

Teleotypification of fungal names and its limitations

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Abstract Article 59.7 of the *ICBN (Vienna Code)* allows the epitypification of a name of a fungus, known until then only as an anamorph, with teleomorphic material in order to avoid introducing an additional name. Redhead suggested calling this procedure teleotypification. We demonstrate that it is not desirable to apply teleotypification to newly discovered teleomorphs of fungi for which a suitable teleomorph genus is available. Describing a newly found anamorphic fungus under a teleomorph-typified generic name may be defended, provided generic homogeneity is proven with molecular methods and no suitable anamorph genus is available. Alternative proposals will be submitted to either return to the previous situation without teleotypification or to restrict teleotypification explicitly to cases where the original genus is monotypic or at least clearly monophyletic, and no suitable teleomorph genus is available.

Keywords dual teleomorph-anamorph nomenclature; monophyletic genera; morphonyms; pleomorphic fungi

■ INTRODUCTION

According to anatomical typification (Hennebert, 1987, 2003), fungi (mainly ascomycetes) can be differentially classified into genera whose names are either teleomorph-typified or anamorph-typified with the permitted recognition of separate legitimate, correct names for different morphs of one and the same fungus (*ICBN* Art. 59.4–5); this contrasts with the general system of botanical nomenclature, where one organism can have only one name (Principle IV of the *Code*; Hennebert, 1987, 1991). In pleomorphic fungi the teleomorph is given higher nomenclatural status than the anamorph, which may have led to a somewhat superficial treatment of anamorphic features. In several ascomycete lineages the anamorphs have been shown to lead often to a somewhat better taxonomic resolution of species than the teleomorphs (e.g., *Trichoderma* vs. *Hypocrea*).

The present *Code* is explicit in Art. 59.4 in saying that “names with a teleomorphic type, or epitype (Art. 59.7) **take precedence** [emphasis added] over names with only an anamorphic type when the types are judged to belong to the same holomorphic taxon”. Different morphonyms, i.e., names applied just to a particular morph of a certain fungus, are thus not each other’s synonyms.

Molecular phylogenetic investigations and increased understanding of the phylogenetic relationships have led to a tendency to move from a dual teleomorph–anamorph nomenclature towards unitary nomenclature for pleomorphic ascomycetes, as forecast in Recommendation 59.A.3 of the *Code*. To what extent such a unification is possible at species and possibly also at genus rank, without causing nomenclatural chaos, requires careful analysis (Hennebert, 2003; Seifert & al., 2003). In any case, this movement is not served by haphazard infringements of the present rules of nomenclature by authors

who wish to change the *Code* according to their views. For example, Crous & al. (2009) in subdividing *Mycophaerella* into monophyletic lineages introduced a series of generic names for clades, defined mainly by their anamorphs, based on priority regardless of whether the names are based on teleomorphic or anamorphic types. In a further step, Lombard & al. (2010) combined the so far only anamorphic species of *Cylindrocladium* in the older, teleomorphic genus *Calonectria*, a procedure that according to the present *Code* is incorrect.

■ TELEOTYPIFICATION

Among a whole set of proposals by Hawksworth (2004) aimed at moving towards unitary nomenclature, only one (184) was adopted at the Vienna Botanical Congress, after some modifications, in a last-minute action to become Art. 59.7. Its formulation “an epitype exhibiting the teleomorph stage may be designated” is permissive, a possible alternative to the previous practice of proposing a new teleomorphic species, and not a strict requirement. This kind of epitype is something different from the epitypes now often used to fix many fungal names with material that can be analysed with molecular methods (Art. 9.7). For ‘epitypes’ in the sense of Art. 59.7 Redhead (in litt.) proposed the term *teleotype* (only briefly mentioned in print by Hawksworth, 2007). For any fungus an epitype may be designated to fix the identity of the name, and if it is an anamorph it can be epitypified with an anamorphic fungus, before an additional teleotype may be assigned to it. A further complication is in the desirability of a formal diagnosis for newly discovered structures, thus also the new teleomorph. The present ruling does not stipulate this for the introduction of a teleotype, but for the efficient characterization of the holomorph it seems desirable.

At Vienna a 2007 starting point was agreed for the beginning of the function of teleotypification; as expressed in Art. 59.4 (“except that teleomorphic typified names published before 1 January 2007 take precedence over anamorphic typified names subsequently epitypified after 1 January 2007 by teleomorphs”), which may possibly be taken as vetting the synonymy of contiguous teleomorph and anamorph generic names (morphonyms). The synonymy between anamorph and teleomorph names applied to the same taxon is implemented in the otherwise very beneficial *Index Fungorum* database, also backwards beyond 2007. This synonymy of morphonyms violates the spirit of fungal nomenclature of more than a century. The so far prevailing dual system cannot be overturned in a single move. A change towards a unitary system might be enacted only from a new starting point onwards (in the future, not 2007) and needs a carefully planned introduction; after that new starting point, the duality of typification for taxa newly described could be abolished (various possibilities described by Hennebert, 2003). In *Index Fungorum* quite an arbitrary selection is made of preferred generic names (‘current names’), teleomorphic or anamorphic morphonyms: *Neosartorya* would be *Aspergillus*, but *Emericella* and *Eurotium* are recognized above the *Aspergillus* anamorphs; some of the connections listed are even erroneous, others are missing. For example, all *Ozonium* species are listed as anamorphic ascomycetes, although the type is a *Coprinellus*. The database *Mycobank* fortunately retains morphonyms clearly marked as such, but many connections are still missing.

The formulation in Art. 59.7 “and for which there is no existing legitimate name for the holomorph” is ambiguous. This provision should certainly also include the absence of an appropriate genus name for the holomorph. Otherwise it would lead to congeneric taxa being arbitrarily scattered among either anamorphic or teleomorphic genera.

■ EXAMPLES

A rare example of a meaningful teleotypification is that by Réblová (2009) of *Rhodoveronaea* Arzanlou & al. 2007. This was a monotypic anamorph genus, the name of which can now be regarded as having holomorphic application. A negative example is the teleotypification by Covert & al. (2007) of *Fusarium tucumaniae* T. Aoki & al. (2003); its affinity with *Haematonectria* was quite evident. This now holomorphic name can thus correctly be recombined in *Haematonectria* (just like *Aspergillus rugulosus* Thom & Raper to *Emericella rugulosa* (Thom & Raper) C.R. Benj. according to Art. 59.5 and Ex. 5); then the epithet will no longer be available for the anamorph alone in *Fusarium*, a situation that will be regretted by many *Fusarium* mycologists (see the present Art. 59.5, Ex. 3). From such cases of teleotypification it is only a small step to arbitrarily publishing a new teleomorph-typified species name in an anamorph genus; such cases are still ruled by Art. 59.5 and Ex. 5, and the procedure can therefore not be recommended.

When the teleomorph of *Aspergillus fumigatus* Fresen. was discovered by O’Gorman & al. (2009), the authors described

it correctly as a new species, *Neosartorya fumigata*, in the genus to which it belongs, according to Art. 59.6. Hawksworth (2009) objected to this procedure and postulated that the authors should have applied teleotypification. According to the present formulation of Art. 59.7, the choice between either describing a new teleomorphic species or teleotypification is at the discretion of the author. In the case of a holomorphic ‘*Aspergillus fumigatus*’, the information about the teleomorph classification in *Neosartorya* would have been missed (although, according to anamorph morphology, this affinity could have been expected). In any case, the epithet remains the same and that is the main concern of most mycologists using the name, who hardly care about the author citation. A similar case is the name of the teleomorph of *Ustilaginoidea virens* (Cooke 1878) Takah. 1896, which was sorted out by Tanaka & al. (2008) and published in a new genus as *Villosiclava virens* (M. Sakurai ex Nakata) E. Tanaka & C. Tanaka. Hawksworth & Kirk (in litt.) again insisted in invoking teleotypification of the name in *Ustilaginoidea* and to conserve the name *U. virens* with a teleotype over the *Villosiclava* name (and so they entered it in *Index Fungorum* with *Villosiclava* as an apparently superfluous synonym). *Ustilaginoidea virens* is not the only species of the genus and the other species have not yet been thoroughly studied with molecular methods. Thus it would be quite premature to declare all species of *Ustilaginoidea* as forming a monophyletic genus that can have holomorphic application.

■ CONCLUSION

Teleotypification thus has its limitations. Its application will not significantly decrease the number of redundant morphonyms. In some cases it can prevent the introduction of new names and fix established links between an ostensibly monophyletic anamorph genus and a newly discovered teleomorph. For the rest it is by far preferable that authors describing a newly discovered teleomorph in the appropriate genus introduce it as novelty with an epithet identical to that of the anamorph, provided there is no competing homonym; this will have almost the same effect for the mycological community as teleotypification. The advantage is that the binomial of the anamorph remains available in case it is desired. This approach was, e.g., applied on two newly discovered *Chaetosphaeria* teleomorphs associated with the anamorphic genus *Menispora* Pers. 1822, viz., *Ch. ciliata* Réblová & Seifert 2006 linked to the *M. ciliata* Corda 1837 anamorph and *Ch. tortuosa* Réblová & Seifert 2008 linked to *M. tortuosa* Corda 1839 (Réblová & al., 2006; Réblová & Seifert, 2008) and on many teleomorphs of *Trichoderma* discovered in recent years.

■ ANAMORPHIC SPECIES IN TELEOMORPH-TYPIFIED GENERA?

It is worth discussing situations when newly found anamorphic taxa, for which no appropriate anamorph-generic name is available, can meaningfully be classified, based on molecular

evidence, in genera whose names are teleomorph-typified. (The opposite situation is demonstrated in present 59.3, Ex. 2.) In this situation a teleomorph-typified generic name accommodates a mixture of teleomorphic and anamorphic taxa, but then at least the monophyletic structure of the genus has been proven. The present version of the *Code* neither prevents nor sanctions this procedure. In a strictly dual system, the wrong placement of a new anamorph species under a teleomorph-typified generic name would have resulted in the species name not being validly published according to pre-Sydney versions of the *Code*. According to present rules, it is simply incorrect unless molecular evidence proves the opposite, and the name may become correct later by some kind of teleotypification.

Adding a Note may be useful to vet the procedure. *Examples*: When Damm & al. (2008) proved with molecular analysis that a newly found phialophora-like hyphomycete was related to the holomorph genus *Jattaea* Berl. 1900 of the *Calosphaeriales*, they described it as a new species, *Jattaea mookgoponga* Damm & Crous, although there was no trace of a teleomorph on the available material. No known anamorph genus was hitherto described for or linked to *Jattaea*. However, the decision to call the known anamorphs of *Jattaea* phialophora-like, which is in fact a descriptive morphological term, is a recommendable solution. Abdollahzadeh & al. (2009) described two new anamorphic taxa in the teleomorphic genera *Barriopsis* and *Phaeobotryon*, providing evidence that they belonged there on phylogenetic grounds, without having an appropriate anamorph-generic name available. According to this reasoning, it might not have been necessary to introduce the genera *Calosphaeriophora* and *Phaeocrella* for the phialophora-like anamorphs of *Calosphaeria* and *Togniniella* (Réblová & al., 2004). However, it is not a matter of the *Code* to provide criteria for the molecular evidence that is needed to sufficiently establish the monophyly of a clade.

■ PROPOSALS

To clarify the situation, Gams & al. (2010: 1297—this issue) offer three proposals. Our main concern is to keep generic classification as clean as possible, i.e., clearly differentiate between teleomorph- and anamorph-typified generic names. It is the genus name that discloses the affinities and often also the morphology of a fungus. It is difficult to harmonize phylogenetic findings with this system. We are aware that both dual and unitary systems of nomenclature have their imperfections; neither of them can do sufficient justice to the fungal diversity and it is difficult to reconcile either of them with phylogenetic information. Introducing a third, mixed system just for phylogenetically founded genera besides this duality is not an attractive alternative. Anamorph genera can inevitably contain permanently anamorphic holomorphs, e.g., *Fusarium oxysporum* is such a case, lacking mating type genes and its affinity to *Gibberella* is well known. This inadvertent inclusion of (anamorphic) holomorphs under anamorph-typified generic names appears less grave than that of squeezing the fungal diversity into a corset of unified names. Enforcing identical

genus delimitations on contiguous teleomorph and anamorph genera, just to make them 'synonymizable', seems a very bad solution that frequently conflicts with mycological knowledge. The case of almost congruent generic delimitation of *Hypocrea* and its anamorphs in *Trichoderma* is rather an exception than the rule. The dual system of nomenclature also has its pronounced advantages which must not be underrated; some freedom of choosing between names without penalties (e.g., 59.5, Ex. 3 in the present *Code*) will be welcomed by many mycologists. The goal of a good system of nomenclature is not only to help building a natural classification but also to help in identification work, especially of anamorphic fungi, in which morphology is not yet completely superseded by DNA sequence phylogeny.

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