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QUESTIONS OF CLASSIFICATION OF BASIDIAL FUNGI

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Surveying mycological works dealing with great number of species about basidial fungi published in the last hundred years (Kalchbrenner [1], Istvánffi [2], Hollós [3], Moesz [4, 5], Bohus et al. [6], Bánhegyi et al. [7], Ubrizsy [8], Bánhegyi et al. [9], Babos [10, 11], Rimóczi–Vetter [12], Rimóczi [13]) the great variety and changes of applied systems is conspicuous. In all works the doubt is expressed whether the currently applied systematic lists and nomenclatural solutions are the best, and whether they have chosen the most appropriate systematic theories.

Hungarian authors have never created an own system though it is conspicuous that their knowledge about foreign mycologist taxonomist's works of the given period is thorough. Critical usage of their elements and critical review in the own works is rare (Ubrizsy–Vörös [14], Ubrizsy [15]).

Aims

This paper aims to show systematic principles and nomenclatural changes applied in the foreign, principally European mycological works of the last decade. This paper is not intended to be complete. This is true even with considering only narrower circles of basidial fungi: *Hymenomycetes* and *Gasteromycetes*. This paper is intended to make recommendations only for works dealing with Hungarian macrofungi, and therefore will not address systematic and nomenclatural questions concerning *Uredinales* and *Ustilaginales*.

Discussion

More than half of macrofungal life of Hungary is unknown. The work must focus on identification of species, and on their role played in ecosystem. After all, answering the question "what is this" is the base of all morphological, physiological and cultivation-physiological works, and this basic question requires a systematic and nomenclatural

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approach. This approach is often formulated with difficulty in the level of species (Rimóczi [16]).

- Bresinsky [17] presents five phyla of fungi: *Acrasiomycota*, *Myxomycota*, *Plasmodiophoromycota*, *Oomycota*, *Eumycota*.
- Courtecuisse [18] includes fungi into four phyla: *Gymnomycota*, which includes slime molds. Phylum *Mastigomycota* includes oosporal fungi with flagellate spore and known generative reproduction, while phylum *Amastigomycota* includes all fungi the spores of which are not flagellate, and the generative reproduction of which is known (subphyla *Zygomycotina, Ascomycotina* and *Basidiomycotina*). The author classifies all other fungi with yet unknown generative reproduction into phylum *Deuteromycota*.
- Webster [19] separates only two phyla: *Myxomycota* and *Eumycota*.
- Ubrizsy and Vörös [14] divides fungi also into two phyla: *Myxophyta* and *Mycota*, but they include the greater part of slime molds into the latter as a subphylum (*Myxomycotina*). This opinion is still in use, because e.g. Folk–Glits [20] write: "Fungi belong to the phylum *Mycota*, and are divided into two subphyla: the one is subphylum *Myxomycota*, where class *Myxomycetes* belongs to; the other is subphylum *Eumycotina*, where classes *Phycomycetes, Ascomycetes, Basidiomycetes* and *Deuteromycetes* belong to".

It follows from the before mentioned that one taxon within basidial fungi (e.g. *Hymenomycetes*) can belong to more kinds of systematic categories. For instance by Kreisel [21] *Basidiomycetes* is a class, which includes three subclasses: subclass *Phragmobasidiomycetidae*, in which two orders by each other are *Auriculariales* and *Uredinales*. Subclass *Hymenomycetidae* includes eight orders, where *Poriales* includes the major part (16 families) of fungi with not lamellate fruiting body, e.g. *Peniohoraceae* and *Meruliaceae*, but *Thelephoraceae* and *Ganodermataceae*, too (i.e. extremely different morphological and life-mode types). Thereupon in order *Polyporales* only two families: *Polyporaceae* and *Schizophyllaceae* remain. Order *Cantharellales* includes 13 families (even families *Fistulinaceae* and *Bondarzewiaceae*), where *Hydnaceae* includes *Cantharellaceae*, too. Orders *Boletales, Russulales* and *Agaricales* are separate, in the latter families *Lepiotaceae* and *Agaricaceae* separates, similarly to the work of Bon [22] 21 years later.

At Kreisel [21] the third subclass is *Gasteromycetidae* with 11 orders, where *Lycoperdales* and *Geastrales* are separate. So Kreisel does not use the name *Holobasidiomycetidae* beside *Phragmobasidiomycetidae* neither later (Kreisel [23]).

Also by Bresinsky [17] *Basidiomycetes* is a class, in which beside subclass *Heterobasidiomycetidae* there is *Holobasidiomycetidae*, and he does not indicate *Gasteromycetidae*.

Within *Heterobasidiomycetidae Ustilaginales* and *Tilletiales* are superorders, where superorder *Exobasidiales* is in close relation with the latter. Bresinsky amalgamates *Uredinales* into superorder *Tremellanae*, because production of sprout cells is not present here, which in spite was more or less characteristic to the former superorders. At the same time he takes also *Dacrymycetales* here as a superorder, because though the long sterigmae – on the tip of which basidiospores develop – arise from undivided basidia, and basidiospores are able to bud.

Subclass *Homobasidiomycetidae* by Bresinsky, where dolipore on the transversal wall of hyphae is more complex in comparison with the former, includes *Lycoperdanae* and *Phallales* as superorders, i.e. all the puff-balls, beside superorders *Porianae* (syn. *Aphyllophoranae*) and *Agaricanae*.

Internal classification of puff-balls shows more similarity with the system of Kreisel [21]: genera *Geastrum* and *Lycoperdon* belong to separate orders, but Bresinsky considers the morphological and structural transition of the gastroid fruiting body, appearing in many different ways, towards the pileate (cap shaped)–stipitate (stalked) fruiting body, as one way development of basidiocarpium realizing in more different ways from the gymnocarp to the hemiangiocarp (*Agaricus – Endoptychum*) or angiocarp (*Entoloma – Richoniella*).

There is no exagerrated importance of separation by the morphology of the hymenophore in the orders of *Agaricanae* (e.g. lamellate families of *Boletales*). Since among puff-balls with gastroid fruiting body there are both lamellate gleba (*Galeropsis, Montagnea*), which can be originated from *Agaricales*, and porous (*Chamonixia*), which is linking to *Boletales*.

These puff-ball species, showing transitional (common) characteristics are included by Moser [24] into the families of *Boletales* and *Agaricales*. Jülich [25] also describes them within the same orders as monotypic genera, but as genera of separate families. So by him out of *Russulaceae Russulales* includes *Elasmomycetaceae,* too with four gastroid genera by Pegler–Young [26].

Although the system of Bresinsky is in complete harmony with newest results of cytology and physiology – and presumably it may stand closest to the phylogenetic reality –, it does not appear in any determinant newer mycological work.

Breitenbach and Kränzlin [27] take over certain elements from Jülich [25], but basically they follow Moser [24] and Singer [28].

Therefore here *Basidiomycetes* is a subphylum, and classes are *Heterobasidiomycetes* (syn. *Phragmobasidiomycetes*), *Holobasidiomycetes* and *Gasteromycetes*. The expression "*Hymenomycetes*" is not used, because they do not attribute such a taxonomical importance to basidium layes covering the surface as a continuous membrane, since e.g. on the surface of the lamella of a *Pluteus* species (*Agaricales*) basidia form a membrane (i.e. hymenium) just as on the lamella of a *Montagnea* (agaricoid *Gasteromycetes*), or on the wall of the gleba-chamber of a *Langermannia* (epigeic *Gasteromycetes*).

In contrast Arnolds et al. [29] mark *Hymenomycetes* and *Gasteromycetes* as classes. After Hawksworth et al. [30] they also consider *Basidiomycotina* as a subphylum.

The two subclasses, *Phragmobasidiomycetidae* and *Holobasidiomycetidae* are separated within the class *Hymenomycetes*. By Arnolds and his colleagues [29] admit the exaggerating character of these contractions with listing five groups within *Aphyllophorales* clearly on morphological basis, without mentioning taxonomic category: "Cantharelloide fungi", "Corticoide fungi", "Clavarioide fungi", "Hydnoide fungi" and "Poroide fungi".

Krieglsteiner [31] in his general work, declares clearly that he intentionally chose alphabetical list not only for lucidity, but he would like to avoid taxonomic classification

and taking a stand on "natural system" of basidial fungi. With this expression in quotation marks he fully reveals his opinion about this question.

Though Krieglsteiner mentions that his work is in accordance with systematic works of Moser [24], Jülich [25] and Kreisel et al. [23] in many aspects, he says "one should take this as his identifying with these systems, or as an opinion against other systems by no means".

Clemençon in his latest work elaborates the anatomy of *Hymenomycetes* through 996 pages (Clemençon [32]). His systematic opinion is very careful and reserved. According to him *Hymenomycetes* is a class with two orders: *Agaricales* and *Aphyllophorales*. He sharply separates *Gasteromycetes* from *Hymenomycetes* for two reasons: either because the inner mycelium, or because active spore scattering is absent in puff-balls, which he considers characteristic to *Hymenomycetes*.

On the topic of the formation of the system of basidial fungi producing hypogeic fruiting body, from the scientific achievement of Vittadini [33], about changing of their system and their present diversity the best summary is given by Montecchi and Lazzari [34].

Hungarian macrofungus taxonomic books either completely take the system of Moser [24] and Jülich [25] over Babosné [11] or in addition to these they they use the works of more other taxonomists to greater or lesser extent mainly for interior analysis of certain families (Rimóczi–Vetter [12], Rimóczi [35]).

In the textbook written for the agrarian higher education (Rimóczi [36]) I described the world of fungi following the system of Webster [19], though in the system of Bresinsky [17] characteristics being qualified as really phylogenetical (e.g. separation of *Oomycota* on the highest level) rather prevail. I have chosen the former for didactic reasons and with regard to aspects of practical use of the textbook.

Appearance of taxonomic and nomenclatural changes are continuous and regular in the level of families and genera of macrofungi, too. One part of these – more significant in Hungarian practice – have been summarized (Rimóczi [16]). A more recent summary of changes should be done in the immediate future.

Summary

The author presents the present state of the system of basidial fungi mainly through the taxonomic judgement of *Hymenomycetes* and puff-balls. The diversity of systematic approaches derives from the fact that certain authors assert data concerning phylogenetic characteristics of fungi and practical didactic relations of their works in the most different rate.

Authors dealing with the largest number of species definitely avoid systematic statements concerning higher taxa. Hungarian mycologists, dealing with macrofungi, can also do this, moreover the unexplored state of the Hungarian fungal world directly requires placing priority on species-level investigations.

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