a, Taf. 58, fig. a) – have really well preserved lamellate hymenophores.

GEOLOGICAL SETTING

Southwest of the village Radvanov, near the town Sokolov (formerly Falknov, Falkenau), a profile in the Staré Sedlo beds was open for a short time in July 1986. The Staré Sedlo Formation was developed in a very typical development known from the locality "Na pískách" close to Radvanov (for details see Knobloch 1963). Plant impresions were present in the soft yellow sandstones, although the leaves were mostly fragmentary and thus not well preserved. Besides sandstones, white

Kaolin clays and coarse-grained conglomerates with rounded pebbles (quartz), also occur in these sites.

Fig. 3   Map of the part of Central Europe showing the location of Radvanov in W. Bohemia, the type locality of *Trametites eocenicus.*

THE FOSSIL FLORA OF THE STARÉ SEDLO FORMATION

The fossil flora of the Staré Sedlo Formation is known since the time of Rossmässler (1840); a summary of the further investigations and some principal information about the fossil flora is given by Knobloch (1963, 1990a). The flora of the Staré Sedlo Formation is dominated by two evergreen angiospermous elements, i. e. *Eotrigonobalanus furcinervis* (Rossm.) Walter et Kvaček (Fagaceæ) and *Daphnogene cinnamomea (*Rossm.) Knobloch (Lauraceæ). The physiognomy of the vegetation corresponds to the broad-leaved evergreen subtropical forests characterized by those species having thick, coriaceous leaves with an entire margin (the systematic position of many of them is unknown). These types of leaves, taken together with the exactly identified species, indicate therefore a most probable a subtropical, perhaps rather wet climate.

Ferns are very rare in these sediments and gymnosperms are represented by pines (several species are known only by needles and cones) and by representatives of the family Taxodiaceæ (cf. *Taxodium, Glyptostrobus, Sequoia*).

The angiosperm leaves mostly belong to the family Fagaceæ, Lauraceæ and Myrtaceæ. The genus *Mastixia, Sterculia,* palms and other important fossils are also present. Some leaves of deciduous trees or shrubs with rather ancient

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features are represented by species of the genus *Populus* – *P. leucophylla* (Rossm.) Knobloch et Kvaček and *Platanus* – *P. fraxinifolia* (Johnson et Gilmore) Walther. Angiospermous plants with a long history, known as *Steinhauera subglobosa* Presl (Altingiaceæ), as well as the extinct *Majanthemophyllum basinerve* (Rossm.) Knobloch and *M. petiolatum* Weber, are also present.

The question, as to which of these trees and shrubs was probably the host of *Trametites eocenicus* – and if this polypore was a parasite or a saprophytic – cannot, of course, be answered.

The sediments of the Staré Sedlo Formation are the oldest in the Tertiary of Bohemia. By comparision and reference to the investigational results of the Paleogene sediments in the former German Democratic Republic performed during the last 30 years, the Staré Sedlo Formation has been thought – since 1963 – to be the Upper Eocene (see Knobloch 1963). This suggestion is reinforced by the recent investigations of Mai, Walther (1985). The Upper Eocene is a time space in the older Tertiary of 35 – 38 million years B. C.

NOTES TO THE OCCURRENCE OF FOSSIL FUNGI

Among fossil fungi similar types as *Trametites eocenicus* are very rare. More often are found plant tissues partly destroyed by the mycelium of some fungus, and, most often, parasitic rust fungi on plant leaves, e. g. *Aecidium rhamni-tertiaria* Engelhardt, a rust which occurred on the leaves of *Trigonobalanopsis rhamnoides* (Rossm.) Kvaček et Walther.

Other evidence of fossil fungi are fungal spores and pyrenomycete perithecia, and on which special literature exists. Especially striking are the perithecia known as *Rosellinites areolatus* (Fres. et Meyer) Kirchh. (which are known also from the Bohemian Tertiary) and the perithecia of *Trematosphærites lignitum* (Heer) Meschinelli.

A taxonomic survey of fossil fungi can be found in Němejc (1959) and of the tertiary fungi in Brabenec (1909). Whereas the older works primarily treated species which parasitized leaves of angiosperms, recently published papers also mention perithecia, which are obtained by diluting samples in water (see e. g. Bůžek, Holý 1964, Gregor 1980). Some perithecia-like structures are known from the Cretaceous (see Knobloch 1971) as well as the Tertiary as *Cenococcum geophilum* Fr. (see e. g. Gregor 1980). The remains of fossil microfungi were also described from the brown-coal deposits of the Tertiary near Turów in W Poland by Skirgiełło (1961). Ascomycetes were represented by *Rosellinites congregatus* (Beck) Meschinelli, *Trematosphærites lignitum* (Heer) Meschinelli and *Meliola* ?, whereas the family Polyporaceæ is represented by some rather nice material which was identified as *Fomes* cf. *fomentarius* (L. : Fr.) Kickx. Except for *Meliola* ?, the other

species are present also in some other brown coal areas (see Bůžek, Holý 1964, Skirgiełło 1961).

Paleobotanists usually study higher, i. e. vascular, fossil plants and they devote less attention to the lower, i. e. non-vascular, plants, or they overlook them. One exception was the German paleobotanist and mycologist Adolf Straus who devoted himself to describing lower plants from Willershausen (Straus 1952a,b, 1956, 1992). He accumulated many fossil fungi which parasitized plant leaves and for which he provided new names. In fossil plants, as well as in fossil fungi, however, he overestimated the close relationship between the recent and fossil organisms, and this is also clear from the often designation of species by recent names (see Knobloch 1990b).

A special chapter on fossil fungi preserved in amber, of which 18 species belonging to 12 genera, are so far known to exist, are given by Czeczott (1961).

Acknowledgments

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The effect of the heat-stable and chloroform-extractable secondary metabolites of filamentous fungi on the respiratory tract cilia movement of one-day-old chickens in vitro

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Piecková E. and Jesenská Z. (1994): The effect of the heat-stable and chloroform-extractable secondary metabolites of filamentous fungi on the respiratory tract cilia movement of one-day-old chickens in vitro. – Czech Mycol. 47: 215–222

The ciliostatic activity of the heat– stable (100° C/10 min.) and chloroform-extractable metabolites of 63 strains of filamentous fungi – growing on the liquid medium – on tracheal cilia of one-day-old chickens in vitro was evaluated. Twenty two (34.9%) from the investigated strains produced ciliostatic metabolites, 4.7%, 7.9%, 3.1%, resp. 19.0% of the strains stopped the movement of cilia after 24, 48, 72, resp. 144 hours. The results are discussed in connection with chronic bronchitis of people working with moulded materials or living in moulded dwellings.

Key words: Fungi, cilia, trachea, chickens, metabolites, bronchitis

Piecková E. a Jesenská Z. (1994): Účinok termostabilných a chloroformom extrahovateľných sekundárnych metabolitov vláknitých húb na pohyb riasiniek respiračného traktu jednodňových kurčiat in vitro. – Czech Mycol. 47: 215–222

Sledovala sa ciliostatická aktivita termostabilných (100° C/l0 min.) a chloroformom extrahovateľných metabolitov 63 kmeňov vláknitých húb, rastúcich na tekutom médiu, na riasinkách priedušnice jednodňových kurčiat in vitro. Ciliostatické metabolity produkovalo 22 (34.9%) z vyšetrených kmeňov, 4.7%, 7.9%, 3.1% a 19.0% kmeňov zastavovalo pohyb riasiniek po 24, 48, 72 a 144 hodinách. Výsledky sa diskutujú v súvislosti s chronickými bronchitídami u ľudí, ktorí pracujú s plesnivými materiálmi, alebo ktorí žijú v plesnivých bytoch.

Children and adults living in the moist and moulded dwellings have health problems with the illnesses of respiratory tract (Platt et al. 1989, Summerbell et al. 1992). Chronic bronchitis is a part of the pathologic processes of some workers of textil factories (Awad-el-Karim et Onsa 1987, Engelberg et al. 1985, Holt 1987, Jaroš 1989, Kawamoto et al. 1987, Kennedy et al. 1987, Lu et al. 1987, Zuskin et al. 1991), in agriculture (Zejda et Dosman 1991) and in other employments. It is considered about the connection between filamentous micromycetes and the "sick building syndrome" or "building related illnesses" (Mishra et al. 1992) – the nonspecific respiratory complaints of uncertain aetiology.

There are many different germs of filamentous fungi or toxic metabolites of filamentous fungi in the working and home environment, intracellular mycotoxins in fungal propagules or extracellular mycotoxins in contaminated plant detritus and

dust. Aflatoxin B_1, ochratoxin A, zearalenone, secalonic acid D and deoxynivalenol were detected in the working and some trichothecenes in the dwelling environment (Croft et al. 1986, Hendry et Cole 1993, Jesenská 1993, Pasanen et al. 1993). It was proved that some mycotoxins have expresive ciliostatic effect on the cilia of the tracheal epithel of the one-day-old chickens in vitro (Jesenská et Bernát – in press, Nair et al. 1970, Cardeilhac et al. 1972).

The aim of our work was to study the ciliostatic effect of the secondary metabolites of the strains of the filamentous fungi, isolated from the samples of cotton, flax, straw and sorghum on the cilia of the one-day-old chickens in tracheal organ cultures in vitro. In this part of our work we studied the ciliostatic activity of the heat-stable (100°C/10 min.) metabolites extract able by chloroform of the isolated strains growing on the liquid medium with saccharose and yeast extract.

MATERIAL AND METHODS

Strains of fungi and their heat-stable and chloroform-extractable metabolites

Sixty three strains of filamentous fungi were isolated from the samples of flax (26 strains), cotton (22), straw (2) and sorghum straw (13) (Table).

The isolated strains were growing 14 days on slant Sabouraud agar (Sabouraud agar IMUNA Co., Šarišské Michaľany, Slovak Republic) in tubes at 25°C.

The culture of each strain growing in 3 tubes was scratched into 200 ml of the liquid medium with yeast extraxt (2%) and saccharose (10%) in 500 ml Erlenmayer flasks and cultivated as a stationary culture at 25°C. After 10 day of growing of the culture the flasks' contents were heated 10 minutes at 100°C. Each fluid was extracted twice by 200 ml of chloroform, the united extract was dried by Na_2SO_4 without water and then the chloroform was evaporated in a water bath.

The determination of the aflatoxin B_1 production ability by strains of *Aspergillus flavus*

The *Aspergillus flavus*-strains were investigated for the aflatoxin B_1-producing–ability by the method of Arca et al. (1988) on liquid medium with 2% yeast extract and 20% saccharose, pH 5.5.

Culture medium for tracheal rings of one-day-old chickens

The minimal essential medium according to Eagle, containing Eartl's salts – E-MEM (The Center for Sera and Vaccination Co. – ÚSOL, Prague, Czech Republic).

Added to the medium were: 1% of the 3% solution of glutamine, 2.5% of the 7.5% $NaHCO_3$ solution with phenol red (ÚSOL, Prague), 10% of fetal serum,

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100 μg of streptomycin and 100 U. of penicillium/ml medium and the heat-stable a chloroform-extractable extracts from the investigated strains (40 μg/ml dissolved in dimethylsulfoxid – DMSO). Reference media in the same way with DMSO, whose concentration in the medium was 1%, as well as control with pure medium were prepared.

Tracheal rings of one-day-old chickens

One-day-old chickens (State Research & Productional Company, Častá hatchery, Slovak Republic) were killed by decapitation. Further treatment and testing of tracheal rings was similar to that reported by Nair et al. (1970), with the following modifications: tracheas were taken within 3 minutes of decapitation and twice washed in E-MEM. After that they were cut with a scalpel into thin slices. 20 – 30 tracheal rings were placed on a Petri dish (diameter – 60 mm) with 2 ml of culture medium.

The cultivation of tracheal rings was carried in an incubator at 37°C, and the atmosphere was enriched with 5% CO_2.

Test evaluation

Ciliary movement was observed on 5 – 7 tracheal rings using a microscope after 0, 24, 48, 72 and 144 hours (Histology Jenamed, Carl Zeiss Jena, magnification 250 times).

Movement of cilia was evaluated as "+", or "–" when the cilia did not move.

RESULTS AND DISCUSSION

Twenty two (34.9%) strains from the 63 investigated strains produced heat-stable and chloroform-extractable metabolites with ciliostatic activity against tracheal cilia of the one-day-old chickens in vitro:

3 (4.7%) strains stopped the movement of cilia already after 24 hours, there were strains of *Aspergillus niger* group (2 strains from cotton and 1 strain from flax),

5 (7.9%) strains after 48 hours, there were 2 *Aspergillus flavus* strains with aflatoxin B_1 producing ability and 1 strains of *Aspergillus niger* group from cotton, and *Pæcilomyces variotii* and *Penicillium* sp. from flax,

2 (3.1%) strains after 72 hours – *Aspergillus glaucus* group from flax and *Aspergillus ochraceus* from cotton

and 12 (19.0%) strains after 144 hours of activity – there were the strains from straw (*Aspergillus candidus*), from flax (*Aspergillus fumigatus, Pæcilomyces variotii*), from sorghum (*Aspergillus glaucus* group, *Trichoderma* sp.) and from cotton (*Aspergillus niger* group, *Aspergillus terreus, Fusarium* sp. – 2 strains),

Tab. 1 The effect of the heat-stable and chloroform extractable secondary metabolites of fungi isolated from the samples of flax (F), straw (S), cotton (C) and sorghum (So) on the respiratory tract cilia movement of one-day-old chickens in vitro

Fungi[a]	Protocoled number of the strains	Time (in hours)				Number of strains	
		24	48	72	144	Σ	+
		Movement of cilia					
Absidia sp.	So/86	+	+	+	+	1	0
Acremonium sp.	So/71,76,83,88	+	+	+	+	4	0
A. candidus	S/163	+	+	+	−	1	1
A. flavus	C/131	+	+	+	+		
	C/92[b], 215[b]	+	−	−	−	3	2
A. fumigatus	F/19,38,40,43,53	+	+	+	+		
	F/18	+	+	+	−	6	1
A. glaucus group	So/77,89;F/29,31	+	+	+	+		
	So/85	+	+	+	−	6	2
	F/21	+	+	−	−		
A. nidulans	C/114, 132	+	+	+	+	2	0
A. niger group	C/207	+	+	+	+		
	C/124	+	+	+	−		
	C/112	+	−	−	−	6	5
	C/91,133;F/208	−	−	−	−		
A. ochraceus	C/93	+	+	+	+		
	C/100	+	+	−	−	2	1
A. terreus	C/97,104,122,216	+	+	+	+		
	C/110,111	+	+	+	−	6	2
Fusarium sp.	F/2	+	+	+	+		
	C/210,346	+	+	+	−	3	2
Mucor sp.	C/125	+	+	+	+	1	0
Nigrospora sp.	S/150	+	+	+	+	1	0
Pæcilomyces varioti	C/119;F/46,49,52	+	+	+	+		
	F/54	+	+	+	−	6	2
	F/48	+	−	−	−		
Penicillium sp.	So/67,75;F/7,15,42,						
	51	+	+	+	+		
	F/64	+	−	−	−	7	1
Stachybotrys sp.	F/24	+	+	+	+	1	0
Trichoderma sp.	So/80;F/33,57,58,59	+	+	+	+		
	So/72,87	+	+	+	−	7	2
Strains with ciliostatic activity		3	5	2	12	63	22
	%	4.7	7.9	3.1	19.0	100	34.9

Note [a] : A ... Aspergillus

[b] : aflatoxin B_1 producing strains

the ciliary movement was not affected by metabolites of the other 41 strains and in the reference media (Table 1).

Various mycotoxins – citreoviridin, cyclopiazonic acid, luteoskyrin, penitren A., sterigmatocystin, verruculogen, viomellein, xanthomegnin – can be stored intracellularly in filamentous micromycetes (Filtenborg et al. 1983). Stachybotryotoxins are concentrated in airborne fungal propagules and are not present as free aerosols in the air (Pasanen et al. 1993). Spores and mycelium of toxigenic strains of *Aspergillus flavus* and *Aspergillus parasiticus* are able to contain aflatoxin B_1 (Hesseltine et al. 1966, Shih and Marth 1975). Detritus from plant material is an important vehicle for inhalation of extracellular mycotoxins (Burg et al. 1981, 1982, Burg and Shotwell 1984, Sorenson et al. 1981). In vitro aflatoxin destroys cultured mice embryonic lung cells (Šabad et al. 1976) and affected function of tracheal cells (Cardeilhac et al. 1972, Cardeilhac and Nair 1974). Aflatoxins are carcinogenic for lung cells (Autrup et al. 1979, Wang et Cerutti 1979).

Ochratoxin A and zearalenon (Palmgren et al. 1983), secalonic acid D with acute inflamatory activity in bronchi (Ehrlich et al. 1982, Sorenson et al. 1982) and deoxynivalenol (Young et Fulcher 1984) were in dust from cereal grains detected.

Ciliostatic activies of some mycotoxins on one-day-old chickens tracheal organ cultures in vitro, especially by sterigmatocystin, trichothecens, aflatoxin B_1 and B_2 were in the previous studies described (Jesenská et Bernát – in press, Nair et al. 1970, Cardeilhac et al. 1972). We continued in the study of ciliostatic activity of secondary metabolites of the strains of filamentous fungi, isolated mainly from substrates of the textil factories – flax and cotton– and from straw and sorghum. Our attention was concentrated on the heat-stable and chloroform extractable metabolites. We found in our study that 34.9% of the investigated strains were in vitro able to produce metabolites with ciliostatic activity against tracheal cilia of one-day-old chickens in vitro. The ciliostatic activity of the metabolites of the filamentous fungi need to be further studied because the movement of cilia is one of the most important defense function of the airway and is a biological barrier between man and his environment (Etievant 1992). The destroyed ciliary movement in airways by mycotoxins may be the first step of the giving rise to bronchitis, chronic bronchitis and chronic respiratory tract illnesses of man in moulded working environment or dwellings. Much research is need to clarify this problem.

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Species of Taphrina on Alnus in Slovakia

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Bacigálová K. (1994): Species of Taphrina on Alnus in Slovakia. – Czech Mycol. 47: 223–236

New data are presented on the occurrence of Taphrina Fr. [T. alni (Berk. et Br.) Gjaerum, Tepiphylla (Sadeb.) Sacc., T. tosquinetii (Westend.) Magn. and T. sadebeckii Johans.) on Alnus Mill. (A. incana (L.) Moench, A. glutinosa (L.) Gaertn.], till now unknown in Slovakia. Brief characteristics as to biology, ecology and distribution of the mentioned fungi as well as their host plants are given together with the ecological characteristics of the new localities.

Key words: Taphrina Fr., Alnus Mill., Slovakia, biology, ecology, distribution

Bacigálová K. (1994): Druhy rodu Taphrina na hostiteľských rastlinách rodu Alnus na Slovensku. – Czech Mycol. 47: 223–236

Sú opísané v rastlinných spoločenstvách na Slovensku doteraz všeobecne málo známe druhy fytopatogénnych húb rodu Taphrina Fr.: Taphrina alni (Berk. et Br.) Gjaerum – grmaník šištičiek jelše, Taphrina epiphylla (Sadeb.) Sacc. – grmaník vetvičiek jelše šedej, Taphrina tosquinetii (Westend.) Magn. – grmaník listov jelše lepkavej, Taphrina sadebeckii Johans. – grmaník listov jelše na druhoch rodu Alnus Mill.: Alnus glutinosa (L.) Gaertn., Alnus incana (L.) Moench). Autorka opisuje symptómy ochorenia na hostiteľských rastlinách, anatomicko-morfologické charakteristiky húb, lokality ich výskytu a ich ekologické charakteristiky.

Phytopathogenic micromycetes of the genus *Taphrina* Fr. are biotrophic pathogens of trees predominantly and shrubs. They cause characteristic changes on infected host plants. Mycofloristic research during the period 1987–1992 showed that *Alnus* species are frequently infected by fungi causing "leaf curl", "witches' brooms", tongue-like outgrowths from female catkins or moderate-size yellow spots on leaves.From this point of view they have an unfavourable influence on the production of host biomass or on their aesthetic appeal. It is thought that they play an important role as indicators of environmental pollution. On the other hand, the results contribute to the knowledge of the mycoflora of Slovakia.

MATERIAL AND METHODS

Material of *Taphrina* species on *Alnus* was obtained from mycofloristic research in Slovakia and from existing herbarium items at the following institutes: Mycological Herbarium of the Slovak National Museum, Bratislava – BRA; Tatry National Park, Tatranská Lomnica – TNP; Moravian Museum, Brno – BRNM; Mycological

Department, National Museum, Prague – PRM; Department of Botany, Faculty of Natural Sciences, Charles University, Prague – PRC.

For identification of the genus *Taphrina* both visual symptoms of infected trees and anatomical–morphological characteristics of fungi were used. They were observed by taking thin cross and longitudinal sections from naturally infected *Alnus* leaves or twigs and applying a method used earlier (Bacigálová 1992). An evaluation was made by means of an Zeiss "Amplival" microscope with microphotographic equipment.

The species of the genus *Taphrina* were identified according to Mix (1949), Gjaerum (1964) and Sałata (1974), and host plants according to Dostál et Červenka (1991). The localities of the fungi and their host plants are arranged in maps. A list of localities grouped according to their phytogeographical classification (Futák 1966) was compiled.

All collected specimens of *Taphrina* are deposited in the Herbarium of the Institute of Botany, Slovak Academy of Sciences – SAV.

Notes: R.– river, B.– brook, surr.– surroundings, Str.- street, M.– mountain
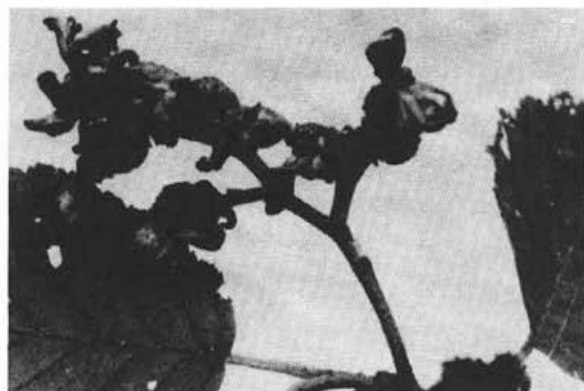
Fig. 1 Tongue-like outgrowths from female catkins of *A. incana*, caused by *T. alni*.
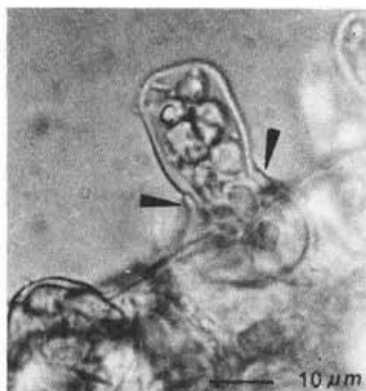
Fig. 2 Cross sections of tongue-like outgrowths on female catkins of *A. incana*. The outer wall of the ascogenous cells ruptures and the asci are developing.

Taphrina alni (Berk. et Br.) Gjaerum, Blyttia 24:188, 1966.

Symptoms. The fungus causes rather large tongue-like outgrowths from the female catkins of *Alnus incana* (L.) Moench. Infected scales of catkins (Fig. 1) are enlarged, thickened, with 1.5 cm large tongue-like or 5–6 cm large tube-like outgrowths, empty inside, red or pale green and have a water-soaked tissues, and a swollen surface covered by asci as a white cover. The infected plant tissues turn brown, dry and remain on the catkins during winter.

Anatomical and morphological characteristics. Cells of the parasitic mycelium are thin, long and divided by layered septa. The mycelium follows vessels and branches in the spaces between cells of host parenchyma. In the region between epidermal cells and cuticle the mycelial cells become strongly thickened and desintegrated to shapeless cells, and thick-walled ascogenous cells are formed. During their further development the cuticle ruptures, the fungal cells increase in length and form asci (Fig. 2).

The asci are one-celled, at the top rounded, at the base broadened, attached to the host cells by a sheath (the rest of the outer layer of ascogenous cells) (Fig. 2). Asci 32–63 x 9–20 μm, most frequently 40–48 x 13–16 μm. According to Mix (1949) 26–53 x 10–23 μm, according to Gjaerum (1964) 34–81 x 9–18 μm, and most frequently 30–40 x 10–15 μm according to Sałata (1974). The asci have 8 ascospores. These are oval or round, 5 x 4–6 μm, and are budding inside the ascus into blastospores of ovoid size 2–4 x 3–3.5 μm.

Localities of the fungus and their ecological characteristics. *T. alni* was collected on *A. incana* for the first in Slovakia by V.Greschik in 1892 in Vysoké Tatry Mts. (BRA) (Bacigálová 1988). New localities have been discovered on *A. incana* in lower submontane to montane belts up to elevations of 1000–1300 m in the Central Carpathians (Západné Tatry Mts., Vysoké Tatry Mts.). We could not find localities of *T. alni* on *A. incana* on sites as were found by Kmeť, Hruby, Picbauer and Cejp (Jeschková 1957). *T. alni* has not been recorded on *A. glutinosa* as is known from Norway (Gjaerum 1964, 1966) and Poland (Sałata 1974).

List of localities (Fig. 3):14e. Štiavnické vrchy Mts.: Prenčov (Kmeť, 1922, in Jeschková 1957). 15. Slovenské rudohorie Mts.: Valkovňa near Šumiac (Hruby, 1930, in Jeschková 1957); Dobšiná–Pusté pole (Picbauer, 1932, MMB), 22. Nízke Tatry Mts.: Čierny Váh (Cejp, 1928, PRC). 23. Tatry Mts.: Rog Tatra (Greschik, 1892, BRA). 23a. Západné Tatry Mts.: Tichá dolina surr. Tichý potok R. 1200 m (Bacigálová, 1987, 1989, SAV); Tomanovská dolina, 1164 m (Bacigálová,1988,1989, SAV). 23b. Vysoké Tatry Mts.: Podbanské, road on 22 km, 1000 m (Bacigálová, 1988, 1992, SAV); dolina Kežmarskej Bielej vody – Šalviový prameň, 1200 m (Bacigálová, 1987, 1988, 1990, SAV); Tatranská Lomnica (Hruby, 1930, in Jeschková 1957); Kežmarské žlaby (Picbauer, 1932, MMB). 26b. Spišské kotliny: Levoča (Greschik, 1928, BRA).

The fungus is at least in Northern Europe montane-maritime (Palm 1917). According to Neger (1906) the fungus is common near the Baltic and has been often seen in Alps. In Norway it has been collected at sites only up to 650 m a.s.l. (Gjaerum 1966), but in our ecological conditions *T. alni* occurs in localities up to 1000m a.s.l. *T. alni* occurs on *A. incana* in Central and Northern Europe (Sałata 1974). We can state that the fungus occurs also in Slovakia only in north regions. According to Gjaerum (1964, 1966) and Neger (1906) from Norway the

fungus requires humid conditions, and the low humidity and winter temperatures are limiting factors. The mentioned data correspond with our records.

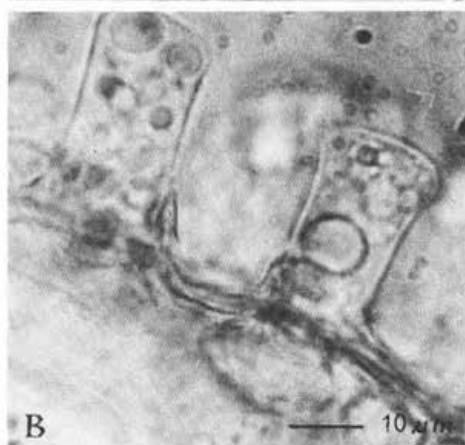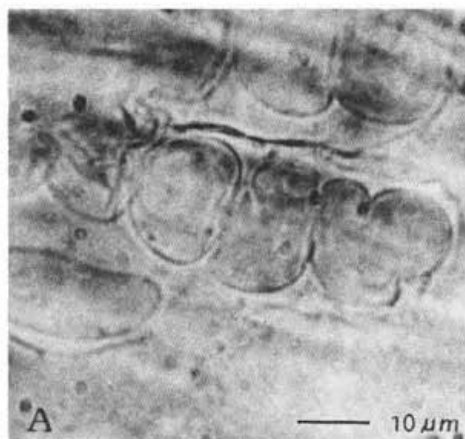Fig. 4   *T. epiphylla* causes "witches brooms" on *A. incana*

Fig. 5 A)   Ascogenous cells of *T. epiphylla* in the subcuticular layer of the leaves of *A. incana*   B)   mature asci with ascospores

Taphrina epiphylla (Sadeb.) Sacc., Syll. Fung. 8: 816, 1889.

Symptoms. The fungus causes "witches' brooms" in crowns of *A. incana* (L.) Moench. Infected twigs – witches' brooms – are long, thickened at the base, grow straight up (negative geotropism) and remain on the trees during the next vegetation seasons (Fig. 4). Leaves of witches' brooms are sometimes enlarged, swollen, have a pale green colour, their tissues are thin, water-soaked, and the surface is covered by asci as a white cover. The infected leaves turn brown, dry out and fall off.

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Anatomical and morphological characteristics. The mycelium penetrates all parts of young twigs, buds and leaves of *A. incana*. The cells of the intercellular and sub-cuticular hyphae are elongated and are divided or partitioned by layered septa which appear to be composed of several bands of cell wall material. The size of the cells change dependent on intercellular spaces of host parenchyma. In the region between epidermal cells and leaf cuticle, the mycelial cells become thickened and round, and thick-walled ascogenous cells are formed (Fig. 5a). During their further development the cuticle is ruptured and ascogenous cells increase in size and form asci.

Asci amphigenous, broadly cylindrical,at the top rounded or widened to a flat head (Fig. 5b). They are 25–44 x 13–20 μm, stalked cells 5–18 x 15–41 μm, most frequently 33–40 x 14–16 μm and stalked cells 8–10 x 25–33 μm. The stalked cells are wider than long, at the base rounded. According to Sałata (1974) they are 35–45 x 12.5–17 μm, stalked cells 8–21 x 10–30 μm; according to Gjaerum (1964) 25–52 x 11–23 μm. Ascospores oval or round, 4–5 x 4–7 μm, budding into blastospores inside the ascus.

Localities of the fungus and their ecological characteristics. *T. epiphylla* was collected for the first time in Slovakia by A. Kmeť in 1889, from the region of Sitno (Štiavnické Mts.) (BRA) and by V. Greschik in 1891, from Vysoké Tatry Mts. (Levoča) (BRA) on *A. incana*. The new localities are situated in communities of submontane and montane alder woods on steep alluvial slopes of valleys along the middle and upper regions of rivers. They were found in Central and Northern Slovakia at elevation of 500 to 1300 m, as well as in Čergovské Mts., Vihorlat Mts. and Nízke Beskydy Mts.

List of localities (Fig. 3): 14e. Štiavnické Mts.: Prenčov, M. Sitno pod Lahotskou (Kmeť, 1889, BRA). 15. Slovenské rudohorie Mts.: Čierny Balog (Bacigálová, 1992, SAV). 16. Muránska planina Mts.: Zlatno pri Červenej skale, Pohronská Polhora (Bacigálová, 1989, SAV). 17. Slovenský raj Mts.: Stratená, surr. Hnilec B. (Bacigálová, 1992, SAV). 18. Stredné Pohornádie.: Margecany surr. Hnilec B. (Bacigálová, 1989, SAV). 20. Vihorlat Mts.: Šmigovec (Bacigálová, 1989, SAV). 21. Veľká Fatra Mts.: Gaderská dolina, surr. Gaderský potok B. (Bacigálová, 1987, SAV). 22. Nízke Tatry Mts.: Jánska dolina, surr. Štiavnica B. 1988; Korytnická dolina, Liptovská osada, surr. Korytnica B. 1987, Jarabá, 1988; Valkovňa, 1992; Švermovo, 1989 (Bacigálová, SAV). 23a. Západné Tatry Mts.: Tomanovská dolina, 1164 m, 1988; Tichá dolina, surr. Tichý potok B. 1987, Kôprová dolina, 1104 m, surr. Kôprový potok B., 1104 m, 1987; Zuberec, Habovka, surr. Biely potok B., 1988 (Bacigálová, SAV). 23b. Vysoké Tatry Mts.: Javorina (Skalický, 1955, PRC); Javorina, surr. Javorinka B., Podspády, Kežmarské žľaby (Bacigálová, 1988, SAV); Bielovodská dolina (Skalický, 1955, PRC); Tatranská Lomnica, 1985, 1992; dolina Kežmarskej Bielej vody – Šalviový prameň, 1987; Stará Lesná, Starý Smokovec,

1988 (Bacigálová, SAV). 25. Turčianska kotlina: Turčiansky sv. Martin (Kmeť, 1909, BRA). 26a. Liptovská kotlina: Liptovský Peter, Liptovský Ondrej, surr. Konský potok B., 1988; Demänová surr., Demänovka B., 1987, 1989; Východná surr. Biely Váh R., 1987; Východná Čierna dolina – valley, 1989; Priehrada Čierny Váh 950 m, 1992; Žiar, surr. Žiarsky potok B., 1988 (Bacigálová, SAV). 26b. Spišské kotliny: Levoča (Greschik, 1891, 1918, BRA, 1923, MMB). 28. Západné Beskydy Mts.: Kysucký Lieskovec, surr. Kysuca R., 1989; Oščadnica surr. Oščadnica B., 1989; Oščadnica Lalíky, 1989; Zakamenné, Oravská Lesná, 1988; Nová Bystrica water reservoir, 1988; Oravská priehrada, surr. Šport hotel, 1988; Oravská Polhora, Rabčice, Slaná voda, 1988, 1992; Zborov, 1989; Zázrivá-Kozliská, 1988; Zázrivá-Mirola, 1988; Podbieľ, 1988; Oravice, surr. Oravica R., 1988 (Bacigálová, SAV). 29. Spišské vrchy Mts.: Červený kláštor, surr. Dunajec R., 1992; Abrahamovce, Vlkov, 1989; Levoča, 1989 (Bacigálová, SAV). 30b. Čergov Mts.: Lukov, Livov, Gerlachov surr. Topľa R. (Bacigálová, 1989, SAV). 30c. Nízke Beskydy Mts.: Nižná Polianka, Stebnická Huta, Krajné Čierno, Ladomírová, Bukovce (Bacigálová, 1989, SAV). 31. Bukovské vrchy Mts.: Kalná Roztoka (Bacigálová, 1989, SAV).

T. epiphylla occurs on *A. incana* in colder valleys of higher mountains in the northern and eastern regions of Slovakia, as well as in Poland, in central and northern European countries and in the Caucasus (Sałata, 1974). It is not known from America (Mix 1949). According to Gjaerum (1964), *T. epiphylla* is common on *A. glutinosa* only at a few sites in Norway. It was not found on that host in Slovakia up to now.

Taphrina tosquinetii (Westend.) Magn., Hedwigia, 29: 25, 1890.

Symptoms. The fungus causes leaf deformations ("leaf-curl" of a part or the whole blade) of *A. glutinosa* (L.) Gaertn. (Fig. 6). The leaf tissues are thin, water-soaked, and pale green. The surface is covered by asci as a white cover. The infected tissues of leaves turn brown and dry. The infections are systemic. The young shoots are most frequently infected, but true "witches' brooms" are never formed.

Anatomical and morphological characteristics. The mycelium of *T. tosquinetii* penetrates buds of *A. glutinosa* in an early stage of their development and grows as an intercellular biotrophic pathogen. The mycelium follows the vessels of host leaf tissues and forms elongated, cylindrical cells divided by layered septa. Its size depends on intercellular spaces of host parenchyma. Between the epidermal cells and the leaf cuticle on the upper or lower leaf surface, the mycelial cells become strongly thickened, packed together, and thick-walled ascogenous cells are formed. During their further development the cuticle ruptures and asci are formed (Fig. 7).

Asci amphigenous, cylindrical, apically rounded, 23–37 x 8–15 μm, most frequently 25–33 x 10–11 μm. Stalked cells inserted between epidermal cells are 5–20 x 6–20 μm, but most frequently 8–10 x 10–16 μm. According to Mix (1949) they

are 17–40 x 7–13 μm, stalked cells 7–17 x 8–17 μm, and according to Sałata (1974) most frequently 27–35 x 8–10.5 μm with stalked cells of 8–19 x 6–18 μm. The asci have 8 ascospores. They are globoid, 3–5 x 3–5 μm; their budding into blastospores inside the ascus is not typical.

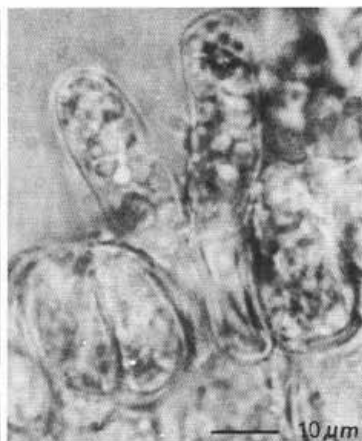Fig. 6   *T. tosquinetii* causes "leaf curl" on *A. glutinosa*

Fig. 7   Ascogenous cells and asci of *T. tosquinetii* on the subcuticular leaf layer of *A. glutinosa*

Localities of the fungus and their ecological characteristics. *T. tosquinetii* was collected in Slovakia for the first time by A. Kmeť in 1886, in Štiavnické Mts. on *A. glutinosa* (PRC) (Bacigálová, 1988). *T. tosquinetii*, being a cosmopolite is the most frequent species of the genus *Taphrina* in Slovakia. The localities are situated in floodplain woods in lowlands, submontane and montane vegetation regions.

List of localities (Fig. 8). 3. Slovenský kras: Plešivec, Pašková (Bacigálová, 1989, SAV). 6. Podunajská nížina: Hul, surr. canal (Bacigálová, 1988, SAV). 7. Košická kotlina: Čermeľské údolie – valley (Bacigálová, 1989, SAV). 8. Východoslovenská nížina: Cejkov, Veľké Kapušany, Kladzany, surr. Ondava R., Sobrance – Komárovce surr. Sobranecký potok B., Vlača, surr. Topľa R. (Bacigálová, 1989, SAV). 9. Biele Karpaty Mts.: Topolecká (Bacigálová, 1988, SAV). 10. Malé Karpaty Mts.: Bratislava-Lamač Zelenohorská Str., 1986, 1987; Pánova lúka, surr. Vydrica B., 1987, 1988; Marianka, 1989; Medenné Hámre-Kozliská, 1992; Limbach, 1988; Sološnica, 1988; Plavecký Mikuláš – Hôrka-Plavecké Podhradie, 1988; Bratislava-Železná studnička, 1987, 1991; Trstín, surr. Trnávka R. 1988 (Bacigálová, SAV). 11. Považský Inovec Mts.: Trstník Hrádok (Hrubý, 1926, in Hrubý (1932)). 14e. Štiavnické Mts.: Prenčov – in a field (Kmeť, 1886, BRA, PRC); Prenčov-Klastava (Kmeť, 1889, BRA); Prenčov, Babí potok B., Počúvadlo, surr. campsite, Evičkino jazero, Antol, surr. Štiavnica R., 1987; Kozelníková dolina, 1987, 1989; Hodruša Hámre, 1989 (Bacigálová, SAV). 15. Slovenské rudohorie: Chata Háj, 1106 m, 1986, 1987; Kokava nad Rimavicou, surr. Kokavka R., 1987, 1992; Kokava nad

Rimavicou, surr. Rimavica R., 1987; source of the Ipeľ R. 1987, 1989; Utekáč 1992; Rožňava, surr. Štitnička R., 1989; Krásna hôrka, 1989; Jasov, 1989; Nováčany, 1989; Nálepkovo-Hencelovská dolina Valley, 1987 (Bacigálová, SAV). 18. Stredné Pohornádie: Margecany (Bacigálová, 1989, SAV). 21b. Malá Fatra Mts.: Belá, Nižné Kamence, Vrátna-Starý dvor, path on Chleb M. (Bacigálová, 1989, SAV). 21c. Veľká Fatra Mts.: Chata pod Šturcom, 1985; Čremošné surr. Teplica R., 1987; Blatnica, Gaderská dolina Valley, surr. Gaderský potok B., 1987 (Bacigálová, SAV). 22. Nízke Tatry Mts.: Banská Bystrica – Jakub, 1987; Uľanka, Staré hory, surr. Starohorský potok B., Richtárová surr. Richtárovský potok B., 1987; Slovenská Ľupča, surr. Moštenica R., 1989; Podbrezová, surr. Hron R., 1987; Bystrianska dolina Valley, surr. Bystrianka R., 1987; Demänovská dolina Valley, surr. Demänovka R., 1987 (Bacigálová, SAV). 23a. Západné Tatry Mts.: Smrečany, surr. Žiarsky potok B. (Bacigálová, 1988, SAV). 23b. Vysoké Tatry Mts.: dolina Kežmarskej Bielej vody Valley – Šalviový prameň, 1987; Starý Smokovec, 1988 (Bacigálová, SAV). 25.Turčianska kotlina: Turčiansky sv. Martin (Kmeť, 1907, BRA), Sučany, Trusalová, 1988; Bystrička – Prieslopská dolina Valley, Bystrička – škôlka drevín, Slovenské Pravno (Bacigálová, 1987, SAV). 26a. Liptovská kotlina: Východná surr. B. (Bacigálová, 1988, SAV). 27. Západobeskydské Karpaty Mts.: Dolná Súča, Horná Súča, Zubák, Lednické Rovne (Bacigálová, 1988, SAV). 28. Západné Beskydy Mts.: Gbeľany, 1987; Kysucký Lieskovec surr. Kysuca R., 1989 (Bacigálová, SAV). 30a. Šarišská vrchovina: Hubošovce (Bacigálová, 1989, SAV). 30b. Čergov Mts.: Gerlachov surr. Topľa R. (Bacigálová, 1989, SAV). 30c. Nízke Beskydy Mts.: Demjata – Raslavice, Rakovčík, 1989; Stebnická Huta, 1992; Domaša – Dobrá, 1989 (Bacigálová, SAV). 31. Bukovské vrchy Mts.: Ubľa (Bacigálová, 1989, SAV).

T. tosquinetii is wide-spread on *A. glutinosa* in Poland (Sałata 1974), Central and Northern Europe (Mix 1949, Gjaerum 1964), as well as in Bulgaria (Najdenov 1986) and in Georgia.

Taphrina sadebeckii Johans. Öfvers. Köngl. Vet. Akad. Förhandl. 42,(1): 38, 1885.

Symptoms. *T. sadebeckii* causes moderate-sized (up to 10 mm in diameter), yellow spots on the leaves of *A. glutinosa* and *A. incana*. Circular spots yellow or white-grey on the abaxial side of the leaf, pale green and a little convex on the adaxial side of the leaf. The spots are never joined together to cause a "leaf-curl" as in the case of *T. tosquinetii*. In the course of ascus development the spots turn brown and remain on the living leaves (Fig. 9).

Anatomical and morphological characteristics. Elongated cells of the mycelium follow the vessels of leaf tissues and branch off in intercellular spaces. In the region between epidermal cells and leaf cuticle mycelial cells become strongly thickened,

are packed together and form thick–walled ascogenous cells. Asci emerge from ascogenous cells by rupture of their cell walls (Fig. 10).

Asci hypophyllous, sometimes also epiphyllous, cylindrical, at the top often truncate, with yellowish epiplasm. They are 33–66 x 11–19 μm, most frequently 41–53 x 15–16.5 μm. Stalked cells are broad, 4–24 x 11–50 μm, most frequently 8–16 x 16–33 μm. According to Mix (1949) they are 17–65 x 10–21 μm, stalked cells 7–23 x 13–30 μm, according to Sałata (1974) most frequently 40–55 x 15–17 μm, stalked cells 6–25 x 12–30 μm.

Fig. 9   *T. sadebeckii* causes moderate sized yellow or white spots on leaves of *A. glutinosa*
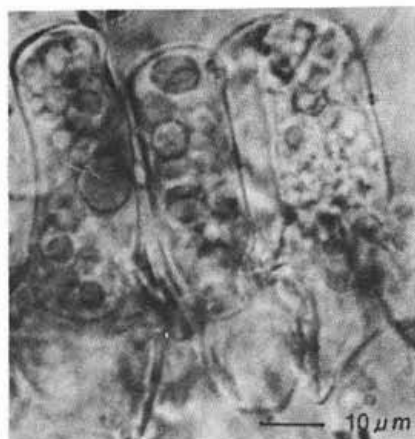
Fig. 10   Mature asci of *T. sadebeckii* with ascospores and blastospores

Localities of the fungus and their ecological characteristics. *T. sadebeckii* was recorded for the first time in Slovakia by A. Kmeť in 1877, in the region of the Štiavnické Mts. (PRC), and by V. Greschik in 1886, in Kežmarok (Vysoké Tatry Mts.) (BRA) on *A. glutinosa. T. sadebeckii* was recorded by V. Greschik on *A. incana* in 1889 from Levoča (BRA). New localities of this so far very rare fungus in Slovakia, were found in floodplain woods of Central, Northern and Southern Slovakia in different vegetation belts. The fungus is considered as the second-most common species of *Taphrina* (the most frequent is *T. tosquinetii*).

List of localities of *T. sadebeckii* on *A. glutinosa* (Fig. 11): 3. Slovenský kras: Pašková surr. Štítnik R. (Bacigálová, 1989, SAV). 4. Záhorská nížina: Plavecký Mikuláš, Plavecké Podhradie, Jakubov, Láb, Malé Leváre, Kamenný Mlyn (Bacigálová, 1988, SAV). 6. Podunajská nížina: Černík, Komjatice surr. Stará Nitra R., Nová Ves nad Žitavou, Hul, Slepčany Žitava R. 1988; Dunajské Klátovo brook near mill, 1989, 1992 (Bacigálová, SAV). 8. Východoslovenská nížina: Sobrance, surr. Sobranecký brook, Cejkov, Veľké Kapušany (Bacigálová, 1989, SAV). 9. Biele Karpaty Mts.: Stará Turá, Zubák– Lednické Rovne, Topolecká – Dudrák, (Bacigálová, 1988, SAV). 10. Malé Karpaty Mts.: Bratislava Lamač-

Zelenohorská Str., 1984, 1987; Bratislava Rača-Pánova lúka, 1988; Borinka surr. brook in village, 1992; Limbach-Potočná Str. 1988; Píla surr. Gidra R., 1988, 1989; Častá, Vinosady surr. Sisek B., 1988; Sološnica, Kuchyňa, 1988; Trstín surr. Trnávka R., Prašník, Krajné u Pagáčov (Bacigálová, 1988, SAV). 14a. Pohronský Inovec Mts.: Nová Baňa (Bacigálová, 1992, SAV). 14e. Štiavnické vrchy Mts.: Konišov-Lyčno (Kmeť, 1877, PRC); Prenčov Babí potok B., 1886; Prenčov, Mount Sitno pod Lahotskou, 1889; Prenčov, Sitno pod Buzalkou, 1889; Bátovce, 1889 (Kmeť, BRA). 15. Slovenské Rudohorie Mts.: Source of the Ipeľ R., 1989; Kokava nad Rimavicou surr. Kokavka R., 1992; Utekáč surr. Rimavica R., 1992; Rožňava surr. Slaná R., Plešivec, Štítnik surr. Štítnik R., Jasov, Nováčany (Bacigálová, 1989, SAV). 21c. Veľká Fatra Mts.: Gaderská dolina surr. Gaderský potok B., 1987; Čremošné surr. Teplica R., 1987; Tajov, Kordíky surr. brook, 1989 (Bacigálová, SAV). 22. Nízke Tatry Mts.: Banská Bystrica-Jakub, Uľanka, Staré Hory surr. Starohorský potok B. 1987; Podbrezová surr. Hron R., 1988 (Bacigálová, SAV). 23a. Západné Tatry Mts.: Smrečany surr. Smrečianka B. (Bacigálová, 1988, SAV). 23b. Vysoké Tatry Mts.:Starý Smokovec, 1988; Stará Lesná, 1989 (Bacigálová, SAV). 25. Turčianska kotlina: Sučany (Bacigálová, 1988, SAV). 26a. Liptovská kotlina: Východná surr. B. in village (Bacigálová, 1988, SAV). 26b. Spišské kotliny: Kežmarok (Kmeť, 1886, BRA). 27. Západobeskydské Karpaty Mts.: Dolná Súča (Bacigálová, 1988, SAV). 28. Západné Beskydy Mts.: Oravská Lesná surr. Harvelka R. (Bacigálová, 1988, SAV). 29. Spišské vrchy Mts.: Levoča (Greschik, 1933, BRA). 30a. Šarišská vrchovina: Hubošovce, 1989; Lipovce, 1992 (Bacigálová, SAV). 30c. Nízke Beskydy Mts.: Kladzany, Malá Domaša, Domaša Dobrá, Dlhé nad Cyrochou, Snina (Bacigálová, 1989, SAV); Demjata, Stebnická Huta, Giraltovce-Mičakovce, Domaša surr. Ondava R. (Bacigálová, 1992, SAV). 31. Bukovské vrchy Mts.: Ubľa (Bacigálová, 1989, SAV).

Localities of *T. sadebeckii* on *A. incana* (Fig. 11). 23a. Západné Tatry Mts.: Žiar surr. Smrečianka B., 1988; Zuberec surr. Studený potok B., 1988 (Bacigálová, SAV). 29. Spišské vrchy Mts.: Levoča (Greschik, 1889, BRA). On both these sites (Zuberec and Žiar) the host plants – *Alnus incana* – were planted after adjustment of a brook.

T. sadebeckii is wide spread in Northern and Western Europe, Georgia and Japan (Sałata 1974). According to Gjaerum (1964), *T. sadebeckii* occurs in Norway as a summer form of *T. epiphylla*. In our ecological conditions *T. sadebeckii* was concluded to be a species occurring both on *A. glutinosa* and *A. incana*. We suppose that the fungus may also be distributed not only at two mentioned localities but also in some other areas of Slovakia. It is remarkable that also in Poland *T. sadebeckii* was found on *Alnus* x *pubescens* Tausch, only at two localities (Sałata 1975).

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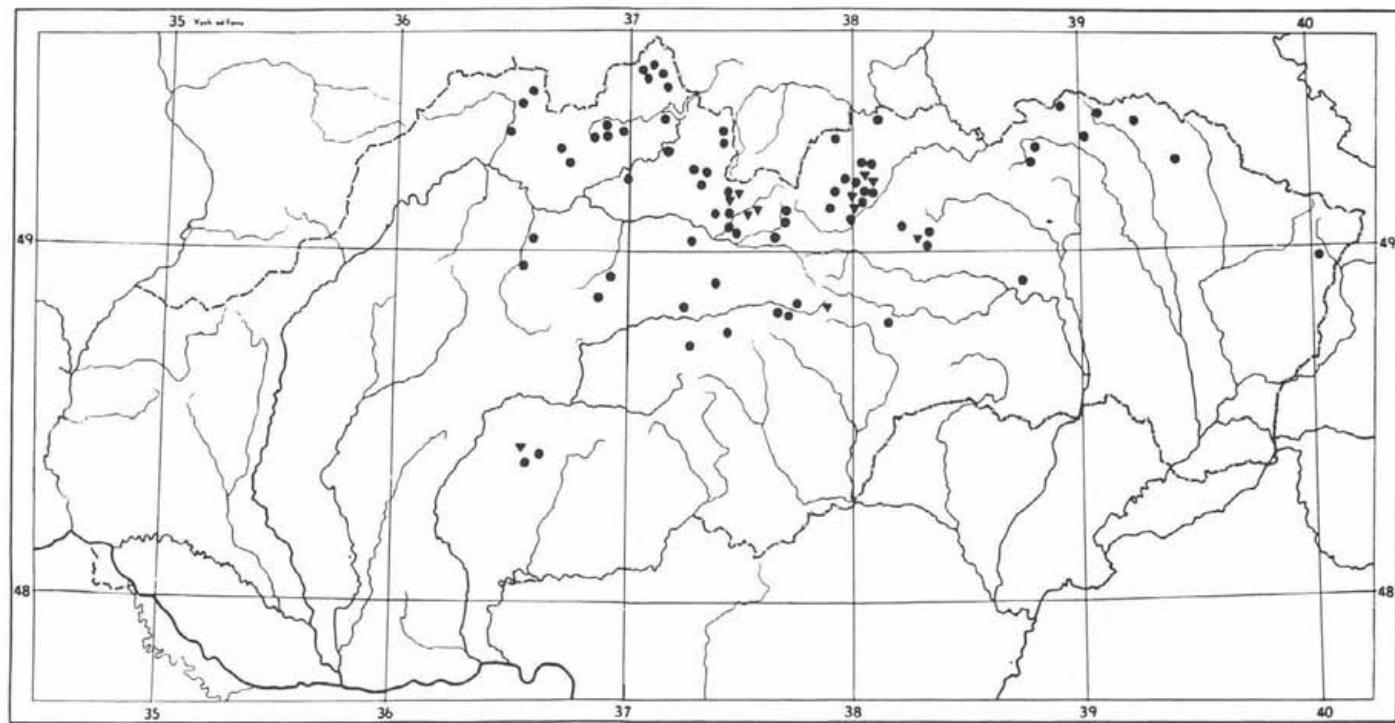
Fig. 3. Distribution map of *T. alni*- ▲ and *T. epiphylla*- ● on *A. incana* in Slovakia
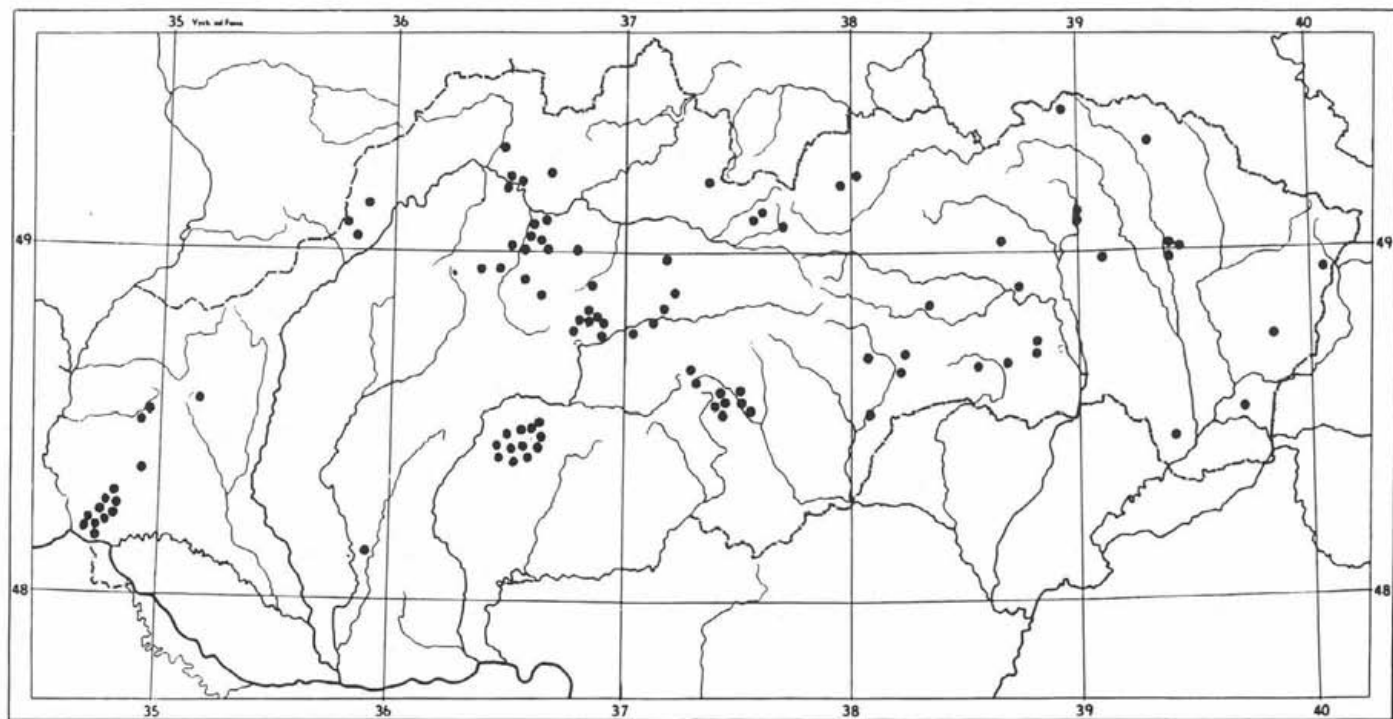
Fig. 8.   Distribution map of *T. tosquinetii* on *A. glutinosa* in Slovakia
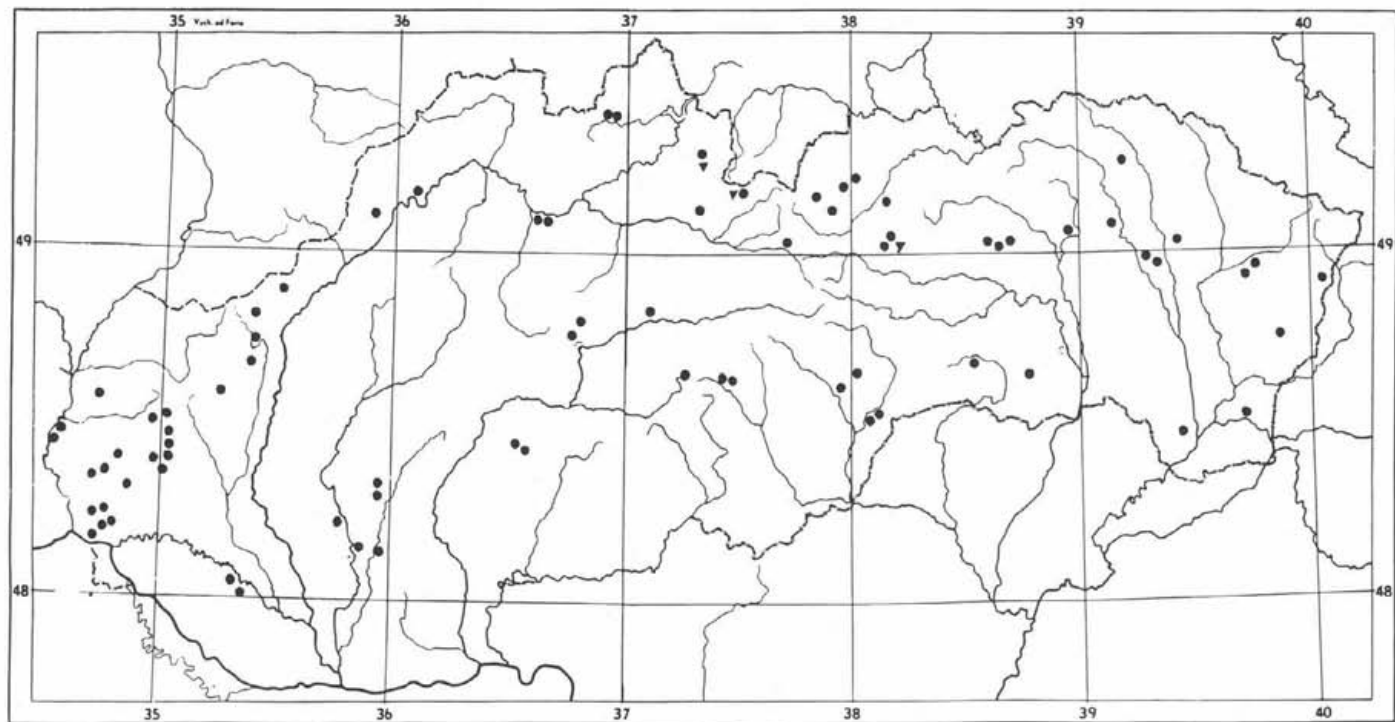
Fig. 11.   Distribution map of *T. sadebeckii* on *A. glutinosa*- ● and *A. incana*- ▲ in Slovakia

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