

On Fennoscandian polypores 6. *Antrodia plicata* n.sp.

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Antrodia plicata Niemelä n.sp. differs from the other species of *Antrodia* s.str. mainly in having larger and thicker, perennial fruit bodies, smaller pores, shorter spores, and pendent false pilei when old. In Fennoscandia, it has been found on *Populus tremula* in one Swedish and two Finnish localities; collected also from Poland on *P. tremula*. Material from *Salix* has been studied from Czechoslovakia and Spain. Cultural characters of *A. plicata* are described.

The identities of *Trametes salicina* Bresadola and *T. salicina* var. *greschikii* Bres. are discussed, and a new combination, *Antrodia salicina* (Bres.) Niemelä, is made. The delimitations and different interpretations of the genus *Antrodia* are reviewed. Preference is given to the strict generic concept comprising only the species causing brown rot, and excluding most of the completely resupinate taxa of the *Poria* group.

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The genus *Antrodia* Karsten (syn. *Coriolellus* Murrill), as delimited by Donk (1966) and others, comprises a group of seemingly closely related polypores. The characters in common are the dimitic hyphal structure with clamped generative hyphae and rarely branched skeletal; the elongated and rather large spores; the production of brown rot, and many cultural similarities (Sarkar 1959, Domański 1972). To these one might add the absence of the iodine and Cotton Blue reactions, the lack of true cystidia but presence of weakly differentiated cystidioles with yellowish refractive contents, and many features of the fruit body shape. The fruit bodies are tough, and when the weather conditions are favourable usually persist for two or more seasons, though not growing so old as the characteristically perennial polypores. They are strongly effused, but in most species capable of producing reflexed parts as well, and have a glabrous or tomentose cover, but no crust, and a very thin context layer. The pores are often wide (e.g. 1—3 per mm) and never very small.

Not all this information was furnished in the original description of *Antrodia* (Karsten 1880): in fact only the effused-reflexed growth habit was noted; otherwise the genus was said to resemble *Trametes* Fries. Seven species were mentioned, which according to present-day criteria represent rather distantly related groups. This led to disagreement in

the typification of the genus, which was not properly settled until the nomenclatorial revision of Donk (1960, 1966, 1972).

At present there seems to be general agreement regarding the typification and the core of the genus. The same cannot be said about the circumscription of the genus as a whole. Many authors, especially those who stress the biological characters, such as the type of rot, nuclear behaviour and cultural characters, often prefer a restricted concept, not much wider than that of Donk, Domański or Sarkar, but a much more extensive concept has been introduced recently (Ryvarden 1977).

The new species described in this paper fits fairly well into the frame of the genus in the strict sense.

Materials and methods

For the present study, specimens were examined from H, O, S and TUR; from the herbarium of Matti Laurila in Helsinki (H-LA), and from the private collections of Dr. Zdeněk Pouzar (abbreviated as Z.P.) and the author (T.N.).

The description of the cultural characters of *A. plicata* is based on the strain Kowalski & Niemelä 1363 (Poland), isolated from decayed wood adjoining the fruit bodies. The strain is deposited in the author's collection in H, and in CBS, Baarn, the Netherlands. The culture was grown in an incubator, at constant temperature and in the dark. The medium was prepared according to the procedure of Nobles (1965), using Difco Bacto preparations.

***Antrodia plicata* Niemelä n.sp.**

Carpophorum perenne, effusum, subereum, crassum. Pars reflexa undulata vel nodulosa, obtusa; superficies glabra, sulcata, colore suberis vel mellis, zonis brunneis indistinctis. Pori rotundi vel ellipsoidei, 4—5 per mm, superficies pororum cremeoalba vel straminea, vel brunnescens in statu senili. Sporae (5.8—) 6.0—7.0 (—8.0) × (2.6—) 2.7—3.2 μm, anguste ellipticae, tenuiter tunicatae, hyalinae, inamyloideae, indextrinoideae, acyanophilae. Systema hypharum dimiticum, hyphae inamyloideae, indextrinoideae, acyanophilae, in KOH non tumescentes. Hyphae generativae 2.1—3.5 μm in diam., fibulatae. Hyphae skeletales 2.3—4.0 μm in diam., parietibus crassis vel subsolidae, in trama intertextae. Consociis in cariete brunnea in ligno.

Typus: Finland. Prov. Satakunta, par. Noormarkku, Kivijärvi, on under-sides of trunk and thick branches of big fallen *Populus tremula* in grass-herb forest, 27.VI.1939 Matti Laurila 550 (H-LA, holotype and isotype; O, isotype).

Fruit body perennial, persisting at least five years. Consistency corky throughout, contracting only slightly when drying. Taste bitterish.

Resupinate; when young 1—3 × 10 cm or larger, 1—3 mm thick, growing along depressions in substrate (Fig. 2); when old covering larger area of up to 8 × 20 cm or more, 5—9 mm thick; old specimens narrowly reflexed with vertical, undulating upper surface formed by split tubes, on vertical or uneven surface forming nodular, pendent false pilei (Figs. 1, 3).

Upper surface light cork coloured in young parts, honey yellow with different shades of brown (buff to cinnamon or sienna) in old specimens, often faintly zoned, colours somewhat darkening when drying; glabrous but vertically grooved or striated according to shapes of split tubes, 3—7 (—20) mm wide. Edge distinct, blunt but not rounded, bruised parts turning brown when drying.

Pore surface smoothly undulating or slightly tubercular, on sloping substrates growing stepwise, in young and actively growing state cream-white or straw-coloured, when old light cork coloured or light brown near margin. Pores (3—) 4—5 (—6) per mm, round or ellipsoid, intermixed with a few larger pores (especially in old, thick specimens) angular or sinuous

in shape; 0.14—0.30 (—0.46) × 0.12—0.24 mm in inner diameter (measured from sections transverse to tubes), dissepiments 0.03—0.06 (—0.10) mm thick, dissepiment edges smoothly rounded, pore mouths laterally opened in steeply sloping places.

Sterile margin bordering substrate 1—2 mm wide, entire, white or cream and cottony in young and actively growing fruit bodies, brown and indistinct in old specimens, firmly attached to substrate.

Tubes in section white to cream; annual layers indistinct, 1—3 mm thick, oldest layers next to substrate changing into chalky, amorphous mass. Subiculum very thin, seldom over 0.5 mm thick, except in depressions in substrate; white to straw coloured. No context between tube layer and upper surface.

Spores (5.8—) 6.0—7.0 (—8.0) × (2.6—) 2.7—3.2 μm, single, narrowly ellipsoid, somewhat arcuate towards apiculus, smooth, thin-walled, hyaline, nonamyloid, indextrinoid, acyanophilous. Apiculus distinct, small, 0.3 × 0.3 μm (Fig. 5).

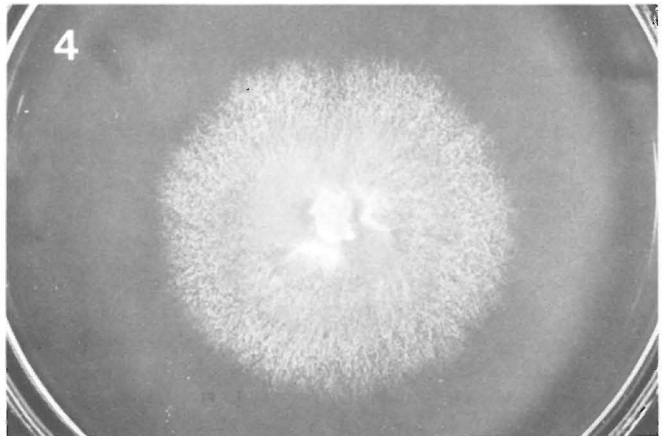
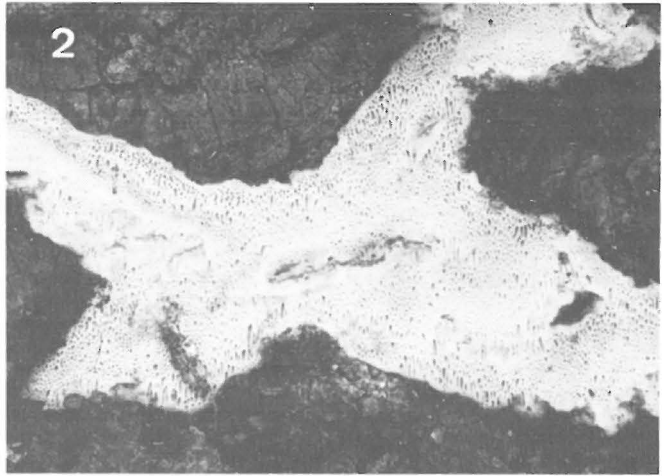
Basidia 17—20 × 5—7 μm, narrowly clavate, standing in rather dense palisade, with four sterigmata 3—4 μm long and basal clamp. Basidioles similar in shape but somewhat shorter. Cystidioles numerous, resembling basidioles in having the same size and thin walls, but with refractive, pale yellowish contents and sometimes with slightly tapering apex. No cystidia. Hymenium collapsing soon after sporulation into thin, amorphous layer.

Subhymenium 5—10 μm, often thinner and not well delimited, formed by very densely packed, tortuous generative hyphae.

Hyphal system dimitic. Generative hyphae 2.1—3.5 μm in diam., hyaline, thin-walled, frequently branched and with clamps; easily seen in young fruit bodies but less common in old parts. Skeletal hyphae 2.3—4.0 μm in diam., hyaline, thick-walled to subsolid, very seldom branched, subparallel to interwoven in dissepimental trama. Trama and subiculum similar in structure and without delimiting zone, subicular hyphae slightly wider, generative hyphae up to 5 μm in diam. Both generative and skeletal hyphae in all parts nonamyloid, indextrinoid, acyanophilous, not dissolving or swelling in KOH.

In Fennoscandia on *Populus tremula*, all collections from dead fallen trees, rare; in C and S Europe also on other species of Salicaceae. Causes intense constricting brown rot.

Figs. 1—4: *Antrodia plicata*. — 1: Pendent fruit bodies on vertical substrate, × 1 (Kowalski & Niemelä 1363, T.N., fresh specimen). — 2: Young, effused fruit body, × 1.6 (1970 Wikström, T.N., herbarium specimen). — 3: Old fruit bodies with striated upper margins, × 2 (1972 Pouzar, T.N. & Z.P., herbarium specimen). — 4: Culture grown on malt agar, at 24°C, for two weeks. Natural size (Kowalski & Niemelä 1363, T.N. & CBS). Photo Tuomo Niemelä.



Occurrence and ecology

Specimens examined

Sweden: *Västmanland*. Sala, northern part, on fallen *Populus tremula*, 1970 Wikström (T.N.). — **Finland:** *Satakunta*. Noormarkku, Poosjärvi, on decorticated branches of big fallen *P. tremula*, 1937 Laurila (H, TUR 34281); Kivijärvi, *P. tremula*, 1939 Laurila 550 (H-LA, holotype and isotype; O, isotype). — **Poland:** *Woj. novosadeckie*. Tatra National Park, Dol. Kościeliska, alt. 1150 m, on dead standing *P. tremula*, 1978 Kowalski & Niemelä 1363 (T.N.). — **Czechoslovakia:** *Slovakia*. Šalá NW, Štrkovec, Galantská síhot, on fallen trunk of *Salix*, 1972 Pouzar (Z.P., T.N.). — **Spain:** *Huesca*. Ordesa National Park, alt. ca. 1500 m, on *Salix caprea*, 1977 Ryvarden 14890 (O, T.N.).

Little can be said about the biology of this species in northern Europe. The notes of M. Laurila suggest that it occurs in fairly luxuriant forest types. My observations from Poland support this concept. It seems to be mainly saprophytic, producing extensive fructifications once the substrate is infected. The scantiness of the herbarium material suggests that it is a rare species, especially because the fruit bodies are striking and surely easily observed in nature.

Dr. Zdeněk Pouzar (Prague) has made numerous observations of this species in Czechoslovakia. He kindly gave me the following information: *A. plicata* is fairly common in some areas of south and south-west Slovakia, where it grows on *Populus tremula*, and also on *P. × canescens*, *P. alba* and *Salix* species. It was once collected from a living tree, and may even be a strong parasite of aspen.

Its distribution seems to be predominantly central-north European. The Polish and Spanish specimens were collected at high altitudes, where the climate roughly corresponds to that in the hemiboreal zone.

Cultural characters

The mycelium of *A. plicata* grows slowly on malt agar. At 24°C, the radial growth is 6–7 (–8) mm in a week, (15–) 19–21 mm in two, and 9–cm Petri dishes with side inoculations become covered with mycelium in about six weeks.

The culture changes only a little with age. The mycelium is white, thin, translucent, appressed, with sparse downy aerial hyphae. Small, irregular patches of denser, felty, white aerial mycelium become visible around the inoculum after the first week, and increase slowly in size. The mycelial mat is even, with a regular margin and without zonation. The odour is very weak, fruity. The agar around the mycelial mat becomes slightly bleached.

Young cultures and the advancing zone are formed by generative hyphae, which are 2–3 (–5) µm in diameter, thin-walled, with regular clamps, branched

(often from a clamp) but with long, straight, unbranched portions in between. The contents of the hyphae are yellow and granular. No swollen parts or special structures were observed.

Old aerial mycelium is apparently formed only from generative hyphae. Chlamydospores are very numerous, 5.5–8.0 × 3.8–4.5 µm, yellowish, rather thick-walled, weakly cyanophilous, truncate, formed by fragmentation of the generative hyphae. A few basidia were detected, ca. 15 × 3 µm, with four sterigmata and juvenile basidiospores. The basidia are deformed in shape, and no mature basidiospores were found.

Species code (cf. Nobles 1965):

1. 3. 7. 36. 38/40. 46. 50. 54.

As pointed out by Nobles (1948: 400), the species of this genus have rather similar cultural characters, especially as to their external appearance. The abundance of chlamydospores connects *A. plicata* with *A. malicola*. The rarity or absence of skeletal hyphae in culture is interesting, because they are found in the other species of the genus, and they are present in the fruit bodies of *A. plicata*. It is probable that they will be found in older cultures, if the medium is suitable for the formation of fruiting areas.

Discussion

This is a typical representative of the genus *Antrodia* in the sense of Donk (1966), or *Coriolellus* as outlined by Sarkar (1959) and Domański (1972), having a dimitic hyphal system with unbranched skeletal hyphae and narrowly ellipsoid spores, and causing brown rot. It is separated from the other species of the genus by its shorter spores, smaller pores and thick fruit bodies with downwards growing reflexed parts, which often make nodular false pilei.

These pilei or reflexed margins are not organologically differentiated as, for instance, in *Antrodia albida* (Fr.) Donk, *A. heteromorpha* (Fr.) Donk, *A. juniperina* (Murr.) Niemelä & Ryvarden (1975), or *A. variiformis* (Peck) Donk. Thus there is no context between the tube layer and the upper surface, and the surface does not contain the specialised structure of the pellicle or tomentum of true pilei: in *A. plicata* it is made up merely of laterally incomplete tubes. In this respect the species resembles *A. sinuosa* (Fr.) Karst. more than the others.

In its surface structure *A. plicata* resembles *Dichomitus campestris* (Quél.) Dom. & Orlicz, but the latter is a thicker fungus, having wider pores and a more complex microscopical structure. Young

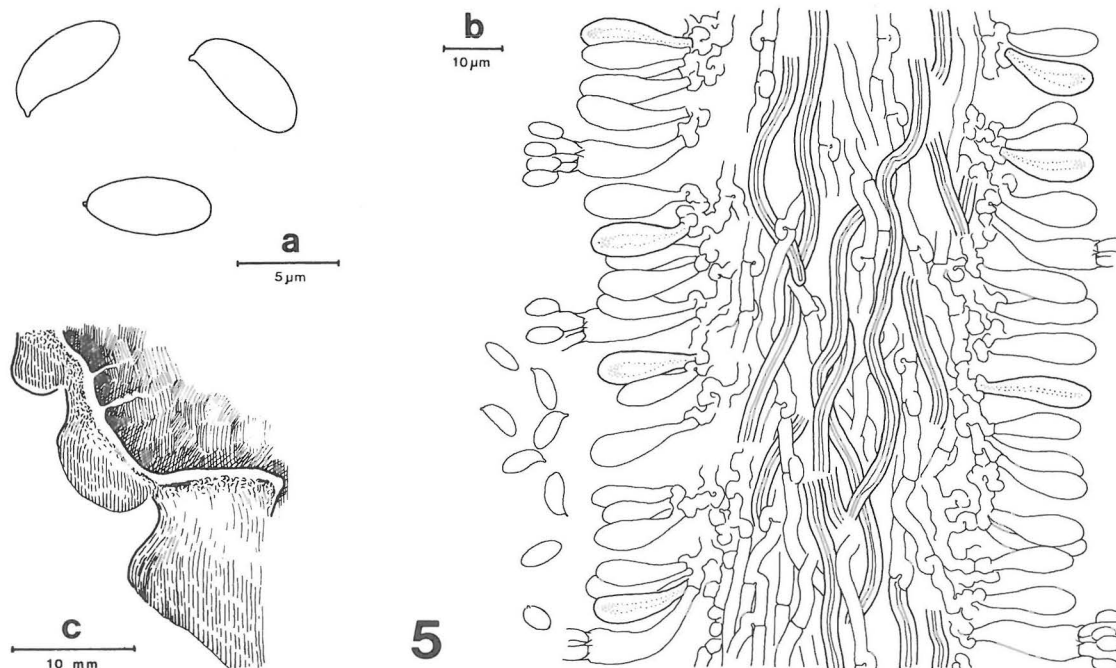


Fig. 5. Anatomical structure of *Antrodia plicata*: a) spores, b) section through dissepiment (1970 Wikström, T.N.), c) vertical section of fruit body (1972 Pouzar, T.N.).

stages may resemble thick specimens of *Oxyporus corticola* (Fr.) Ryv., having the same host tree species, and being similar in colour and growth habit, but *O. corticola* is annual, has obovoid spores, capitate cystidia, and a simple-septate, monomitic hyphal structure.

As pointed out by Leif Ryvarden (in litt.), *A. plicata* resembles *Poria crassa* (Karst.) Sacc. in having a chalky consistency in the oldest parts of the fruit body. *P. crassa* differs from it in having smaller pores, thicker spores, hyphae that swell in KOH and coniferous hosts.

Very young fruit bodies of *A. plicata* are rather similar to those of *Trametes salicina* Bresadola in Egeland (1914). *T. salicina*, however, is smaller species and mostly annual, having wider pores, 2–3 per mm, and distinctly larger spores: (8.5–) 9–10 × (3.7–) 4.0–4.2 µm in the material studied by me, and up to 12 µm according to Egeland (1914).

Trametes salicina Bresadola (1920) is a later homonym and synonym of that name. The descriptions seem to relate to the same species, although deriving from different types. Overholts (1953) thought that *T. salicina* of Bresadola (1920) is in fact *Trametes trogii* Berk. Domański (1966) referred the type to *Coriolellus (Antrodia) malicola* (Berk. & Curt.) Murrill. Donk (1966) also suggested

that two species may be involved, but seemed to reject this possibility in his final work (Donk 1974). The type of *T. salicina* Bresadola (1920, 'Ad ramos *Salicis grandifoliae*, Paneveggio, Aug. 1893, leg. G. Bresadola', S) is resupinate, having pores (2–) 3 per mm, and spores 8–10 × 3–4 µm. It fits rather well with *T. salicina* Bres. in Egeland, but is badly eaten by insects, and therefore difficult to identify with certainty. So the meaning of the later homonym is somewhat obscure, and I prefer to base the species concept of *T. salicina* on its first description (Egeland 1914) only.

Bresadola's (1920) description of *T. salicina* var. *greschikii* Bres. (*Poria greschikii* (Bres.) Bourd. & Galz.) somewhat reminds *A. plicata*, especially because the spores were reported to measure 7–9 × 3.5–4 µm. However, the pores were described as being venously elongated, and the host is *Prunus acida*, which do not fit with the new species. Furthermore, the spores are in the very badly preserved holotype ('Löese, in ramis dejectis *Prunus acida*, VIII.1913 V. Greschik 46', S) larger than as described, 8–10.5 × 3.5–5 µm. The type is hardly distinguishable from the type material of *T. salicina* Bresadola (1920).

The spore size in *T. salicina* is about the same as in *A. albidia* and *A. serpens* (Fr.) Karst., and some authors consider them synonymous (Ryvarden 1977),

while others regard them as separate species (Bondarcev 1953, Christiansen 1960, Domański 1972). These taxa are undoubtedly closely related, but in my opinion the separation of *T. salicina* is justified by its light ochraceous colour, the hymenophore with small regular pores and the thin, totally resupinate growth habit. Thus:

Antrodia salicina (Bresadola) Niemelä n.comb. Basionym: *Trametes salicina* Bresadola in Egeland, *Nyt Mag. Naturvidensk.* 52: 166. 1914. Lectotypus: '*Trametes salicina* Bres., på *Salix*, Ullern, 27.X.1912 J. Egeland' (O, selected here).

?*Trametes salicina* Bresadola, *Ann. Mycologici* 18:40. 1920 (homonym). — *Coriolellus salicinus* Bond. [(Bres.) Bond.], cf. Code Art. 72], *Trutovye griby evropejskoj časti SSSR i Kavkaza*: 515. 1953. — *Antrodia salicina* Parmasto [(Bres.) Parm.], *Consp. Syst. Corticiacearum*: 178. 1968 (comb. inval.: Art. 33).

Note on the genus *Antrodia*

Recently, the concept of the genus *Antrodia* has been greatly widened (Ryvarden 1977) by the introduction of species with very small and short spores, hygrophanous fruit bodies and hyphae swelling in KOH, fungi causing white rot, etc. This solution was clearly motivated by the desire to achieve a practical genus for the herbarium determination routine, identifiable on a few distinct characters. But in my view this has been done at the cost of the homogeneity of the group, and disagrees with the original aim of Donk (1966) and others to keep *Antrodia* as a natural genus of closely allied species.

So, at least at present, I prefer to maintain the strict concept of the genus, though am aware of the difficulties in its delimitation, and of the practical advantages of a wider concept. For instance, I should like to exclude from *Antrodia* the white-rot causing *Polyporus semisupinus* — *Poria romellii* complex and the *Poria crassa* — *lindbladii* — *xantha* complex with hyphae swelling in KOH, as well as other strictly resupinate species of the *Poria* form group.

The generic names *Antrodia* and *Coriolellus* circumscribe essentially the same group of polypores. *Antrodia* was described earlier (Karsten 1880), and it is typified by *Trametes serpens* Fr. (Donk 1960). After studying the specimens sub n. *T. serpens* in the Karsten herbarium (H), Domański (1974) came to the conclusion that Karsten's concept of this species of Fries was incorrect. The Code does not give clear rules regarding the concept to be used in typifying a genus: Domański (1974) treated *Antrodia* as a nomen

confusum, and preferred *Coriolellus* as the valid name for the genus. This problem was discussed by Niemelä & Ryvarden (1975), who preferred *Antrodia* as typified by *T. serpens* in the original sense of Fries. Accordingly, the new species is here described in the genus *Antrodia*.

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