HETEROBASIDION (FOMES) ANNOSUM AND THE BONDARZEWIACEAE

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Summary

The taxonomic position of *Heterobasidion annosum* is discussed. The species is closely related to *Bondarzewia* and has to be placed in the Bondarzewiaceae. This family includes the Amylariaceae and the Echinodontiaceae.

The family Bondarzewiaceae was erected by Kotlaba and Pouzar (1957), who included the following genera: *Bondarzewia* Singer (type), *Amylaria* Corner apud Balfour-Browne and *Hericium* Pers. ex S. F. Gray. The main characters were amyloid spores and non-resupinate basidiocarps. Donk (1964) removed *Hericium* from the Bondarzewiaceae on behalf of the gloeoplerous hyphae and the gloeocystidia. He characterized the Bondarzewiaceae by the absence of gloeocystidia and the globose to ellipsoid spores, which are small (5–8 μm), colourless (to pale ochre-yellow in print), and ornamented with conspicuous, strongly amyloid spines and crests.

The removal of *Hericium* is fully justified. The only character it shares with *Bondarzewia* is the amyloid spores and even there exists a difference. The ornamentation of *Hericium* dissolves quickly in alkali (as does the ornamentation of, for example, *Aleurodiscus*, *Gloeocystidiellum* and *Xenasma*), while the ornamentation of the spore walls of *Bondarzewia* remains intact after treatment with alkali.

Recently Corner (1970) and Pegler and Young (1972) proposed the removal of *Amylaria* from the Bondarzewiaceae on account of the clamped hyphae and the erect, flabellate basidiocarps, which branch in one plane and are stereoid, but multifid. Corner (1970) even created a new monotypic family for it, the Amylariaceae, stating that "there are such great differences between their (*Amylaria* and *Bondarzewia*) fruit-bodies that many generic transitions must have become extinct or remain to be discovered." In fact the position of *Amylaria* in the Bondar-

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zewiaceae is comparable with that of *Lachnocladium* in the Lachnocladiaceae. The amyloid families in the Aphyllophorales display a wide variability in the shape of the basidiocarps, which is probably best illustrated in the Auriscalpiaceae. Basidiocarps in that family may be effused to effused-reflexed (*Steccherinum*), stipitate-pileate and hydnoid (*Auriscalpium*) or lamellate (*Lentinellus*). The spores of *Amylaria* are not only similar to those of *Bondarzewia* (Pegler and Young, 1972), but also to those of *Vararia* (*Dichostereum*), a genus of the Lachnocladiaceae (SEM pictures of Lanquetin, 1973).

The nature of the spores of *Heterobasidion annosum* (Fr.) Bref. has never been described accurately. They are regarded as smooth by Bondarzew (1953), Jahn (1963) and Domański et al. (1967). According to Keller (1973) and Ryvarden (1976) the spores are asperulate. This character is visible on most spores when viewed in Melzer's reagent. Moreover, when a spore-print of a specimen (made directly on an object glass) is examined in Melzer's reagent, a number of spores always show a blue colour. As the amyloid reaction is only distinct in a minority of the spores and is probably confined to the ornamentation, it is not amazing that this reaction has escaped recognition.

The above set of characters suggests a close relationship between *Heterobasidion* and *Bondarzewia*; other characters also support this view:

1. Both genera seem to be dimitic. The skeletal or better skeletoid hyphae, however, are irregular and not of the type seen in genera like *Trametes*.
2. Clamp connections are found in cultures of *H. annosum, H. insulare* (Murr.) Ryv. and *Bondarzewia montana* (Quél.) Sing. although they may be rare (Stalpers, 1978). They are absent in the basidiocarps.
3. A *Spiniger*-anamorph (Stalpers, 1974) is known for *H. annosum, H. insulare* and *B. berkeleyi* (Fr.) Bond. & Sing.
4. The species of both genera produce a white rot and possess laccase.
5. Both genera contain parasitic species.

It is reasonable to conclude that *Heterobasidion* and *Bondarzewia* are closely related and that *Heterobasidion* should be included in the Bondarzewiaceae. This family belongs to the Aphyllophorales and not to the Agaricales (*Russula*) as suggested by Singer (1975) on the basis of spore ornamentation and amyloidity. The spores of *Bondarzewia*, however, lack a distinct suprahilar plage, characteristic of *Russula* spores (Pegler and Young, 1972).

Another family with amyloid spores is the Echinodontiaceae Donk, originally characterized by the hydnoid hymenophore, woody context, clamped hyphae, seta-like cystidia, and smooth, amyloid spores (Donk, 1961). Gross (1964) emended the family by including a stereoid element; he incorporated the genus *Laurilia* Pouzar in *Echinodontium*. In this sense the family is characterized by the woody to leathery context, stereoid to hydnoid hymenophore, clamped hyphae, thick-walled, encrusted cystidia and smooth to ornamented amyloid spores. The characters which differentiate this family from the Bondarzewiaceae are the clamped hyphae and the characteristic cystidia. On the other hand, they do have several things in common. Both families are seemingly dimitic (*Laurilia sulcata* (Burt) Pouzar is said to be trimitic). The skeletal hyphae, however, do not fit Corner's (1932) diagnosis and may well be sclerified generative hyphae with relatively long cell length. They are irregular, not straight, sometimes branched, and occasionally have clamped septa as confirmed by Eriksson and Ryvarden (1976) in their description of *Laurilia sulcata*: "Hyphal system trimitic, consisting of straight, thick-walled skeletal hyphae, 2.5–4 μm wide, with sparse septa *and clamps* . . ." Moreover, *Laurilia sulcata* has a *Spiniger* anamorph.

The genus *Amylaria* seems to be intermediate between the Bondarzewiaceae, with which it shares the typical ornamentation of the spores and lack of cystidia, and the Echinodontiaceae, with which it has in common the stereoid basidiocarp and clamps at all septa.

To conclude, it is difficult to estimate the value of a certain character, but there are many examples in the modern literature where the constant presence of clamps versus an inconstant or occasional occurrence of clamps, or even their absence, is considered permissible within a genus, e.g., *Peniophora* s. str. (Eriksson, 1950), *Aleurodiscus* (Lemke, 1964), *Athelia* (Jülich, 1972), and *Vararia* (Parmasto, 1970). There are many examples of genera in which some species

have cystidia and others do not, even when these cystidia have a tramal origin (e.g., *Peniophora* s. str.). For these reasons the separation of families on the basis of these characters does not seem justifiable, especially when the three families concerned are extremely small.

BONDARZEWIACEAE Kotlaba & Pouzar

Bondarzewiaceae Kotlaba & Pouzar. *Ceská Mykol.* 11: 163. 1957. Holotype: *Bondarzewia* Sing.

Echinodontiaceae Donk. *Persoonia* 1: 405. 1961. Holotype: *Echinodontium* Ellis & Everh.

Amylariaceae Corner. *Beih. Nova Hedw.* 33: 5. 1970. Holotype: *Amylaria* Corner apud Balfour-Browne.

Basidiocarp resupinate, effused-reflexed and reflexed part sometimes clavarioid, or pileate. Hymenium often thickening. Hymenial surface even to hydnoid or poroid. Hyphal system seemingly dimitic, but the skeletal hyphae may well be sclerified generative hyphae. Clamp connections present or absent. Gloeocystidia absent. Thick-walled, encrusted cystidia may be present. Basidia clavate, with 2-4 sterigmata. Spores globose to ellipsoid, hyaline, ornamented (at least in Melzer's reagent), amyloid. Parasitic or saprophytic on wood of angiosperms and gymnosperms.

Anamorph (if present): *Spiniger* Stalpers.

Genera: *Amylaria* Corner apud Balfour-Browne, *Bondarzewia* Sing., *Echinodontium* Ellis & Everh., *Heterobasidion* Bref., *Laurilia* Pouzar, *Wrightoporia* Pouzar.

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