

hypothesis inferred from a phylogenetic tree, and this is the best representation we have to date of the real Tree of Life. Fensome & al. (in Contr. Ser. Amer. Assoc. Stratigr. Palynologists 50: 13. 2019) and the online database system DINOFLAJ3 (http://dinoflaj.smu.ca/dinoflaj3/index.php/Main_Page) provide an easy means to obtain accepted names to synonyms and vice versa.

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(261–266) Proposals to amend the *Code* to update regulations of the nomenclature of fossils

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These initiatives consist of a few specific, mostly editorial amendments of the provisions of the *International Code of Nomenclature for algae, fungi, and plants (ICN)*; Turland & al. in Regnum Veg. 159. 2018) in order to reflect the historical development of palaeobotanical nomenclature.

Because the former outdated notions such as “organo-genus”, “forma-species” and others have been eliminated in the newest revisions of the *ICN*, it is necessary to formally fix their correspondence with modern notions of the *ICN*, thereby allowing their correct treatment in the functioning indexing centres. However, the *ICN* should also have additional operational notions for how to proceed with another category of artificial binary “names”, which have been applied to fossil spore, pollen and other microfossil taxa (algal and fungal in nature). These proposals formally outline the distinction between fossil-taxa and these artificial designations and will significantly help indexing centres correctly interpret nomenclatural difficulties found in the old palaeobotanical literature.

The International Fossil Plant Names Index (IFPNI; <http://ifpni.org/>) has recorded numerous fossil “names” generated in the early years of palaeopalynology (1930s–1960s), which were formed as binary designations, but unlike fossil-species names (formed as a combination of a generic name and a specific epithet) these designations were associated with the artificial “names” of non-generic groups or subgroups of fossil spore, pollen or other microfossils. These designations, substituting at generic level in artificial systems of classification, were initially developed in the artificial system of classifications of fossil spores and pollen. The most influential authority of such a classification approach, Russian palaeopalynologist Sofia Naumova (in Trudy XVII Sess. Mezhdunar. Geol. Kongr. 1937(1): 357. 1940 [“1939”]), explicitly stated that “in the description of the spores and pollen a binary nomenclature is adopted: the «generic» names are given to the author’s subgroups; and the names of «families», to groups”. “*Leiotriletes*” (Naumova, l.c.: 357. 1940) was published as

a name of a subgroup of fossil spores in the artificial classification of microfossils (“Group *Azonotriletes* Luber of Class *Irrimales* Naumova”). “*Leiotriletes*” is not therefore a fossil-generic name, although it was used in binary combinations such as “*L. minutissimus*” (Naumova in Izv. Akad. Nauk S.S.S.R., Ser. Geol. 1949(4): 52. 1949). As a fossil-generic name, *Leiotriletes* was later validly published based on different fossil spore materials by various researchers nearly simultaneously and independently: *Leiotriletes* Naumova (in Trudy Inst. Geol. Nauk Akad. Nauk S.S.S.R. 143: 20, 17 [rank]. 27 Oct 1953) and *Leiotriletes* Naumova ex R. Potonié & Kremp (in Geol. Jahrb. 69: 120. 31 Mar 1954).

Such an approach forming artificial fossil spore/pollen designations eliminated the potential nomenclatural conflict if the fossil spore/pollen genus or species would be found and described earlier than its fossil plant, because the spore/pollen designations would not then compete with the fossil-genus names established on other organs of the plant. However, later in palaeopalynology another option was chosen to form the so-called “form-genera” or “organ-genera” in plant classification (which formally existed in former editions of the *Code* from Stockholm [Lanjouw & al. in Regnum Veg. 3. 1952] to Tokyo [Greuter & al. in Regnum Veg. 131. 1994], superseded by “morphogenus” from Saint Louis [Greuter & al. in Regnum Veg. 138. 2000] to Melbourne [McNeill & al. in Regnum Veg. 154. 2012], and all at least now eliminated from the *ICN* after Melbourne). Nevertheless, fossil spore taxa designations, formed as artificial binary combinations, persisted and were actively used in palaeopalynology up to the 1990s (!). In addition, as IFPNI has recorded, it was a usual practice to recombine species of these artificial designations into exact fossil spore or pollen genera, and vice versa: fossil species of exact fossil spore or pollen genera might be recombined under these artificial designations. For example, the fossil spore species *Selaginella hirta* Bolchovitina (in Trudy Inst. Geol. Nauk Akad. Nauk S.S.S.R. 145: 33. 1953), validly published under the generic

name *Selaginella* P. Beauv. (in Mag. Encycl. 9(5): 478. 1804) and the simultaneously published morphographic binary combination of species epithet and subgroup name of fossil spores “*Lophotriletes hirtus*” (Bolchovitina, l.c.: 33. 1953), was later transferred (recombined) as the fossil spore species *Lophotriletes hirtus* (Bolchovitina) Bolchovitina ex E.V. Semenova (Spory Pyl. Jursk. Otlozh. Donbassa: 48. 1970). In this case, *Lophotriletes* S.N. Naumova ex R. Potonié & Kremp (in Geol. Jahrb. 69: 129. 1954) was accepted as a name of a fossil spore genus, not as a name of a formal artificial subgroup of fossil spores, “*Lophotriletes*” (Naumova, l.c.: 357. 1940). “*Lophotriletes hirtus*” in 1953 is not therefore a fossil-species name, but merely a morphographic binary combination of species epithet and subgroup name of fossil spores, and has no standing in botanical nomenclature, even for the purposes of homonymy; it is superseded by *Lophotriletes hirtus*, validly published only in 1970 as a new combination with a validly published fossil spore genus name. As a result of the existence of natural and artificial systems of classification of fossil spores and pollen with their own binary names in the past, IFPNI now faces an enormous nomenclatural conundrum of artificial and non-artificial (exact) designations, which should be distinguished in taxon records. Needless to say, none of these artificial designations is validly published in terms of botanical nomenclature, and none is to be considered even for the purposes of homonymy. In this connection, a few new provisions are proposed below to resolve the historical situation.

(261) Amend Art. 20.4 as follows (new text in bold) and add two new Examples:

“20.4. The following are not to be regarded as generic names:

- (a) Words not intended as names.
- (b) Unitary designations of species.

(c) **Designations representing fossil spore, pollen, or other microfossil groupings (substituting at generic level in artificial systems of classification) that are usually followed by an epithet.**

(d) **Designations representing microfossils (substituting at generic level in artificial systems of classification) intended to be distinct in rank from the fossil-genus names used by authors in the same work.”**

“Ex. n1. “*Leiotriletes*” (Naumova in Trudy XVII Sess. Mezhdunar. Geol. Kongr. 1937(1): 357. 1940 [“1939”]) was published as a “name” for a subgroup of fossil spores in an artificial classification of microfossils (“Group *Azonotriletes* Luber of Class *Irrimales* Naumova” in Naumova, l.c. 1940). Naumova explicitly stated that “in the description of the spores and pollen a binary nomenclature is adopted: the «generic» names are given to the author’s subgroups; and the names of «families», to groups”. “*Leiotriletes*” was not therefore a generic name, although it was used in binary combinations such as “*L. minutissimus*” (Naumova in Izv. Akad. Nauk S.S.S.R., Ser. Geol. 1949(4): 52. 1949). As a fossil-generic name, *Leiotriletes* was later validly published based on different fossil spore materials by various researchers nearly simultaneously and independently: *Leiotriletes* Naumova (in Trudy Inst. Geol. Nauk Akad. Nauk S.S.S.R. 143: 20, 17 [rank]. 27 Oct 1953) and *Leiotriletes* Naumova ex R. Potonié & Kremp (in Geol. Jahrb. 69: 120. 31 Mar 1954).”

“Ex. n2. In the author’s artificial classification of fossil coccoliths, “*Lophodolithus*” (Deflandre in Ann. Paléontol. 40: 146. 1954) was published with the rank of “manipula” for some fossil coccoliths (then classified as fossil protists of Coccolithophorida or now algae of *Prymnesiophyceae*); at the same time, the genera *Clathrolithus* Deflandre (l.c.: 168. 1954) and *Pyxolithus* Deflandre (l.c.: 170.

1954), explicitly published with the rank of genus in the same work, are considered as validly published generic names. As a genus, “*Lophodolithus*” was validly published later: *Lophodolithus* Deflandre ex Bramlette & Sullivan (in Micropaleontology 7: 145. 1961).”

In order to provide a distinction between the “names” of the artificial groupings of fossil spore and pollen names from names of fossil-genera, traditionally accepted in botanical nomenclature, new special provisions are proposed below. Because in palaeobotany several now obsolescent and nearly forgotten generic categories, now considered fossil-genera, were used – “pseudogenus”, “form(a)-genus”, “organ(o)-genus”, “sporogenus”, “morphogenus” – it is proposed to describe their equal status with fossil-generic names in contrast to artificial names of spore and pollen subgroupings.

(262) Add a new paragraph to Art. 20 with two new Examples:

“20.n. Names with their rank denoted by the terms “pseudo-genus”, proposed for artificial fossil-taxa, or “form(a)-genus”, “organ(o)-genus”, “sporogenus”, or “morphogenus”, or their equivalents in modern languages, once permissible under past editions of this *Code*, are treated as having been published at the rank of genus.”

“Ex. n3. *Cycadeorhachis* Stopes (Cretac. Fl. 2: 53. 1915), originally published with the rank-denoting term “pseudo-genus”, is treated as published at the rank of fossil-genus, reflecting the author’s intention to consider “rachises of Cycadean foliage”, on which the name was based, as an artificial fossil-taxon with no clear relations with other fossil-taxa.”

“Ex. n4. *Maceopolipollenites* Leffingwell (in Spec. Pap. Geol. Soc. Amer. 127: 29. 1970) was published as an organ-genus for fossil dispersed pollen; *Insulapollenites* Leffingwell (l.c.: 48. 1970) was created in the same work as a form-genus for fossil dispersed pollen; both generic names are treated as validly published at the rank of genus.”

(263) Add a new paragraph to Art. 23:

“23.n. Names with their rank denoted by the terms “form(a)-species”, “organ(o)-species”, “sporospecies”, “species praedicta”, “sporomorphia” (if the epithet is associated with a generic name, not an artificial spore group designation), “morphospecies”, or their equivalents in modern languages, once permissible under past editions of this *Code*, are treated as having been published at the rank of species.”

(264) Amend Art. 23.6 as follows (new text in bold) and add a new Example:

“23.6. The following designations are not to be regarded as species names:

(a) Designations consisting of a generic name followed by a phrase name (Linnaean “nomen specificum legitimum”) commonly of one or more nouns and associated adjectives in the ablative case, but also including any single-word phrase names in works in which phrase names of two or more words predominate.

(b) Other designations of species consisting of a generic name followed by one or more words not intended as a specific epithet.

(c) Designations of species consisting of a generic name followed by two or more adjectival words in the nominative case.

(d) Formulae designating hybrids (see Art. H.10.2).

(e) **Designations formed as a combination of the name of the fossil pollen (sub)group followed by an epithet.”**

“Ex. n5. “*Leiotriletes minutissimus*” (Naumova in Izv. Akad. Nauk S.S.S.R., Ser. Geol. 1949(4): 52. 1949), originally proposed for fossil sporomorphs (erroneously treated as spores), is not a fossil-species name (although labelled “sp. nov.”), because it is formed as a combination of the fossil pollen subgroup “*Leiotriletes*” (Naumova in Trudy XVII Sess. Mezhdunar. Geol. Kongr. 1937(1): 357. 1940 [“1939”]) and the sporomorph epithet “*minutissimus*”. The name of this microfossil, now treated in the algal group *Acritarcha*, was first validly published as *Leiosphaeridia minutissima* Jankauskas (Mikrofoss. Dokembr. S.S.S.R.: 79. 1989). Although Jankauskas wrongly transferred “*Leiotriletes minutissimus*” to the fossil-genus *Leiosphaeridia* Eisenack (in Palaeontographica, Abt. A, Paläozool. 110: 2. 1958), he otherwise met the conditions for valid publication of the name of a new fossil-taxon.”

In order to emphasize the artificial status of the binary names of sporomorphs, not accepted under the *ICN* even for the purposes of homonymy, it is proposed to add a new Example demonstrating that these designations are not to be considered as alternative names under Art. 36.3, and therefore do not nullify otherwise validly published species names of fossil-taxa, when such artificial sporomorph binary names are proposed simultaneously for the same fossil remains.

(265) Add a new Note and a new Example after Art. 36.3:

“Note n1. Names published and accepted simultaneously for the same fossil pollen, spore, or other microfossil remains (so-called sporomorphs) are not alternative names as defined by Art. 36.3 if one is a designation formed by combining a sporomorph group with a sporomorph epithet.”

“Ex. n6. Bolchovitina (in Trudy Inst. Geol. Nauk Akad. Nauk S.S.S.R. 145: 1–183. 1953) employed two parallel systems of classification of fossil spores and pollen, one natural (assigning microfossils to extant genera) and another artificial (combining pollen or spore group designations with an epithet). *Ginkgo tripartita* Bolchovitina (l.c.: 62. 1953) and “*Dolichotrilestrium tripartitum*” (Bolchovitina, l.c.: 62. 1953), based on the same type, are not alternative names as defined by Art. 36.3, because “*D. tripartitum*” (although labelled “sp. nov.”), resulting from combining the fossil pollen subgroup “*Dolichotrilestrium*” (Naumova in Trudy XVII Sess. Mezhdunar. Geol. Kongr. 1937(1): 358. 1940 [“1939”]) and the sporomorph epithet “*tripartitum*”, is not the name of a fossil-species (see Art. 23.6(e)). *Ginkgo tripartita* was therefore validly published by Bolchovitina.”

When the provision on the publication date of Schlotheim’s *Petrefactenkunde* (1820) was first established in the Paris *Code* (Lanjouw & al. in *Regnum Veg.* 8. 1956), the initial idea was to suppress this work in favour of Sternberg’s *Flora der Vorwelt*, Heft

1 (1820). The precise dates of publication of the two monographs were not known at that time. However, there were concerns about the possible priority of Schlotheim’s fossil-taxa over those of Sternberg, which could disrupt the established nomenclature of plant fossils. But these concerns turned out to be unfounded, because all of Schlotheim’s fossil-taxa except one, *Anthotypolites ranunculiformis* Schloth., were not validly published, because Schlotheim failed to provide separate generic descriptions for his new genera, and therefore no fossil-species were validly published as well (Art. 35.1). However, the name *A. ranunculiformis* and that of its monotypic genus *Anthotypolites* Schloth. were validly published in 1821 (Schlotheim in Arch. Neuesten Entdeck. Umwelt 3: 174. 1821), but both have recently been rejected against *Ullmannia* Göpp. and *U. bronnii* Göpp. (see Doweld in *Taxon* 65: 190. 2016; Wiersema & al., Int. Code Nomencl. Algae, Fungi, and Plants: Appendices I–VII. 2018+ [continuously updated] <https://naturalhistory2.si.edu/botany/codes-proposals/> [accessed 28 Jan 2023]), such that concerns about destabilization of palaeobotanical nomenclature from Schlotheim’s monograph are no longer relevant. The historical bibliographical studies of Stafleu & al. (for *Taxonomic Literature*, ed. 2, in *Regnum Veg.* 94, 98, 105, 110, 112, 115, 116, 125, 130, 132, 134, 135, 137, 149, 150. 1976–2009) and myself (for the IFPNI, see <http://ifpni.org/publication.htm?id=38E68EF4-00BC-42A9-A48A-72DF8CFD181F>) regarding precise publication dates for Sternberg’s and Schlotheim’s monographs have confirmed the priority of Sternberg (June 1820) over Schlotheim (September 1820: Becker’s advertisement [“ist so eben erschienen” in Leipziger Literatur-Zeitung, # 238, col. 1904, for 16 September 1820]). This new bibliographic finding finally erases the need to establish in Art. 13(f) a specific provision that Schlotheim’s *Petrefactenkunde* (1820) is regarded as published before 31 December 1820, because this coincides with reality, hence this rule is proposed for deletion. Finally, I can see no reason not to adopt the exact date of publication of Sternberg’s *Flora* as 8 July 1820 (IFPNI: <http://ifpni.org/publication.htm?id=D0BCBFC6-DDC6-4B75-8CC0-AF311DE7BEA4>), rather than using the conventional albeit artificial date, because the underlying concerns over the relative priority of the two works are no longer relevant, as discussed above. But this problem might be further discussed among palaeobotanists.

(266) Delete the second sentence of Art. 13.1(f) as follows (deleted text in strikethrough):

“Fossil organisms (diatoms excepted):

(f) All groups, 31 December 1820 (Sternberg, *Flora der Vorwelt*, Versuch 1: 1–24, t. 1–13). ~~Schlotheim’s *Petrefactenkunde* (1820) is regarded as published before 31 December 1820.~~”